ANNUAL TECHNICAL REPORT

FOREST BIOLOGY LABORATORY

1941

1941-~~1942~~

ANNUAL TECHNICAL REPORT

Prepared
by the
FOREST INSECT LABORATORY, WINNIPEG, MANITOBA.

Division of Entomology, Science Service.

Submitted to Ottawa May 26, 1942.

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I. GENERAL REVIEW OF ACTIVITIES FOR 1941-1942

A. INTRODUCTION

During the year 1941 the Winnipeg Laboratory undertook all detail connected with the operation of the Forest Insect Survey in central Canada. Prior to this, the work was restricted to field contacts and instruction on the aims and objects of the Survey, but the actual rearing, determinations and recording of data were handled in Ottawa. The inauguration of the Survey increased to a marked degree the volume of work handled and necessitated an adjustment in personnel as well as methods and programs of field investigations. Two separate divisions of work were organized; the Forest Insect Survey, headed by Mr. L. T. White and assisted by Mr. D. N. Smith, and field studies under Mr. R. R. Lejeune, assisted by Mr. F. B. Rabkin. Through the cooperation of the Dominion Seed Branch, two girls were loaned for the summer who were utilized as insectary helpers at the laboratory.

The main insect work for 1941 was concentrated on the Jack pine budworm in Ontario, Manitoba, and Saskatchewan; the European larch sawfly, chiefly in Manitoba; and bark beetles and wood borers in the three provinces. The budworm was particularly severe in the La Corne forest of Saskatchewan, the Spruce Woods Forest, Manitoba, and in parts of the Fort Frances and Port Arthur regions of Ontario. One new outbreak was investigated on the Riding

Mountain Park, Manitoba, where it promises to be very severe. Elsewhere, it was much lighter than in previous years. Budworm studies occupied most of the season from spring until early August. The European larch sawfly showed a marked increase on the Spruce Woods, Riding Mountain and Riverton areas of Manitoba. Large cocoon collections and sample plot studies were conducted during late August and early fall. The bark beetle and wood borer problem is becoming increasingly important from the standpoint of salvage of fire- and insect-damaged timber. This constitutes a large and full-time investigation, but, due to conditions, it must be handled as time permits and as it can be worked in between other studies. It is an acute problem throughout central Canada but particularly so in Saskatchewan.

The year was marked by an early spring with a wet, cold fall. Rains and cold weather commenced before mid-August and continued almost incessantly until winter. This was a severe handicap in so far as fall work was concerned and affected particularly the sawfly and sample plot studies.

During the year, certain improvements were made to the nursery and to the grounds surrounding the laboratory. A small insectary was constructed at the rear of the laboratory by members of the staff at an approximate cost of $60. Other minor changes have been made as occasion permitted; the furnace room was partitioned off, the dark room improved, etc. Important visitors included Mr. J. J. de Gryse, September 29 - October 4 inclusive;

Dr. Arthur Gibson, September 29;

Dr. J. M. Swaine, October 6 and 7; and Mr. L. S. McLaine. The following reclassifications of positions were made:

L. T. White to Agricultural Assistant Grade 11;

R. R. Lejeune to Agricultural Assistant, Grade 8;

D. N. Smith and F. B. Rabkin to Agricultural Assistants, Grade 7;

Miss P. Silverman to Stenographer, Grade 2.

These increases plus the cost of living bonuses operative since the mid-year have contributed much toward meeting the rising cost of living resulting from war conditions.

War conditions are beginning to affect the work in various ways. Forest Service personnel is suffering a rapid turnover and many well instructed men who previously gave much assistance are no longer available. Thus far, the laboratory staff have not been taken in to the active forces, but indications point to a considerable upset in the near future.

In the pages that follow, an analysis of all 1941 work is set forth, with the exception of 1941 sample plot work, which was not completed due to rain, and the developmental study of the budworm which cannot be finished due to lack of time.

All of which is respectfully submitted.

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

B. ORGANIZATION

H. A. Richmond	Assistant Entomologist in charge.
L. T. White	Agricultural Assistant, Grade 11 (As from April 1, 1941.).
R. R. Lejeune	Agricultural Assistant, Grade 8 (As from April 1, 1941.).
D. N. Smith	Agricultural Assistant, Grade 7 (As from April 1, 1941.).
F. B. Rabkin	Agricultural Assistant, Grade 7 (As from April 1, 1941.).
Miss P. Silverman	Stenographer, Grade 2 (As from August 1, 1941.).
V. Taylor	Part time janitor.

C. SUMMARY ACCOUNT OF WORK

During 1941, the principal work was concerned with the Jack pine budworm, the European larch sawfly, bark beetles and wood borers, and the Forest Insect Survey. Minor studies included: The Jack pine scale, Toumeyella sp.; Jack pine sawfly; yellow-headed sawfly, Pikonema; carpenter ants; and general reconnaissance work.

The following summarizes the results of the 1941 work in so far as the analyses of data have progressed.

I. JACK PINE BUDWORM

Two main divisions of this work were investigated:

a. The biological study of this insect and its natural control factors, subdivided as follows: (i) Pupal parasites; (ii) Larval parasites; (iii) Egg studies; (iv) Population studies; (v) Growth and development and its relation to diet.

b. A study on the effect of the budworm on the forest as revealed through 50 quarter-acre sample plots as well as marked spruce growing in the spruce infestation in the Spruce Woods Reserve.

(i) Pupal Parasites. A total of 23,171 budworm pupae was received from 16 study areas. With the exception of 2 new areas, the Spruce Woods, and The Riding Mountains, Manitoba, all other areas were sampled for the third consecutive year. The same major parasites were obtained during 1941 as in 1940; namely, 7 Ichneumonoidea, 8 Chalcidoidea and 10 Diptera. The most important parasites again appear to be *Ephialtes conquisitor* Say and *Phaeogenes hariolus* Cress. The average parasitism for all areas was: *Ephialtes conquisitor*, 13.42%; *Phaeogenes hariolus*, 6.60%; Chalcids, 4.64%; Diptera, 6.28%; miscellaneous, 0.30%; or a total for 1941 of 31.23%. The average total parasitism for the past 3 years has been:

1939 ...... 48.47%
1940 ...... 15.33%
1941 ...... 31.23%

All important pupal parasites were universally distributed in considerable numbers throughout the range of budworm in central Canada, with the exception of *Phaeogenes hariolus* which, in the Spruce Woods, was responsible for but 0.16% parasitism. A summary of percentage parasitism in all areas sampled in 1941 follows:

Fort a la Corne, Saskatchewan.	34.92%
Sandilands, Manitoba.	28.52%
Riding Mountain National Park, Man.	21.42%
Spruce Woods, Manitoba.	15.90%
Hawk Lake, Ontario.	13.87%
Dryden, Ontario.	37.86%
Ignace, Ontario.	40.26%
Basswood Lake, Ontario.	26.19%
Beaverhouse Lake group, Ontario.	34.87%
Calm Lake group, Ontario.	32.42%
Kakabeka, Ontario.	64.27%
Graham, Ontario.	24.52%
Savanne, Ontario.	31.01%

33.92

Parasitism in the La Corne forest, Saskatchewan, generally increased since 1939 with the budworm remaining more or less stationary. In the Sandilands, Manitoba, Dipterous parasitism has made a remarkable increase from zero in 1940 to 9.9% in 1941. In the Riding Mountains, Manitoba, Diptera exerted the greatest degree of parasitism. The Ichneumon, Phaeogenes hariolus, was very effective in the Ignace, Ontario, region, being responsible for 23.5% of a total of 40.26% parasitism. Similarly, in the Fort Frances country, it was again a dominant parasite. It was extremely scarce in the Spruce Woods, Manitoba, and in the Port Arthur region. In the latter, Ephialtes conquisitor predominated, destroying 46.6% of the budworm pupae in the Kakabeka area. Parasitism in the Hawk Lake, Ontario, infestation continued to drop, a trend recorded since 1939 coincident with a corresponding decrease of the budworm in that country. Attempts to assign definite values to the factors responsible for the total mortality encountered by the budworm during the year are under study but, thus far, no definite figures or conclusions can be reached. At least 25% of the pupae collected in the Spruce Woods, Manitoba, were destroyed by disease and predators. The predator Anatis mali destroyed 10-12% in that area. Tables have been prepared showing the mortality of male and female pupae from all causes, the sex ratios of Cacoecia fumiferana, Ephialtes conquisitor and *Phaeogenes hariolus*, as well as the relationship of sex ratios of *E. conquisitor* and *P. hariolus* in relation to sex ratios of the budworm host.

(ii) Larval Parasites. Larval parasitism in the three regions studied was:

Spruce Woods, Manitoba.	15.3%
Fort a la Corne, Sask.	39.4%
Hawk Lake, Ontario.	8.7%

Over 90% of the larval parasitism was due to an Ichneumon and a Braconid not yet determined.

(iii) Egg Studies. Egg studies of the budworm were continued as for the past four years. A total of 5,630 eggs was counted, examined and incubated. Populations of eggs were correlated with terminal buds, to give data comparable with larval and pupal counts. For the 5,630 eggs, 18,378 buds were counted. The following summarizes the 1941 egg survey data:

Eggs destroyed by parasites	1.83%
Eggs destroyed by predators	1.92%
Infertile eggs	3.28%
Total egg mortality	7.03%
Sound eggs	92.95%
Eggs per mass (average)	52.13
Eggs per branch (average)	99
Egg masses per branch	1.89
Egg masses per tree	67.3
Eggs per tree	3,527
Eggs per 100 terminal buds	30.6

The minimum number of moths necessary to deposit the average number of eggs per average tree as calculated for 1941 is 35. Egg abundance was approximately 2½ times as great as in 1940. While the above was recorded in the pine forests of Hawk Lake, Ontario, similar records were obtained in the spruce forest of the Spruce Woods, Manitoba. All oviposition appears restricted to spruce in that area, none being recorded on larch, and budworm infestation on the latter species seems probably due to larval migration.

(iv) Population Studies. Population studies were made in Hawk Lake, Spruce Woods, Riding Mountain and la Corne. Larval abundance was correlated with the number of terminals examined. The Hawk Lake, Ontario, population averaged 6.28 larvae per 100 pine terminals. Larval populations on the upper and lower half of Jack pine trees averaged 10.8 and 2.76 per 100 terminals. Larval counts per 100 terminals averaged 13.27 on staminate trees as compared to 0.26 on non-staminate trees. By means of population counts, the mortality of budworm at Hawk Lake in 1941 was estimated to be 97.5%, of which parasites accounted for one-seventh.

On the Spruce Woods Reserve, Manitoba, larval populations on spruce averaged 50 per 100 terminals, while on larch they averaged 5.3 per 100 terminals. Larval counts on the upper and lower half of spruce averaged 55.9 and 43.3 per 100 terminals, while on larch they averaged 3.2 and 7.5, the reverse to spruce. Budworm mortality inflicted by parasites, predators and disease in the Spruce Woods from the 5th instar to moth emergence averaged 42%.

Comparative figures on population counts in the four areas studied are as follows:

Location	Larvae per 100 Terminals on Lower Half of Tree
Hawk Lake, Ontario.	2.76
Riding Mountains, Manitoba.	20.3
Spruce Woods, Manitoba.	43.3
Fort a la Corne, Saskatchewan.	45.5

The host-parasite relationship is being analyzed from several new angles but at the time of writing no results are available for summarizing.

(v) Growth & Development.

Controlled Studies

From the individual rearing of larvae on staminate cones (pollen) and terminal buds, various important points in the growth and development of larvae were determined. The presence of 7 instars in the larval stage was determined and various bionomical data--statistical standards--derived for the first time (for this insect). Food-type or sex was found to have no influence on the number of instars, but indications were that the size of larva was affected. Further, it seemed that pollen in the larval diet exerted a considerable influence. It was shown that pollen was not definitely essential for the successful maturation of larvae, but lack of it had a decided detrimental effect, especially on males. Information was obtained on other important biological phases--duration of larval life, larval feeding habits, relative importance of each instar in the development of the larva, larval mortality, etc.

Field Studies

The field study conducted in the summer of 1940 comprised microscopic examination and dissection of some 1,100 larvae gathered from cones and terminals in the forest. This study served as a check for the controlled rearings as well as a study on the actual field conditions of the larvae. On the basis of counts made at the time of collection, migration of larvae was established and the inter-relationships involved were indicated. The migratory movements of larvae, from terminals to cones and back to terminals, was found to influence the data considerably, due to the resulting heterogeneity of population. The first migration was towards cones, right from emergence in the spring. The first appreciable signs of migration from cones back to terminals were coincident with the appearance of 4th instar larvae in the field. General migration persisted throughout the 4th instar and reached a maximum during the 5th and early 6th instars. Despite the extreme heterogeneity of populations due to migration, it was found that in most cases the effect of pollen was sufficiently predominant to appear significant in statistical analyses.

The first phase of the study dealt with population movements and larval development through the instars at approximately weekly intervals for sex and type of food. Here it was found that male larvae feeding on cones were always in advance of terminal larvae. Approximate duration of larval stadia was computed (in days) on statistical bases and the above results further emphasized.

Analyses of sex ratios of these field-collected larvae showed the considerable fluctuation in number of male and female larvae on cones and terminals from week to week. Maximum sex ratios, on cones, occurred before the mid-point of larval development for the season and, on terminals, some two weeks before completion of larval development. Analysis of sex ratios per instar found the maximum number of females to occur in the 5th instar, disregarding food source. On terminals, the maximum sex ratio occurred in the 3rd instar and, on cones, it was found in the 5th instar. Examination of changing sex ratios seemed to indicate a definite correlation with migratory movements. The data indicated the greater movement of male larvae towards cones in the early phases of development and towards terminals in the final period of growth.

A comparison of size and size differences of staminate and terminal larvae comprised the major portion of the study. Considerable care was taken in measurement of head capsules and this was used as a criterion for size of larvae. The contention was that size of larva, as indicated by size of head capsule, influenced the vigour of the larva and, in turn, affected the biotic potential. Hence, any changes in size of larvae and indications as to their causes would be extremely valuable in determination of important factors in the biology of the budworm.

It was found that staminate larvae did not measure more than approximately 20% larger than terminal larvae, as a maximum, and usually the difference ranged from 1% to 5%. Such a difference in size, approximately 5%, although not apparently a substantial amount, was found to be highly significant on the basis of considerable statistical tests applied. Thus, in the examination of results, where staminate larvae were in the neighbourhood of 5% larger than terminal larvae, the difference could be attributed to the effects of pollen in the diet.

Considerable comparisons of size were made between male and female larvae on cones and terminal buds. Analyses are available as to changes in size, etc. per instar for sex and food type of larvae. Further, analyses were made as to changes in size between initial size of larvae per instar, maximum, minimum and final sizes of larvae per instar--again for sex and food-type of larvae. Differences here were many and variable. The results are very valuable in consideration of the various factors contributing to the development of the budworm. The data have definitely indicated the larger condition of larvae taken from staminate cones under actual field conditions.

From the mean head capsule size per instar, a series of growth coefficients was determined for male and female larvae on staminate cones and terminal buds. These coefficients were selected as expressions of the many environmental factors operating in the growth and development of the larvae. Since these coefficients were derived from the summation of all the individual measurements, they represent the sum total effect of the environment on the development of larvae expressed in terms of their growth. Due to various factors influencing the growth coefficient, statistics were applied to the mean head capsule sizes and "regression factors" obtained. This resulted in the determination of significant differences in rate of growth between staminate and terminal larvae. Then, by applying these regression coefficients, the validity of the series of head capsule measurements was established and thus statistical standards are now available for purposes of yearly comparison, etc.

The various data definitely indicated some discrimination operating to the disadvantage of budworm generally, especially males, when deprived of pollen in the larval diet. Such larvae, completing their development on terminal buds alone, show definite retardation in their early growth and appreciable curtailment of their adult life. Thus, the presence of pollen in the larval diet would seem to affect the normal development of budworm larvae, imparting a more vigorous constitution to the insect and thus equipping it to better withstand the various adverse factors of the environment. This would be further reflected in the fertility and fecundity of the adult moths and ultimately would influence the epidemicity of the insect.

Various studies into the pupal stage have been made in the light of the influence of larval habits upon later stages. In a study on the fertility and fecundity of adult moths of known origin (cones or terminals), various data are available showing the significantly greater number of eggs produced per female amongst moths from pollen-reared larvae. This represents the final or end result of pollen in the development of the budworm and clearly indicates the importance of pollen in the biology of the budworm.

II. EUROPEAN LARCH SAWFLY

The principal larch sawfly work occurred during early September when cocoon collections, population counts, sample plot and general reconnaissance were pursued in the Riding Mountain National Park with the assistance of 4 men supplied by the Park and 3 men of our own. Four main areas were worked: (1) Wasagaming Townsite; (2) Norgate Road; (3) Sec. 12, R. 19, T. 20; (4) Mile 13, Lake Audy. Additional to heavy infestations, these areas were significant from the standpoint of liberations of the parasite Bessa selecta. Area (1) is the point of liberation in 1941; Area (2), liberation of 1940 and 1941; Areas (3) and (4), points of no liberation. Cocoon populations per square foot of ground were 8.0 in Area (2); 20.6 in Area (3); 67.8 in Area (4). The average was 28.1 per square foot.

In these collections, 23,003 cocoons were collected and prepared for spring rearing. The following summarizes these data:

AREA	SOUND COCOONS		DESTROYED				TOTAL	AVGE. COCOONS PER SQUARE FOOT
			MICE		OTHER CAUSES			
	No.	%	No.	%	No.	%		
1	3258	92.	201	5.68	82	2.31	3541	----
2	7261	89.46	837	10.31	21	0.26	8119	8.0
3	4325	89.83	479	9.95	11	0.23	4815	20.6
4	8159	88.36	1078	11.67	0	0.00	9237	67.8

Additional to the Riding Mountain collections, 4,000 cocoons were collected in the Spruce Woods Forest Reserve in two areas, the Epinette and the Delta Swamps. Of the cocoons collected, 89.45% were sound, 10.09% were destroyed by mice and 0.44% were damaged by one cause or another.

At the time of writing, no definite results of the rearing work at Belleville are available but from rearing work and periodic dissections the following has been reported: The average parasitism thus far recorded by Mesoleius tenthredinis Morl. is 25% in the Riding Mountain material and 2.5% in the Spruce Woods. Parasitism by this species in Area (3) in the Riding Mountain was 34%. Mortality from all causes in the same area was 53%. Some difficulty is being experienced in Belleville in the rearing work due, they believe, to inadequate winter temperatures. Rearings conducted in the Winnipeg Laboratory have produced 149 adult sawflies and 2 Mesoleius from the Spruce Woods material. Additional to Mesoleius, one specimen each of Perilampus and Tritneptis klugii has been reared from the Riding Mountain and Spruce Woods collections respectively. These data, while incomplete at the time of writing, are highly significant, in view of the past records of Mesoleius liberations. Liberations in the Riding mountain were made by Dr. J. M. Swaine in 1912 and in the Spruce Woods by Norman Criddle in 1913. During the sawfly outbreak of 1924-28, parasitism by Mesoleius was recorded by Watson as 88% in the Spruce Woods. The final figures from the 1941 material will be of much value as will those from future work.

The recovery of Bessa selecta is also significant, for liberations have been made in this area during 1939 and 1940.

A comparison with 1940 parasitism from these same areas shows an apparent optimistic future for this biological control. In 1939, a total of 7,850 cocoons produced 1 specimen of Bessa selecta, a parasitism of 0.012%. In 1940, 11,462 cocoons produced no parasitism. The 1941 material points to significant improvement in the status of parasites and the appearance of Mesoleius is most encouraging.

Another region of severe sawfly attack was examined in the vicinity of Riverton, Manitoba. While time did not permit any intensive study, the general situation was mapped and cocoon collections are anticipated early this spring.

The parasite Bessa selecta was liberated in these areas during 1941 as follows:

July 8	1,783	at Riding Mountain, Norgate Road;
July 10	3,325	at Riding Mountain, in Townsite;
July 11	1,170	at Riverton, Manitoba.

Four permanent sample plots, comprising 136 trees, were established in the Riding Mountain Park. Sample plot work was organized during the fall. Plots were selected after the foliage had turned yellow, when readily discernible from adjacent spruce. Each tree was tagged, marked with a white band, and its defoliation, crown class and condition were recorded. The D.B.H., height, age and site were left until 1942, due to lateness of the season and torrential rains. Colour photographs were made from definite spots and these will be repeated annually for comparisons.

The history of survival or mortality will thus be recorded annually together with the future trend of the sawfly.

III. BARK BEETLES & WOOD BORERS

During 1941, all data relating to bark beetles and wood borers in the budworm country have been obtained from two sources: (1) the examination of 50 quarter-acre sample plots located in southeastern Manitoba and northwestern Ontario and (2) from tree analyses made in northern Saskatchewan during a two-day examination.

Quantitative data and biological records have been obtained at the Hawk Lake, Ontario, study centre during the past two years. During 1941, further data were obtained from the sample plot study in which the progress of death or recovery has been tabulated annually for all trees in 50 quarter-acre sample plots located in Ontario and Manitoba. Records from this source indicate an increase in damage sustained by wood borers in the partially defoliated stands. Data in relation to secondaries and budworm are constantly increasing and some interesting and important detail should be forthcoming. Opportunities have not been available this winter to summarize the sample plot records, but it is evident that trees weakened in 1937 and 1938 through partial defoliation are still subject to the attack of wood borers and these insects are taking an annual toll in these forests.

The Saskatchewan work consisted of a 2-day analysis of scorched, burned and dead trees and the examination of two areas, one burned in 1941 and still smouldering at the time examined, and the second, a 1937 burn. Interest in these two areas centred about the salvage question. Evidence procured showed that timber damaged by fire between June 28th and July 15th is immediately attacked by Buprestidae, Trypodendron, Ips integer and Orthotomicus ornatus. The braconid parasite, Coeloides, was found to be quite prevalent in that area but not evident in the actual fire-burned area. Buprestid larvae were found 400 per square foot, while Trypodendron had penetrated to a depth of 2 inches. The above records were from an area examined July 23rd and which was still in a smouldering condition. Dead timber in the 1937 burn showed a heavy attack of Cerambycidae and trees that appeared sound externally proved to be badly riddled when examined inside. One tree examined over an area of 4½ square feet revealed 18 larval tunnels at 1-inch depth, 22 tunnels at 2-inch depth, and 27 tunnels at 3-inch depth. This condition prevailed throughout this area.

The significance and importance of the damage of wood borers bears on the matter of salvage of fire-damaged timber. In central Canada, this is of paramount importance. Investigations thus far are but superficial and, in view of the many factors such as date of burn, extent of injury, moisture content, etc., require much study before any salvage program can be considered.

A complete memorandum on conditions in the Pasquia Forest of Saskatchewan was submitted to Mr. E.H. Roberts, Director of Forests; a strong request has been made from that source for further study into the salvage possibilities of fire-damaged timber.

IV. FOREST INSECT SURVEY

In this initial year of the survey as conducted by this laboratory, 472 samples were received from the following cooperators:

	No. of Samples Received
Ontario	
Ontario Forestry Branch	153
Private companies	24
Manitoba	
Manitoba Forest Service	66
Private Companies	9
Saskatchewan	
Saskatchewan Dept. of Natural Resources	40
Dominion Division of Entomology	85
Other Dominion Departments	
Prince Albert National Park	20
Riding Mountain National Park	28
Dominion Forest Service	8
Miscellaneous Services	4
Hudson's Bay Company	29
Miscellaneous Cooperators	6
TOTAL	472

The principal insects for the year were the Jack pine budworm, the spruce budworm, the European larch sawfly, the forest tent caterpillar, the birch leaf skeletonizer, and sawflies of the genera _Neodiprion_ and _Pikonema_.

A total of 23,756 pupae of the budworm was received, sexed and reared. Of these, there were 9,690 adult moths reared, 932 Diptera, 2,193 _Ephialtes conquisitor_, 893 _Phaeogenes hariolus_, 458 other Ichneumonidae.

A total of 27,003 cocoons of the European larch sawfly was handled through the survey, but the rearing of these, unlike the budworm, was for the most part not accomploshed at the laboratory. These cocoons are in winter storage at Belleville and results are not yet available.

Tabulations summarizing life histories, mortalities, parasitism, etc. have been prepared for all insects received in the survey. For those insects that have completed their development, these summaries are completed and have been sent to Ottawa for inclusion in the official records. Overwintered insects have now mostly completed their development and similar summaries are in the course of preparation.

During the summer, the entire forest service personnel in the Sioux Lookout district in Ontario was visited by Mr. D. N. Smith of this laboratory, at which time individual instruction was given on the aims and methods of the survey and a general reconnaissance was made of the insects concerned. During this trip, lasting between August 15th and 27th, a total of 57 forest service men was visited in the following regions: Sioux Lookout, Red Lake, Lake St. Joseph and Armstrong. Every ranger district of the Ontario Forestry Branch in northwestern Ontario has now been visited and the personnel individually instructed. Additional to the Sioux Lookout forest district, many contacts were made with individuals, both provincial and Dominion, in the three central provinces during 1941. To date, therefore, every ranger district in central Canada, with the exception of a part of eastern Manitoba, has been visited with individual instruction given to the personnel concerned. This has extended over the past 3 years. Key men have been supplied with lists of the insects submitted by their men during 1941, a summary account of the major forest insects prevalent in central Canada during the year and a map showing all collections made and the identity of the insects of importance. Following this, approach letters have been sent to all cooperators requesting information on their ability to continue during 1942 and, at the time of writing, replies have been received from about one-half, all of which appear very anxious to continue. One conference has already been arranged for April 24th, at which time the wardens of the Prince Albert National Park will be addressed.

V. JACK PINE SCALE

Due to prevailing conditions and the incorporation of the Forest Insect Survey in the program of work for this laboratory, there has been no opportunity for continuing this study. General field observations were made, however, and records obtained on the current status of this insect. Generally, it may be said that this scale has passed its low ebb and is on a definite increase. Predators and parasites do not appear to be a factor at present in retarding its development. A general review of all field data on file was completed during the winter and important considerations for a general or detailed study were set forth.

VI. JACK PINE SAWFLY

This being a "Class C" project, work on it has been discontinued in favour of more important work. The only work performed consisted of general reconnaissance recording its prevalence and distribution and miscellaneous rearings for adult and parasite material.

The general intensity of defoliation by this insect has dropped greatly during the past two years. Work during 1941 was restricted to rearing detail for parasite records and general reconnaissance records. Parasite material is now at Ottawa and determinations are not available for inclusion in this report.

VII YELLOW-HEADED SAWFLY

This project was conducted as a side-issue to the more important budworm work. In the past, this work consisted of general reconnaissance, rearings and parasite liberations. During 1941, it was reduced to a general reconnaissance.

During 1941, an area of severe infestation was examined in the neighborhood of Schreiber, Ontario, where annual records have been maintained for the past three years. Material was obtained where possible and supplied to the Forest Insect Survey. Results of rearings and parasite determinations are not yet available.

VIII. CARPENTER ANTS

Due to prevailing conditions, the carpenter ant study has been almost eliminated in so far as any intensive work is concerned. Observations have been maintained, however, on poles set in the ground at the laboratory in anticipation of attack. These poles are for the study of the effect of so-called penetrating preservatives and, in time, should prove if such produce immunity to ant attack. Checks are established beside those treated.

During the season, 4 poles were treated by boring holes at a 45° angle of a size 4 cm. wide and 9 cm. deep. Holes were filled with preservative on 4 occasions during the summer. The penetration of the liquid should continue with time and eventual carpenter ant attack may be thwarted by unfavourable conditions so produced. Thus far, no attack has occurred to either the treated or the check poles. The testing of the preservative may entail several years' observation or until such time as ant attack occurs.

Another study on cuprinol penetration is under way but, until pole dissections are made and the heartwood examined, no conclusions can be made.

II. BIOLOGICAL CONTROL & FLUCTUATIONS IN BUDWORM POPULATIONS

A. Status of *Cacoecia fumiferana* Clem.

for 1941

1. Introduction

During 1941, efforts were made, as in previous years, to survey as completely as possible the extent and intensity of the budworm infestation. An annual survey of this nature is extremely valuable from the standpoint of providing information on the course of the infestation and to evaluate the damage done and the potential danger to the forest that may be expected in succeeding years. Information on the condition of the epidemic over the large tracts in northwestern Ontario was obtained chiefly by aerial surveys supplemented by ground examinations whenever possible. Additional reports by foresters, rangers and other individuals were used to complete the survey data. In Manitoba and Saskatchewan, it was possible to examine the few relatively small infested areas from the ground, thereby eliminating the necessity for aerial mapping.

2. Classification of Defoliation

For reconnaissance purposes, the degree of infestation has been classified into four categories; namely, heavy, medium, light, and a trace. These categories are based on the field standards of the Forest Insect Survey and are recognized as follows:

Heavy--	Browning throughout the crown, being decidedly marked at top of tree. Larvae fall with each disturbance of the foliage.
Medium--	Browning at top of crown quite visible, lower twigs commonly browned.
Light--	Browning distinct but not conspicuous from the air. Larvae beaten from trees in small numbers.
Trace--	Browning barely noticeable from the air. Occasional larvae found in the terminals.

By correlating ground examinations with observations of the same area from the air, it is possible to make accurate estimates on the basis of the broad classification mentioned above. In addition to this, population counts of larvae made in areas under direct observation by the personnel of the Winnipeg Laboratory provide valuable comparative data between areas. The latter, however, are dealt with in detail in Section C (Population Studies), P. 88.

3. General Situation in 1941

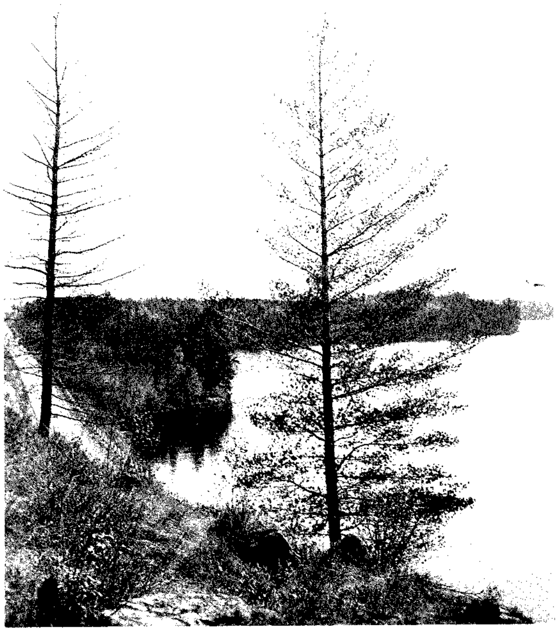
The budworm situation for 1941 is, with some exceptions, considerably improved over conditions prevailing from 1937-1940. The most important centre of infestation remains in northwestern Ontario, although the infested area is now considerably reduced. There appears to be very little timber dying, although in the older areas of heavy infestation a certain percentage of trees succumbed in 1941 as a result of previous heavy defoliations. Three isolated outbreak centres prevail in Manitoba and there is one in Saskatchewan. These four areas, however, are extremely important from the commercial or aesthetic standpoint and, therefore, are worthy of continued close and careful observation.

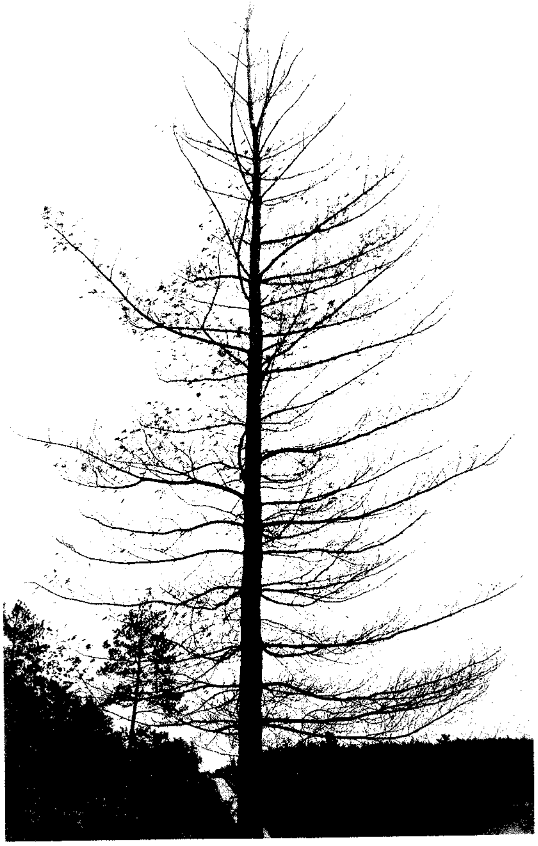
4. Description by Area

(a) Northwestern Ontario

As already stated, the situation in Ontario continues to improve, although large areas were again infested in 1941. The entire eastern parts of the Kenora and Fort Frances district experienced an epidemic varying in degree of intensity from light to heavy, the heaviest defoliation in general occurring towards the eastern limits of the territory. Severe defoliations took place in three relatively small areas; namely, Beaverhouse Lake, Sturgeon Narrows and Eagle Rock Lake (See red areas on map, P. 40). The infestation at Beaverhouse Lake was the heaviest observed in Ontario in 1941 with larvae causing severe defoliation of red and white pine, in addition to their normal Jack pine host. The entire southwest portion of Quetico Park also experienced a medium budworm 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, although on the whole the infestation here was of medium intensity. With the exception of a few isolated islands, the infestation elsewhere in

Top left:	Budworm defoliation to Jack pine near Kenora, Ontario, in 1941.
Top right:	Budworm defoliation to white pine at Kenora, Ontario, in 1941.
Bottom centre:	Dead Jack pine in the Kenora district as a result of budworm defoliation in 1938.





Top: Duplicate of Kodachrome transparency at Willard Lake, Ontario, showing dead and dying Jack pine as a result of budworm defoliation.

Bottom: Duplicate of Kodachrome transparency showing dead and dying trees as a result of attacks by budworm and secondary insects. The red foliage of several dying trees in the group is not apparent in monochrome.

this general area was light.

The area thus far considered appears to be the focal point of the infestation in northwestern Ontario. Budworm has been found over its entire range, but the area now infested is much smaller than it was in 1939-1940, having contracted eastward in the Kenora and Fort Frances districts and westward from the Port Arthur district. The territory including Hawk Lake, Vermilion Bay and Dryden, which was the scene of heavy outbreaks from 1937-1940, revealed only a trace of budworm in 1941.

A few relatively small budworm infestations were found outside of the limits of this large central range. 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 has declined rapidly since 1940. Four comparatively small areas of medium infestation were recorded. These are 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. Light infestations were recorded northeast of Sandy Lake, north of Griff, southwest of Black Sturgeon River, northeast of Graham and north of Pashashkan Lake.

Top: Mature tamarack in the Epinette swamp, Spruce Woods Forest Reserve, showing heavy defoliation by budworm.

Bottom: General view of the Epinette swamp, showing reddened spruce (dark in the print) amongst green tamarack (light in the print).

Upper centre: Duplicate of a Kodachrome transparency showing a spruce leader heavily defoliated by budworm.

Lower left and right: Close-ups of budworm-damaged terminals on spruce. Pupae can be seen amongst the foliage.

(b) Manitoba

Three important infestations were under close observation in Manitoba in 1941. The most interesting of these at the Spruce Woods Forest Reserve is unique in many respects. A severe budworm outbreak has developed here since 1939. The infestation appears to have spread from the spruce islands in the Epinette larch swamp onto the surrounding larch and eventually moved for a considerable distance into the park-like scattered white spruce in the rolling sandy country bordering the swamp on the south. The infestation on the white spruce bordering the swamp and on the spruce islands in the swamp was most severe in 1941. The larch in the swamp was also attacked but to a much lighter degree.

The most interesting feature of the outbreak is that it is confined entirely to spruce and larch, there being no Jack pine in the territory. Moreover, the appearance of the larvae, pupae and adults is typical of the spruce budworm strain and they are easily distinguished from budworm obtained from Jack pine. Another point of interest is that infestation is in an isolated area at least 50 to 60 miles removed from the nearest extensive stands of Jack pine or spruce. It is probable, therefore, that the budworm has been present here in an endemic condition indefinitely and that one or more favorable circumstances has permitted it to develop to the present dangerous proportions. As a result of the unusual conditions encountered in this area, the distinct complex of biological control agents which obtains here was to be expected. This complex is discussed in Section B, P. 58 (Biological Control).

To date heavy defoliation has not produced any apparent mortality in either the spruce or larch. Should the outbreak continue in its present severe form, however, the destruction of timber might become serious. As it is, the injury to trees resulting from loss of growth and from gnarled, twisted terminals and leaders will no doubt be considerable. Moreover, if the defoliation of larch from additional feeding by the European larch sawfly should become acute, serious decimation of larch is likely to occur.

Another outbreak in the Riding Mountain National Park is at present confined to a small area of Jack pine east of Wasagaming on the Norgate Road. Light defoliation was first observed in the area in 1940. Light to medium defoliation resulted from budworm feeding in 1941 and, while the situation is not serious at present, the infestation is potentially dangerous. The timber in the park is valuable both from the commercial and aesthetic standpoints and any losses resulting from destructive insect outbreaks would be a matter of grave concern.

The old infestation at the Sandilands Forest Reserve is still active but on a much reduced scale. The defoliation on the Reserve as a whole is light, although in a few isolated areas it is somewhat heavier.

(c) Saskatchewan

The only known budworm infestation in this province is in the Fort a la Corne Forest Reserve. The outbreak is scattered and patchy, varying from light to medium. It covers an area of about three counties. Little mortality of Jack pine as a result of budworm defoliation has been observed. In this respect, Fort a la Corne is similar to the Sandilands Forest Reserve, where very little mortality has resulted from at least three years of heavy defoliation.


1941
BUDWORM INFESTATION
FOR
CENTRAL CANADA
LEGEND
Red .... Heavy Yellow ... Light
Brown .. Medium Green .... Trace
MANITOBA

B. Biological Control of Cacoecia fumiferana Clem.

1. The Budworm Pupal Survey

(a) Introduction

The Jack pine budworm pupal survey which was so successfully initiated in 1939 was again operated in 1941 with gratifying results in spite of severe handicaps imposed by curtailment of funds and by the greatly increased volume of work handled by the Winnipeg Laboratory in undertaking the operation of the Forest Insect Survey for central Canada. During the winter of 1940-41, it was foreseen that some difficulty would arise in attempting to enlarge the scope of the survey due to the limiting factors already mentioned. It was imperative that collections be made from two important new areas, the Spruce Woods Forest Reserve and Riding Mountain National Park, in which budworm outbreaks had occurred. To this end, several stations in the Fort Frances district were omitted from the survey in 1941. This district previously received more complete coverage than any other area under surveillance and the areas omitted were selected in such a manner that the accuracy and value of the data obtained from the district would not be materially impaired. Moreover, the infestations in these areas have declined to such an extent that it is doubtful if they would have yielded a sufficient number of pupae in any case.

As in previous years, grateful acknowledgment is made of the continued and willing co-operation of the provincial and Dominion forestry services and private companies. Without their efforts, the coverage of the survey would have been reduced by approximately 70%.

A complete discussion of the organization and operation of the survey appears in the 1940-41 Annual Report, Pages 35-42. As the procedure was modified very little in 1941, the bulk of this discussion has been omitted from this year's report.

(b) Areas Contributing and Pupae Received

Pupae were received from 16 study areas in 1941. Considering the difficulties involved in obtaining pupae from many localities, this number compares favourably with the 1940 total of 18 study areas. The contributors at Eva and Sphene Lakes in the Fort Frances District and Vermilion Bay and Minaki in the Kenora District were unable to submit pupae in 1941, due mainly to a scarcity of budworm. This year, collections were initiated in two important new areas of infestation; i.e., the Spruce Woods Forest Reserve and Riding Mountain National Park, both in Manitoba. The collections started from three areas in the Port Arthur District in 1940 were continued in 1941. Pupae were procured as usual from Fort a la Corne, Sandilands Forest Reserve, Hawk Lake, Dryden and Ignace.

The locality, name, service in which employed, number of collections and number of pupae received from each contributor in 1941 are shown in Table 1.

TABLE 1

SOURCE & NUMBER OF PUPAE RECEIVED IN THE 1941 BUDWORM PARASITE SURVEY

LOCALITY	COLLECTOR	SERVICE OR COMPANY	NUMBER OF Collections	NO. OF PUPAE
SASKATCHEWAN				
Fort a la Corne	F.B. Rabkin	For. Ins. Investigations	13	2724
MANITOBA				
Sandilands For. Reserve	L.T. White and F.B. Rabkin	For. Ins. Investigations	2	1056
Spruce Woods For. Reserve	R.R. Lejeune & F.B. Rabkin	For. Ins. Investigations	4	2470
Riding Mtn. National Park	R.A. Richmond & C.O. Camp 1	For. Ins. Investigations and National Parks	18	1878
ONTARIO				
Kenora District				
Hawk Lake	R.R. Lejeune	For. Ins. Investigations	6	1160
Dryden	O.S. Jackson & D. Horn	Dryden Paper Company Ltd.	10	1428
Ignace	J. Horn	Ontario Forestry Branch	9	1486
Fort Frances District				
Basswood Lake	S. Roberts	Ontario Forestry Branch	6	959
Calm Lake	F. Clark	Ontario Forestry Branch	6	1400
Crooked Pine Lake	P. Peltier	Ontario Forestry Branch	1	123
Beaverhouse Lake	N. Ross and A. Galbraith	Ontario Forestry Branch	2	
Sturgeon Lake	J. S. Sullivan	Ontario Forestry Branch	6	
Lake la Croix	J.A. Bissonnette	Ontario Forestry Branch	1	
Total Beaverhouse, Sturgeon & la Croix				1593
Port Arthur District				
Savanne	T. Guerard	Ontario Forestry Branch	6	3924
Graham	J. Dawson	Ontario Forestry Branch	5	920
Kakabeka	D.C. White	Ontario Forestry Branch	10	2050
TOTALS			105	23171

(c) Summary of Organization & Operation of the Survey

The budworm survey was again operated in Winnipeg in 1941. The technique of handling and rearing pupae was exactly the same as that used in 1940. A full discussion of the methods used will be found in the Annual Report for that year, Pages 35-47. A further development of the pupal survey was its inclusion as a part of the Forest Insect Survey. This made for greater uniformity in the handling of the pupal material, at the same time making the data more readily available for the Forest Insect Survey report.

A departure from the standard types of pupal collections was made in 1941 in some areas to procure additional information on the habits of the hosts and parasites. Two series of collections were made in the Fort a la Corne Forest Reserve, the first in the area where several hundred adults of Ephialtes conquisitor and Phaeogenes hariolus were released in 1939 and the second at a point 15 miles distant from the first. These two series were reared separately to determine what influence these parasite liberations exerted on the intensity of parasitism in subsequent years.

Separate collections were made from larch and spruce in the Spruce Woods Forest Reserve. These categories were further subdivided by collecting pupae from the top and bottom of each tree species. At Hawk Lake, similar collections were obtained from the top and bottom of Jack pine. Through these various collections, it was hoped to establish the influence of site and stratification on insect parasitism.

Pupae received from several Fort Frances stations were again grouped as in previous years. Pupae from Calm and Crooked Pine Lakes were combined to form a series as were the collections received from Beaverhouse Lake, Sturgeon Narrows and Lake la Croix.

(d) Analysis of Data

(i) Parasites reared. So far as is known, all the important parasites obtained in previous years were obtained in 1941. Although time has not permitted the critical examination of all parasites for species determination, the identity of the following has been established from the 1941 survey material:

Phaeogenes hariolus Cress.
Ephialtes conquisitor Say.
Amblymerus verditor Nort.
Syntomosphyrum esurus Riley
Tetrastichys sp.
Dibrachys sp.
Atrometus sp.

It has not been possible to assemble all the dipterous material for identification, but by far the greatest percentage of flies obtained appears to be Nemorilla maculosa Meigh.

(ii) Pupal parasitism for 1941. The percentage parasitism of pupae caused by various species or groups of parasites for each area is shown in Table 2. Only mortality caused by parasites is taken into consideration here and the parasitism is based on the total number of pupae received minus those dead from causes other than parasitism as 100%. The reason for this procedure is outlined in the 1940-41 Annual Report, P. 46. It might be stated here that the problem of dealing with the factors other than parasites responsible for the death of pupae is a very difficult one. Certain possible causes have been considered and, in an attempt to evaluate their importance, the data have been analysed and some tentative conclusions reached in Section (iii), P. 63 .

It will be observed in Table 2 that the usual grouping of all Diptera, Chalcids and miscellaneous parasites has been followed.

TABLE 2

PERCENTAGE MORTALITY OF PUPAE FROM THE 1941 BUDWORM SURVEY

AREA	DIPTERA	EPHIALTES CONQUISITOR	PHAEOGENES HARIOLUS	CHALCIDS	MISCELLANEOUS	TOTAL
SASKATCHEWAN						
Fort a la Corne						
Area 1 1st sample	20.12	12.50	2.82	0.08	2.57	38.10
Area 1 2nd sample	14.20	6.65	0.00	6.34	0.60	27.79
Area 2 1st sample	17.59	4.86	2.68	4.02	3.52	32.66
Total	18.46	9.40	2.34	2.19	2.53	34.92
MANITOBA						
Sandilands	9.92	13.69	3.27	1.26	0.38	28.52
Riding Mountain National Park	8.99	7.65	2.67	1.62	0.49	21.42
Spruce Woods Forest Reserve						
Top ½ of spruce	2.72	3.21	0.25	1.23	0.00	7.41
Lower ½ of spruce	5.73	4.74	0.20	0.79	0.00	11.46
Top ½ of larch	4.85	3.69	0.00	13.01	0.00	21.55
Lower ½ of larch	5.21	11.42	0.20	4.61	0.00	21.44
Total for Spruce Woods	4.73	5.87	0.16	5.14	0.00	15.90
ONTARIO						
Kenora District						
Hawk Lake						
Top ½ of Jack pine	0.65	0.65	6.14	2.58	0.00	10.02
Lower ½ of Jack pine	1.54	9.67	1.98	5.93	0.00	19.12
Total for Hawk Lake	1.02	4.47	4.38	4.00	0.00	13.87
Dryden	2.28	13.50	15.51	6.57	0.00	37.86
Ignace	1.42	7.22	23.48	8.13	0.00	40.26
Fort Frances District						
Basswood Lake	10.85	7.14	5.29	2.91	0.00	26.19
Beaverhouse L., Lake la Croix, Sturgeon Narrows	3.77	8.10	13.20	9.71	0.02	34.87
Calm & Crooked Pine Lakes	4.61	10.41	5.38	11.69	0.34	32.42
Port Arthur District						
Kakabeka	11.88	46.61	2.50	3.19	0.10	64.27
Graham	1.92	17.95	3.85	0.80	0.00	24.52
Savanne	1.73	22.46	3.76	3.06	0.00	31.01
AVERAGE FOR ALL AREAS	6.28	13.42	6.60	4.64	0.30	31.2[illegible]

Pupal parasitism, generally speaking, increased by 100% over that of 1940. The average parasitism of all areas for the last three years shown in Table 3 below will illustrate this point very readily.

TABLE 3

AVERAGE PARASITISM FOR ALL AREAS IN 1939, 1940 & 1941

Year	Diptera	Ephialtes conquisitor	Phaeogenes hariolus	Chalcids	Misc.	Total
1939	5.87	12.07	26.38	3.57	0.58	48.47
1940	2.62	8.04	2.62	1.55	0.50	15.33
1941	6.28	13.42	6.60	4.64	0.30	31.23

Furthermore, it will be observed that all types of parasitism increased by almost equal amounts to bring about this general rise. Diptera, Chalcids and Ephialtes are playing a more important role than they did in any previous year. Phaeogenes hariolus which contributed over 50% of the pupal parasitism in 1939 is now carrying on at a much reduced level. This species appears to be very sensitive to host fluctuations and apparently functions at a greatly reduced efficiency at a low population density but appears to be very effective against the denser host populations experienced in outbreak years. The comparative specificity of this species (having few alternate hosts) in all probability is the cause of these extreme fluctuations. Ephialtes, on the other hand, being a more general parasite, does not fluctuate as rapidly and, on the whole, appears to possess greater stability.

Perhaps one of the most striking features brought to light in the three years of the survey is the universality in the distribution of the major pupal parasites. This is an extremely important factor when considering the question of the possibility of budworm outbreaks being brought under control by natural agents, particularly parasites.

The fundamental concept that the fraction of the host population destroyed by parasites varies directly with the density of the host population is now generally accepted by most biologists. This concept is assumed to be particularly applicable to the more specific parasites such as Phaeogenes hariolus. Provided then, that a series of major parasites is distributed throughout the range of an infestation, as is the case with the budworm, a potential controlling force exists which under normal conditions becomes increasingly effective as the host population increases. If no other factors interfere to disrupt the normal course of events, these parasites should increase to such an extent that they eventually become the decisive factor in reducing the density of the host.

This does not necessarily mean that biotic factors produce a greater mortality than abiotic agencies, but the fact remains that climatic factors for example act independently of host density and, on the average, destroy the same fraction of hosts at low and high densities. Biotic factors, on the other hand, destroy a greater fraction at high host densities and therefore are more likely to be a decisive factor in controlling an insect outbreak.

Assuming these arguments to be valid, it follows that a reservoir of efficient parasites constitutes a controlling force which springs into action when an imbalance of host populations results in an epidemic. In several areas of the pupal survey in which the percentage parasitism reached a peak in 1939, the epidemic subsided rapidly. In many of these areas such as Hawk Lake, Sandilands, Vermilion Bay, and Sphene and Off Lakes, the budworm population is now very light. In other areas such as Fort a la Corne, Beaverhouse Lake, Sturgeon Narrows and Lake la Croix in which the percentage mortality of pupae by parasites was lower, the infestation is still very active. While the importance of parasites in influencing the budworm populations in the former areas cannot be definitely proved, circumstantial evidence, particularly at Hawk Lake and the Sandilands Forest Reserve, would seem to indicate very strongly that as a control agent pupal parasitism was decisive.

In 1940, parasitism over the whole range of the infestation was extremely low (see Table 3). This may have been due to one or a series of decimating factors acting against the parasites and about which we have no knowledge. As a result of this, it is possible that those areas in which the host population was not effectively reduced in 1939 (Fort a la Corne, Beaverhouse Lake, etc.) had an opportunity to increase their numbers in 1940 and appear again in outbreak form in 1941.

The above discussion is of a general nature and attempts to explain in a general way the influence of parasites over the entire range of the outbreak. Each individual area, however, has certain peculiarities of its own which, in many cases, tend to modify the general trends. It is deemed advisable, therefore, to discuss each area separately, thereby affording a clearer picture as to how the parasites operate under different sets of conditions. The sequence of the areas discussed is from west to east, beginning with Fort a la Corne in Saskatchewan and ending with Kakabeka in the Port Arthur District.

Fort a la Corne

This is the only area under observation since 1939 in which parasitism has more or less shown a tendency to increase. The percentage parasitism for the last three years from 1939 to 1941 was 25.41, 22.97 and 34.92 respectively. Dipterous parasitism is of major proportions here, accounting for between 40 and 60% of the total parasitism during the last three years. After a decrease in 1940, Ephialtes conquisitor increased markedly in 1941 to 9.40%. Phaeogenes hariolus has generally not shown the same importance as it has in other outbreak areas.

There is a certain sequence of parasitism in the budworm which may account for the degree of parasitism exhibited by the various species of parasites at Fort a la Corne. Diptera attack the larval stage of the budworm. Then, when budworm pupation commences, Ephialtes appears in the field. Parasitism by Phaeogenes reaches a peak a few days later than that by Ephialtes. Bearing this in mind, an examination of the total parasitism at Fort a la Corne (Table 2) shows highly suggestive trends. By the time the budworm reached the pupal stage, 18.46% or approximately 1/5 of the pupae were parasitised by Diptera. This reduced the budworm population available to Ephialtes considerably. Ephialtes, however, managed to parasitise 9.40% of the pupae. By the time Phaeogenes appeared, approximately 25% of the pupae had been destroyed by Diptera and Ephialtes, plus a not inconsiderable larval mortality caused by other larval parasites. Phaeogenes, having in previous years shown to be influenced very markedly by fluctuations in host population, may not have been able to locate a sufficient number of hosts to destroy any considerable fraction of the budworm population. Hence, parasitism by Phaeogenes accounted for a mere 2.34% of the pupae. In 1940, as a corollary to the above situation, a low dipterous parasitism (9.11%) was followed by a low Ephialtes parasitism (1.95%), possibly leaving a greater density of host for Phaeogenes which in that year parasitised 6.05% of the pupae.

In an attempt to establish if the release of several hundred adults of Ephialtes and Phaeogenes in 1939 might have had any effect on the subsequent degree of parasitism, collections were made from two areas in 1941. Two samples of pupae were collected in the area where the liberations were made in 1939. These collections are designated Area 1, samples 1 and 2, in Table 2. A third collection was made from an area 15 miles distant from Area 1 and is designated Area 2 in Table 2. Approximately 85% of the parasites released were Phaeogenes hariolus. An examination of Table 2 for Fort a la Corne shows that the average parasitism by Phaeogenes in Area 1 is lower than in Area 2. Ephialtes, however, which only constituted 15% of the parasites released, increased to 9.41% in 1941. While not much reliance can be placed on these data in interpreting the effect of parasite liberation, due to the innumerable other factors that could influence host and parasite populations, indications are that over a period of two years the results of these liberations are negative. Furthermore, even in 1940, the year following liberation, there was no significant increase in the percentage parasitism by either <u>Ephialtes</u> or <u>Phaeogenes</u>.

Excluding other factors, the general trend of both host and parasite populations at Fort a la Corne during the last three years seems to indicate a moderate degree of balance between the two, with parasites gradually gaining the upper hand. This area has not experienced the spectacular increases in budworm populations that occurred at Hawk Lake and Sandilands from 1935 to 1938. Instead, the outbreak has taken the form of sporadic scattered infestations of light to medium intensity. Possibly some other environmental condition which did not operate to the same extent in the other areas is functioning at Fort a la Corne. In any case, the prospect is hopeful that the infestation in the reserve will be brought under control by natural enemies and other environmental factors before irreparable damage is done. On the other hand, the complexity of factors involved makes any definite predictions of this nature an extremely hazardous procedure.

<u>Sandilands Forest Reserve</u>

Parasitism here was over 100% higher than it was in 1940. This was chiefly the result of a remarkable increase in dipterous parasitism from 0.0% to 9.92% in

1941. Slight increases in the remaining species make up the rest of the increase.

There is a possibility that the increase in dipterous parasitism in 1941 can be associated with changes in the population of Neodiprion sp. in the reserve. The most important dipterous parasite, Nemorilla maculosa has been reared from larvae of Neodiprion sp. in the reserve. In 1940, there was light but general outbreak of Neodiprion throughout the area. In 1941, however, very little defoliation by Neodiprion was in evidence. It is possible therefore that the sawfly population completely absorbed the dipterous parasites in 1940. In 1941, when no sawfly larvae were available to the Diptera, budworm was the only host available.

Parasitism by Ephialtes and Phaeogenes was slightly higher than in 1940. Chalcids and miscellaneous parasites remained relatively unimportant.

Riding Mountain National Park

This is the first year in which samples have been procured from this area. A total pupal parasitism of 21.42% was experienced with Diptera and Ephialtes accounting for approximately 16% of the pupal parasitism. Since this is the first sample from the area, it remains to be seen what the future trends of parasitism will be.

Field camp at the Spruce Woods Forest Reserve used during co-coon collections.

Spruce Woods Forest Reserve

This interesting and important area yielded some highly informative data with respect to pupal parasitism. First and foremost is the fact that Phaeogenes hariolus is practically non-existent in this area. This parasite has invariably assumed a position of major importance in Jack pine areas subjected to heavy budworm defoliations. It will be recalled that the infestation in the Spruce Woods is unique in that the area is made up entirely of scattered white spruce in the upland portion with a uniformly heavy stand of larch and black spruce in the Epinette swamp. It should also be noted that Phaeogenes is much more specific in its selection of hosts than any other of the pupal parasites. Since this is the first record of a budworm outbreak in this area, it is quite within the realm of possibility that there has never been any extensive budworm population to maintain a reservoir of Phaeogenes parasites. Perhaps there has never been any budworm at all in the area previous to the present outbreak, in which case the insignificant population of Phaeogenes that was present probably owed its existence to a relatively small population of a few alternate hosts. Moreover, over a period of years Phaeogenes may have developed such a degree of specificity for these other hosts that it is unable to synchronize its activities with those of the budworm. The other pupal parasites, being much more general in nature would no doubt accept any suitable host such as the budworm which was available in sufficient quantities.

Another point of interest is that the average parasitism of pupae collected from larch was more than twice as heavy as parasitism of pupae collected from spruce. Chalcids and Ephialtes in particular contributed to this higher total. Dipterous parasitism was also higher on pupae collected from larch.

The nature of the two types of stands--larch and white spruce--may account for the higher parasitism of pupae collected from the former. It is believed that the physical environment of the larch swamp is much more favorable for the activity of the parasites. The stand is denser, the humidity higher and the variations in temperature are not so excessive or extreme. Moreover, for those parasites which overwinter in the ground, and probably most of them overwinter in the ground in some stage, the moist and protective habitat provided by the duff and moss in the swamp is probably far superior to the dry, sandy soil on which the white spruce is located.

Parasitism was higher in pupae collected from the lower half of spruce. The difference in parasitism, however, is not great. In the case of collections from larch, parasitism of pupae from the upper half was practically the same as that on pupae collected from the lower half. Ephialtes, however, destroyed 11.42% of the pupae from the lower half as compared with 3.69% from the upper half of larch trees. Chalcids, on the other hand, parasitised 4.61% of the pupae from the lower half and 13.01% of the pupae from the upper half, reversing the condition obtaining for Ephialtes. The significance of these differences is not at once apparent and will require further observation.

Pupal parasites at Spruce Woods do not appear at present to constitute an effective force in reducing the budworm population, but in association with other factors discussed in Section C. (b) "Population Studies," P. 112, a considerable mortality of larvae and pupae occurred in 1941. It remains to be seen, however, if this will have an appreciable effect in reducing the budworm population for 1942.

Hawk Lake

Parasitism at Hawk Lake experienced a further decrease in 1941. This is consistent with trends observed since 1939. Ephialtes again showed a decline but Phaeogenes increased somewhat. Diptera and chalcids also made gains.

Some extremely interesting information resulted from segregating collections made from the upper half and lower half of Jack pine sampled as in the case of larch and spruce in the Spruce Woods. The total parasitism of pupae from the upper half of Jack pine was higher but the difference in parasitism by the various species as a result of this stratification was not consistent with the general trend. Parasitism by Ephialtes, chalcids and Diptera was higher on pupae collected from the lower half of Jack pine, while parasitism by Phaeogenes was higher on pupae collected from the upper half. It is interesting to note that in all samples taken from the lower half of the tree both at Spruce Woods and Hawk Lake parasitism by Diptera and Ephialtes was consistently higher than in samples taken from the upper half of the tree.

As in only one instance (Hawk Lake) was the sample of Phaeogenes large enough for comparison, it is not possible to say if the opposite trend shown by this species is constant. Unfortunately, this is the first time samples of this nature have been attempted and it will therefore be necessary to repeat this experiment over a period of years before any definite statements may be made. In the two series of collections from the Spruce Woods, chalcid parasitism was higher on material collected from the top half of trees, whereas this condition was reversed at Hawk Lake. No possible explanations for these discrepancies have been suggested and a positive statement on the reasons for this phenomenon must await further investigation.

Dryden

Parasitism at Dryden increased from 15.43% in 1940 to 37.86% in 1941. Dipterous parasitism was low, while parasitism by Ephialtes and Phaeogenes was comparatively high. Chalcids were also of considerable importance in this area in 1941.

Ignace

The infestation at Ignace was scattered but isolated trees and clumps of trees were very heavily defoliated. The fact that budworm populations were concentrated in force on such isolated trees might account for the relatively high parasitism of 40.26%. Over half of this total (23.48%) was inflicted by Phaeogenes hariolus, while chalcids, Ephialtes and Diptera came next in order of importance.

Fort Frances District

The range of parasitism in the areas in this district was fairly uniform, varying from 26.19 to 34.87% (See Table 2). There was considerable variation, however, in the degree of parasitism by the different species between areas. Phaeogenes hariolus produced the greatest mortality in the Beaverhouse Lake group, the centre of the heaviest infestation of the district. It is also significant that the highest total parasitism occurred in this area of heavy infestation. Other interesting points are:

(1) the relatively high dipterous parasitism at Basswood

Lake and (2) the unusually high parasitism by chalcids in the other two areas.

Port Arthur District

The most striking feature here is the comparatively high parasitism by Ephialtes in the three study areas of this district (See Table 2). Parasitism by Ephialtes in the three areas, Kakabeka, Graham, and Savanne, was 46.61%, 17.95% and 22.46% respectively. Strangely enough, this follows the same order as in 1940, when parasitism by this same species amounted to 13.76%, 10.82% and 12.18% respectively. Dipterous parasitism, while low in 1940, increased to 11.88% in 1941. Phaeogenes hariolus was relatively unimportant. The total parasitism at Kakabeka was the highest recorded in all the 1941 study areas, amounting to 64.27%. It would seem that such a high percentage of pupal parasitism in addition to mortality from other causes should effect a considerable reduction of the host population for 1941.

(iii) Natural mortality of pupae and possible causes. One of the most difficult problems in the analysis of data from the pupal survey has been the question of dealing with pupae dying from causes which are not apparent and which shall be designated "natural dead" in the subsequent discussion. The percentage of pupae dead from natural causes in the 1941 survey is shown in the following tabulation.

TABLE 4

PUPAE DEAD FROM NATURAL CAUSES IN THE 1941 PUPAL SURVEY

AREA	PERCENTAGE DEAD	AREA	PERCENTAGE DEAD
Beaverhouse Lake Group	33.40	Ignace	47.85
Calm Lake Group	23.05	Riding Mtn.	24.17
Basswood Lake	60.58	Sandilands	24.62
Graham	32.17	Spruce Woods	22.06
Savanne	30.89	Fort a la Corne	23.05
Kakabeka	51.12	Hawk Lake	7.41
Dryden	20.10		

Pupae in the last four areas in the second column were collected by the staff of the Winnipeg Laboratory and will henceforth be referred to as "personal collections."

The number of natural dead pupae present in collections from some of the above areas appears to be abnormally high. It is believed that in some cases methods of handling and collecting, such as beating or shaking pupae from trees onto ground sheets, long periods of confinement in overheated railway cars, packing pupae too closely in the survey boxes or in unsuitable packing material, and various other treatments may cause considerable mortality of pupae. On the other hand, precautions were made to subject the personal collections from Spruce Woods, Sandilands, Fort a la Corne and Hawk Lake to the same uniform treatment but there is a considerable variation in the number of natural dead pupae between areas. It is therefore inconceivable that any amount of this variation in natural mortality in the personal collections resulted from methods of handling and collecting. It is apparent, then that one or a combination of causes such as adverse weather conditions, disease, vitiation of the strain and parasitic feeding habits must have contributed primarily to the differences in areas where personal collections were made. It is difficult to say, however, what proportion of those pupae collected by other co-operators was killed by (1) handling and (2) other causes. It is necessary first to establish these proportions by comparing the mortality of collections made by the co-operators with a series of collections made at the same time in the same area by a member of the Winnipeg Laboratory.

It has been shown experimentally that the feeding habits of _Ephialtes_ _conquisitor_ and possibly _Phaeogenes hariolus_ are responsible for some mortality of budworm pupae. On the basis of this information, the possibility that natural deaths could be correlated with population densities of _Ephialtes_ and _Phaeogenes_ was suggested. Accordingly, correlation surfaces were drawn up to show the correlation between (1) percentage natural dead pupae and percentage parasitism by _Ephialtes_, (2) percentage natural dead pupae and percentage parasitism by _Phaeogenes_ and

(3) percentage natural dead pupae and percentage parasitism by Ephialtes and Phaeogenes combined. No correlation was apparent. Nevertheless, it is obvious that there must be a correlation between the density of these two species and the number of hosts destroyed by their feeding habits. The very fact that no correlation is apparent in the areas under observation indicates the presence of additional lethal factors.

Similar correlation surfaces were constructed for (1) natural mortality of pupae collected at Hawk Lake since 1938 and percentage parasitism, (2) natural mortality of pupae in the personal collections made in 1941 against percentage parasitism and (3) natural mortality of pupae within areas (i.e., the 4 collections made at Spruce Woods) for 1941 with percentage parasitism. Again, there was a lack of any high degree of correlation furnishing additional evidence that other lethal factors were also operating in these areas.

From another angle, a comparison of natural mortality in the personal collections with that in collections made by co-operators would seem to suggest that some mortality does occur through handling. As previously stated, every effort is made to reduce the handling mortality to a minimum in the personal collections. On the other hand, any person not accustomed to working with live insect material may at times not be fully aware of all the care required to keep this handling mortality as low as possible. Of the pupae collected by co-operators, 35.92% died "natural deaths", whereas only 19.28% of the pupae in the personal collections died from natural causes. This is a difference of approximately 16%.

Briefly then, the evidence available suggests the following possible causes of natural deaths in pupal collections:

(1) It is certain that some pupal mortality results from the feeding habits of Ephialtes conquisitor and possibly Phaeogenes hariolus. It is also obvious that the degree of mortality must vary with the density of these two species, but it is impossible to attribute any exact value to this source in the light of our present knowledge.

(2) Environmental resistance in the form of adverse climatic conditions, disease and possibly vitiation of the strain must invariably result in additional pupal mortality. It is probable that most of the natural mortality of pupae in the personal collections made by the Winnipeg Laboratory is due to a combination of (1) and (2).

(3) Some mortality of pupae is inevitable in some cases through lack of precautions to prevent injury in collecting and handling. It is hazardous to attempt a guess on the probable mortality caused by this factor, but an average estimate of 16% for 1941 is ventured on the basis of the

observed difference in the natural mortality of pupae collected by co-operators and in the personal collections made by the staff of the Winnipeg Laboratory. It should be emphasised that this figure is merely offered as a rough guide. It is quite possible that the handling mortality of the personal collections is much higher and conversely it is equally possible that this same mortality is lower than the estimated 16% in the collections received from co-operators.

The fact that it is not possible to place an exact value on the several lethal factors producing natural mortality in budworm pupae imposes definite limitations on the interpretation of data from the pupal survey. These restrictions cannot be ignored until laboratory and field experiments to determine pupal mortality caused by (1) handling and (2) natural causes are conducted. For example, a comparison of total and species parasitism between areas must be taken merely as an indication of the true picture, not as an accurate estimate. Moreover, a comparison of parasitism in the same area over a period of years can be considered reliable only if there are no great differences in the natural mortality of pupae in the years concerned. Discrepancies in natural mortality, however, in no way affect the validity of the ratios between parasites in any one area in a given year. Furthermore, a comparison of these ratios between areas and years is also valid.

(iv) Other host-parasite relations of the budworm pupal survey. Under this heading are included a series of tables dealing with other host-parasite relations. Similar tabulations can be found in the 1939-40 and 1940-41 Annual Reports. This year, however, the time available is not adequate to discuss in sufficient detail the significance of the various interrelations. The tables are therefore listed without comment so that all the records from the survey may be preserved in some permanent form. Moreover, it is believed that the time involved might be more profitably spent in bringing the records together at some future date when the trends over a period of years may be more readily interpreted.

Tables 5, 6 and 7 show the total percentage mortality of male, female and all pupae respectively for all the 1941 study areas. The total number of pupae received in each case represents 100%. The figures on parasitism in Table 7 will therefore not correspond with those in Table 2, Page 48, where the total number of pupae minus those dead from natural causes represents 100%.

TABLE 5

PERCENTAGE MORTALITY OF MALE PUPAE IN 1941

PERCENTAGE MORTALITY / AREA	Ephialtes conquisitor	Phaeogenes hariolus	Diptera	Chalcids	Misc.	Total Parasitism	Natural Dead	Total Mortality
FORT A LA CORNE	8.01	3.09	12.28	2.79	2.65	28.82	20.37	49.19
SANDILANDS	9.58	3.49	3.27	1.52	0.22	18.08	25.71	43.79
SPRUCE WOODS	5.33	0.00	3.00	3.42	0.00	11.75	20.58	32.33
RIDING MT. NATIONAL PARK	7.43	3.00	7.14	2.00	0.57	20.14	27.43	47.57
HAWK LAKE	2.58	5.34	0.52	4.48	0.00	12.91	7.23	20.14
DRYDEN	8.24	15.57	1.28	8.61	0.00	33.70	21.79	55.49
IGNACE	3.85	16.64	0.53	7.53	0.00	28.55	50.26	78.81
BEAVERHOUSE LAKE GROUP	6.85	12.07	3.26	9.46	0.16	31.81	26.43	58.24
CALM LAKE GROUP	8.50	6.94	4.92	17.22	0.89	38.47	26.17	64.64
BASSWOOD LAKE	3.48	4.48	3.73	2.24	0.00	13.93	51.24	65.17
SAVANNE	14.59	4.21	1.31	2.98	0.00	23.08	27.50	50.58
GRAHAM	12.26	4.24	1.41	0.47	0.00	18.40	22.88	41.27
KAKABEKA	21.96	1.31	4.35	1.52	0.10	29.25	56.37	85.62

TABLE 6

MORTALITY OF FEMALE PUPAE IN 1941

PERCENTAGE MORTALITY AREA	Ephialtes conquisitor	Phaeogenes hariolus	Diptera	Chalcids	Misc.	Total Parasitism	Natural Dead	Total Mortality
FORT A LA CORNE	6.45	0.51	16.13	0.59	1.25	24.93	25.00	49.93
SANDILANDS	10.89	1.68	10.72	0.50	0.34	24.12	23.78	47.90
SPRUCE WOODS	3.85	0.24	4.33	4.57	0.00	12.99	23.46	36.46
RIDING MT. NATIONAL PARK	4.84	1.44	6.62	0.76	0.25	13.92	22.24	36.16
HAWK LAKE	5.70	2.76	1.38	2.94	0.00	12.78	7.60	20.38
DRYDEN	12.36	10.43	2.15	3.17	0.00	28.12	19.05	47.17
IGNACE	3.71	9.51	0.87	2.18	0.00	16.28	46.34	62.62
BEAVERHOUSE LAKE GROUP	4.49	6.73	2.04	4.59	0.00	17.86	37.75	55.61
CALM LAKE GROUP	7.81	2.97	2.97	5.58	0.00	19.33	21.75	41.08
BASSWOOD LAKE	2.33	0.36	4.67	0.36	0.00	7.72	67.32	75.04
SAVANNE	16.02	1.73	1.14	1.65	0.00	20.54	32.72	53.26
GRAHAM	12.09	1.21	1.21	0.60	0.00	15.12	40.12	55.24
KAKABEKA	23.54	1.13	7.16	1.60	0.00	33.43	46.23	79.66

TABLE 7

MORTALITY OF ALL PUPAE IN 1941

PERCENTAGE MORTALITY AREA	Ephialtes conquisitor	Phaeogenes hariolus	Diptera	Chalcids	Misc.	Total Parasitism	Natural Dead	Total Mortality
FORT A LA CORNE	7.23	1.80	14.21	1.69	1.94	26.87	23.05	49.93
SANDILANDS	10.32	2.46	7.48	0.95	0.28	21.50	24.62	46.12
SPRUCE WOODS	4.57	0.12	3.68	4.01	0.00	12.39	22.06	38.50
RIDING MT. NATIONAL PARK	5.80	2.02	6.82	1.22	0.37	16.24	24.17	40.42
HAWK LAKE	4.14	4.05	0.95	3.71	0.00	12.84	7.41	20.26
DRYDEN	10.78	12.39	1.82	5.25	0.00	30.25	20.10	50.35
IGNACE	3.77	12.25	0.74	4.24	0.00	21.00	47.85	68.84
BEAVERHOUSE LAKE GROUP	5.39	8.79	2.51	6.46	0.06	23.23	33.40	56.62
CALM LAKE GROUP	8.01	4.14	3.55	9.00	0.26	24.95	23.05	48.00
BASSWOOD LAKE	2.81	2.08	4.27	1.15	0.00	10.32	60.59	70.91
SAVANNE	15.52	2.60	1.20	2.12	0.00	21.43	30.89	52.32
GRAHAM	12.17	2.61	1.30	0.54	0.00	16.63	32.17	48.81
KAKABEKA	22.78	1.22	5.80	1.56	0.05	31.41	51.12	82.53
	113.39	56.53	54.33	41.90	2.96	269.06		
	9.71	4.35	4.18	3.22	.23	20.70		

Table 8 shows the sex-ratios of *Cacoecia fumiferana* pupae, *Phaeogenes hariolus* and *Ephialtes conquisitor* for all the areas included in the 1941 pupal survey. As this table is merely concerned with sex-ratio correlations between host and parasite, natural dead pupae, from which no parasites emerged, were not included in the computation of sex-ratios of *Cacoecia*.

TABLE 8

SEX-RATIOS OF *CACOECIA FUMIFERANA*, *EPHIALTES CONQUISITOR* AND *PHAEOGENES HARIOLUS* FOR THE 1941 PUPAL SURVEY

AREA	Sex-Ratio of *Cacoecia fumiferana*	Sex-Ratio of *Ephialtes conquisitor*	Sex-Ratio of *Phaeogenes hariolus*
Graham	.476	.509	.417
Basswood Lake	.481	.592	.200
Fort a la Corne	.488	.650	.286
Hawk Lake	.498	.750	.511
Spruce Woods	.506	.513	.667
Kakabeka	.570	.552	.520
Sandilands	.572	.569	.231
Beaverhouse Lake Group	.575	.651	.643
Dryden	.626	.662	.650
Savanne	.632	.729	.461
Ignace	.634	.625	.560
Riding Mountain	.643	.660	.500
Calm Lake Group	.718	.713	.556
TOTAL	.576	.639	.537

1941

TABLE 9

1941

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
Graham	.327	.333	.666	.667
Basswood Lake	.643	.167	.538	.500
Ft. a la Corne	.477	.238	.864	.571
Hawk Lake	.667	.355	.788	.812
Spruce Woods	.391	None	.673	.666
Kakabeka	.442	.385	.648	.667
Sandilands	.409	.000	.677	.600
Beaverhouse Lake Group	.524	.486	.773	.818
Dryden	.556	.529	.706	.761
Savanne	.582	.224	.801	.773
Ignace	.773	.358	.529	.782
Riding Mountain	.596	.238	.719	.823
Calm Lake Group	.553	.355	.786	.750
TOTAL	.503	.356	.735	.766

Attempts to correlate sex-ratios of either parasite with the degree of parasitism by that species in the following year have not met with any great measure of success.

2. Larval Survey

A study of larval mortality was again made in 1941 with the object of determining the importance of larval parasitism and other mortality factors. The most intensive study was undertaken at the Spruce Woods Forest Reserve where, in addition to rearing of larvae for parasitism, a large series of field counts and observations on the relative importance of various mortality factors were recorded. Less extensive projects involving only the collecting and rearing of larvae were made at Hawk Lake, Sandilands and Fort a la Corne. Larval collections were reared under the Forest Insect Survey for larval parasites. In all cases a known number of larvae were intorduced into the Forest Insect Survey cages but unfortunately an unknown number of larvae subsequently escaped through tiny holes and cracks in the cages. Some of the data then ~~is~~ are not to be relied on from a purely quantitative standpoint, but may be regarded as a rough estimate of parasitism.

In the following report on the larval survey, each area is reviewed individually.

(a) Spruce Woods Forest Reserve

(i) Methods. Two methods of approach were used in this area to determine larval mortality through parasitism and other causes. The first and simplest of these was the collection of a series of larvae from the upper and lower half of larch and spruce trees. The larvae were transported to Winnipeg in special cages and reared under the Forest Insect Survey.

The second method involved a quantitative and qualitative analysis in the field. At the time pupal collections were being made, all the larval parasites had emerged. About 90% of the larval parasites consisted of an Ichneumon similar in appearance to the pupal parasite, Ephialtes conquisitor and tentatively subsequently determined as Glypta sp and Glypta fumiferanae

identified as ~~Itoplectis~~ sp., which pupates in thin, parchment-like cocoons on spruce and larch twigs. Braconid cocoons making up the bulk of the remaining 10% are also quite conspicuous. It was therefore a relatively easy matter to make counts of larval parasites in conjunction with pupal collections.

At the same time, counts were also made on the number of mature larvae and pupae destroyed by (1) disease and (2) predators. While these counts on destruction by predators may be somewhat underestimated, as it was not possible to keep a check on its importance previous to the time of pupal collections, it does indicate the relative value of predators in this region in 1941.

<u>(ii) Results obtained and discussion</u>. The degree of parasitism in a series of larvae collected from spruce and larch is shown in Table 10. In each of the series tabulated below, 250 larvae were originally introduced into the cages and it will be observed that in most cases a large number of larvae could not be accounted for due to escapes.

TABLE 10

PARASITISM OF BUDWORM LARVAE FROM
THE SPRUCE WOODS FOREST RESERVE IN 1941

SOURCE OF LARVAE	NO. OF LARVAE ACCOUNTED FOR	NO. OF PARASITES	PERCENTAGE PARASITISM
Lower ½ of spruce	202	23	11.39
Upper ½ of spruce	148	13	8.78
Lower ½ of larch	114	19	16.66
Upper ½ of larch	175	25	20.00
TOTAL	639	80	12.52

While the above data cannot be absolutely relied upon from a quantitative standpoint for reasons already expressed, one very significant feature is apparent; namely that, as in the case of pupal parasites, a far higher degree of parasitism occurred on larvae collected from larch in the swamp. Possibly the same reasons suggested for pupal parasites (i.e., that a more favourable parasitic habitat is supplied in the swamp) also applies to larval parasites.

The field counts of larval parasitism yielded information which is probably somewhat more accurate than the data in Table 10. As most budworm larvae which escape destruction by parasitism in the sixth and seventh instars reach the pupal stage, a process of totalling pupal counts and the larval parasites should give a reasonably reliable estimate of the original larval population before mortality from larval parasitism became effective. This was done and, out of a total of 734 individuals recorded, 112 or 15.26% died as a result of larval parasitism.

Additional information was procured regarding destruction of mature larvae and pupae by predators and disease. While technically most of the mortality occurred in the pupal stage, the diseased individuals undoubtedly became infected during the larval stage and a considerable degree of predatorism occurred prior to the appearance of pupal parasites in the field. For these reasons, this phase has been included in the larval survey. All the quantitative records in this study were obtained at the time pupal survey collections were made.

Table 11 indicates the total number and percentage of sound and diseased and predatorised budworm examined at the time pupal collections were made. Where the data are available, the degree of mortality inflicted by (1) disease and (2) predators is shown.

TABLE 11

MORTALITY OF BUDWORM FROM DISEASE AND PREDATORS IN 1941

Source	Sound Budworm		Diseased		Predators		Disease& Predators		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Lower ½ of spruce	647	69.5					284	30.5	931	100
Upper ½ of spruce	450	72.3					172	27.7	622	100
Lower ½ of larch	1015	76.2	164	12.3	153	11.5	317	23.8	1332	100
Upper ½ of larch	701	78.8	103	11.6	86	9.7	189	21.2	890	100
TOTAL	2813	74.5					962	25.5	3775	100

Mortality from disease and predators was somewhat lower on larch than on spruce. On the average, at least 25.5% of the last instar larvae and pupae died as a result of disease and predators. It is noteworthy that on larch over 50% of this mortality was due to disease alone. What the incidence of disease was on spruce is unfortunately not known, but observations indicate that the ratio between disease and predators was approximately the same there.

The most important predator observed in the Spruce Woods was a Coccinellid of the genus Anatis, probably mali. On many occasions the voracious larvae of this species were observed in the act of devouring budworm larvae or pupae. Many typically Coccinellid egg masses, presumably of this species, were seen on spruce and larch twigs. Other observed predators of lesser importance were (1) ants, (2) a species of lepidopterous larva and (3) the occasional case of cannibalism by budworm larvae.

(b) Fort a la Corne

A series of larvae was collected from this area and reared through under the Forest Insect Survey. From a total of 132 larvae which could be accounted for, 52 parasites were obtained. These were made up of (1) 1 unidentified Ichneumon believed to be Itoplectis sp., (2) 43 unidentified Braconids, (3) 1 swarm of Chalcids and (4) 7 Diptera. On the basis of these figures, the larval parasitism at Fort a la Corne in 1941 amounted to the remarkable high total of 39.4%. This is the highest larval parasitism yet recorded on the budworm in central Canada since the inception of these investigations in 1937.

(c) Sandilands Forest Reserve

An unknown number of larvae was procured from the Reserve and reared through under the Forest Insect Survey. Therefore the data obtained therefrom are purely qualitative. Some 16 specimens of the same unknown Ichneumon believed to be a species of Itoplectis were recovered from the Sandilands larvae. this is Glypta

(d) Hawk Lake

A total of 500 larvae were collected at Hawk Lake in 1941 and reared through under the Forest Insect Survey. 250 larvae were collected from the upper half of Jack pine and 250 from the lower half. Of this total, only 137 larvae from the former and 104 from the latter could be accounted for when the final entries were made in the records. On the basis of these survival figures, the following tabulation has been compiled to show parasitism of larvae collected from the upper and lower parts of Jack pine.

SOURCE OF LARVAE	PARASITES OBTAINED	PERCENTAGE PARASITISM
Upper half	4 Braconids, 4 Diptera	5.8
Lower half	12 Braconids, 1 Diptera	12.5
TOTAL	16 Braconids, 5 Diptera	8.7

3. Egg Survey

(a) Object

The object of the budworm egg survey is to determine the following points:

(1) Egg populations per terminal for comparison with similar counts on subsequent stages of the budworm so that population fluctuations may be followed and evaluated. Egg population determinations also permit the forecasting of infestation trends in the light of past experience and afford comparisons of infestations from year to year in the same area.

(2) Egg mortality as a result of parasitism, predators and infertility.

(3) The average number of eggs per mass.

(4) From information obtained from (1), (3) and controlled studies on mating and oviposition it is possible to calculate the moth population per tree, branch or terminal required to deposit the observed number of eggs.

(b) Methods

The methods used in 1941 at Hawk Lake were exactly the same as those used in 1939 and 1940, a full account of which may be obtained from the 1940-41 Annual Technical Report, Page 11. In addition to the data procured in previous years, a complete count of all the infestable terminals on all the branches examined was also made in 1941. In this way, a figure showing the original budworm population per terminal comparable with similar subsequent larval counts was obtained.

(c) Results Obtained

Eight trees in widely scattered representative sites were examined at Hawk Lake in 1941. The following table shows the size and number of branches examined on each sample tree that was felled. It should be noted here that only 1/5 of the branches on each tree was removed for egg masses.

TABLE 12

SUMMARY OF TREES EXAMINED AT HAWK LAKE IN 1941

Tree No.	No. of branches examined	Height of Tree	D.B.H. of Tree
1	5	24'	6.0"
2	5	22'	5.0"
3	6	26'	6.5"
4	9	35'	7.0"
5	8	20'	6.0"
6	8	25'	8.0"
7	7	17'	5.0"
8	9	22'	4.0"

Table 13 is a complete tabulation of all the data obtained in the 1941 egg survey.

TABLE 13

Tree No.	Branches Examined	No. of Terminals	No. of Egg Masses	Sound Eggs	Eggs Killed by Predators	Parasitised	Infertile	Total
1	5	1341	5	220	4	0	0	224
2	5	2553	9	507	2	0	21	530
3	6	2088	14	683	0	68	51	802
4	9	3270	7	274	23	0	13	310
5	8	2146	16	954	15	0	36	1005
6	8	3113	22	983	25	18	34	1060
7	7	2221	25	997	14	17	23	1051
8	9	1646	10	615	26	0	7	648
TOTALS	57	18378	108	5233	109	103	185	5630

While the summary of the survey in Table 13 may not look like a very large sample, the work involved in carefully inspecting 57 branches with a total of 18,375 terminals is extremely time-consuming. On the average, only 1 tree a day can be recorded by one man and the period available to conduct the egg survey is restricted to less than 2 weeks a year.

All the significant data regarding the egg survey have been extracted from Table 13 and are listed below:

Eggs destroyed by parasites	1.83%
Eggs destroyed by predators	1.92%
Infertile eggs	3.28%
Total egg mortality	7.03%
Sound eggs	92.95%
Eggs per mass	52.13
Eggs per branch	99.00
Egg masses per branch	1.89
Egg masses per tree	67.30
Eggs per tree	3527.00
Eggs per 100 terminals	30.60

It is to be observed that a relatively small portion, 7.03% of the total eggs deposited were destroyed by parasites, predators and infertility. Parasites and predators combined formed about half of this total. This compares with a total egg mortality in 1940 of 3.8%, not a very significant difference.

The average number of eggs deposited in 1941 was 1.89 egg masses or 99 eggs per branch, or about 2.5 times as many egg masses as in 1940. It is difficult to say whether this increase is due to normal random fluctuations of an endemic budworm population or whether it is the beginning of a new period of epidemicity. It is suspected that the former contingency is most probable, as small normal fluctuations are to be expected with any insect population. Then too it is possible that the present scope of the egg survey itself is not sufficiently sensitive to gauge accurately small differences in budworm populations of low densities. However, careful field observations over a period of years should establish the accuracy or lack of accuracy of the egg survey. If the survey estimates for 1941 are reliable, there should be a perceptible but not a large increase in the 1942 budworm population.

One rather important feature of the data obtained from the egg surveys and controlled mating studies at Hawk Lake is the relatively small variations observed in the number of eggs per mass from year to year. The following tabulation shows the average number of eggs per mass in the field data from 1937 to 1941.

Year	Eggs per Mass
1937	42.4
1938	51.4
1939	46.9
1940	58.1
1941	52.1

The number of eggs per mass in these five years varied from 42 to 58. This appears to be merely a normal random series of differences without any particular trend. Moreover, the number of eggs per mass obtained from controlled mating studies was 43.0 and 47.8 respectively for 1937 and 1940. The latter are in fairly close agreement with the field data and suggest that the field counts are sufficiently representative and random to give a reasonably accurate picture of actual field conditions.

Referring again to the tabulation on Page 84, it is possible to obtain some very interesting information on ovipositing moth populations. Assuming that the rough average of 200, obtained from controlled mating studies, is approximately the number of eggs deposited per female under optimum conditions and that the sex-ratio is 0.500, which it was in 1941, the minimum number of moths required to deposit the observed number of eggs on the average tree sampled in 1941 was $\frac{3527}{200} \times 2 = 35$. In 1937 it was calculated that the number of moths laying eggs on one tree examined was 386. Thus, the number of moths depositing eggs in 1937, a year of extremely heavy defoliation and oviposition, was 11 times as great as in 1941, a year of light infestation. Bringing these computations a step farther, it was calculated that with densities at Hawk Lake of from 125 to 250 trees per acre the moth population in 1937 varied roughly between 50,000 and 100,000 per acre. On the same basis, the moth population in 1941 varied roughly from 4,400 to 8,800, a great reduction.

In connection with egg surveys, it should be noted here that observations, not supported by quantitative field data, indicate an extremely heavy initial budworm population on spruce for 1942 in the Spruce Woods Forest Reserve. Egg masses on spruce were very abundant in 1941 and a considerable series was collected and preserved.

A point of some significance with regard to this infestation is that careful examination revealed no egg clusters on larch. Larch needles, being quite small and thin, are probably unsuitable for oviposition by budworm moths. This leads to the rather obvious conclusion that the infestation on larch must rely entirely on the migration and dissemination of larvae from spruce. This offers possibilities for some clear-cut and decisive studies on the migration of budworm larvae. It also brings up the question of the fate of the budworm moths maturing on larch.

C. Population Studies on *Cacoecia fumiferana* Clem.

1. Introduction

During the last five years, intensive studies on the budworm have been undertaken on all possible phases which might give some clue to the causes for the sudden appearance and disappearance of epidemics. It became increasingly more apparent as these studies progressed that some accurate and not too laborious system must be devised to determine budworm populations from year to year, from area to area, and also to measure budworm population fluctuations within one budworm generation from the egg to the subsequent adult in order to evaluate properly the various factors in the environment, biotic and physical, acting for or against the budworm. With this in mind, several methods were tried. Some are distinctly superior to others and it is believed that the most satisfactory system has now been developed and efforts will be made to utilize it in studying budworm populations in the years to come.

2. Object

The object of these studies then is to establish either relative or absolute measures of budworm populations so that comparisons can be made of the following:

(1) Intensity of infestations in any area from year to year.

(2) The intensity of infestations between areas.

(3) Budworm population fluctuations in one generation from egg to adult.

Other more or less incidental information such as establishing population densities for light, medium and heavy infestations and the influence of staminate trees and light, etc. on population densities may also be obtained from the data.

3. Methods

Various methods of estimating budworm populations have been used. Each of these is described below and the merits and demerits of each pointed out.

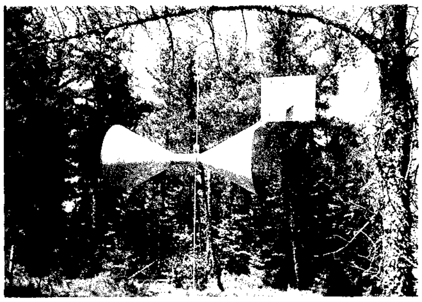
(a) Average Defoliation per Tree in the Permanent Sample Plots

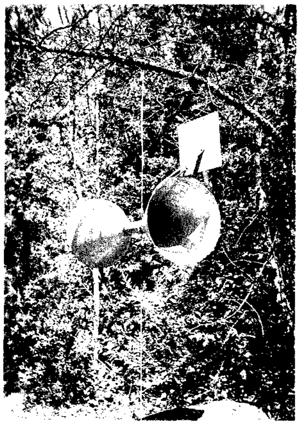
This merely consists of totalling the defoliation, expressed in percentage, of all trees in the permanent sample plots of one area and computing the mean defoliation per tree. As the defoliation figures reflect the intensity and activity of budworm larval populations, especially from the 4th to 7th instars inclusive, the average defoliation per tree may be used as a relative measure of the annual larval populations in the same area, and populations between two or more areas.

The average defoliation per tree has been used with some measure of success to interpret the relation between host and parasite fluctuations at Hawk Lake and Sandilands. However, as the defoliation estimates are entirely ocular and depend for their accuracy on the

Top centre:	Apparatus used at Hawk Lake in 1941 to trap male budworm moths.
Bottom left:	Another view of the same apparatus.
Bottom right:	A different type of male budworm moth trap used at Hawk Lake in 1941.

<u>NOTE</u>: Both traps were unsuccessful in attracting males.





experience and judgment of the observer, they may not always be comparable. Furthermore, it will be very difficult to obtain reasonably accurate estimates when the budworm population densities are very low.

This method therefore has a limited use as a relative criterion of budworm populations of medium and heavy densities but its value is definitely limited.

(b) Trapping

Attempts have been made to trap male budworm moths with live females and female extracts in alcohol. So far, this method has been completely unsuccessful.

(c) Population Counts

This is the most accurate but time-consuming method yet devised. The following plan was designed to show fluctuations in budworm populations at various critical periods of the season and also provides absolute criteria for comparing populations between areas and years. Several steps are involved, each of which is discussed below.

(i) Egg survey. By means of the egg survey, already described, a figure is obtained on the number of eggs per terminal. This establishes the initial maximum budworm population for the year in the area where the egg survey was conducted.

(ii) Larval counts. A minimum of one and, if possible, two or more larval counts should be made during a season.

The first larval count per terminal should be made in the spring after the larvae have emerged from hibernation and become established in the buds or cones. This should give an estimate of the migrating and overwintering mortality. The second larval count is made when the larvae are in the 5th, 6th and 7th instars, after larval parasitism has taken its toll. It is then possible to determine the mortality of larvae from the time of establishment in the buds in the spring until they are mature and ready to pupate. If only one larval count can be made, the later one is preferable.

Attempts were made to conform as closely as possible to the following suggested technique of sampling:

(1) Trees are selected at random in the area to be sampled.

(2) An equal number of branches is removed from the top and bottom of the tree. Then all the larvae and all the terminal buds which are capable of being infested are counted. Often many terminal buds on a branch are undeveloped or underdeveloped and are normally not inhabited by larvae. Such terminals are omitted from the count.

Some difficulty arises in the case of Jack pine branches with staminate cones. In this case, all the larvae in the cones and terminal buds are counted. In most cases, the twig bearing the cone also has a

Modified tree pruners used to sample budworm populations from the top of trees.

terminal bud at the tip of the cone. Therefore, all the terminal buds with and without staminate cones are recorded , as all of the larvae in the cones will eventually feed on these terminal buds. This difficulty does not arise in sampling spruce or larch. When sampling populations on Jack pine, it is imperative that the selection of trees be purely random or, as an alternative, that allowances are made for the proportion of staminate and non-staminate trees in the stand when computing the average population per terminal for the area a s a whole. Larval populations are usually much higher on staminate trees and therefore, if the sample is not randomized, the final result will be biased unless the alternative mentioned above is used.

For illustration, let it be assumed that a series of counts is not random and that the average populations per 100 terminals are determined as 20 on staminate trees and 5 on non-staminate trees. If the staminate trees comprised one-fifth of the total stand, the average population per 100 terminals for the entire stand would be $\frac{(20x1) + (5x4)}{5} = 8$

A distinct advantage of this method is that a smaller series of trees can be sampled and it is particularly useful where budworm densities are light.

Unfortunately, the importance of randomization was not fully appreciated in the 1941 samples and therefore an attempt has been made to apply this alternative method to the data.

Another point is that in computing larval populations from the records the number of larvae from the top and bottom of the tree should be reduced to a common denominator (i.e., so many larvae per 100 terminals) and the average population for the tree calculated on that basis. Otherwise, the same difficulty encountered in the case of staminate trees will arise. Larval populations are denser at the top of the tree; therefore, if the counts from the top and bottom are not equal or reduced to a common denominator, another bias will result.

<u>(iii) Pupal counts</u>. As most of the 6th and 7th instar larvae survive to pupate, the last larval count may be used to indicate the initial pupal population in the field. Then, by laboratory rearings and field counts, the mortality of pupae from parasites, predators, disease and climate, etc. may be established and the emergence of moths per terminal determined.

<u>(iv) Survival of moths</u>. The number of moths per terminal required to deposit the observed number of eggs in the field is computed from the results obtained from the egg survey in the fall of the year and with data available from controlled oviposition studies. As the emergence of moths per terminal from the pupae is known from (iii) above,

it is a simple matter to determine that percentage of moths which did not survive to deposit eggs.

4. Results Obtained

(a) Hawk Lake

The methods outlined in Section (c) "Population Counts", Page 91 , were applied for the first time at Hawk Lake in 1941. Some valuable data from larval counts are available for 1937 and 1938. Most of the egg survey data from preceding years are also applicable and will be brought into the discussion. Only one series of larval counts was made at Hawk Lake in 1941 between June 12th and June 17th. At that time, most of the larvae were in the 5th, 6th and 7th instars. The following table is a summary of data obtained from all the trees examined.

TABLE 14

SUMMARY OF LARVAL POPULATION COUNTS AT HAWK LAKE IN 1941

Tree No.	Height (Feet)	D.B.H. (In.)	Staminate Cones	Type	Location of Sample	No. of Terminal Buds	No. of Larvae	Larvae per 100 Terminals
1	30	6.0	light	high crowned	Top ½	75	13	17.33
1	30	6.0	light	high crowned	Lower ½	233	1	0.43
2	32	7.0	light	high crowned	Top ½	106	53	50.00
2	32	7.0	light	high crowned	Lower ½	63	10	15.87
3	30	5.0	none	semi-orchard	Top ½	125	0	0.00
3	30	5.0	none	semi-orchard	Lower ½	168	0	0.00
4	30	6.0	none	high crowned	Top ½	117	0	0.00
4	30	6.0	none	high crowned	Lower ½	54	0	0.00
5	32	6.5	light	semi-orchard	Top ½	139	39	28.06
5	32	6.5	light	semi-orchard	Lower ½	106	3	2.83
6	28	4.5	none	orchard	Top ½	126	0	0.00
6	28	4.5	none	orchard	Lower ½	126	0	0.00
7	30	7.0	none	semi-orchard	Top ½	142	3	2.11
7	30	7.0	none	semi-orchard	Lower ½	149	0	0.00
8	34	8.0	moderate	orchard	Top ½	341	126	36.95
8	34	8.0	moderate	orchard	Lower ½	254	4	1.57
9	40	8.0	light	high crowned	Top ½	266	20	7.51
9	40	8.0	light	high crowned	Lower ½	409	2	0.49
10	32	5.0	light	semi-orchard	Top ½	174	6	3.45
10	32	5.0	light	semi-orchard	Lower ½	178	6	3.37
11	35	10.0	moderate	semi-orchard	Top ½	214	27	12.62
11	35	10.0	moderate	semi-orchard	Lower ½	267	32	11.98
12	30	6.0	light	orchard	Top ½	512	63	12.30
12	30	6.0	light	orchard	Lower ½	579	44	7.60
TOTALS:								
12						4923	452	8.94

A total of 12 trees, with samples taken from the top and bottom of each, was examined. The terminal buds counted numbered 4,923 and yielded 452 larvae or 9.18 larvae per 100 terminals. Taking the average of the column at the right, however, shows 8.94 larvae per terminal and this figure is a little more accurate than the first average of 9.18.

Again, using the column at the right in Table 14, the number of larvae per 100 terminals for staminate trees averaged 13.27 as compared with 0.26 larvae per 100 terminals on non-staminate trees. This difference is remarkably large and demonstrates conclusively that larvae prefer pollen-producing trees. During years of light infestation such as in 1941, a great percentage of the budworm larval population is concentrated on staminate trees. This attraction for pollen is probably just as strong in years of heavy infestation but, due to competition and crowding, the larvae are often forced to migrate from the extremely crowded staminate trees. Larval populations in heavy years of infestation appear to be more generally dispersed throughout the entire stand.

The influence of pollen on the grouping of larvae can be further illustrated by comparing populations on moderately staminate, lightly staminate and non-staminate trees. The larvae per 100 terminals on these three types in the order given averaged 15.78, 12.43 and 0.26.

This population study also illustrates the known tendency of budworm larvae to mass together in the upper parts of the tree, a phenomenon which is probably the exhibition of a positive heliotropic reaction. Table 15 shows the number of larvae per 100 terminals on the upper half and lower half of trees sampled in 1941.

TABLE 15

Location on Tree	LARVAE PER 100 TERMINALS		
	Staminate	Non-staminate	Mean
Top ½	21.03	0.57	10.80
Lower ½	5.52	0.00	2.76

Table 15 indicates that the density of budworm populations is on the average about four times as heavy in the upper portion of the tree. Populations at the top are particularly heavy in the case of staminate trees. No larvae were found on some 500 terminals examined from the lower half of non-staminate trees.

One of the main objects of these population studies was to get an estimate of the larval population at Hawk Lake for 1941. As previously stated, the importance of randomization was not fully realized at the time and it is believed that an unconscious selection of staminate trees occurred. Moreover, at the time no effort was made to determine the proportion of staminate and non-staminate trees in the stand. The proportion selected, however (8 staminate and 4 non-staminate) was far too high. Not even 50% of the trees are staminate, but in order not to err too much in the other direction it has been assumed that the ratio of staminate to non-staminate trees in the stand was 1 to 1. In that case, the average population per 100 terminals is:

$$\frac{\text{larvae per 100 t. on stam.} + \text{larvae per 100 t. on non-stam.}}{2}$$

or $\frac{13.27 + .26}{2} = 6.26$. This has been selected as the average larval population per 100 terminals in the 5th-6th ~~instars~~ stadia at Hawk Lake for 1941. It is hoped that the opportunity will arise to establish the correct ratio of staminate to non-staminate trees in this area so that a revision of this estimate can be made.

With the data available from the egg, larval and pupal surveys and results of laboratory and field determinations of parasitism, predators, etc., it is possible to evaluate for the first time the importance of the various mortality factors in the environment acting against the budworm in 1941. One of the ultimate aims of this work is to make such annual assays of the mortality factors through a complete epidemiological cycle and establish definitely the role played by the various components of the environmental resistance in bringing budworm outbreaks under control.

Table 16 shows the degree of mortality inflicted on the different budworm stages by the various natural control agents at Hawk Lake in 1941. The table starts out with an arbitrarily selected number of 100 eggs in the fall of 1940 and traces the mortality through the egg, larval and pupal stages to the final survival of moths.

The column, "Apparent Mortality," indicates the percentage mortality of budworm by the particular agent under discussion at the time of observation. For example, 22.2% of the pupae collected in 1941 were destroyed by various factors and this represents the apparent mortality. This, however, is 22.2% of that part of the original budworm population of 100 which survived to the point immediately preceding the action of pupal predators and parasites in the field. In Table 16, this survival is shown as 45.8 budworm (Row C). Therefore, the real mortality is only 22.2% of 45.8 or 6.1%.

All the mortalities in Table 16 are not based on actual counts or observation. Some, such as the survival of moths, were deduced by various methods, all of which will be explained shortly.

Each row in the table is identified by a letter. The explanation of how the data in each row were obtained follows under the proper identification letters.

Row A:--7.0% of the original 100 eggs were destroyed by parasites, predators and infertility, leaving 93.0 larvae.

Row B:--The initial egg population in the field after egg mortality is taken into account was 11.6 per 100 terminals. The larval population in the 5th instar in the following year averaged 6.26 per 100 terminals. This is a loss of 5.34 larvae per 100 terminals or 46%.

Row C:--Larval parasitism was determined as 8.7% by laboratory rearings.

Row D:--Determined by field and laboratory rearings.

Row E:--The number of eggs deposited in 1941 was 2.55 times greater than in 1940; therefore, on the basis of the 100 larvae selected as the initial population for this year, the initial population for next year is 2.55 as great or 255 eggs. The average optimum number of eggs deposited per female is 200 and the sex-ratio of moths is.500. Therefore, the minimum number of moths required to deposit the observed number of eggs is $\frac{255}{200} \times 2 = 2.5$. However, 35.6 moths emerged from the original 100 budworm and so 35.6-2.5 or 33.1 moths did not survive to deposit eggs. In the field, of course, it is probable that a greater number of females survive to deposit fewer eggs per female. However, in effect, only 2.5 moths survived to deposit their full quota of eggs.

TABLE 16

INCIDENCE OF MORTALITY FACTORS AT HAWK LAKE IN 1941

Row	Stage of Development	Mortality Source	Total Effective Mortality	Real Mortality	Survival of 100 Individuals
A	Egg	Parasites 1.83%; predators 1.92%; infertility 3.28%	7.0%	7.0%	93
B	1st to 5th instar larvae	Climate, predators, disease, dissemination.	46.0%	42.8%	50.2
C	6th to 7th instar larvae	Parasites	8.7%	4.4%	45.8
D	Pupae	Predators 2.44%; "natural dead" 7.23%; parasites 12.53%	22.2%	10.2%	35.6
E	Moths	Weather, predators, etc.	93.0%	33.1%	2.5
	Ratio of parasites to other mortality factors for "effective mortality"		1:6.7		
	Ratio of parasites to other mortality factors for real mortality		1:7.1		

It is noteworthy that parasitism accounted for approximately one-seventh of the budworm mortality whereas other factors such as climate, dissemination and predators accounted for the remaining six-sevenths of the mortality. The budworm population is now at a very low ebb and it would seem therefore that parasitism assumes a minor role in endemic or incipient populations, with other factors inflicting a much greater degree of mortality. Even if parasites were to decline still further, it is probable that no great increase in budworm populations would occur for some time. On the other hand, a series of favourable years from the standpoint of the other factors (climate, food supply, etc.) would result in an inevitable rapid increase in the budworm population. This does not mean however that parasites are now unimportant. They are undoubtedly vital and necessary in the maintenance of a very delicate balance, but it would seem that they will not be able to prevent the development of a new outbreak should conditions conducive to an increase in the budworm arise.

Once the budworm has reached epidemic proportions, however, the role of parasites, influenced as they are by host density, would become progressively more important until the outbreak subsides. Let us assume for the sake of argument that factors other than parasitism inflicted the same mortality on the budworm in 1939, the peak year of parasitism at Hawk Lake. By computing mortalities on the same basis as in Table 16, we receive an entirely different picture of the value of parasites. In that year, approximately one-half of the real mortality resulted from parasites alone. Indications are, therefore, that while parasites may not be able to prevent outbreaks, they are decisive in controlling outbreaks once they have developed, if the parasites are able to increase without interruption.

It is to be observed in Table 16 that the total mortality of the budworm is shown to be 97.5% or 97.5 out of the original 100 individuals. The survival figure of 2.5 was determined as the absolute minimum number of moths required to deposit the observed number of eggs. Actually, the survival of moths might have been a little higher, perhaps between 3 and 5 moths per 100 individuals. In that case, the mortality of budworm moths in Row E would not be as high as indicated. It was assumed, on the basis of controlled mating studies, that the average number of eggs deposited per female was 200, but thus far it has been impossible to determine the number deposited under actual field conditions. In practice, it is therefore probable that the average number deposited per female is less than 200.

Additional analyses have been made and new concepts developed with regard to the host-parasite relations at Hawk Lake. Graphs and charts have been constructed to show the relation between host populations, parasite population and the percentage parasitism during the last 5 years. However, time did not permit the incorporation of the results in this year's report. All the preliminary charts, tables and interpretations have been retained by the author for future reference. For a discussion of the work already presented on this phase, the reader is referred to the 1940-41 Annual Technical Report of the Winnipeg Laboratory, Pages 62-82.

(b) Spruce Woods Forest Reserve

Larval counts similar to those made at Hawk Lake were made in the Spruce Woods Forest Reserve on white spruce and larch in 1941. The difficulties arising on Jack pine as a result of staminate cones are of no consequence here and the interpretation of the data is thereby greatly simplified.

Table 17 shows the results of larval counts on spruce in 1941. Larvae were mostly on the 6th and 7th instar when the observations were made.

TABLE 17

Tree No.	Height (Feet)	Location of Sample	No. of Terminal Buds	No. of Larvae	Larvae per 100 Terminals
1	30	Top ½	435	324	74.48
2	43	Top ½	233	184	78.97
2	43	Lower ½	168	102	60.71
1	30	Lower ½	86	47	54.02
3	38	Top ½	184	77	41.85
3	38	Lower ½	260	88	33.85
4	38	Top ½	459	211	44.97
4	38	Lower ½	248	92	37.10
5	25	Top ½	209	82	39.23
5	25	Lower ½	539	167	30.98
TOTALS: 5			2821	1374	49.62

Branches from 5 trees, yielding a total of 2821 terminals and 1374 larvae, were examined. The number of larvae per 100 terminals averaged 49.62. This infestation on spruce can be classified as heavy and these larval counts are a good criterion of the degree of infestation. The infestation on spruce is comparable with data obtained from Jack pine at Hawk Lake where the larvae per 100 terminals averaged 6.26. Hence the infestation on spruce in the Reserve in 1941 was between 7 to 8 times as heavy as on Jack pine at Hawk Lake.

An analysis of larval concentrations in different levels on the tree shows the same trends here as on Jack pine at Hawk Lake. Table 18 shows the number of larvae per 100 terminals on the upper and lower portions of spruce in the Reserve.

TABLE 18

BUDWORM LARVAL CONCENTRATIONS IN THE UPPER & LOWER HALF OF SPRUCE

Location on Tree	Larvae per 100 Terminals
Top ½	55.9
Lower ½	43.3

Here again larval populations are denser at the top of the tree but not nearly to the same extent as in Jack pine where larval populations were about 4 times as dense in the upper portions. It is very likely that the much heavier host populations in the Spruce Woods through competition for food forced larvae to migrate and disseminate through other portions of the tree.

In this connection, an interesting observation on spruce showed that buds at the top of the tree were frequently quite retarded in development, with bud scales persisting in many cases. As a result, larvae from the top were not as advanced as those from the lower portions, larvae from the former being in the 3rd and 4th instars while those from the latter were in the 6th or 7th. Consequently, the competition for suitable buds in the upper portions must have been quite keen, forcing many larvae to migrate to the lower parts of the tree. Moreover, it is probable that many larvae remaining at the top were not able to complete their development due to a lack of food, as quite often the budworm larvae destroyed the buds completely before they could expand.

The results of larval counts from larch are shown in Table 19. These were made at the same time as those on spruce.

TABLE 19

Tree No.	Height (Feet)	Location of Sample	No. of Terminal Buds	No. of Larvae	Larvae per 100 terminals
1-2	35	Top ½	1837	69	3.76
3-4	28	Top ½	2163	38	1.76
1-4		Lower ½	1455	135	9.96
5	30	Top ½	1508	69	4.58
6-9		Lower ½	3751	256	6.82
TOTALS: 9			10714	567	5.29

Due to the nature of the foliage on larch, bud counts are not comparable with those on spruce or Jack pine. Larch needles are deciduous and therefore all the foliage on the tree consists of the present year's growth. Each tuft of needles growing from a bud was designated as a terminal shoot. Each larva destroys from 2 to 8 terminal shoots and, as a consequence, an infestation of 15 larvae per 100 terminals may be considered very heavy. The number of larvae per terminal in 1941 averaged 5.29. This may be classified as a medium infestation. The number of larvae per 100 terminals averaged 3.20 and 7.51 respectively from the upper and lower portions of larch. This is directly opposite to the conditions prevailing in Jack pine or spruce and no suitable or plausible explanation for this situation has presented itself.

With records available from larval counts and rearings of the larval and pupal surveys, it is possible to construct a table for the Spruce Woods similar to that for Hawk Lake, showing the contributions made by the various natural control agents in 1941. Unfortunately, information is available from only the 5th instar to the end of the pupal stage and it is therefore impossible to reconstruct more than about one-third of the story. However, the table does show that natural agents are inflicting a considerable mortality on the budworm populations in the Spruce Woods. The mortality indicated in Table 20 is, if anything, underestimated.

TABLE 20

INCIDENCE OF MORTALITY FACTORS AT THE SPRUCE WOODS FOREST RESERVE IN 1941

Stage of Development	Mortality Factor	Apparent Mortality	Real Mortality	Survival of 100 Individuals
5th-7th Instar	Parasites	15.3%	15.3%	84.7
7th Instar and Pupae	Predators & Disease	25.5%	21.6%	63.1
Pupae	"natural mortality" from climate, disease, etc.	22.1%	13.9%	49.2
Pupae	Parasites	15.9%	7.8%	41.4

As a result of the various mortality factors listed in Table 20, only 41.4 of the original 100 fifth instar larvae survived to develop into moths. This considerable mortality of 58.6% was due almost entirely to the action of parasites, predators and disease.

(c) Comparison of Infestations between Areas

In addition to the above, larval counts were made on Jack pine in 1941 by H. A. Richmond at the Fort a la Corne Forest Reserve and Riding Mountain National Park. These counts were procured from the lower half of the trees examined; therefore, for comparative purposes only, the counts made on the lower half of Jack pine and spruce in the preceding Sections (a) and (b) are used. At Fort a la Corne, counts were made on non-staminate and staminate trees in the heaviest part of the infestation. A summary of the data collected from this area is shown below:

Type of Tree	Total Terminals Examined	No. of Larvae	Larvae per 100 Terminals
Staminate	332	236	71.1
Non-staminate	741	148	20.0
Average for the District			45.5

The observer recorded the above infestation as quite severe.

Terminal counts at the Riding Mountain National Park were obtained only from staminate trees and this figure will of necessity have to serve as an index of population for this area. Some 365 staminate terminals were examined, yielding 74 larvae or 20.3 larvae per 100 terminals.

The following table shows the comparative number of larvae found per 100 terminals at Hawk Lake, Fort a la Corne, Spruce Woods Forest Reserve and Riding Mountain National Park. The data are divided into staminate and non-staminate trees and the results tabulated in their proper categories, where available. Spruce Woods counts show only those procured from spruce. It has been pointed out previously that staminate trees as such do not occur in the case of spruce; consequently, for this area no data are available for that category. Also, only the results of the counts from the lower half of the trees examined at Hawk Lake and Spruce Woods are shown.

TABLE 21

COMPARATIVE RESULTS OF THE 1941 LARVAL COUNTS

Type of Tree	LARVAE PER 100 TERMINALS			
	Hawk Lake	Ft. a la Corne	Spruce Woods	Riding Mountain National Park
Staminate	5.52	71.1	-----	20.3
Non-Staminate	0.00	20.0	43.3	-----
Average for the Area	2.76	45.5	43.3	20.3

This table illustrates in a striking manner the differences in larval populations in these areas.

Considering first the average for each area, it is notable that the Hawk Lake infestation is now very light, with only 2.76 larvae per 100 terminals. Fort a la Corne and Spruce Woods are about equal. These infestations have been described by their observers as severe and, according to the table, are between 15 and 16 times as heavy as at Hawk Lake. The infestation at Riding Mountain was described as potentially serious but of only medium intensity. The table shows it to be about 7 times as heavy as at Hawk Lake. There seems to be a very close agreement here between the observed ocular estimates and the larval counts. Indications are that these counts constitute an accurate and relatively easy method of estimating and comparing budworm populations. However, efforts must be made to procure a good, average, representative series of counts from non-staminate and staminate trees before absolutely reliable comparisons can be made.

SUMMARY

A. Status of *Cacoecia fumiferana* Clem. for 1941

1. A detailed map showing the extent and intensity of infestation has been prepared.

2. The budworm situation is, with some exceptions, considerably improved over conditions prevailing from 1937-1940. The most important centre of infestation remains in northwestern Ontario, although the outbreak area is now considerably reduced. Three isolated outbreaks prevail in Manitoba and one in Saskatchewan.

B. Biological Control of *Cacoecia fumiferana* Clem.

1. A total of 23,171 pupae was received from 16 study areas in 1941 for the pupal survey. Pupae were received for the first time from the Spruce Woods Forest Reserve and Riding Mountain National Park.

2. The same major species of parasites obtained in previous years were again present in 1941.

3. The average parasitism of pupae for all areas was as follows:

Diptera	6.28%
Ephialtes conquisitor Say. .	13.42%
Phaeogenes hariolus Cress. .	6.60%
Chalcids	4.64%
Miscellaneous	0.30%
TOTAL	31.23%

4. The average total parasitism for the last three years compares as follows:

1939	48.47%
1940	15.33%
1941	31.23%

5. All the important pupal parasites were universally distributed in considerable numbers throughout the range of the budworm in central Canada, with the exception of the Spruce Woods Forest Reserve where parasitism by <u>Phaeogenes hariolus</u> amounted to a mere 0.16%.

6. The incidence of parasitism in the 1941 study areas is shown in the following tabulation:

AREA	PERCENTAGE PARASITISM
Fort a la Corne	34.92
Sandilands Forest Reserve	28.52
Riding Mountain National Park	21.42
Spruce Woods Forest Reserve	15.90
Hawk Lake	13.87
Dryden	37.86
Ignace	40.26
Basswood Lake	26.19
Beaverhouse Lake Group	34.87
Calm Lake Group	32.42
Kakabeka	64.27
Graham	24.52
Savanne	31.01

7. Parasitism at Fort a la Corne has shown a general tendency to increase since 1939 while the budworm infestation has remained more or less stationary.

8. Dipterous parasitism at the Sandilands Forest Reserve has made a remarkable comeback, increasing from 0.00% in 1940 to 9.9% in 1941.

9. The first sampling from Riding Mountain National Park shows dipterous parasites to be most prevalent.

10. In the Spruce Woods Forest Reserve, parasitism of pupae collected from tamarack was about twice as heavy as on pupae collected from spruce. The most remarkable feature in this area is the very low incidence of parasitism by *Phaeogenes hariolus*.

11. Parasitism at Hawk Lake showed a further decrease in parasitism in 1941. This is the continuation of a trend in progress since 1939 coincident with a decrease in the budworm infestation in the area.

12. The relatively high parasitism of 40.26% at Ignace was due primarily to *Phaeogenes hariolus* which alone destroyed 23.5% of the pupae.

13. The range of parasitism in the Fort Frances district was fairly uniform, varying from 26% to 35%. The highest total parasitism and parasitism by *P. hariolus* occurred in the areas most heavily infested by budworm.

14. The comparatively high parasitism by _Ephialtes conquisitor_ was the most striking feature in Port Arthur district. This species destroyed 46.6% of the pupae at Kakabeka. _Phaeogenes hariolus_ thus far has been relatively unimportant in this district.

15. Attempts to assign definite values to various factors inflicting so-called natural mortality in pupal collections were not successful. The mortality received through collecting, shipping and handling has been tentatively estimated to be about 16%, but no estimate of mortality inflicted by the feeding habits of parasites, disease, climate and predators is possible at present.

16. Tables have been presented to show: (a) the mortality of male and female pupae from all causes, (b) the relation between sex-ratios of _Cacoecia fumiferana_, _Ephialtes conquisitor_ and _Phaeogenes hariolus_ and (c) the sex-ratios of _Ephialtes conquisitor_ and _Phaeogenes hariolus_ from male and female pupae.

17. At least 25.5% of the pupae collected in the Spruce Woods Forest Reserve were destroyed by disease and predators. Predators alone (chiefly a Coccinellid, _Anatis mali_) killed about 10 to 12% of the pupae.

18. Larval parasitism in three areas under observation in 1941 was determined as follows:

AREA	PERCENTAGE PARASITISM
Spruce Woods Forest Reserve	15.3
Fort a la Corne	39.4
Hawk Lake	8.7

Over 90% of this parasitism was caused by an undetermined Ichneumon and an undetermined Braconid.

19. All the significant data from the 1941 egg survey at Hawk Lake is listed below:

Eggs destroyed by parasites	1.83%
Eggs destroyed by predators	1.92%
Infertile eggs	3.28%
Total egg mortality	7.03%
Sound eggs	92.95%
Eggs per mass	52.13
Eggs per branch of Jack pine	99
Egg masses per branch of Jack pine	1.89
Egg masses per tree	67.3
Eggs per tree	3527
Eggs per 100 terminals	30.6

20. An analysis of previous egg count data indicates that a representative sample is being obtained by the methods now employed.

21. The minimum number of moths required to deposit the observed number of eggs on the average tree sampled in 1941 was 35.

22. Approximately $2\frac{1}{2}$ times as many eggs were deposited in 1941 as in 1940.

23. At the Spruce Woods Forest Reserve, many egg masses were found on spruce, but none were located on larch. This would seem to indicate that the infestation on larch originates from larvae migrating from spruce.

C. Population Studies on Cacoecia fumiferana Clem.

1. Counts at Hawk Lake showed an average larval population of 6.26 per 100 Jack pine terminals.

2. Larval populations on the upper and lower half of Jack pine averaged 10.80 and 2.76 respectively per 100 terminals.

3. Larvae per 100 terminals averaged 13.27 on staminate trees as compared with 0.26 on non-staminate trees.

4. By means of population counts, the mortality of budworm at Hawk Lake in 1941 was estimated to be 97.5%. Parasites accounted for approximately one-seventh of this mortality and other factors such as climate, dissemination, etc. for the remaining six-sevenths.

5. Counts in the Spruce Woods Forest Reserve indicated larval populations of 50 per 100 terminals on spruce (an extremely heavy infestation) and 5.3 per 100 terminals on larch. Larvae per 100 terminals averaged 55.9 from the upper half of spruce and 43.3 from the lower half; on tamarack, larvae averaged 3.2 from the upper half and 7.5 from the lower half.

6. Budworm mortality inflicted by parasites, predators and disease at the Spruce Woods Forest Reserve from the 5th instar to the emergence of moths was at least 42%.

7. Appropriate comparative figures show the relative incidence of the budworm infestation in the four areas sampled in 1941 to be as follows:

LOCATION	LARVAE PER 100 TERMINALS ON THE LOWER HALF OF THE FOLIAGE
Hawk Lake	2.76
Fort a la Corne	45.5
Spruce Woods	43.3
Riding Mountain National Park	20.3

These figures are extremely accurate and useful for determining the relative incidence of infestation between areas.

8. The host-parasite relations at Hawk Lake have been analysed from several new angles but time did not permit the incorporation of the results in this report.

III. LARVAL STAGE OF THE JACK PINE BUDWORM

A. Introduction

Considerable data were derived from various studies on the Jack pine budworm. These included observations and experiments which determined habits and preferences of the various stages of the budworm, sex-ratios and mortalities of the pupal stage, fecundity of the adult moths, etc. Controlled studies conducted at Hawk Lake, Ontario, in 1939 and 1940 emphasized the larval stage of the insect and established certain bionomical data and statistics and also indicated the influence of the larval habits on adult life. The controlled studies definitely established dietary preferences of the larvae and the effects of such food on their growth. Such studies were of necessity conducted under controlled conditions where abnormal temperatures, humidity, light, etc. prevailed and they could not be used as indications of actual field conditions. Thus, although the importance of the larval stage was established, there was the need for determining the effect and the influence of the various larval habits on the individual under actual field conditions.

In an epidemic of a forest insect, considerable territory is involved, including many different types of habitat and environment. Such factors as forest composition, density, age, climax, site, etc. all affect an epidemic through their influence on larval feeding.

Consequently, in examination of any particular area, considerable variation is to be expected, both in habitat and environment. This would lead to considerable heterogeneity in the distribution of population and tend to conceal actual conditions. Thus, in analysis of data based on field collected material, results and conclusions must be based on trends of the data, usually proven significant through statistical procedures.

The following study on the larval growth of the Jack pine budworm was conducted at Hawk Lake, Ontario, in the summer of 1940, with the purpose of determining the influence of the various larval habits upon the growth and development of the individual, based on actual field conditions. In this manner, it is possible to obtain a better insight into the status of an insect under epidemic conditions in the forest and lead to a determination of the factors contributing to the epidemiology of the budworm.

In principle, the study involved the collection of budworm larvae from Jack pine in the forest and the preservation of these for microscopic examination during the winter. Larvae were collected at random from both staminate cones and terminal buds of the Jack pine. Thus, two categories of larvae were dealt with, based on the presence or absence of pollen in the diet. Collections were made at intervals throughout the summer season and counts taken on the number of cones and buds examined and number of larvae collected. In all, eight samples were taken throughout the larval period which lasted from approximately May 29th to July 15th in 1940. These were distributed as follows:

1.	June 3	Examination of 100 cones and 100 terminals and preservation of larvae;
2.	June 10	Examination of 100 cones and 100 terminals and preservation of larvae;
3.	June 20	Examination of 100 cones and 100 terminals and preservation of larvae. First signs of migration noted in the field;
4.	June 22	Collection of 100 larvae from cones and 100 larvae from terminals. General migration of larvae in the field;
5.	June 26	Examination of 100 cones and 100 terminals and preservation of larvae;
6.	July 3	Examination of 100 cones and 100 terminals and preservation of larvae. Heavy migration almost over. Pollen no longer a very important factor;
7.	July 8	Examination of 100 cones and 100 terminals and preservation of larvae;
8.	July 10	Collection of 100 larvae from cones and 100 larvae from terminals.

B. Population Distributions

1. Field Distributions

First emergence of budworm larvae in the field in 1940 occurred on May 29th (coincident with first occurrence of a large pollen dissemination (poplar?) on the lake). In 1940, due perhaps to low population density, no initial migratory movement of larvae was noted; i.e., there was no definite larval migration on emergence with large numbers of larvae hanging from their threads, nor were there any considerable numbers of larvae feasting on the surface of the lakes (as in 1939). Examinations of buds and cones on May 30th showed a small percentage of these to be infested with larvae which had already settled down to feed.

The results of the field collections were summarized in Table 1. Here, 100 cones and 100 terminals were examined for each date and the percentage infested determined. The number of larvae taken from each cone and terminal was recorded and then the number of larvae per sample and number of larvae per infested sample were determined. After migration had started, some cones and terminals collected did not contain larvae but showed very distinctly that they had been infested. Since the damage to such foliage was already accomplished through the feeding activity of the larvae, such samples were classified as infested. However, the total count of larvae was thus lowered. Therefore, the column, "number of larvae per sample," in Table 1 would give a better indication of population distribution than the number of larvae per infested sample. The latter provides information as to the density of the population.

First collection of larvae for laboratory examination was made on June 3rd, approximately 5 days

TABLE 1

with larvae and damaged by feeding from which migration

LARVAL BUDWORM POPULATION DISTRIBUTIONS (AS TO FEEDING SITES)

Fred says more accurate than next column

DATE	NUMBER OF SAMPLES INFESTED		NUMBER OF SAMPLES NOT INFESTED		TOTAL NO. OF LARVAE (FROM SAMPLES)		PERCENTAGE OF SAMPLES INFESTED		NUMBER OF LARVAE PER SAMPLE		NUMBER OF LARVAE PER INFESTED SAMPLE		MAXIMUM NO. OF LARVAE PER INFESTED SAMPLE	
	Cones	Term.	Cones	Term.	Cones	Term.	Cones	Term.	Cones	Term.	Cones	Term.	Cones	Term.
June 3	60	18	40	82	93	18	60.0	18.0	.93	.18	1.55	1.0	4	1
June 10	62	10	38	90	107	10	62.0	10.0	1.07	.10	1.7	1.0	4	1
June 20	55 (6)	12	45	88	71	13	55.0	12.0	.71	.13	1.29	1.1	5	2
June 26	70 (18)	18 (2)	30	82	67	21	70.0	18.0	.67	.21	.96	1.17	3	2
July 3	68 (27)	15 (3)	32	85	52	14	68.0	15.0	.52	.15	.76	.93	3	3
July 8#	19	16	81	84	19	18	19.0	16.0	.19	.18	1.0	1.13	1	2

Based on 100 cones and 100 terminals for each date. Small figures in parentheses in first two columns indicate that number of samples which had been infested but larvae had left. Thus, the number of infested samples actually supporting larvae would be somewhat lower (equal to the small figure in brackets).

Only those samples supporting larvae were considered as infested. Thus, figures on percentage samples infested are somewhat lower than actual.

following first emergence of larvae in the field. At this time counts showed about 18 larvae per 100 terminals, and 93 larvae per 100 cones. Only 1 larva per infested terminal was found to 1.55 larvae per infested cone. Up to 4 larvae were taken from one cone. The next collection of larvae was made on June 10th from the identical area. At this time, there was found 10 larvae per 100 terminals and 107 larvae per 100 cones. This showed a population of 1.7 larvae on each infested cone and 1.0 larva on each infested terminal. Up to 4 larvae per cone and only 1 larva per terminal was found. Third collection of larvae, from the same area, was made on June 29th. First signs of migration were apparent at this time, on the basis of cones which had previously been infested and were now abandoned. Counts at this time showed 71 larvae per 100 cones and 13 larvae per 100 terminals. Up to 2 larvae per terminal and 5 larvae per cone were found. The data showed a population of 1.3 larvae per infested cone and 1.1 larvae per infested terminal.

Observations up to June 21st had established the fact that no appreciable migration of larvae from cones to terminals had occurred. Pollen from the cones was first disseminated in the forest (from normal cones) on June 4th. Thus the cones were dry and empty for approximately 7 to 10 days prior to June 21st. Collections prior to June 22nd would be based on conditions resulting from the first migration of larvae following emergence. From Table 1 it is seen that up to this time cones were 5 to 6 times as heavily infested as terminals. Number of larvae per cone or terminal showed that up to this time the population on terminals was insignificant.

Collections made on June 26th and July 3rd covered the migration period of the larvae and consequently unbalanced conditions and many variations resulted. In general, a decrease of population on cones was to be expected. There were indications of this, although percentage number of samples infested tended to remain stationary. However, the number of larvae per sample decreased, indicating that the earliest movement comprised a migration away from crowded conditions. This was substantiated through a drop in maximum number of larvae in cones. At this time also, the number of larvae per infested sample on terminals exceeded that on cones. This indicated that the favoured feeding sites, such as leaders and co-leaders, first attracted the migrating larvae.

The final collections on July 8th and 10th covered the period following general migration. Very little difference between cones and terminals, in population density, was to be expected, except in favour of the terminals. This is established in Table 1, where on July 8th no difference between cones and terminals occurred in percentage number infested, in number of larvae per sample and number of larvae per infested sample.

These analyses of population distribution determine a number of important points. They clearly indicated the preference, by Jack pine larvae, for staminate cones and that the larvae remain on such sites well after pollen has normally been shed in the forest. Thus, in the early part of the season, the budworm population is concentrated on the staminate cones in the forest where they are completely hidden from view. Larvae not fortunate enough to find staminate cones are very restless and wander about for some time, as indicated by the changing figures for percentage number of terminals infested and also number of larvae per sample. Earliest migration occurred amongst the crowded population on cones. Such individuals tended to leave the cones around June 20th to 26th to seek the preferred buds--on leaders and co-leaders. At the end of migration, uniformity of the larval population was established and there was not much difference between staminate cones and terminal buds in population densities and distribution.

2. Distribution by Instars

The instars were determined from microscopic examination and measurement of larvae. The results were summarized as to sex and food-type for each date of collection and are presented in Tables 2 and 3. In these

TABLE 2

LARVAL BUDWORM POPULATION DISTRIBUTIONS
(IN PERCENTAGES PER INSTAR FOR EACH DATE OF COLLECTION)

DATE	INSTAR	STAMINATE				TERMINAL			
		MALE		FEMALE		MALE		FEMALE	
		No.	%	No.	%	No.	%	No.	%
June 3	2	23	82.14	38	86.36	9	100.0	9	100.0
	3	5	17.86	6	13.64	--	---	--	---
June 10	2	--	---	--	---	4	100.0	4	100.0
	3	38	90.48	48	92.31	--	---	--	---
	4	4	9.52	4	7.69	--	---	--	---
June 20	3	--	---	--	---	2	40.0	4	50.0
	4	22	75.86	34	82.93	3	60.0	4	50.0
	5	7	24.14	7	17.07	--	---	--	---
June 22	3	--	---	1	1.82	2	5.0	5	6.76
	4	30	60.0	40	72.72	32	80.0	61	82.43
	5	18	36.0	14	25.45	6	15.0	8	10.81
	6	2	4.00	--	---	--	---	--	---
June 26	3	--	---	--	---	--	---	3	15.79
	4	2	10.53	11	24.44	3	50.0	9	47.37
	5	13	68.42	30	66.67	2	33.33	7	36.84
	6	4	21.05	4	8.89	1	16.67	--	---
July 3	3	--	---	--	---	1	20.0	--	---
	4	--	---	2	7.14	--	---	1	14.29
	5	12	60.0	22	78.57	1	20.0	5	71.43
	6	6	30.0	4	14.29	3	60.0	1	14.28
	7	2	10.0	--	---	--	---	--	---
July 4	4	--	---	1	1.64	4	8.16	7	12.50
	5	5	14.29	30	49.18	27	55.10	41	73.21
	6	22	62.85	23	37.71	15	30.61	8	14.29
	7	8	22.86	7	11.47	3	6.12	--	---
July 8	5	--	---	--	---	--	---	5	33.33
	6	2	20.0	5	55.56	1	25.0	8	53.34
	7	8	80.0	4	44.44	3	75.0	2	13.33
July 10	5	--	---	1	1.72	--	---	6	8.11
	6	5	12.82	4	6.90	9	21.43	20	27.03
	7	34	87.18	53	91.38	33	78.57	48	64.86

TABLE 3

LARVAL BUDWORM POPULATION DISTRIBUTIONS
(IN PERCENTAGES PER INSTAR)*

DATE	INSTAR	STAMINATE		TERMINAL		AVERAGE	
		No.	%	No.	%	No.	%
June 3	2	61	84.72	18	100.0	79	87.78
	3	11	15.28	--	---	11	12.22
June 10	2	--	---	8	100.0	8	7.84
	3	86	91.49	--	---	86	84.32
	4	8	8.51	--	---	8	7.84
June 20	3	--	---	6	46.15	6	7.23
	4	56	80.0	7	53.85	63	75.90
	5	14	20.0	--	---	14	16.87
June 22	3	1	.95	7	6.14	8	3.65
	4	70	66.67	93	81.58	163	74.43
	5	32	30.48	14	12.28	46	21.00
	6	2	1.90	--	---	2	.92
June 26	3	--	---	3	12.0	3	3.37
	4	13	20.31	12	48.0	25	28.09
	5	43	67.19	9	36.0	52	58.42
	6	8	12.50	1	4.0	9	10.12
July 3	3	--	---	1	8.33	1	1.67
	4	2	4.17	1	8.33	3	5.00
	5	34	70.83	6	50.00	40	66.67
	6	10	20.83	4	33.34	14	23.33
	7	2	4.17	--	---	2	3.33
July 4	4	1	1.04	11	10.48	12	5.97
	5	35	36.46	68	64.76	103	51.24
	6	45	47.88	23	21.90	68	33.83
	7	15	15.62	3	2.86	18	8.96
July 8	5	--	---	5	26.32	5	13.20
	6	7	36.84	9	47.36	16	42.10
	7	12	63.16	5	26.32	17	44.70
July 10	5	1	1.03	6	5.18	7	3.29
	6	9	9.28	29	25.0	38	17.85
	7	87	89.69	81	69.82	168	78.86

* For each date of collection.

tables, the total number of larvae in each category (sex and food) for each date was taken to represent 100%. Then, numbers of larvae per instar for each date and category were computed as a percentage of this total (100%) in that particular category. For example, on June 3rd male staminate larvae showed 82.14% in the 2nd instar and 17.86% in the 3rd instar, or a total of 100% in this category. Similarly, for other dates of collection and different categories of larvae. Table 3 comprised a summary of Table 2, where, in the former, averages were derived for each food-type, disregarding sex.

Initial movements of larvae resulted in a concentration of population on staminate cones. Here, the larvae appear to settle down immediately and proceed to feed and moult, appreciable numbers of 3rd instar larvae being found within 4 to 5 days following first emergence in the field. After approximately 10 full days of feeding, no 3rd instar larvae were found on terminal buds, while 4th instar larvae were being taken from staminate cones. In this latter case, male larvae predominated somewhat. First appearance of 3rd instar larvae from terminal buds was noted on June 20th. This was coincident with first signs of migration of larvae from staminate cones in the field. At this time, both 3rd and 4th instar larvae were found on terminal buds. Distribution of population on this date indicates that 3rd instar larvae must have been present on terminal buds prior to this date but it is thought that due to the very light density of population on the latter site they were not present in sufficient numbers to influence the sample taken. Third instar larvae persisted on terminal buds up until July 3rd, or more than one month after emergence.

The data from Tables 2 and 3 are more readily analyzed from the graphs, Figs. 1 and 2 prepared from these tables. In these graphs, the ordinate axis is divided into 6 units, each representing one instar, from 2nd to 7th inclusive. The abscissa axis is segregated into 9 units, one for each date of collection. Each unit, representing one instar, is divided into percentages, from 0 to 100%. A 100% population is derived by totalling the various percentage populations for any one category of larva distributed through the instars for any one date.

Examination of the graph, Fig. 1 , shows the great diversity in distribution of the population as to instars and dates. It is readily noted that male larvae from staminate cones are usually in advance of all other larvae; i.e., the first appearance of larvae in successive instars was always males from cones. The greater uniformity of the population on cones is readily apparent when

FIG. 1

DISTRIBUTION of BUDWORM LARVAL POPULATION PER INSTAR (IN PERCENTAGE POPULATION PER INSTAR) AT VARIOUS TIMES of THE SEASON

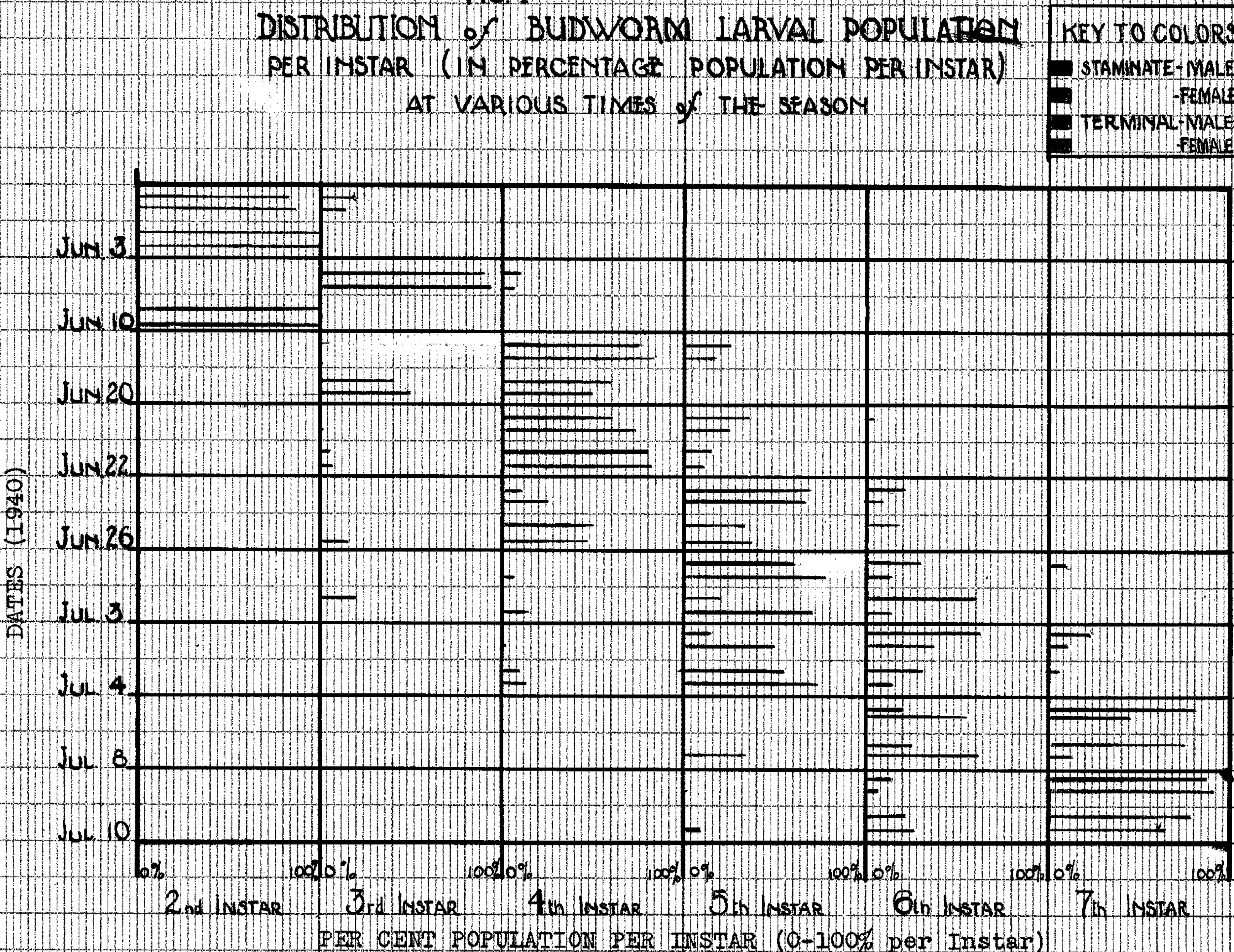
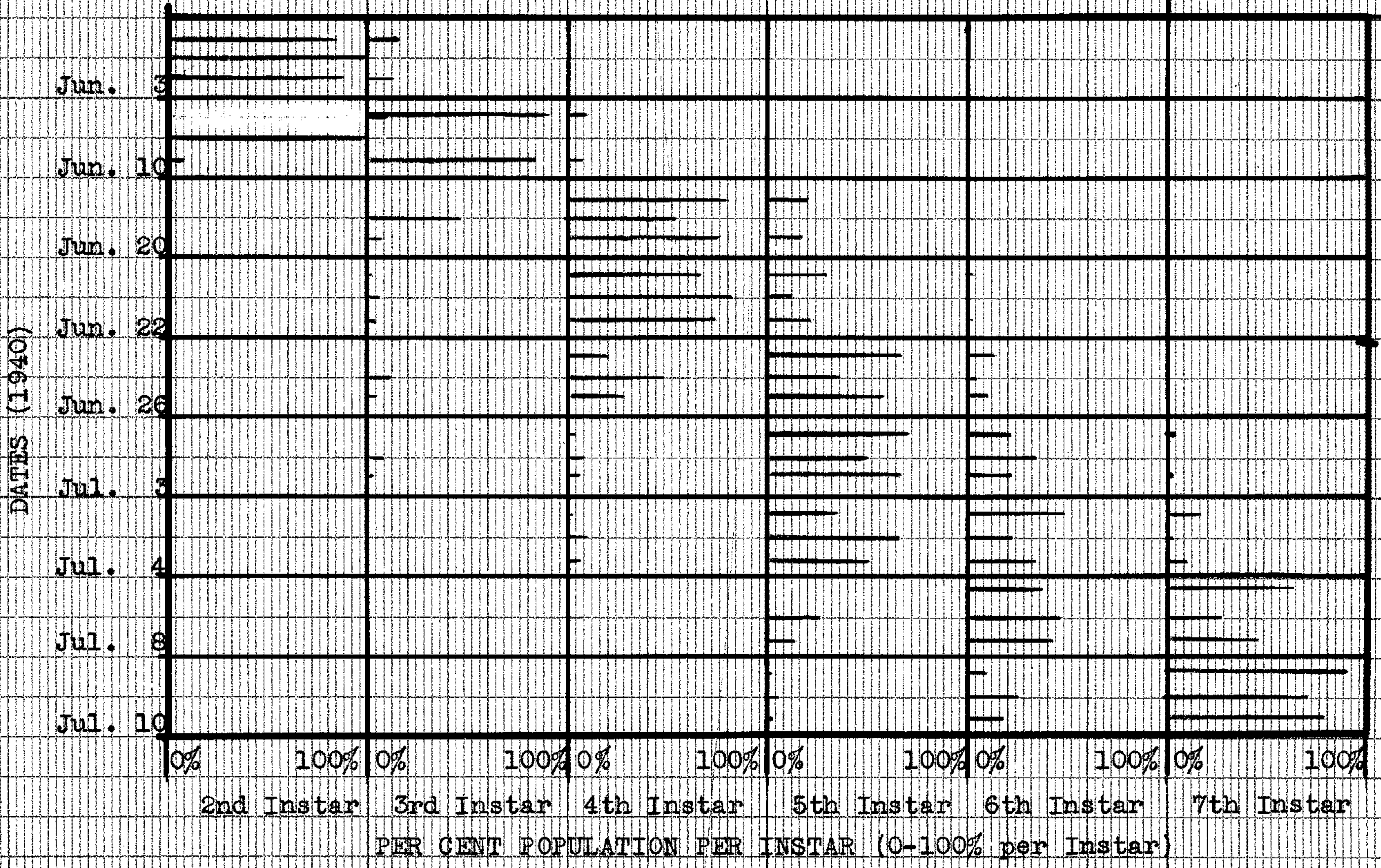


FIG. 2

DISTRIBUTION OF BUDWORM LARVAL POPULATION PER INSTAR (In percentage population per instar) AT VARIOUS TIMES OF THE SEASON

KEY TO COLORS
- STAMINATE
- TERMINAL
- AVERAGE



compared to larvae on terminals. In the former case, samples in any instar reach a maximum shortly after the appearance of that instar in the field and then taper off and disappear completely. Any one instar of terminal larvae is spread over a considerably longer period of time. Thus, for any one date of collection amongst staminate larvae, there is a predominant instar and a lesser number of individuals from the preceding instar, with a slightly larger number of individuals from the successive instar. Amongst terminal larvae for any one date of collection, more instars were represented in the sample than amongst staminate larvae.

Fig. 2 represents graphically the data of Table 3. Here the changes from instar to instar through the various dates are more readily noted. Again it is noted that the first appearance of an instar was always represented by staminate larvae. It is interesting to note from Fig. 2 , when using the "date-axis" as ordinate, that the bars representing the percentage population become arranged in a "normal frequency" distribution. First there is only a representation of larvae in an instar; then the numbers of larvae reaching that instar increase to a maximum, then decreasing. In this manner, it is seen that staminate larvae in each instar reach their maximum in advance of terminal larvae.

The two graphs generally indicate the occurrence of an instar through the various dates of collection. Thus, it is possible to obtain an approximation of the duration of instars and the period of occurrence. Peak periods of occurrence for each instar were: 2nd instar-June 3; 3rd instar-June 10; 4th instar-June 21; 5th instar-July 1; 6th instar-July 7; 7th instar-July 12.

The results here have shown the more uniform development of larvae on cones, as indicated by distribution of instars. Pollen feeding resulted in an acceleration of growth, causing ~~terminal~~ staminate larvae, especially males, to complete each instar in advance of terminal-feeding larvae. The graphs, Figs. 1 and 2, give a graphic representation of the population in the field and indicate the considerable heterogeneity.

3. Duration of Stadia

Using the data of Table 2, a table was constructed (Table 4) showing the duration of stadia for the different categories of larvae. The number of days spent in each instar was derived in the following manner: From Table 2, the figures for percentage population were treated as units, to the nearest whole number. The number of days spent in each instar was computed from a "zero" date of May 30th to each of the dates that the particular instar occurred in the field, as indicated from the dates of collection. Thus, for example, male larvae developing on staminate cones, 4th instar larvae occurred on June 10th, June 20th, June 22nd and June 26th. The computations were as follows:

10	x	12	=	120
76	x	22	=	1672
60	x	24	=	1440
11	x	28	=	308
157(larvae)				3540 (days)

$3540 \div 157 = 22.5$ days.

The first column above, 10, 76, etc., is the percentage population, treated as units. The second column, 12, 22, etc., is the number of days between "zero" and June 10, 20, etc. Thus, a total of 3540 days was taken by "157" larvae to reach the fourth instar, or an average of 22.5 days. Then, by subtracting the number of days required to reach the third instar, a figure is obtained for the duration of the third instar. In this manner, Table 4 was constructed.

Examination of Table 4 shows that in the 2nd and 3rd instars staminate larvae were much more rapid in their development than terminal larvae. The duration of the 4th instar cannot be relied on, since it is not conceivable that larvae could complete a stadium in 2 days (terminal larvae) and it does not follow that staminate larvae should require approximately 12 days for this stadium. Hence, some factors must have influenced the larval population in the field to obscure the actual conditions which were not apparent from the samples taken.

Due to various factors, too much credence cannot be placed in this table. This is due to larvae from various

TABLE 4

AVERAGE DURATION OF BUDWORM LARVAL STADIA
(IN DAYS)

DURATION OF INSTAR	STAMINATE			TERMINAL		
	MALE	FEMALE	AVGE.	MALE	FEMALE	AVGE.
Second	5	5	5	8.5	8.5	8.5
Third	5.8	6.3	6.1	13.7	15.0	14.5
Fourth	11.7	12.4	12.1	2.7	2.4	2.4
Fifth	6.7	7.5	7.1	7.3	8.7	8.4
Sixth	6.2	6.3	6.0	4.0	4.7	3.7
Seventh	4.8	3.4	4.2	4.6	2.4	3.6
SECTION "B"						
2nd & 3rd	10.8	11.3	11.1	22.2	23.5	23.0
2nd, 3rd & 4th	22.5	23.7	23.2	24.9	25.9	25.4
5th	29.2	31.2	30.3	32.2	34.6	33.8
6th & 7th	11.0	9.7	10.2	8.6	7.1	7.3

2 + 3 11.1 21
4 + 5 19.2 10.4
6 + 7 10.2 7.3

instars migrating from one food type to another. Also, the last sample did not carry on to the final disappearance of larvae in the field. Thus, the 7th instar in many cases would then be longer than that recorded. However, the indications from this table are that male larvae on cones spend the least time of all other larvae in each instar while female larvae on terminals spend more time per instar than any other. Another readily discernible point is the general "equalization" of time spent per instar; where male larvae on terminals were slower in the first instars than similar larvae on cones, the reverse took place in the latter instars; similarly female larvae. In general, the early instars of staminate-developed larvae were completed more quickly than similar instars for terminal larvae. The reverse took place in the last two instars. However, here migration and other factors influenced the results considerably.

Since the last sample was taken 42 days after the emergence of larvae in the spring, no figure for the average duration of an instar was possible. The duration of a stadium, Table 4, ranged from a minimum of 2.4 days to a maximum of 15.0 days. However, as pointed out above, such figures provide only indications. To avoid the effect of migration and other factors tending to influence the trends of the data, summaries of Table 4 are included in Section "B" of this table. Here, the average duration of the 2nd and 3rd instars, 2nd,3rd and 4th instars, 5th instar, and 6th and 7th instars are compared.

It is seen from Section "B", Table 4, that staminate larvae took less than one-half the time to complete the 2nd and 3rd instars than terminal larvae. By the 4th instar, there was a difference of only 2 days. Thus, migration and slower developing larvae affected the field run of larvae so that in the 4th instar considerable heterogeneity of population obtained. Conditions had changed for the last 2 instars (6th and 7th) so that larvae on terminals required less time in the completion of these than staminate larvae.

To compare the various times spent in each instar, Table 5 was constructed to show the maximum, minimum and mean average number of days required to complete successive instars for each sex and food-type. Here, the uniformity of development in the 2nd instar can be noted. From the time of emergence in the spring, staminate larvae required less time to complete each successive instar than did terminal larvae. Comparison of minimum days required to complete each successive instar showed an even greater difference, in favour of staminate larvae. On both staminate cones and terminals male larvae always required less time to complete an instar than female larvae, on the basis of means. This difference was

TABLE 5

DURATION OF BUDWORM LARVAL STADIA

AVGE.NO.OF DAYS RE-QUIRED TO COMPLETE	STAMINATE									TERMINAL								
	MALE			FEMALE			AVERAGE			MALE			FEMALE			AVERAGE		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
2nd instar	5	5	5	5	5	5	5	5	5	12	5	8.5	12	5	8.5	12	5	8.5
3rd instar	12	5	10.8	24	5	11.3	24	5	11.1	35	22	26.2	28	22	23.5	35	22	23.0
4th instar	28	12	22.5	36	12	23.7	36	12	23.2	36	22	24.9	36	22	25.9	36	22	25.4
5th instar	36	22	29.2	42	22	31.2	42	22	30.3	36	24	32.2	42	24	34.6	42	24	33.8
6th instar	42	24	35.4	42	28	37.5	42	24	36.3	42	28	36.2	42	35	39.3	42	28	37.5
7th instar	42	35	40.2	42	36	40.9	42	35	40.5	42	36	40.8	42	40	41.7	42	36	41.1

less marked when considering maximum and minimum time required for terminal larvae.

Staminate larvae had completed their 4th instar on an average of approximately 2½ days before terminal larvae. Male larvae were approximately 1½ days in advance of female larvae and staminate male larvae in advance of all the others. The minimum number of days required for staminate larvae to complete the 4th instar was 12, while terminal larvae required 22. Here alone is a difference of 10 days and this would tend to be a more accurate picture of conditions, since larvae feeding on pollen would tend to remain there, while terminal larvae would occupy considerable time in location of feeding site and movement after feeding had commenced. Beyond the 4th instar, differences in time requirements between staminate and terminal larvae became less marked.

It is very interesting to note that the minimum time required to complete each of the 2nd, 3rd and 4th instars was the same for each sex, but different for the two food-types. This would indicate a uniformity of conditions on staminate cones and terminal buds. Changes in these minimum time periods of development could be attributed to environmental resistance and food-type. Since environmental resistance is theoretically the same for each food-type, then pollen becomes the important variable. Thus, the effect of pollen is illustrated in its absence, resulting in an increase of 2 to 3 times the number of days required to complete the 2nd, 3rd and 4th instars.

On the basis of time spent in each instar by each category of larva, it was shown that male larvae on cones required the least time, while female larvae on terminals required the most. The average duration of stadia ranged from a minimum of 2½ days to a maximum of 15 days, with an average of approximately 7 days. In general, staminate larvae required less time to complete each successive instar than did terminal larvae. On the basis of minimum time spent per instar, it was shown that for each of the 2nd, 3rd and 4th instars the time spent was the same for male and female larvae but from 2 to 3 times less for staminate-type larvae than for terminal. Thus, pollen was shown to influence the rate of growth of larvae through its effect on the number of days spent in each stadium.

C. Sex Ratios

From discussions of population movements in the previous section, it was seen that male and female larvae did not have the same rate of development. This would tend to influence collections taken on any one date and would result in different numbers of male and female larvae when considering any one instar or total population. In many cases, collections were too small to result in a valid sex-ratio.

TABLE 6

SEX-RATIOS OF BUDWORM LARVAE
(ASSORTED AS TO FOOD TYPES & INSTARS, ON VARIOUS DATES OF LARVAL PERIOD)

DATE	INSTAR	STAMINATE				TERMINAL				AVERAGE			
		♂	♀	Total	S.R.	♂	♀	Total	S.R.	♂	♀	Total	S.R.
June 3	2	23	38	61	.623	9	9	18	.500	32	47	79	.595
	3	5	6	11	.545	--	--	--	----	5	6	11	.545
June 10	2	--	--	--	----	4	4	8	.500	4	4	8	.500
	3	38	48	86	.558	--	--	--	----	38	48	86	.558
	4	4	4	8	.500	--	--	--	----	4	4	8	.500
June 20	3	--	--	--	----	2	4	6	.667	2	4	6	.667
	4	22	34	56	.607	3	4	7	.571	25	38	63	.603
	5	7	7	14	.500	--	--	--	----	7	7	14	.500
June 22	3	--	1	1	----	2	5	7	.714	2	6	8	.750
	4	30	40	70	.571	32	61	93	.656	62	101	163	.620
	5	18	14	32	.438	6	8	14	.571	24	22	46	.478
	6	2	--	2	----	--	--	--	----	2	--	2	----
June 26	3	--	--	--	----	--	3	3	----	--	3	3	----
	4	2	11	13	.846	3	9	12	.750	5	20	25	.800
	5	13	30	43	.698	2	7	9	.778	15	37	52	.712
	6	4	4	8	.500	1	--	1	----	5	4	9	.444
July 3	3	--	--	--	----	1	--	1	----	1	--	1	----
	4	--	2	2	----	--	1	1	----	--	3	3	----
	5	12	22	34	.647	1	5	6	.833	13	27	40	.675
	6	6	4	10	.400	3	1	4	.250	9	5	14	.357
	7	2	--	2	----	--	--	--	----	2	--	2	----
July 4	4	--	1	1	----	4	7	11	.636	4	8	12	.667
	5	5	30	35	.857	27	41	68	.603	32	71	103	.689
	6	22	23	45	.511	15	8	23	.348	37	31	68	.456
	7	8	7	15	.467	3	--	3	----	11	7	18	.389
July 8	5	--	--	--	----	—	5	5	1.000	--	5	5	1.000
	6	2	5	7	.714	1	8	9	.889	3	13	16	.813
	7	8	4	12	.333	3	2	5	.400	11	6	17	.353
July 10	5	--	1	1	----	--	6	6	1.000	--	7	7	1.000
	6	5	4	9	.444	9	20	29	.690	14	24	38	.632
	7	34	53	87	.609	33	48	81	.593	67	101	168	.601

TABLE 7

SEX RATIOS OF BUDWORM LARVAE
(ASSORTED AS TO FOOD TYPE & INSTARS FOR EACH DATE OF COLLECTION

INSTAR	SEX RATIOS OF LARVAE																										
	June 3			June 10			June 20			June 22			June 26			July 3			July 4			July 8			July 10		
	S.	T.	A.	S.	T.	A.	S.	T.	A.	S.	T.	A.	S.	T.	A.	S.	T.	A.	S.	T.	A.	S.	T.	A.	S.	T.	A.
Second	.62	.50	.60	--	.50	.50																					
Third	.55	--	.55	.56	--	.56	--	.68	.68	--	.71	.75															
Fourth				.50	--	.50	.61	.57	.60	.57	.66	.62	.85	.75	.80				--	.64	.67						
Fifth							.50	--	.50	.44	.57	.48	.70	.78	.71	.65	.83	.68	.86	.60	.69	--	1.0	1.0	--	1.0	1.0
Sixth													.50	--	.44	.40	.25	.36	.51	.35	.46	.71	.89	.81	.44	.69	.63
Seventh																			.47	--	.39	.33	.40	.35	.61	.59	.60

1. Sex-ratios in relation to Stadia and Dates of Occurrence in the Field

From dissections of the field material, the sexes of larvae were determined and recorded in Table 6. Here, the number of male and female larvae is listed for staminate cones, terminal buds and then averaged to derive a figure which disregards food-type--"Average." The dates of collection are the same as previously, and the sex-ratios are computed for the various instars appearing on each date of collection. For ease of examination and analysis, the data from Table 6 were rearranged as in Table 7. Here, the sex-ratios for each instar are recorded on each date of occurrence, for staminate larvae (S.), terminal larvae (T.) and average (A.).

Examination of Table 7 shows the decided trend for an increase in the ratio for each instar as the season progressed. This indicates that male larvae always develop more rapidly than female larvae and assume the next instar in advance of the female. This results in a relatively lower sex-ratio of larvae in an instar appearing for the first time in the season. It is difficult to account for the various fluctuations within one instar, from date to date. It is to be remembered that these data are derived from separate samples and, as such, deal with different larvae each time. This does not take into account movements of

TABLE 8

SEX RATIOS OF BUDWORM LARVAE FROM THE FIELD FOR EACH DATE OF COLLECTION (DISREGARDING INSTAR)

	STAMINATE				TERMINAL				AVERAGE			
	♂	♀	T.	S.R.	♂	♀	T.	S.R.	♂	♀	T.	S.R.
VI-3	28	44	72	.611	9	9	18	.500	37	53	90	.588
VI-10	42	52	94	.553	4	4	8	.500	46	56	102	.549
VI-20	29	41	70	.585	5	8	13	.615	34	49	83	.590
VI-22	50	55	105	.523	40	74	114	.649	90	129	219	.589
VI-26	19	45	64	.703	6	19	25	.760	25	64	89	.719
VII-3	20	28	48	.583	5	7	12	.583	25	35	60	.583
VII-4	35	61	96	.635	49	56	105	.528	84	117	201	.580
VII-8	10	9	19	.473	4	15	19	.789	14	24	38	.631
VII-10	39	58	97	.597	42	74	116	.637	81	132	213	.619

larvae, mortality, etc., except as it affects the numbers of male and female larvae present. However, the trend is clearly indicated. Each instar begins with a relatively low sex-ratio which is approximately the same as or slightly higher on cones than on terminals. As the season progresses, successive samples indicate a decided trend for the sex-ratio of each instar to approach a maximum.

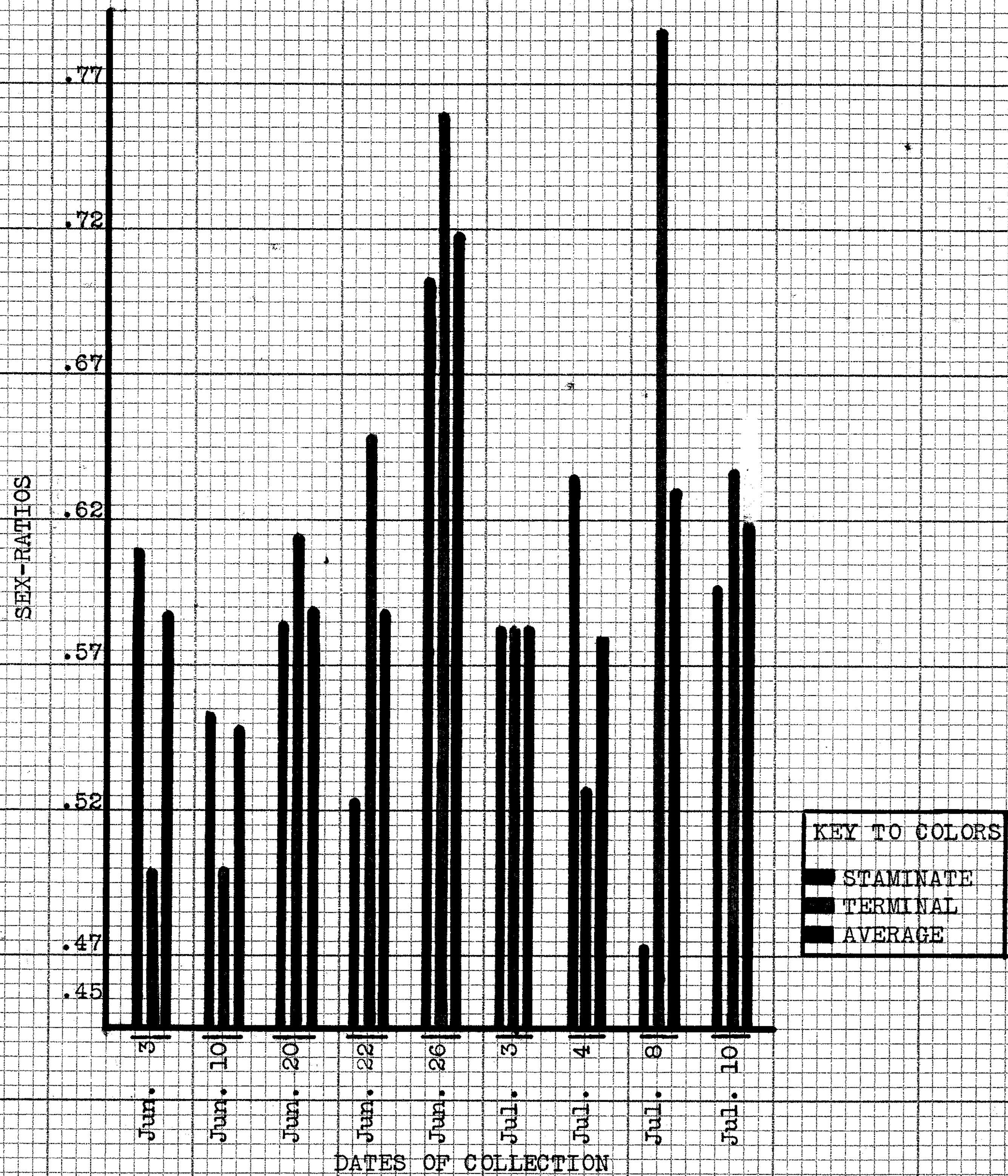
2. Sex-ratios in relation to Dates

Another summary table, Table 8, was prepared showing the sex-ratios of all larvae, disregarding instars, for each date of collection and for staminate, terminal and "average" food types. This table shows the number of male and female larvae on cones and on terminals on each date that collections were made. In analysis of this table, a graph was prepared, Fig. 3 , plotting the recorded data.

Fig. 3 shows that in all cases, except staminate larvae on July 8th, the sex-ratios were above .50. The sex-ratio of .473 from staminate larvae on July 8th is believed to be in error, due to sampling technique. The sex-ratios varied considerably and there did not appear to be any correlation between such variations and food-type. It is interesting to note the alternate rise and fall in sex-ratio of staminate larvae for each successive date of collection. The terminal larvae showed an increase in sex-ratio up to June 26th, followed by a considerable drop, then reaching the maximum sex-ratio on July 8th. Examination of averaged sex-ratios shows the maximum here to have occurred on June 26th. There were strong indications of a trend towards a sex-ratio of between .58 and .60 in the latter case (average, no food). There did not appear to be a significant difference between initial and final sex-ratios of larvae on cones--.61 and .60 respectively. Terminal larvae showed an increase of .14 from the initial to final sex-ratio--.50 and .64 respectively. Another point of interest is the sex-ratio of all types of larvae on July 3rd--.58.

Examination of the above data in the light of migratory movements of larvae providessome interesting correlations. The similarity between initial and final sex-ratios of larvae on cones would seem to indicate that the major portion of the budworm population selected such feeding sites and remained there to complete their development. Fluctuations in this ratio between these two mentioned points indicate a considerable movement of population to and from cones. The peak sex-ratio on cones occurred on June 26th coincident with the period of heavy migration and indicates the considerable movement of male larvae towards terminal buds which must have occurred just prior to this date--June 22nd.

FIG. 3
SEX-RATIOS OF FIELD-RUN BUDWORM
LARVAE FROM DIFFERENT FOOD-TYPES
(DISREGARDING INSTARS)



The steady increase of sex-ratio on terminals up to June 26th would indicate the migration of male larvae away from such food-type. During heavy migration, the sex-ratio then dropped again, showing the movement of males (from cones) back to this food-type. In all these movements, a point of equilibrium appeared to have been reached on July 3rd, when sex-ratios from each of the food-types (and both, on the average) were identical. This date was coincident with the apparent termination of large migratory movements. Fluctuations beyond this date are varied. The collection of July 8th which consisted of only 38 larvae (19 from each food-type) was not sufficiently large to avoid errors in sampling technique. The averaged sex-ratios, disregarding food-types, indicate the general sex-ratio of larvae in the field tended to remain at an equilibrium with a somewhat higher ratio--more females at the close of larval development. A peak sex-ratio of larvae in the field on June 26th--.76--is unaccountable.

3. Sex-ratios in relation to Instars

The sex-ratios of larvae were finally examined in relation to instar, disregarding date of occurrence. A table was prepared summarizing such ratios for staminate and terminal larvae and then averaging, to give a figure disregarding food (Table 9). The data from this table were plotted on a graph, Fig. 4 ,

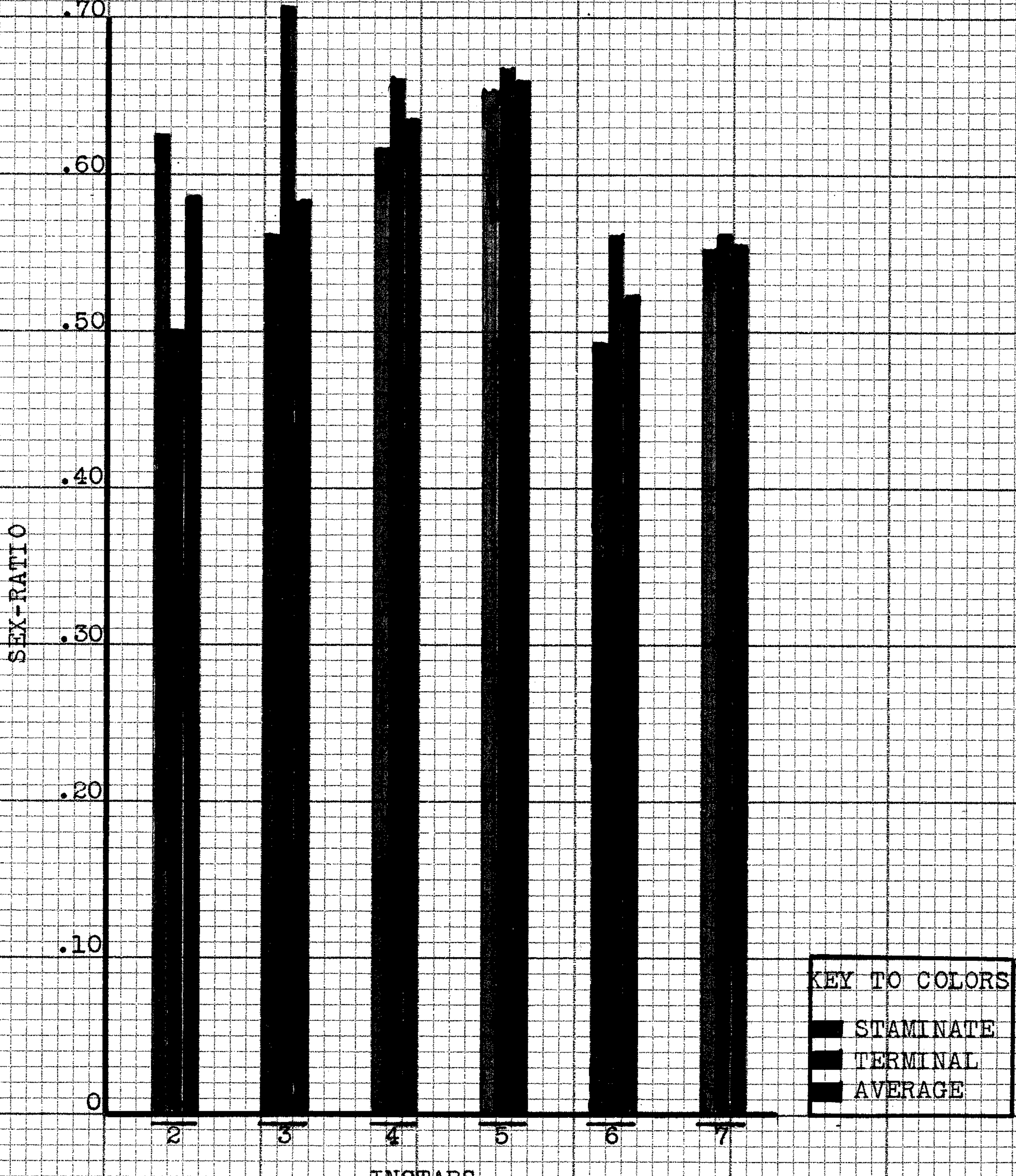
TABLE 9

SEX RATIOS OF BUDWORM LARVAE PER INSTAR
(ASSORTED AS TO FOOD-TYPES)

	STAMINATE				TERMINAL							
	♂	♀	Total	S.R.	♂	♀	Total	S.R.	♂	♀	Total	S.R.
Second	23	38	61	.623	13	13	26	.500	36	51	87	.586
Third	43	55	98	.561	5	12	17	.706	48	67	115	.583
Fourth	58	92	150	.613	42	82	124	.661	100	174	274	.635
Fifth	55	104	159	.654	36	72	108	.667	91	176	267	.659
Sixth	41	40	81	.494	29	37	66	.561	70	77	147	.524
Seventh	52	64	116	.552	39	50	89	.562	91	114	205	.556

Here it is seen that the sex-ratios of larvae varied within a range of .50 to .71. The lowest sex-ratio occurred amongst staminate larvae in the 6th instar, while the maximum sex-ratio was found from terminal larvae in the 3rd instar. Second instar sex-ratio of larvae on cones was appreciably higher than that of larvae from terminals--.62 and .50 respectively. The maximum sex-ratio--.71--was reached in the 3rd instar, and this occurred on the terminals; the sex-ratio on the cones, in this instar, had dropped to .56. In the 4th instar, the sex-ratio was still higher on terminals than on cones. The highest sex-ratio on cones occurred in the 5th instar--.65. The sex-ratio on terminals in this instar was almost identical--.67. A drop in the sex-ratio occurred in the 6th instar, with the sex-ratio on terminals slightly greater than that on cones. No change of sex-ratio occurred in the 7th instar amongst terminal larvae; staminate larvae showed a small increase in this instar. The average sex-ratio, disregarding food sources, showed a gradual increase in this figure up to a maximum in the 5th instar--.66, then a sudden drop to .52 in the 6th instar, with not much change in the 7th instar--.56.

FIG. 4
SEX-RATIOS OF BUDWORM LARVAE PER INSTAR
(ARRANGED AS TO FOOD-TYPE)



It is difficult to understand the changing sex-ratios from instar to instar, but certain trends are readily noted. From an initial "low" sex-ratio on terminals in the 2nd instar, there was an immediate jump in the 3rd instar; i.e., from the minimum to the maximum larval sex-ratio (irrespective of food) in one general moult. This could only be due to migration or mortality. No data are available on mortality of larvae but it must undoubtedly be heavy in the 2nd instar as a result of migration, feeding habits, etc. Since the sex-ratio of 2nd instar larvae in general is .59, it is not to be expected that more male than female larvae would succumb to the various controlling agencies. Hence, an increase in sex-ratio of 3rd instar larvae could be attributed to migration of male larvae to cones, away from terminals. This would result in a decreased sex-ratio amongst larvae on cones, in the third instar. This did occur. Thus, initial migrations of larvae resulted in a higher sex-ratio on terminals than on cones. This was maintained, with varying degrees of difference, right up to the end of larval development.

It would seem that the migrations of male larvae, apparently in search of suitable feeding sites, influence the sex-ratios of larvae on cones and terminals. Following the maximum sex-ratio of larvae on terminals, in the 3rd instar a drop occurred which was maintained to the end of the 5th instar. The decided drop in sex-ratios of larvae following the 5th instar is not readily explained. Previous experimentation has shown that mortality due to parasitism of larvae is manifested in the 5th instar. Further, female larvae appeared to suffer more heavily. This might account for the drop in sex-ratio on both cones and terminals. Cross migrations would result in the sex-ratio of larvae reaching an equilibrium at the end of development. The average sex-ratio of larvae in the field showed generally similar trends.

4. Summary

The various analyses into the sex-ratios of budworm larvae have shown the considerable heterogeneity in numbers of male and female larvae feeding on staminate cones or terminal buds. It was found that, due to male larvae developing more rapidly than female larvae, changes in sex-ratios were affected through male larvae assuming an instar some days in advance of female larvae. This resulted in a relatively lower sex-ratio of larvae in an instar appearing for the first time in the field. Thus, each instar begins with a relatively low sex-ratio and, as the season progresses, this figure tends to approach a maximum at the close of the instar.

The agreement between initial (2nd instar) and final (7th instar) sex-ratios of larvae on cones seemed to indicate that the major portion of the budworm population selected such feeding sites on emergence and remained there to complete their development. Fluctuation in the sex-ratio would appear to have been caused by migratory movements of larvae, first towards staminate cones and then towards terminal buds. It seems that male larvae were most subject to such movements. There was a close correlation between changes in sex-ratio and migratory movements of larvae.

Examination of sex-ratios by instars related the movements of larvae to various instars. Thus, initial migration of larvae in the 2nd instar resulted in a higher sex-ratio on terminals than on cones, and this was maintained per instar with varying degrees of difference right up to the end of larval development.

D. Size Relationships

1. Introduction

Field collected larvae were dissected and measured under the microscope. The head capsule of the larva was selected as a criterion for size, since it is a highly sclerotized structure and not subject to appreciable growth during a stadium. The assumption was made that an instar of the insect could be characterized by a dimension of a sclerotized part of the body; i.e., the head capsule. Further, it was assumed that any increase in size of the head capsule occurred only at ecdysis.

In all, 1095 larvae were dissected and measured. The width of the head capsule was selected for purposes of measurement. The high power of a binocular microscope was used and calibrations made with an ocular micrometer (10 squared). One square of the micrometer disk was calibrated at .216 mm. Interpolations up to tenths of one square were made. Thus, measurements of head capsules were accurate to 1/100 mm. with interpolations to 1/1000 mm. Individual measurements were averaged, separately, for sex and food-type of larvae and segregated for each sample. The series of measurements were included in the 1940-41 Annual Report.

The various collections of larvae comprise samples collected in the field on the dates indicated. Thus, the recorded measurements are from different series of individuals in the same instar and from the separate food-types. The average width of head capsule represents the various individual measurements averaged for instar, sex and food-type. In the following discussions, head capsule size or width always refers to the average measurement, unless otherwise indicated.

Theoretically, the size of larvae does not vary through an instar. However, due to collection of different series of larvae at different periods, the average size of head capsule would be different for the different dates. It is this increase or decrease in

TABLE 10

SUMMARY OF HEAD CAPSULE MEASUREMENTS FROM LARVAE COLLECTED IN THE FIELD

DATE	INSTAR	STAMINATE						TERMINAL					
		MALE			FEMALE			MALE			FEMALE		
		No. Caps.	Total	Avge.	No. Caps.	Total	Avge.	No. Caps.	Total	Avge.	No. Caps.	Total	Avge.
VI-3	2	23	6.16	.268	38	10.25	.270	9	2.39	.266	9	2.40	.267
	3	5	1.93	.386	6	2.34	.390	--	-----	-----	--	-----	-----
VI-10	2	--	-----	-----	--	-----	-----	4	1.05	.263	4	1.01	.253
	3	38	14.74	.388	48	18.65	.389	--	-----	-----	--	-----	-----
	4	4	2.34	.585	4	2.42	.605	--	-----	-----	--	-----	-----
VI-20	3	--	-----	-----	--	-----	-----	2	.64	.320	4	1.31	.328
	4	22	13.26	.603	34	20.40	.600	3	1.53	.510	4	2.01	.503
	5	7	6.40	.914	7	6.40	.914	--	-----	-----	--	-----	-----
VI-22	3	--	-----	-----	1	.49	.490	2	.72	.360	5	1.80	.360
	4	30	18.13	.604	40	23.74	.594	32	17.72	.554	61	32.47	.532
	5	18	17.76	.987	14	13.28	.949	6	5.02	.837	8	6.42	.803
	6	2	2.27	1.135	--	-----	-----	--	-----	-----	--	-----	-----
VI-26	3	--	-----	-----	--	-----	-----	--	-----	-----	3	1.35	.450
	4	2	1.23	.615	11	6.29	.572	3	1.56	.520	9	4.58	.509
	5	13	11.75	.904	30	26.50	.883	2	1.64	.820	7	5.92	.846
	6	4	4.38	1.095	4	4.86	1.215	1	1.01	1.010	--	-----	-----
VII-3	3	--	-----	-----	--	-----	-----	1	.45	.450	--	-----	-----
	4	--	-----	-----	2	1.19	.595	--	-----	-----	1	.64	.640
	5	12	11.31	.943	22	18.55	.843	1	.79	.790	5	3.98	.796
	6	6	7.40	1.233	4	5.47	1.368	3	3.50	1.167	1	1.30	1.300
	7	2	3.48	1.740	--	-----	-----	--	-----	-----	--	-----	-----
VII-4	4	--	-----	-----	1	.62	.620	4	1.99	.498	7	3.73	.533
	5	5	4.16	.832	30	23.79	.793	27	22.01	.815	41	32.14	.784
	6	22	26.77	1.217	23	30.56	1.329	15	17.78	1.185	8	10.37	1.296
	7	8	13.67	1.709	7	14.19	2.027	3	5.01	1.670	--	-----	-----
VII-8	5	--	-----	-----	--	-----	-----	--	-----	-----	5	4.05	.810
	6	2	2.47	1.235	5	6.69	1.338	1	1.12	1.120	8	9.75	1.219
	7	8	13.37	1.671	4	7.84	1.960	3	5.23	1.743	2	4.05	2.025
VII-10	5	--	-----	-----	1	.77	.770	--	-----	-----	6	5.46	.910
	6	5	6.68	1.336	4	5.04	1.260	9	10.12	1.124	20	24.42	1.221
	7	34	61.92	1.821	53	109.23	2.061	33	59.02	1.788	48	94.81	1.975

TABLE 11

AVERAGE LARVAL HEAD CAPSULE MEASUREMENTS PER INSTAR
(ARRANGED AS TO DATES OF OCCURRENCE)

INSTARS	AVERAGE WIDTH OF HEAD CAPSULE																																			
	VI-3				VI-10				VI-20				VI-22				VI-26				VII-3				VII-4				VII-8				VII-10			
	S.		T.		S.		T.		S.		T.		S.		T.		S.		T.		S.		T.		S.		T.		S.		T.		S.		T.	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Second	.268	.270	.266	.267			.263	.253																												
Third	.386				.388	.389					.320	.328		.490	.360	.360				.450			.450													
Fourth					.585	.605			.603	.600	.510	.503	.604	.594	.554	.532	.615	.572	.520	.509		.595		.640		.620	.498	.533								
Fifth									.914	.914			.987	.949	.837	.803	.904	.883	.820	.846	.943	.843	.790	.796	.832	.793	.815	.784				.810		.770		.910
Sixth													1.135				1.095	1.215	1.010		1.233	1.368	1.167	1.300	1.217	1.329	1.185	1.296	1.235	1.338	1.120	1.219	1.336	1.260	1.124	1.221
Seventh																					1.740				1.709	2.027	1.670		1.671	1.960	1.743	2.025	1.821	2.061	1.788	1.975

average head capsule size in the same instar for different series of larvae on successive dates of collection that leads to a more complete understanding of the factors influencing the growth of larvae. It is felt that, due to the different rates of growth amongst larvae and other factors influencing the size of head capsule, discussion of size of larvae per instar in general does not completely cover the development of the larvae. Thus, in studying the various changes in size of larvae and their contributing causes, it is possible to examine the influence of sex, food-type and instar on the size of larvae and the influence of various environmental factors on larvae of the same category.

2. Larval Size in relation to Sex & Food-Type

The average size of head capsule in relation to sex and food-type of larva is recorded in Table 10. Here, for each date of collection and each category of larva, the total number of head capsules per instar (occurring on that date) is recorded and the sum of all the measurements included under column, "Total." Thus, the average size of head capsule is computed, based on the number of individuals designated under "Number of Capsules."

The data from Table 10 are arranged in a more convenient form for analysis in Table 11. From this table, various trends are indicated which can be

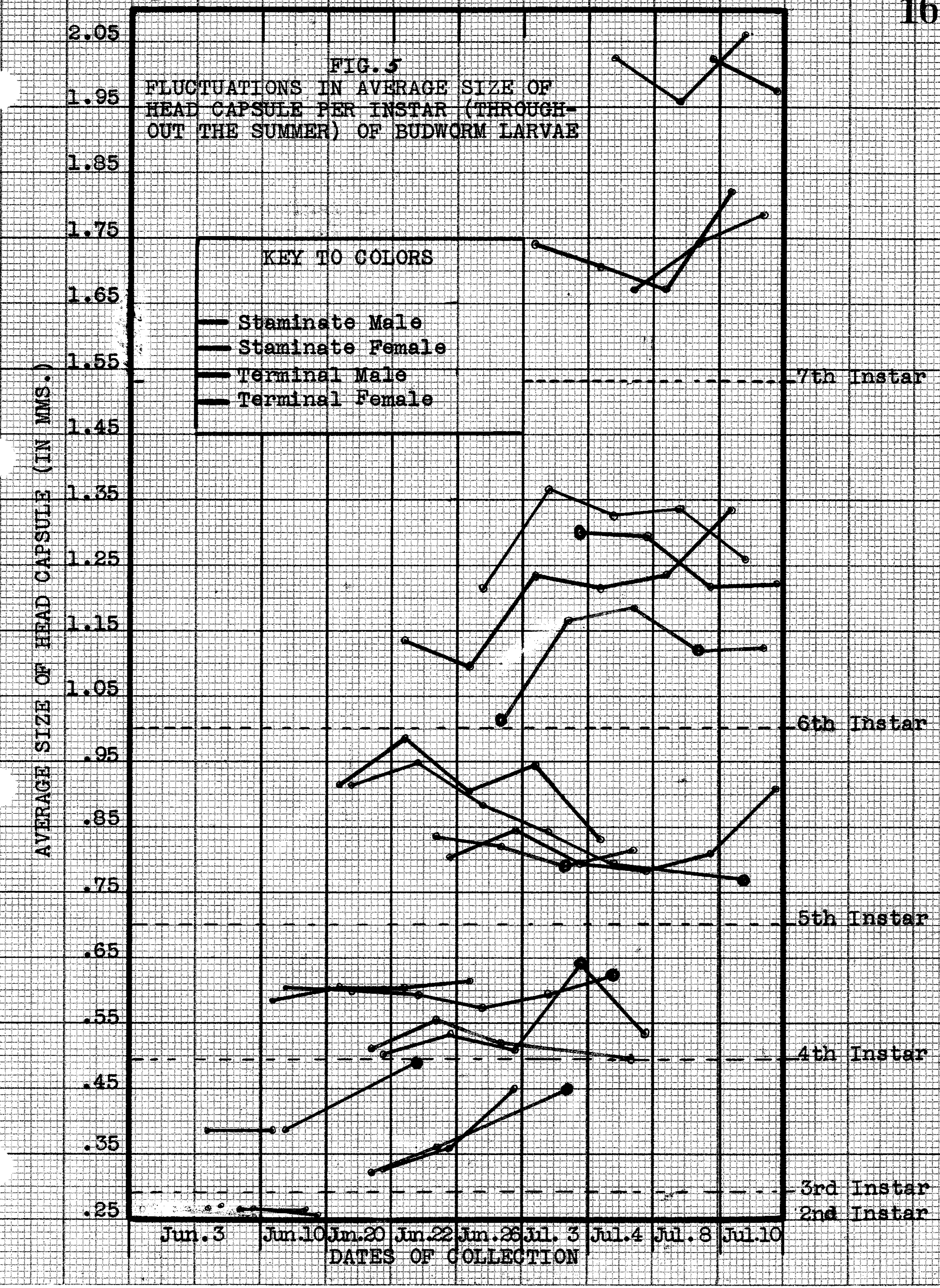


FIG. 5
FLUCTUATIONS IN AVERAGE SIZE OF HEAD CAPSULE PER INSTAR (THROUGHOUT THE SUMMER) OF BUDWORM LARVAE

readily noted from the graph, Fig. 5 , of these data. In Table 11, a number of average head capsule measurements are based on a single measurement, due to only one larva occurring in such a category. This would tend to influence results considerably and full cognizance of this is taken in the following discussion. The graph, Fig. 5 , indicates such single measurements with a circle. (in red)

Second instar larvae were taken only from cones on the one date only--June 3rd. Hence, no changes could be noted. Between the two dates of collection--June 3rd and June 10th, terminal larvae (2nd instar) showed a slight decrease in size amongst females only, amounting to approximately 6%. Male larvae remained stationary.

Third instar larvae showed some variation in size. Male and female larvae on cones were of the same size in their initial appearances in this instar. The males here remained stationary in size, while female larvae showed some increase. This increase, however, may not be valid, due to the single measurement for the staminate female on June 22nd. The initial size of staminate larvae for this instar was approximately 21% greater for males and 22% greater for females compared to terminal larvae. However, terminal larvae approximated staminate larvae in size at the close of the instar, while terminal males tended to exceed staminate males. The latter is again based on one measurement (for terminal males) and thus may not be valid. In this instar, terminal larvae were collected in from 10 days to 2 weeks, after no further staminate larvae occurred.

The first 4th instar larvae were collected in the field on June 10th, when both males and females were taken from cones. The size of the male head capsule showed a tendency to remain constant throughout the period of occurrence, only a very slight increase being noted. Female staminate larvae were of approximately the same size as male staminate larvae at the "start" of the instar. The average size of the female head capsule in this instar decreased through the season, reaching a minimum on June 26th, after which it increased, terminating on July 4th at approximately the same size as at the start. Fourth instar males on cones had ceased to appear after June 26th. Terminal larvae started the instar appreciably smaller than staminate larvae. By comparison of head capsule sizes, it was found that staminate males were 15% larger than terminal males and staminate females 20% larger than terminal females at this time. There was close agreement in the various fluctuations of male and female terminal larvae. At the close of the instar, the head capsule of terminal larvae was of approximately the same size as at the start of the instar. Both sexes of terminal larvae and female staminate larvae disappeared from collections after July 4th.

Fifth instar larvae showed the greatest variation in period of occurrence and duration of instars. First specimens of this instar were taken June 20th (both male and female) from cones; terminal larvae were not far behind. Male staminate larvae showed alternate increase and decrease in size, reaching a maximum size on June 22nd and a minimum on June 26th, finally completing the instar on July 4th with an approximate 9% decrease in size (compared to the initial appearance). Female staminate larvae reached a maximum on the same date as male staminate larvae--June 22nd--and then steadily declined in size, completing their development in this instar on July 10th, with an average decrease in size of approximately 12% compared to initial sizes of this instar. Terminal larvae were consistently smaller than staminate larvae and commenced this instar at 8% smaller in size for males and 12% for females, compared to staminate larvae. Male terminal larvae here tended to decrease in size through this instar but finally completed this instar on July 4th at approximately the same size as at the start of the instar. Female terminal larvae showed a slight increase in size in the early part of the instar and then decreased to a minimum on July 4th, finally completing their development on July 10th, approximately 13% larger than at the start.

Variations in size of larvae began to show appreciably more difference in the 6th instar. The occurrence and duration of this instar was approximately the same for both staminate and terminal larvae; however, male staminate larvae appeared in this instar in advance of all others. In this instar, difference in size between male and female larvae generally was more apparent, male larvae on cones and terminals being appreciably smaller than female larvae. Staminate larvae of both sexes showed a sharp increase in size after the initial appearance (males, June 22nd and females, June 26th). On July 3rd males had shown an increase in average size by approximately 9.0% and females by about 13.0%. Samples of 6th instar male staminate larvae continued to increase in size and, at the completion of the instar on July 10th, were approximately 18% larger than samples taken at the start of the instar. Samples of female larvae on cones decreased in size after the maximum (July 3rd) and the last specimens of larvae in this category (on July 10th) were not appreciably larger than the first. The largest larvae in this instar were females from staminate cones. Terminal male larvae were the smallest individuals in this instar and, while the size of the first specimens here was very small (head capsule of 1.01 mm. compared to the average of 1.16), it is not accepted as valid, due to only one specimen being available for measurement. The largest specimens of male terminal larvae in this instar were found on July 4th and larvae from the last sample of this instar were only 5% smaller than this maximum. Successive samples of female larvae from terminals showed a decrease in size and larvae on July 10th (last collection) were approximately 6% smaller than the first specimens of similar individuals. At the close of the instar, July 10th, female terminal larvae were not more than 3% smaller than female staminate larvae.

Collections were not carried on for a sufficient length of time to completely cover the 7th instar. However, enough samples were taken to show the decided difference in size between male and female larvae generally and the equalization or similarity in size of larvae of the same sex from the different food types. First 7th instar specimens were male larvae collected from cones on July 3rd. However, female staminate and male terminal larvae were found on July 4th. Successive samples of staminate male larvae decreased in size down to a minimum on July 8th and the maximum size was found on July 10th. The average size of male staminate larvae on July 10th (maximum size) was 5% greater than similar first specimens taken and 9% greater than the minimum size of the larvae in this category. Female staminate larvae attained the greatest size amongst budworm larvae. Specimens of these larvae on July 10th were not more than approximately 3.0% greater in size than the first specimens on July 4th. There was not more than 5% difference between the maximum and minimum size of these staminate female larvae. Successive samples of terminal male larvae showed a steady increase in size and on July 10th the average size of larvao was approximately 7% greater than that of similar larvae on July 4th. Only two samples of terminal female larvae were available and these showed a small decline in average size. Terminal female larvae were the last to attain the 7th instar. The first sample showed the terminal female larvae to be of approximately the same size as staminate females. However, on July 10th the latter were approximately 4% larger.

(a) Discussion

As stated previously, considerable attention was devoted to this phase of the study since it was felt that the size of the larva, as indicated by size of head capsule, influences the vigour of the larva and, in turn, influences the biotic potential. Hence, any changes in size of larvae and indications as to their causes would be extremely valuable in determining important factors in the biology of the budworm. It was felt that close examination of changes in size for each instar over a continual period was preferable, for such analysis, to averages for the instar as a whole.

In general, from the above discussions on the graph, Fig. 5 , it was seen that differences in size between staminate and terminal larvae did not exceed an amount of approximately 20% of the latter as a maximum. Usually the difference ranged between 5 and 10%. Thus, although a 5% difference in size does not appear to represent a substantial amount, such a difference is valid on the basis of statistical analysis (See "Mathematical Expressions of Growth"), which have shown the difference in size between staminate and terminal larvae to be significant. Comparisons here, as stated, are based on different lots of larvae collected at different periods; however, in most cases collections are large enough to provide good averages. Further, it is the difference between successively appearing larvae of an instar that is being studied. Hence, the method of treatment of these data is substantiated.

For purposes of summary, a table was prepared (Table 12) combining the various percentage differ-

TABLE 12

DIFFERENCES IN SIZE BETWEEN STAMINATE & TERMINAL TYPE LARVAE
(ARRANGED FOR SEX AND EACH INSTAR)

INSTAR		INITIAL SIZES		MAXIMUM SIZES		MINIMUM SIZES		FINAL SIZES		Diff.in % bet. Max.&Min. Sizes	Diff.in % bet. initial & final Sizes
		Avge. Size	Diff.in %	Avge. Size	Diff.in %	Avge. Size	Diff.in %	Avge. Size	Diff.in %		
2	Stam.♂ 23	.268	--	--	--	--	--	--	--		
	Stam.♀ 38	.270	--	--	--	--	--	--	--		
	Term.♂ 13	.266		--		.263					-1
	Term.♀ 13	.267		--		.253		.253			-6
3	Stam.♂ 43	.386	21	.388	8	.386	21	.388	-3	1	1
	Stam.♀ 55	.389	22	.490*	9	.389	22	(.439)	-2	26	13
	Term.♂ 5	.320		.360*		.320		(.400)		13	25
	Term.♀ 12	.328		.450		.328		.450		37	37
4	Stam.♂ 58	.585	15	.615	11	.585	17	.615	23	5	5
	Stam.♀ 92	.605	20	.620*	16	.572	14	(.605)	14	8	0
	Term.♂ 42	.510		.554		.498		.498		11	-2
	Term.♀ 82	.503		.533*		.503		.533		6	6
5	Stam.♂ 55	.914	9	.987	18	.832	5	.832	2	19	-9
	Stam.♀ 104	.914	14	.949	4	.770*	-2	(.770)	-15	23	-16
	Term.♂ 36	.837		.837		.790*		.815		6	-3
	Term.♀ 72	.803		.910		.784		.910		16	13
6	Stam.♂ 41	1.135	1	1.336	13	1.095	8	1.336	19	22	-15
	Stam.♀ 40	1.215	-7	1.368	5	1.215	0	1.260	3	13	-4
	Term.♂ 29	(1.120)		1.185		1.010*		1.124		17	0
	Term.♀ 37	1.300		1.300		1.221		1.221		6	-6
7	Stam.♂ 52	1.740	4	1.821	2	1.671	0	1.821	2	9	5
	Stam.♀ 64	2.027	--	2.061	2	1.960	-1	2.061	4	5	2
	Term.♂ 39	1.670		1.788		1.670		1.788		7	7
	Term.♀ 50	2.025		2.025		1.975		1.975		3	-3

TOTAL 1095

ences discussed above. In this table, the difference in size of larvae per instar is compared for staminate and terminal larvae on the basis of initial size, maximum size, minimum size, final size, difference between maximum and minimum size and difference between initial and final sizes. The calculations are in percentages and are carried out to the nearest whole figure. Figures marked with an * indicate that only one measurement was available. Figures presented in parentheses are a result of substituting for such single measurements an arbitrary figure derived from interpolation on the graph, Fig. 5 , thus providing a more valid basis of comparison.

Comparison of initial size of larvae per instar (from Table 12) shows that in the first appearance of larvae in any instar staminate specimens are always larger in size, except amongst females in the 6th instar. In general, this difference starts off at a maximum in the 3rd instar and decreases through the instars until parity is obtained between the two types of larvae in the 7th instar (females). This is thought to be a result of migration, since differences in size up to the 6th instar between staminate and terminal larvae are appreciable and general migration of larvae occurred in the late 5th instar and most of the 6th. Beyond the 5th instar, size differences fluctuate and are insignificant. In the 3rd instar, difference in size amongst first larvae to appear are the same for both sexes; i.e., staminate larvae, both male and female, are equally larger than terminal larvae. In the 4th and 5th instars, although staminate larvae are larger than terminal larvae, the difference between sexes is greatest amongst females (5% in each instar).

Examination of percentage differences in minimum size between staminate and terminal larvae shows that, except for females in the 5th and 7th instars, the smallest larvae per instar occurred amongst terminal larvae. However, this difference was almost negligible amongst female larvae in the 5th, 6th and 7th instars. The minimum size of larvae, of both sexes and food types, was approximately the same in the 7th instar.

Maximum size of larvae showed a more consistent difference in favour of staminate larvae. In all instars, amongst males and females feeding on cones, the maximum size of larvae was greater than amongst terminal larvae. This difference was generally most pronounced up to the 5th and 6th instars. The column in Table 12 above, "Percentage Differences between Maximum and Minimum Size," provides a sort of representation of the "spread" in size range of larvae in each category per instar. Thus, some idea as to the uniformity of development is obtained. For staminate larvae, it is seen that the percentage difference in size (between maximum and minimum) is greatest amongst females in the 3rd, 4th and 5th instars, with the reverse in the 6th and 7th instars, thus indicating the greater uniformity in the development of males up to the 6th instar and especially so in the 3rd and 4th instars. Similar conditions, i.e., greatest percentage difference between maximum and minimum sizes amongst females, were found in terminal larvae for the 3rd and 5th instars, while the reverse occurred in the 4th, 6th and 7th instars. In the third instar, this percentage "spread," as it might be termed, was considerably greater amongst terminal larvae. In the 4th instar, this condition prevailed only for male larvae and the reverse for female larvae. In the 5th, 6th and 7th instars, the "Percentage Spread" was greatest amongst staminate larvae. These fluctuations can be readily accounted for on the basis of migration of larvae. Male larvae migrate to staminate cones in the 2nd and 3rd instars and generally develop under uniform conditions which do not result in great size variations. Males left on terminals in these early instars do not settle down to feed very readily and some are more retarded than others, which in general results in considerable fluctuation of sizes. After initial feeding on pollen and general migration in the 5th and 6th instars, an equilibrium is established, as in the 7th instar.

From the above table (Table 12), it is seen that the percentage difference in final size of staminate and terminal type larvae per instar varied considerably. With continued migration of emergent larvae to cones, larvae on this medium at the close of the 3rd instar were somewhat smaller than larvae on terminals, but this difference was not appreciable. With initial migration no longer a factor and pollen-feeding exerting its influence, staminate larvae completed the 4th instar considerably larger than terminal larvae--males were 23% and females 14% larger here. With the beginning of the second migration, the difference between the two food-type larvae in the 5th instar was not appreciable. The fairly large difference between male larvae on cones and terminals in favour of the former at the end of the 6th instar is difficult to explain. The somewhat larger size of staminate larvae at the end of the 7th instar is to be expected.

Comparison of initial to final size of larvae, per instar, is not, strictly speaking, a very exact procedure, since it is based on the average size of larvae at the beginning and end of an instar and does not take into account the changes that did occur between these two points. However, it does provide a comparison between the first larvae to attain the particular stadium and the last ones to complete it. Here again the data are complicated through migration and other factors.

From the above table, it is seen that differences between initial and final size of larvae varied considerably. In the 2nd instar, female terminal larvae were somewhat smaller--6%--at the close of the instar, perhaps due to the prolonged period of settling down to feed on the buds. Male larvae here were approximately of the same size, indicating that those males which did not migrate to cones remained at the same size throughout the instar. Third instar larvae generally showed an increase at the end of the instar over the first individuals here, except amongst staminate males which remained approximately stationary. Staminate females showed a substantial increase but terminal larvae at the close of the instar were: males 25% larger and females 37% larger than similar larvae at the beginning of the instar. The increases in size were greater here in the 3rd instar than any other instar and are difficult to explain. It was to be expected that staminate larvae would show an increase in size, due to the superior food, etc., but terminal larvae increasing by as much as 37% can be explained only by the fact that larvae at the beginning of the instar were smaller as a result of poor feeding, etc. in the 2nd instar and then finally becoming accustomed to terminal buds in the 3rd instar and putting on normal growth. This is substantiated somewhat by the fact that terminal larvae were approximately 20% smaller at the beginning of the instar and only approximately 2% smaller at the close of this instar (3rd) compared to staminate larvae. Male staminate and female terminal larvae showed approximately the same amount of increase in size at the close of the 4th instar (about 5%), while female staminate larvae remained stationary and terminal male larvae were somewhat smaller upon their completion of the instar. This is believed due to almost static conditions in this instar. Initial migration to cones had subsided in intensity and larvae had remained on the two food types, feeding without much movement, etc. Fifth and sixth instar larvae were substantially smaller at completion of their development than at the start of these instars. In the 5th instar, female terminal larvae showed a 13% increase on their completion of this stage, male and female staminate larvae showed a 9% and 16% decrease, respectively. In the 6th instar, male terminal larvae remained stationary while male staminate larvae showed a decrease of 15%. Female larvae in the 6th instar, of both food types, decreased approximately 5%. This decrease in the 5th and 6th instars might be due to migration, effects of parasitism, etc. No apparent explanation is available for the substantial decrease amongst staminate larvae, except that retardation in development due to parasitism would become effective in the 5th instar and possibly carry over into the 6th. Further, larvae that had not migrated to cones until the 3rd instar, or later, would be smaller and also inclined to remain on cones longer. Migration back to terminals in the 5th and 6th instars would complicate size relationships here. In the 7th instar, larvae again showed some increase at the close of their development.

3. Mean Head Capsule Sizes of Budworm Larvae

Summary tables of head capsule measurements were prepared presenting the maximum, minimum and mean size of head capsule for sex and food-type per instar, regardless of date of collection. These tables (Tables 13 and 14) are included below. Here it is seen that various fluctuations were found in the maximum and minimum sizes of larvae for the two food types. However, in both categories (maximum and minimum), staminate larvae tended to be larger with no appreciable difference for sex. Examination of mean head capsule sizes per instar showed that in all cases staminate larvae were larger than terminal larvae. The percentage differences in size of head capsule between staminate and terminal type larvae are shown in Table 15 for male, female and average (no sex) in each instar.

TABLE 13

SUMMARY TABLE OF HEAD CAPSULE MEASUREMENTS
STAMINATE REARED LARVAE
(DISTRIBUTED AS TO SEX)

INSTAR	MAXIMUM		MINIMUM		MEAN	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Second	.28	.30	.25	.26	.268	.270
Third	.43	.43	.32	.32	.388	.391
Fourth	.64	.82	.54	.50	.603	.594
Fifth	1.08	1.10	.70	.67	.934	.858
Sixth	1.62	1.73	1.01	1.19	1.219	1.316
Seventh	1.94	2.33	1.57	1.72	1.778	2.051

TABLE 14

SUMMARY TABLE OF HEAD CAPSULE MEASUREMENTS
TERMINAL REARED LARVAE
(DISTRIBUTED AS TO SEX)

INSTAR	MAXIMUM		MINIMUM		MEAN	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Second	.27	.27	.25	.24	.265	.262
Third	.45	.47	.30	.30	.362	.372
Fourth	.71	.64	.50	.44	.543	.530
Fifth	.98	1.04	.64	.64	.818	.805
Sixth	1.25	1.38	1.08	1.04	1.156	1.239
Seventh	1.96	2.18	1.62	1.40	1.776	1.977

TABLE 15

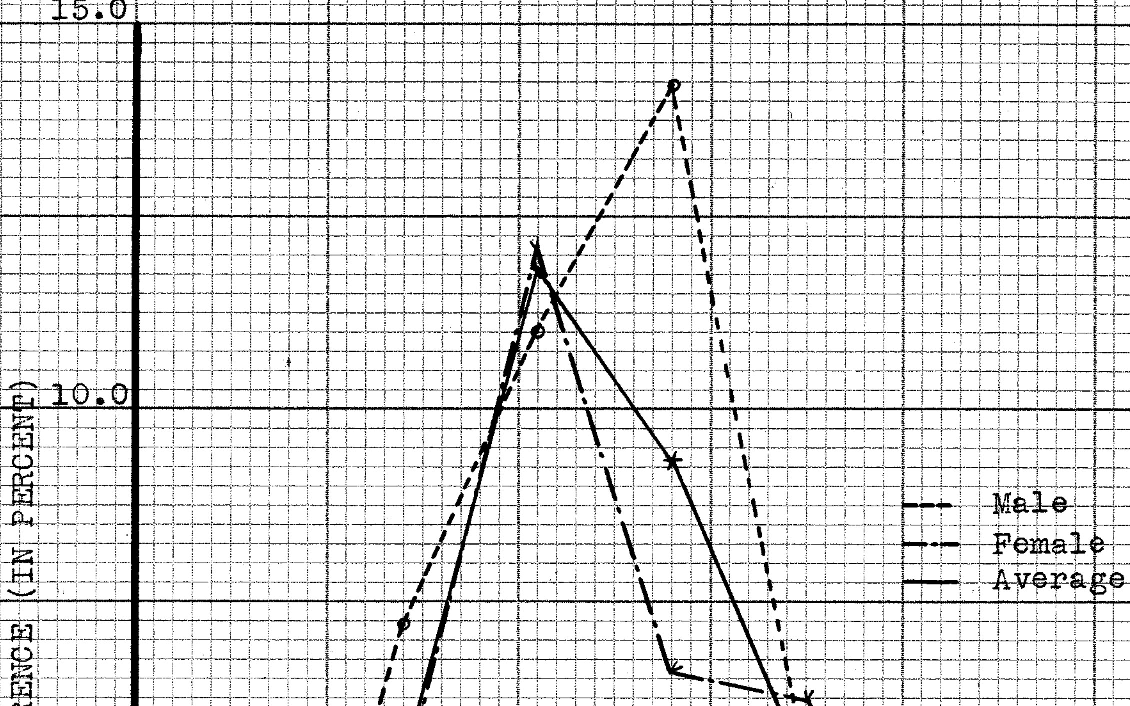
PERCENTAGE DIFFERENCE IN MEAN HEAD CAPSULE SIZE
BETWEEN STAMINATE AND TERMINAL LARVAE

INSTAR	DIFFERENCE IN MEAN HEAD CAPSULE SIZE					
	MALE		FEMALE		AVERAGE	
	Amt.	%	Amt.	%	Amt.	%
2	.003	1.1	.008	3.1	.006	2.3
3	.026	7.2	.019	5.1	.020	5.4
4	.060	11.0	.064	12.1	.063	11.8
5	.116	14.2	.053	6.6	.075	9.3
6	.063	5.4	.077	6.2	.064	5.3
7	.002	---	.074	3.7	.039	2.1

Table 15 is based on Tables 13 and 14, where the mean head capsule size of staminate larvae is larger than that of terminal larvae for each instar. It is noted that in all cases the percentage difference in head capsule size between the two types of larvae increased up to a maximum in the 4th or 5th instars and then decreased again to the 7th instar. This is better illustrated in the graph, Fig. 6 , from Table 15, where the amount of difference, in percentages, between staminate and terminal larvae is plotted for each instar and for male, female and average(no sex) larvae.

From the graph, Fig. 6 , it is seen that percentage difference in head capsule size between staminate and terminal larvae is very low in the 2nd instar but somewhat higher for females than for males. By the 3rd instar, the

FIG.6
PERCENTAGE DIFFERENCE IN MEAN HEAD
CAPSULE SIZE (PER INSTAR)
BETWEEN STAMINATE & TERMINAL LARVAE



difference between male larvae on cones and terminals was still greater. In the fourth instar, the percentage difference in head capsule size was slightly greater amongst female larvae than male. In this instar (4th), the maximum difference in size between female staminate and terminal larvae was found to be 12.1%. The maximum difference in size between male larvae on cones and on terminals occurred in the 5th instar, where a difference of 14.2% was computed. Female larvae in the 5th instar showed approximately the same percentage size difference as that between specimens on cones and terminals in the 3rd instar. By the 6th instar, the percentage difference in size of larvae on cones and terminals had decreased to approximately the same amount as in the 3rd instar and there was no appreciable difference between males and females. The difference in size between the two types of larvae decreased still further in the 7th instar. Amongst males, there was no difference in size of individuals from cones and terminals. Females still showed a slight difference.

Analysis of these data indicates very pointedly the effect of pollen feeding on the size of larvae. From the 2nd instar, the difference in size of larvae feeding on cones as compared to terminals increased sharply through the 3rd instar and reached a maximum in the 4th instar for females and 5th instar for males. Following this maximum in the 4th and 5th instars, the difference in size between the two types of larvae decreased again, although not as precipitously as the increase, to the 7th instar. Here the difference in size between staminate and terminal larvae was of the same magnitude as that of the 2nd instar. It is believed that the sharp increase in size of staminate larvae through the 3rd and 4th instars is truly representative of the effect of pollen in the diet and the cumulative effect of such a diet is most pronounced in the field in the 5th instar. Migratory movements (and death from various factors removing the smaller and weaker specimens) would help to account for the decline in size of staminate larvae following the 5th instar. This is substantiated from 7th instar data, male larvae, where, due to intermigration, completion of development and other factors, no difference in size was found between larvae from cones and buds. The greatest difference in size between staminate and terminal larvae occurred amongst males in the 5th instar, where it was found that specimens which had access to pollen were 14.2% larger than those feeding on terminals. It is interesting to note the similarity of the percentage difference curve to a normal distribution curve.

A summary table (Table 16) of head capsule measurements was compiled from the original measurements (1940-41 Annual Technical Report) listing mean size of head capsule

TABLE 16

SUMMARY TABLE OF HEAD CAPSULE MEASUREMENTS

INSTAR	STAMINATE			TERMINAL			Avge. (No Sex-Food)
	Male	Female	Avge. (No Sex)	Male	Female	Avge. (No Sex)	
Second	.268	.270	.269	.265	.262	.263	.267
Third	.388	.391	.389	.362	.372	.369	.386
Fourth	.603	.594	.597	.543	.530	.534	.569
Fifth	.934	.858	.885	.818	.805	.810	.854
Sixth	1.219	1.316	1.267	1.156	1.239	1.203	1.238
Seventh	1.778	2.051	1.928	1.776	1.977	1.889	1.911

for each sex, on staminate cones and terminal buds and then averages were obtained, again from the original measurements, disregarding sex and finally disregarding food-type. Since this table was to be used further for various mathematical analyses, the mean measurements are recorded to the nearest 1/1000 mm. The data are included in Table 16.

This table (Table 16) shows the larger condition of staminate-reared larvae in all cases. In plotting this table in graph form, Fig. 7 , a number of interesting points become apparent. From Fig. 7 , it is seen that the mean size of head capsule in the 2nd instar is approximately the same for staminate and terminal larvae and also for sex. Through the succeeding instars, the mean head capsule size for the various categories of larvae becomes more diversified, until in the 7th instar a considerable range of sizes is involved. The mean size of staminate larvae appreciably exceeds that of terminal larvae in the 3rd instar, but there is a uniformity for the sexes in each case. This conditions is maintained in the 4th instar with the difference between staminate and terminal larvae becoming more appreciable. It is interesting to note, in the 5th instar amongst staminate larvae, that females were appreciably smaller than males but then exceeded the males in size and gradually increased this condition through the 6th and 7th instars,

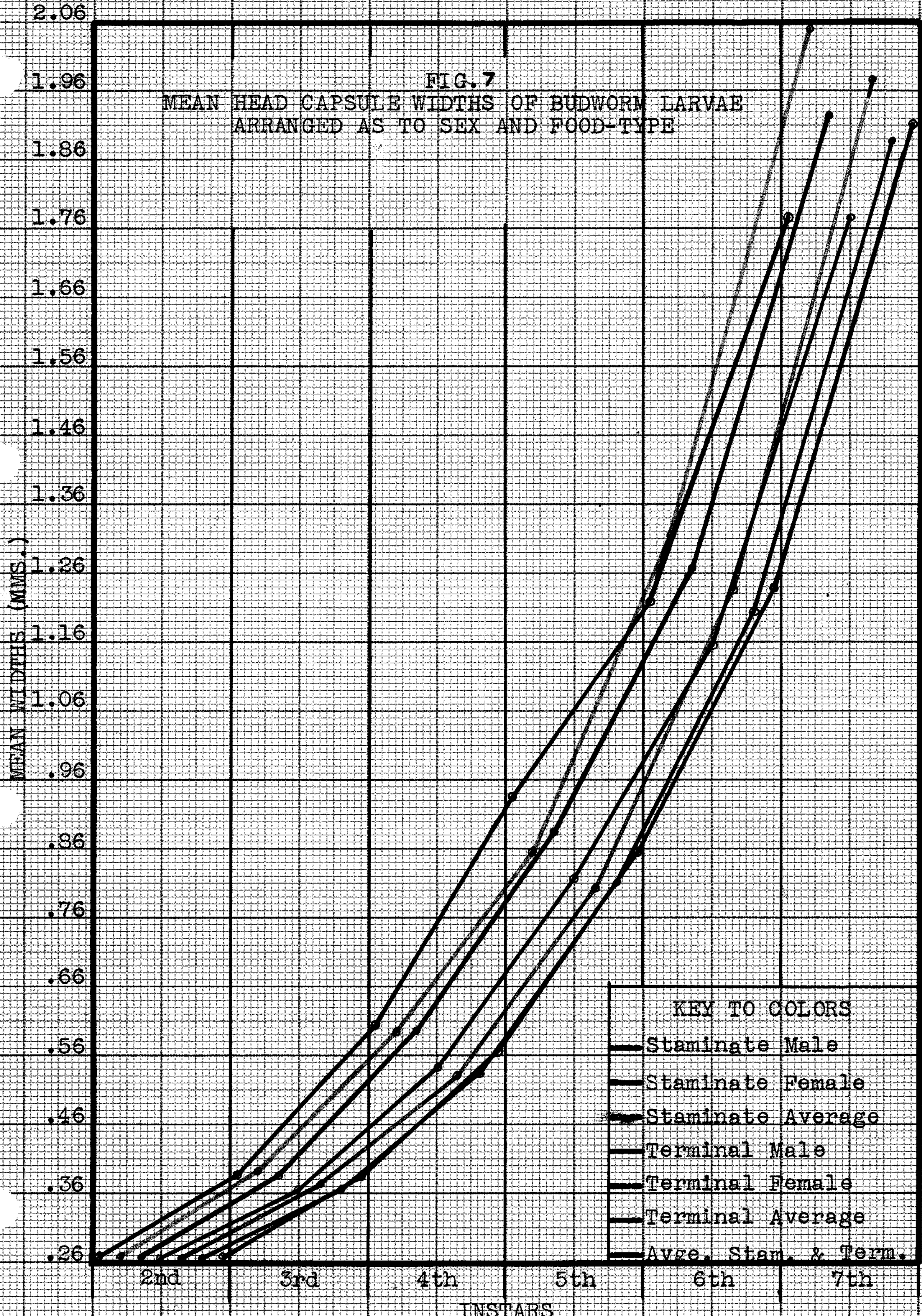


FIG.7
MEAN HEAD CAPSULE WIDTHS OF BUDWORM LARVAE
ARRANGED AS TO SEX AND FOOD-TYPE
2.06
1.96
1.86
1.76
1.66
1.56
1.46
1.36
1.26
1.16
1.06
.96
.86
.76
.66
.56
.46
.36
.26
MEAN WIDTHS (MMS.)
2nd
3rd
4th
5th
6th
7th
INSTARS
KEY TO COLORS
Staminate Male
Staminate Female
Staminate Average
Terminal Male
Terminal Female
Terminal Average
Avge. Stam. & Term.

reaching the maximum size for all budworm larvae in the 7th instar. Amongst terminal larvae, there was no appreciable difference between the sexes in the 5th instar. The females were only slightly larger than males in the 6th instar but in the 7th instar were not appreciably smaller than staminate females.

The graph clearly indicates that despite considerable migration, parasitism and other factors which would exert a considerable influence on size, the effect of pollen was of sufficient magnitude and predominance to maintain the larger condition of larvae on such food, in comparison to larvae feeding on terminals. This is exceedingly interesting and, in addition to indicating the effect of pollen on size of larvae, it provides an insight into the changes taking place amongst the larval population under actual field conditions.

4. Summary

The analysis of size relationships was based on the microscopic measurement of 1095 larvae. The measurements were accurate to .01 mm. and interpolations carried them out to .001 mm. Various treatments were applied to the data, first arranging the average sizes of larvae per instar per date of collection for each category of larvae. Then mean head capsule sizes were determined for each category of larvae. Such procedures allowed for investigation into the various changes in size

of larvae from one date to another and then responsible or influencing factors could be indicated. It is this increase or decrease in average head capsule size, in the same instar, for different series of larvae, on successive dates, that leads to a more complete understanding of the factors influencing the growth of larvae and would result in the determination of important influences in the biology of the budworm.

In general, it was found that differences in size between staminate and terminal larvae did not exceed an amount of approximately 20% of the latter, as a maximum. Usually, the difference ranged from 5% to 10%. Thus, although a 5% difference in size does not appear to represent a substantial amount, such a difference is valid on the basis of statistical analyses which have shown the difference in size between staminate and terminal larvae to be significant.

A summary table was prepared comparing the size differences per instar for staminate and terminal larvae on the basis of initial size, maximum size, minimum size, final size, difference between maximum and minimum size and difference between initial and final size. It was found that in the first appearance of larvae in any instar, staminate larvae were nearly always larger than terminal larvae and this difference is at a maximum in the 3rd instar.

The smallest larvae per instar, on the basis of minimum sizes, always occurred amongst terminal larvae, except for females in the 5th and 7th instars. Maximum sizes of larvae showed a more consistent difference in favour of staminate larvae. In all instars for both males and females feeding on cones, the maximum size was greater than amongst terminal larvae, the difference being most pronounced up to the 5th and 6th instars.

Examination of the percentage differences between maximum and minimum sizes for each category of larvae, per instar, provided a representation of the uniformity in development for the category of larva concerned. Here it was found that amongst staminate larvae, males showed the greatest uniformity in development up to the 6th instar and especially so in the 3rd and 4th instars, while amongst terminal larvae the uniformity in development for both males and females was considerably less. These differences were explained on the basis of migration.

The percentage difference in final size per instar for staminate and terminal larvae did not show any direct trends but seemed to be closely correlated with migration.

Finally, comparisons were made between initial and final sizes per instar for each category of larvae. Here the data are considerably involved and no direct relationships are apparent.

Comparison of mean size of head capsule showed the larger condition of staminate larvae in all cases. The results clearly showed that despite considerable migration, parasitism and other factors influencing the size of larvae, the effect of pollen was of sufficient magnitude and predominance to indicate the larger condition of larvae on such food compared to larvae feeding on terminals, on the bases of average figures derived from a consideration of larvae collected at random in the field.

Analysis of differences in mean head capsule size per instar of staminate and terminal larvae indicates very pointedly the effect of pollen feeding on the size of larvae. Beginning at the 2nd instar, the difference in size between staminate and terminal larvae (always in favour of the former) increased sharply through the 3rd instar and reached a maximum in the 4th instar for females and 5th instar for males. Beyond the maximum point, the difference in size decreased, not as sharply as the increase, until in the 7th instar the difference in size between staminate and terminal larvae was of the same magnitude as in the 2nd instar. This size difference is real and valid and represents the effect of pollen in the larval diet as a cumulative process, becoming most pronounced in the 5th instar.

E. Mathematical Expressions of Growth

1. Introduction

Insect growth has received considerable attention from workers in many fields and various rules and laws have been advanced. The abruptness of the change in length or size which undoubtedly accompanies the moulting of many arthropods has enabled investigators to detect an approximately constant ratio between the successive stages. Possibly the earliest of these announcements was that by Brooks in 1886, a modification of whose law was published by Fowler in 1909--"During early growth each stage increases at each moult by a fixed percentage of its length, which is approximately constant for species and sex." This percentage was called the "growth factor."

The next attempt to establish growth indices in arthropods was apparently that of Dyar (1890) who pointed out that "the widths of the head of a [lepidopterous] larva in its successive stages follow a regular geometrical progression." The ratios, he found, were different for different species and this progression has subsequently been termed "Dyar's Law."

Other empirical laws have been advanced--Przibram's rule and the work of Huxley, etc. However, numerous investigators of growth rates have been impressed with the very great irregularity of growth of the individual. Nevertheless, there is a characteristic post-embryonic growth rate which apparently holds true for many animals, namely, that it is highest, with respect to the size of the individual, when the organism is still very young; i.e., the percentile rate is greatest in early age.

In general, it has been concluded that within rather wide limits there probably is a specific growth factor, but there is much individual variation and the factor changes from moult to moult in most cases. With these qualifications, it seems that an ideal specific growth rate may have its advantages as a standard from which the deviations of a given individual may be estimated.

2. Coefficient of Growth

In many cases, the amount of growth which is achieved at each moult is predictable from certain empirical laws. On the basis of apparent close agreement between calculated and actual widths of the heads of larval instars, Dyar (in 1890) sought to establish a criterion by which it would be possible to determine by simple mathematics the correctness or incorrectness of the number of instars observed. He determined the ratios by dividing the width of the head of the last stage into the width of the head of the preceding stage, and so on.

In the following discussion, the reverse of the Dyarian ratio was used. In addition to using such a ratio as a test for the correctness of the number of instars observed, in such form it becomes an actual measurement of the amount of growth per instar for each type of larva and thus it is referred to as a coefficient of growth.

From the summary (Table 16)--mean head capsule measurements--, a series of growth coefficients were calculated. These are tabulated in Table 17. The growth coefficients were derived by dividing the mean head capsule size of one instar into that of the succeeding instar. The average growth coefficients were obtained as an arithmetic mean from the series of coefficients concerned.

The table of growth coefficients shows the considerable diversity of a theoretical constant. In this table, the values of the coefficient ranged from a low of 1.305 amongst staminate males in the 5th-6th instars to a maximum of 1.596 amongst terminal females in the 6th-7th instars. There did not appear to be a correlation between the series of growth coefficients as a whole and sex or food-type of larvae. However, there was a strong tendency for the coefficient of growth amongst staminate larvae in the early instars to be appreciably larger than that of terminal larvae for the same instars.

TABLE 17

SUMMARY TABLE OF GROWTH COEFFICIENTS

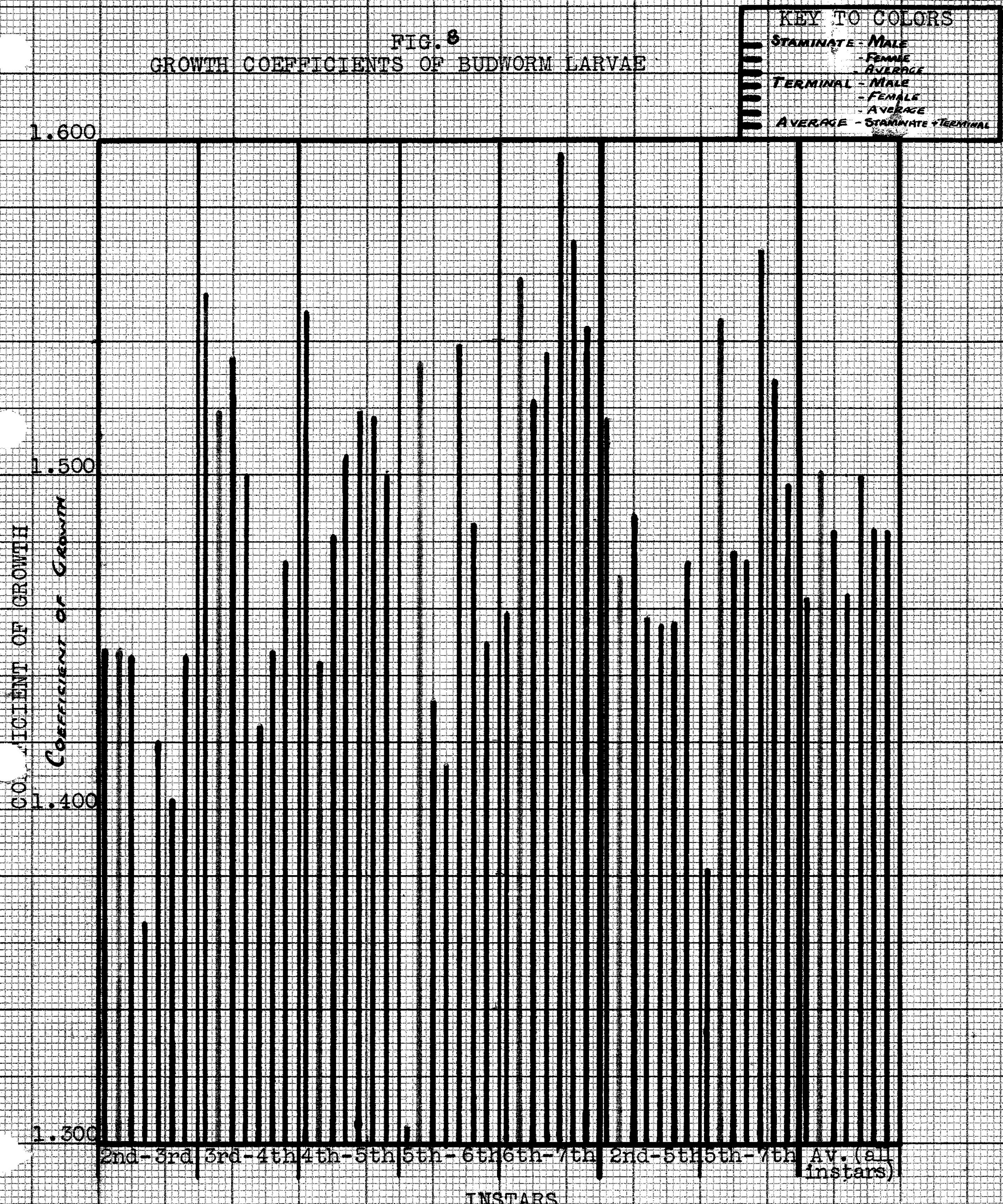
INSTARS	STAMINATE			TERMINAL			Avge. (No Sex-Food)
	Male	Female	Avge. (No Sex)	Male	Female	Avge. (No Sex)	
2nd-3rd	1.448	1.448	1.446	1.366	1.420	1.403	1.446
3rd-4th	1.554	1.519	1.535	1.500	1.425	1.447	1.474
4th-5th	1.549	1.444	1.482	1.506	1.519	1.517	1.501
5th-6th	1.305	1.534	1.432	1.413	1.539	1.485	1.450
6th-7th	1.459	1.559	1.522	1.536	1.596	1.570	1.544
Avge. 2nd-5th	1.517	1.470	1.488	1.457	1.455	1.456	1.474
Avge. 5th-7th	1.382	1.546	1.477	1.474	1.567	1.528	1.497
AVERAGE ALL INSTARS	1.463	1.501	1.483	1.464	1.500	1.484	1.483

Thus, for the second portion of Table 17 the coefficients of growth were averaged for the 2nd to 5th instars and 5th to 7th instars. This tended to eliminate various factors as migration, etc. which disturbed the actual condition of growth. Further, a rate of growth was thus available for the first and second halves of the larval development period. Finally, average growth coefficients for all instars are included in the last part of the table.

A graph of the growth coefficients from the above table was prepared and is included as Fig. 8 . This provides for a comparison of all the coefficients of growth at one time. The diversity of the various coefficients is readily seen from this graph. Further, in some cases there is a considerable change in the growth coefficient within one class of larvae from one instar to the succeeding one. The explanation is offered that a constant rate of growth is not to be expected from living organisms subjected to all the vagaries of the environment and further complicated by distinctive features of development peculiar to the various stadia, all this in addition to the movement (migration), parasitism, etc. of larvae. For example, in the early instars the larva is concerned with the immediate choice of a suitable feeding site. Difficulties encountered here would result in reserve stores of energy being used up culminating in a retarded development for that stage. Again, beyond the 5th instar, growth in size

FIG. 8

GROWTH COEFFICIENTS OF BUDWORM LARVAE



size of larvae is in direct competition with growth of the fat body and maturation of the gonads, etc. Hence, a coefficient of growth for size of larva would be distinctly lower at this stage. Thus, such larvae as are able to select suitable feeding sites (staminate cones) very shortly after emergence in the spring and commence their development immediately would have a decided advantage over larvae not similarly affected and this would be reflected in the growth coefficient. Weather conditions and various biotic and abiotic factors would exert some influence on the growth coefficient for each stadium.

With the above considerations in mind, the diversity of the growth coefficient is understandable. Also, it helps to account for the discrepancies in changes of growth coefficient. From the 2nd to 3rd instar, the coefficient of growth for staminate larvae is the same for both sexes and appreciably larger than that of terminal larvae. From the 3rd to 4th instars, the coefficient of growth amongst staminate males was greater than for staminate females but again both greater than that for terminal larvae. The average growth coefficient for terminal larvae exceeded that for staminate larvae in the 4th to 5th instar. However, male staminate larvae still showed the greatest coefficient of growth in this instar. Considerable diversity in the values of the growth coefficient for various larvae is noted in the 5th to 6th instar. Male larvae had dropped down to the minimum value for the coefficient here, while female larvae were approximately the same. In the 6th to 7th instar, the coefficient of growth for male staminate larvae was approximately the same as that for the 2nd to 3rd instar. Female staminate larvae attained their highest value for the coefficient, while male terminal larvae attained the maximum growth coefficient recorded here for the budworm.

In analysis, it is seen that the coefficient of growth for larvae feeding on staminate cones increased considerably after the 2nd instar moult. The coefficient for male larvae on terminals also showed considerable increase after the 2nd instar moult, while female terminal larvae remained stationary at this time. Following the 4th instar moult, the growth coefficient for male staminate larvae remained stationary, while that of female staminate larvae decreased to approximately the value following the 2nd instar moult. At this time (4th instar moult), male terminal larvae remained stationary, while female terminal larvae showed substantial increase. Thus, apparently terminal larvae begin making important gains in their growth following the 4th instar moult. This might be due to migration of larvae back to terminals, but more likely to continued migration of smaller individuals to cones, thus lowering the mean head capsule size. No apparent explanation is available for the decrease of growth coefficient amongst staminate female larvae following the 4th instar moult, unless it is due to the smaller mean head capsule size of 5th instar larvae caused by migration and other factors.

Beyond the 5th instar moult, the growth coefficient fluctuated considerably. The considerable decrease in the coefficient amongst male staminate larvae at this stage (5th instar moult) can be accounted for only through migration or other factors contributing towards an appreciably decreased mean head capsule size in the 6th instar. This would be possible through the larger and more vigorous larvae leaving the cones in the 5th instar and migrating to terminals which would result in "stragglers" and weaker larvae being left on cones. Such a condition would reduce the growth coefficient of larvae on cones following the 5th instar moult and, at the same time, increase the coefficient on terminals. This was found to be the case, as indicated from the graph. The steady increase of growth coefficient amongst female larvae, even beyond the 5th instar moult, could be attributed to a lesser tendency for migration amongst female larvae feeding on cones, also to female larvae putting on more growth in the latter instars due to reserves being necessary for maturation of eggs, while male larvae proceed to complete their development, thus resulting in an increase on both cones and terminals for female larvae. The 6th instar moult growth coefficients could not be analysed in the light of staminate cone or terminal bud feeding, due to the heterogeneity of population resulting from migration and other factors.

In averaging the growth coefficients from the 2nd to 5th instars and comparing them to the coefficients of growth from the 5th to 7th instar, some of the above observations are further clarified. The coefficient of growth for male larvae on cones for the 2nd to 5th instars is considerably greater than that for the 5th to 7th instars. The reverse of this condition obtains for female larvae on cones, although the difference between the coefficients is not as great. The difference between growth coefficients of terminal male larvae for these two periods of development was not very great. However, the growth coefficient of female terminal larvae changed from the minimum value for all larvae in the first period of development (2nd to 5th instars) to the maximum for all larvae in the last period (5th to 7th instars). Such a difference, although considerable, does not equal the change in growth coefficients amongst staminate males between the two periods of development. Thus, it is seen that male larvae have a much higher rate of growth in the early stages of their development compared to the final stage, so much so that even with migration of larger and more vigorous larvae to terminals in the latter stage of development, the coefficient of growth amongst terminal larvae generally in this period is not appreciably altered. That is, with the lower rate of growth amongst terminal males in the first phase of development (2nd to 5th instars), the expected decrease in coefficient of growth in the final phase of development (5th to 7th instars) did not occur, due to the influx of larger larvae (from cones) at this time which resulted in an increased mean head capsule width for the 5th and 6th instars. Amongst female larvae generally, the rate (coefficient) of growth was lower in the first phase of development than in the last phase, with terminal females showing the greatest increase. This indicates that the greatest growth amongst female larvae in general occurs from the 5th to 7th instars. Comparison of average growth coefficients (disregarding sex) for staminate and terminal larvae shows the former with the greater coefficient from the 2nd to 5th instars and the reverse condition from the 5th to 7th instars.

Finally, comparison of average growth coefficients of all instars for staminate and terminal larvae as well as the average growth coefficient for budworm larvae in general shows no difference whatsoever between the three categories of larvae. Further, the coefficients of growth for male larvae are identical, regardless of food, similarly for female larvae, but the growth coefficients of the latter are appreciably higher than that of the males. This is exceedingly interesting in that from the separate measurement of some 1100 larvae and obtaining averages of size for sex and food-type per instar and finally determining coefficients of growth for staminate, terminal and average types of larvae, no difference whatsoever in these figures (for coefficient of growth) was found. This would seem to prove that there exists for budworm larvae a uniform and standard rate of growth which appears to be specific to the insect and is distinct only for sex. Any changes in this coefficient of growth are due to such factors as food-types and various environmental agencies, which have been discussed above. Thus, factors contributing to changes in the coefficient of growth are extremely important in their influence on the biology and development of the budworm and their influence on the general vigour and, finally, epidemiology of the insect.

3. Regression Coefficient

Due to the many vagaries of the growth coefficient which tended to obscure its actual value, a series of statistical analyses was applied to the summary table (Table 16) of mean head capsule measurements. These were based on the statistics of linear regression and fitting of polynomials. The explanations for the statistical procedures are involved and need not be entirely set forth here. The point is that there are a series of head capsule measurements for each instar; i.e., two variables--instars and size (of head capsule). To determine relationships between size of head capsule and instar, and series of head capsule measurements as a whole, some method of testing the validity of the data must be applied, followed by comparison and analysis of relationships. Graphs are plotted from the actual data but from an uneven line based on actual experimental results, no definite relationships are obtained. However, definite trends were observed. In order to obtain from the graph a general expression for the relation between the two variables from which the line could be reconstructed at any time, it would be necessary to draw out the graph very accurately and make an average number of measurements. Thus, the "method of least squares" is used. This means that a line is fitted such that the sum of the squares of the deviations of the points in the graph from a straight line is a minimum. It gives a statistic known as the "regression coefficient" which expresses the increase or decrease in the dependent variable for one unit of increase in the independent variable. From the regression coefficient can be set up a regression equation which can be used to make predictions and it also defines the straight line known as the regression straight line.

In examination of the following computations, it is to be remembered that the linear regression is the line of best possible fit to the observed data because it is a line computed to fit the data so that the sum of the squares of the deviations of the actual measurements from the computed measurements is a minimum. The regression coefficient (b_{yx}) gives the slope of the line which, in this case, is the average increase in size of head capsule from instar to instar. Therefore, the higher the coefficient, the steeper is the slope of the line indicating a larger increase in the size of the head capsules from instar to instar. (For methods of statistical procedures, see Goulden, "Methods of Statistical Analysis.")

A graph, plotting logarithm of size of head capsule per instar, was prepared for each category of larva; i.e., sex, food-type and average. The regression coefficient was determined in each case and then, using the formula, $Y = a + bx$, a new series of head capsule

MALE STAMINATE LARVAL WIDTHS FOR 1940 FIELD COLLECTIONS

Mean head capsule widths plotted against instars.
Log of widths used instead of actual widths.

Actual Widths y	Log y	Instar
268	2.428135	2
388	2.588832	3
603	2.780317	4
934	2.970347	5
1219	3.076004	6
1778	3.249932	7

x	2	3	4	5	6	7	$T_x = 27$
log 6	2.4281	2.5888	2.7803	2.9703	3.0760	3.2499	$T_y = 17.09$ (.0934)

Σxy = 79.8006
$T_xT_y/N = 27 \times 17.0934/6 = 461.5218/6$ = 76.9203
Difference = $\Sigma(y-\bar{y})(x-\bar{x})$ = 2.8803

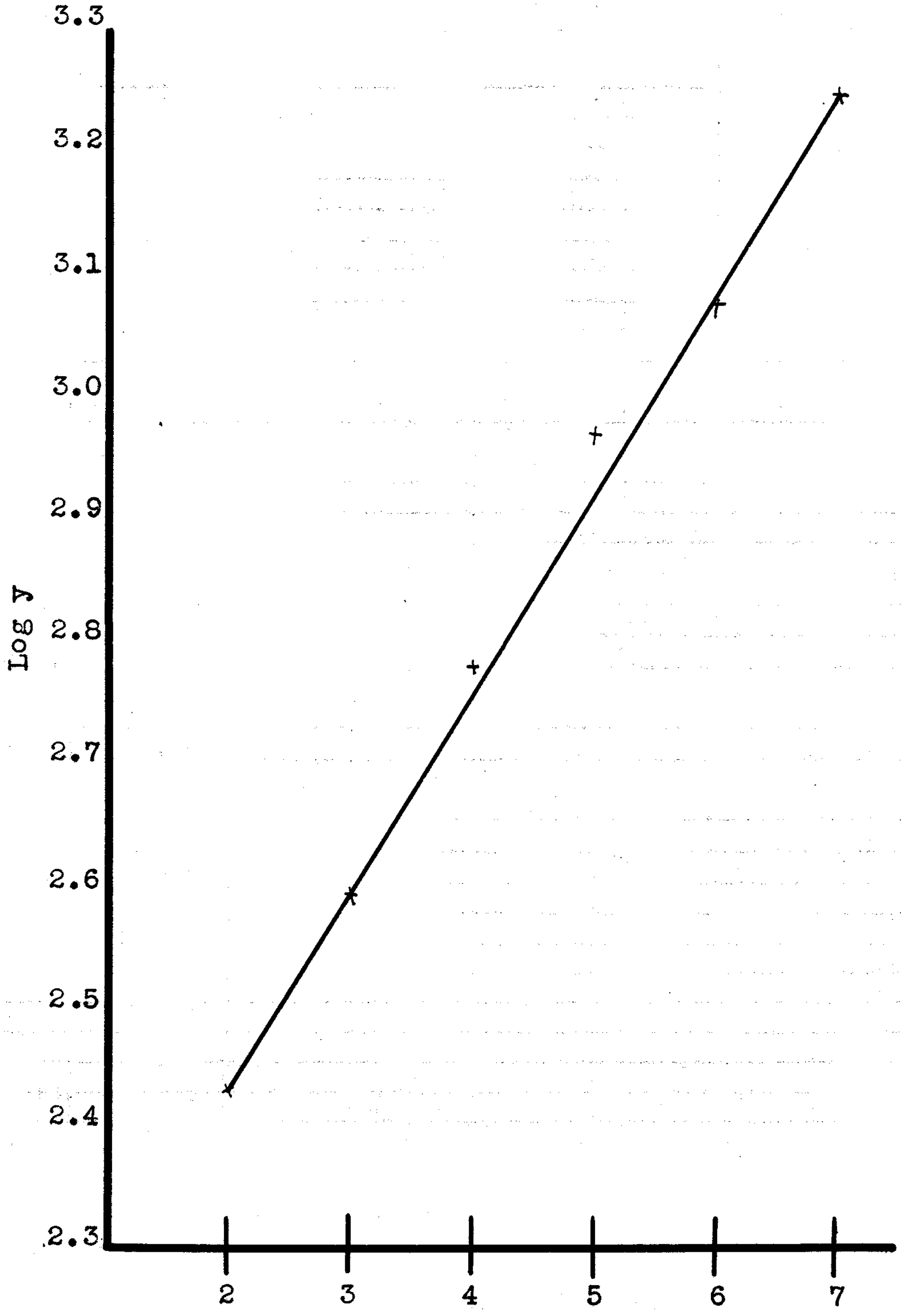
Σx^2 = 139.00
$T_x^2/N = 27^2/6 = 729/6$ = 121.5
Difference = $\Sigma(x-\bar{x})^2$ = 17.5

$b_{yx} = 2.8803/17.5 = .1646$ $\bar{x} = 4.5$ $\bar{y} = 2.8489$
$a = (\bar{y}-b\bar{x}) = 2.8489 - .1646 \times 4.5 = 2.8489 - .7407 = 2.1082$

Log y_1 = 2.4374 y_1 = .273
Log y_2 = 2.6020 y_2 = .4000
Log y_3 = 2.7666 y_3 = .5843
Log y_4 = 2.9312 y_4 = .8535
Log y_5 = 3.0958 y_5 = 1.247
Log y_6 = 3.2604 y_6 = 1.821

NOTE: Actual widths are first transferred to whole numbers without decimals to avoid negative logs; i.e., .262 to 262.0. In final determinations of y, whole numbers result, after which the decimals are entered in their proper place; i.e., 2.3962 = log of 248.9 = .2489 mm.

FIG. 9
CALCULATION OF LINEAR REGRESSION
COEFFICIENT FOR MALE STAMINATE-FED LARVAE



FEMALE STAMINATE LARVAL WIDTHS FOR 1940 FIELD COLLECTIONS

Mean head capsule widths plotted against instars.
Log of widths used instead of actual widths.

Actual Widths y	Log y	Instar
270	2.431364	2
391	2.592177	3
594	2.773786	4
858	2.933487	5
1316	3.119256	6
2051	3.311966	7

x	2	3	4	5	6	7	Tx = 27
log y	2.43140	2.5922	2.7738	2.9335	3.1192	3.3120	Ty = 17.1621

$\Sigma xy = (2x2.4314) + (2x2.5922) + \text{etc.}$ = 80.3013
$TxTy/N = 27 \times 17.1621/6 = 463.3767/6$ = 77.2294
Difference $= \Sigma(y-\bar{y})(x-\bar{x})$ = 3.0719

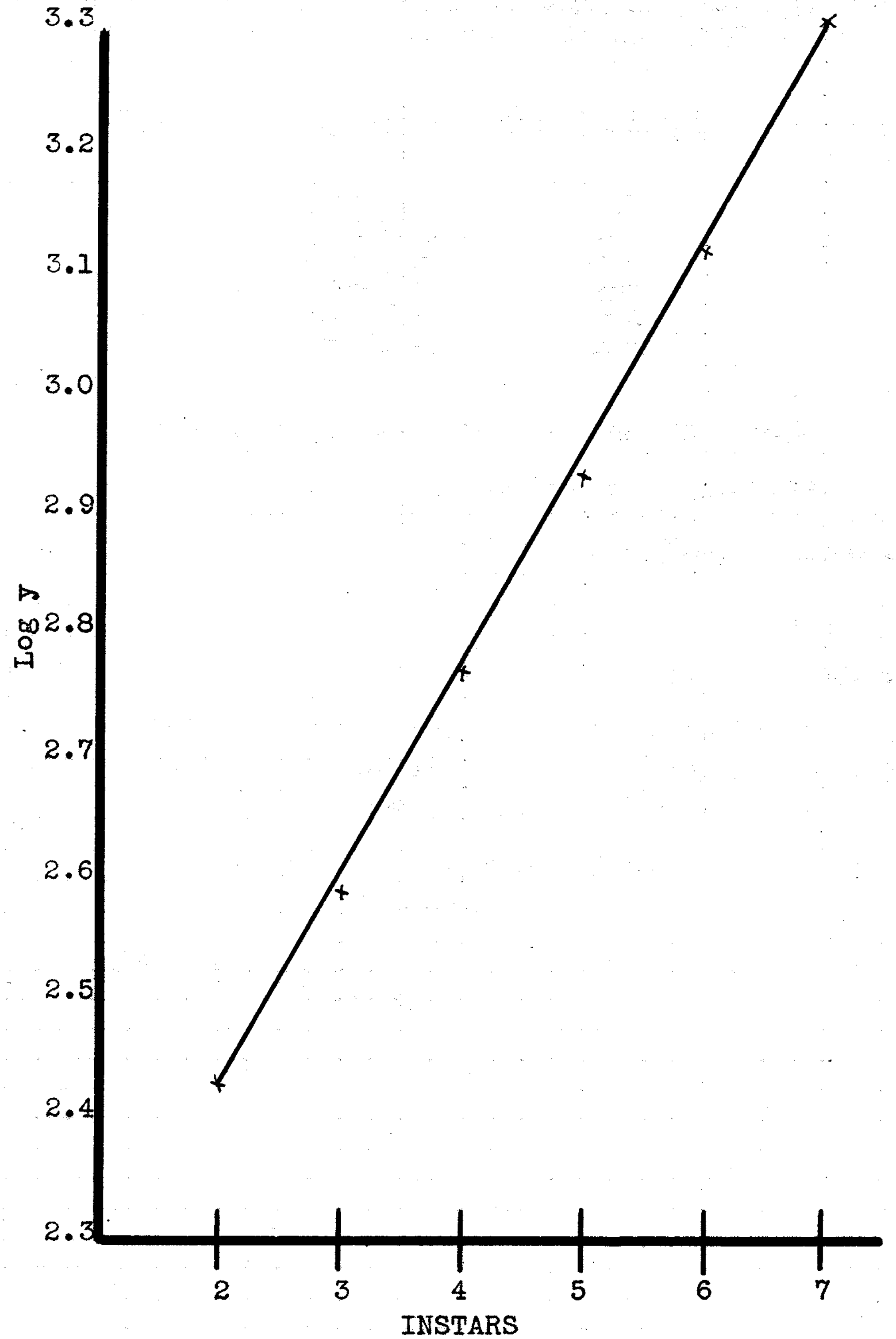
Σx^2 = 139
$Tx^2/N = 27^2/6$ = 121.5
Difference $= \Sigma(x-\bar{x})^2$ = 17.5

$b_{yx} = 3.0719/17.5 = .1755$ $\bar{x} = 4.5$ $\bar{y} = 2.8604$
$a = \bar{y} - b\bar{x} = 2.8604 - .1755x4.5 = 2.8604 - .7898 = 2.0706$
Regression formula $= y = a + bx$

Log y_1=2.4216 Log y_2=2.5971 Log y_3=2.7726 Log y_4=2.9481 Log y_5=3.1236
Log y_6=3.2991

y_1=.2640 y_2= .3955 y_3= .5924 y_4= .8874 y_5=1.329
y_6=1.992

FIG. 10
CALCULATION OF LINEAR REGRESSION
COEFFICIENT FOR FEMALE STAMINATE-FED LARVAE



AVERAGE WIDTH OF MALE AND FEMALE STAMINATE FED LARVAE FOR 1940 FIELD COLLECTIONS

Mean head capsule widths plotted against instars.
Log of widths used instead of actual widths.

Actual Widths (y)	Log y	Instar
269	2.429752	2
389	2.589950	3
597	2.775974	4
885	2.946943	5
1267	3.102777	6
1928	3.285107	7

x	2	3	4	5	6	7	
Log y	2.4298	2.5900	2.7760	2.9469	3.1028	3.2851	

$T_x = 27$
$T_y = 17.1306$

$\Sigma xy = (2\times2.4298) + 3\times2.5900) + \text{etc.} \qquad = 80.0806$

$T_xT_y/N = 27\times17.1306/6 = 462.5262/6 \qquad = 77.0877$

Difference $= \Sigma(y-\bar{y})(x-\bar{x}) \qquad = 2.9929$

$\Sigma x^2 = \qquad = 139$

$T_x2/N \qquad = 121.5$

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

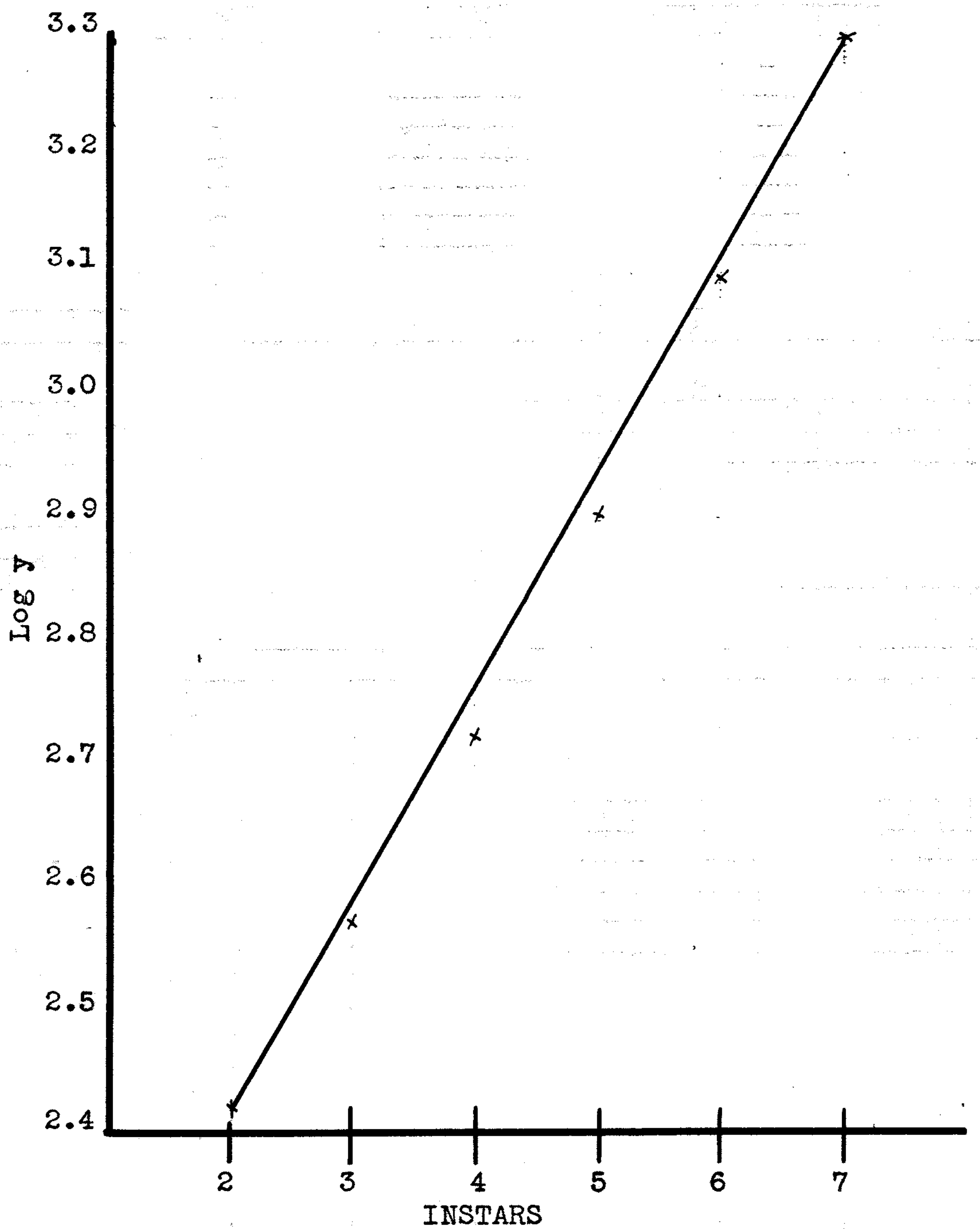
$b_{yx} = 2.9929/17.5 = .1710 \qquad \bar{x} = 4.5 \qquad \bar{y} = 2.8551$

$a = \bar{y} - b\bar{x} = 2.8551 - .1710\times4.5 = 2.8551 - .7695 = 2.0856$

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

Log y_1 =	2.4276	y_1 =	.2677
Log y_2 =	2.5986	y_2 =	.3969
Log y_3 =	2.7690	y_3 =	.5876
Log y_4 =	2.9406	y_4 =	.8722
Log y_5 =	3.116	y_5 =	1.293
Log y_6 =	3.2826	y_6 =	1.917

FIG. 11
CALCULATION OF LINEAR REGRESSION
COEFFICIENT FOR MALE AND FEMALE
STAMINATE-FED LARVAE
(BASED ON AVERAGE WIDTH OF HEAD CAPSULE)



MALE TERMINAL FED LARVAL WIDTHS FOR THE 1940 FIELD COLLECTIONS

Mean head capsule widths plotted against instars.
Log of widths used instead of actual widths.

Actual Widths	Log y	Instars
y		x
265	2.423246	2
362	2.558709	3
543	2.734800	4
818	2.912753	5
1156	3.062958	6
1776	3.249443	7

x	2	3	4	5	6	7	$T_x = 27$
y	2.4232	2.5587	2.7348	2.9128	3.0630	3.2494	$T_y = 16.9419$

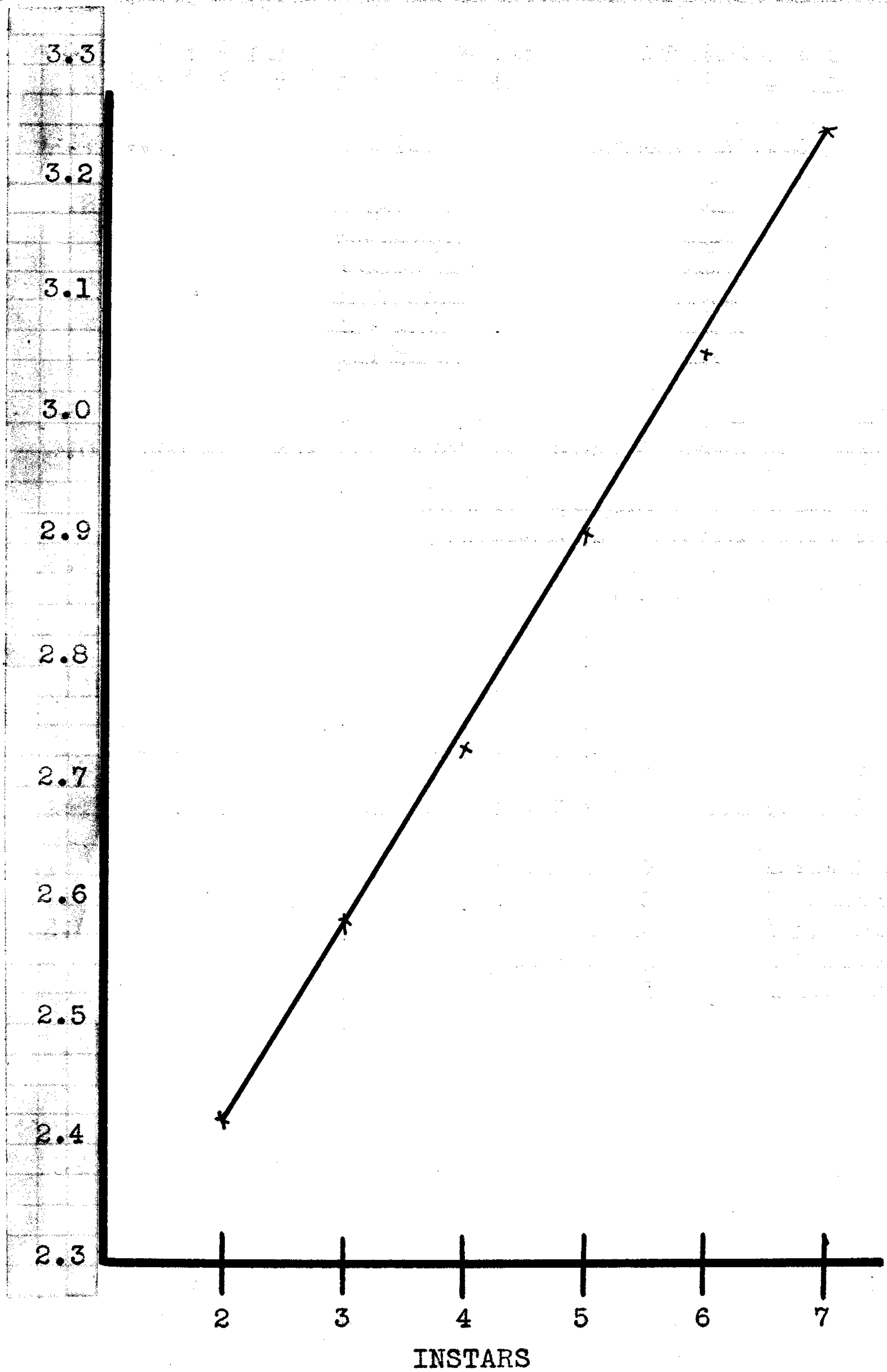
$\Sigma xy = (2x2.4232) + (3x2.5587) + \text{etc.}$ $= 79.1495$
$T_xT_y/N = 27x16.9419/N = 457.4313/6$ $= \underline{76.2386}$
Difference $= \Sigma(y-\bar{y})(x-\bar{x})$ $= 2.9109$

$\Sigma x^2 =$ $= 139$
T_x2/N $= \underline{121.5}$
Difference $= 17.5$

$b_{yx} = 2.9109/17.5 = 0.1663$ $\bar{x} = 4.5$ $\bar{y} = 2.8236$
$a = \bar{y} - b\bar{x} = 2.8236 - .1663x4.5 = 2.8236 - .7484 = 2.0752$

Log $y_1 = 2.4078$ $y_1 = .2557$
Log $y_2 = 2.5741$ $y_2 = .3751$
Log $y_3 = 2.7404$ $y_3 = .5501$
Log $y_4 = 2.9067$ $y_4 = .8067$
Log $y_5 = 3.0730$ $y_5 = 1.183$
Log $y_6 = 3.2393$ $y_6 = 1.735$

FIG. 12
CALCULATION OF LINEAR REGRESSION
COEFFICIENT FOR MALE TERMINAL-FED LARVAE



FEMALE TERMINAL FED LARVAL WIDTHS FOR 1940 FIELD COLLECTIONS

Mean head capsule widths plotted against instars.
Log of widths used instead of actual widths.

Actual Widths	Log y	Instar
y		x
262	2.418301	2
372	2.570543	3
530	2.724276	4
805	2.905796	5
1239	3.093071	6
1977	3.296007	7

x	2	3	4	5	6	7	$T_x = 27$
y	2.4183	2.5705	2.7243	2.9058	3.0931	3.2960	$T_y = 17.0080$

$\Sigma xy = (2x2.4183) + (3x2.5705)$ .... $+ (7x3.2960)$ $= 79.6049$

$T_xT_y/N = 27 \times 17.0080/N = 459.2160/6$ $= 76.5360$

Difference $= \Sigma(y-\bar{y})(x-\bar{x})$ $= 3.0689$

Σx^2 $= 139$

T_x^2/N $= 121.5$

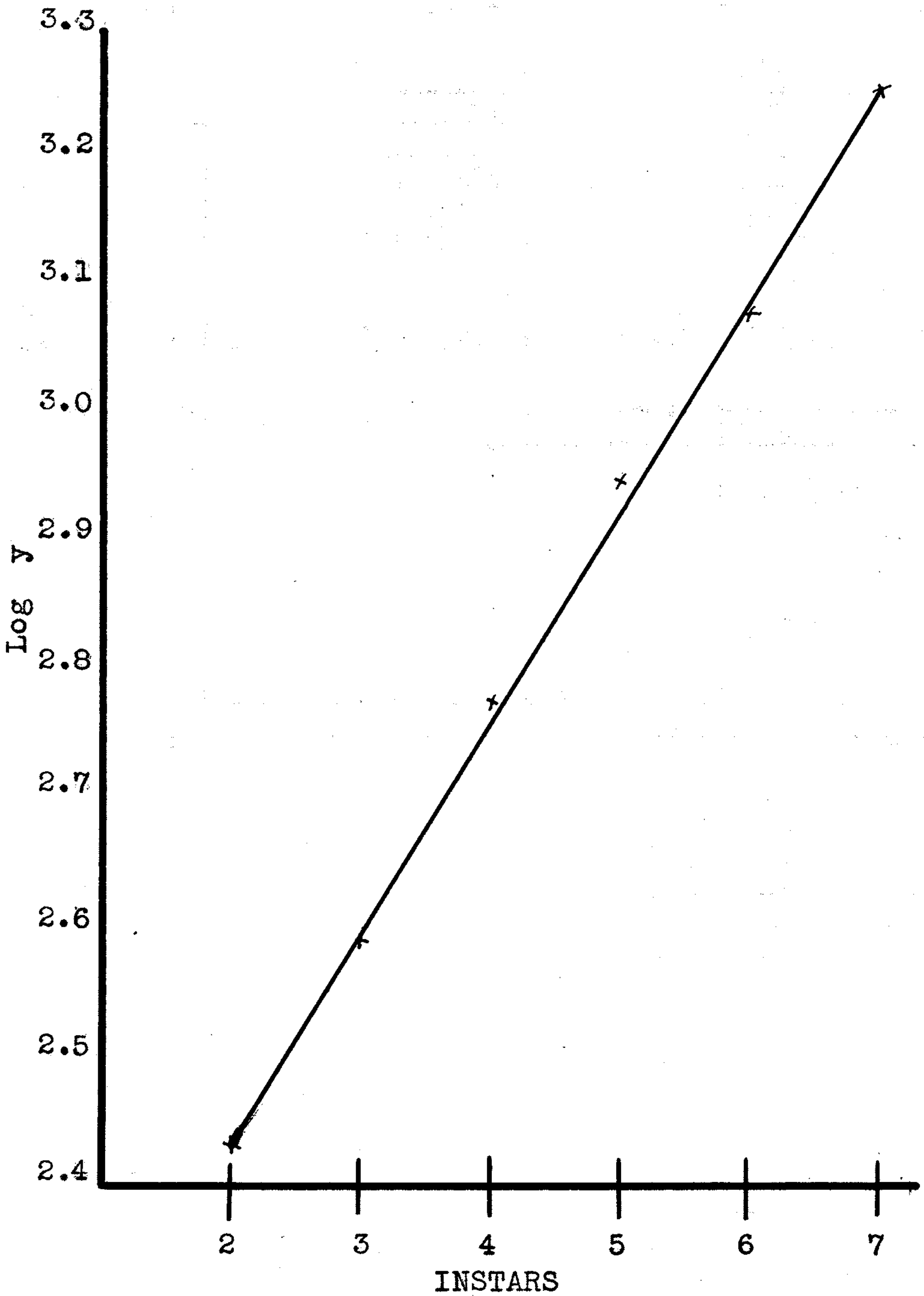
Difference $= \Sigma(x-\bar{x})^2$ $= 17.5$

$b_{yx} = 3.0689/17.5 = .1754$ $\bar{x} = 4.5$ $\bar{y} = 2.8347$

$a = \bar{y}-b\bar{x} = 2.8347 - .1754x4.5 = 2.8347 - .7893 = 2.0454$

Log y_1 = 2.3962	y_1 = .2489
Log y_2 = 2.5716	y_2 = .3729
Log y_3 = 2.7470	y_3 = .5585
Log y_4 = 2.9224	y_4 = .8364
Log y_5 = 3.0978	y_5 = 1.243
Log y_6 = 3.2732	y_6 = 1.876

FIG. 13
CALCULATION OF LINEAR REGRESSION
COEFFICIENT FOR FEMALE TERMINAL-FED LARVAE



AVERAGE HEAD CAPSULE WIDTHS FOR TERMINAL FED LARVAE IN 1940 FIELD COLLECTIONS

Mean head capsule widths plotted against instars.
Log of widths used instead of actual widths.

Actual Widths	Log y	Instars
y		x
263	2.419956	2
369	2.567026	3
534	2.727541	4
810	2.908485	5
1203	3.080266	6
1889	3.276232	7

x	2	3	4	5	6	7	$T_x = 27$
y	2.4200	2.5670	2.7275	2.9085	3.0803	3.2763	$T_y = 16.9796$

$\Sigma xy = (2\times2.4200) + (3\times2.5670) + \text{etc.}$ $= 79.4094$
$T_xT_y/N = 27\times16.9796/6 = 458.4492/6$ $= \underline{76.4082}$

Difference $= \Sigma(y-\bar{y})(x-\bar{x})$ $= 3.0012$

$\Sigma x^2 =$ $= 139$
T_x2/N $= \underline{121.5}$

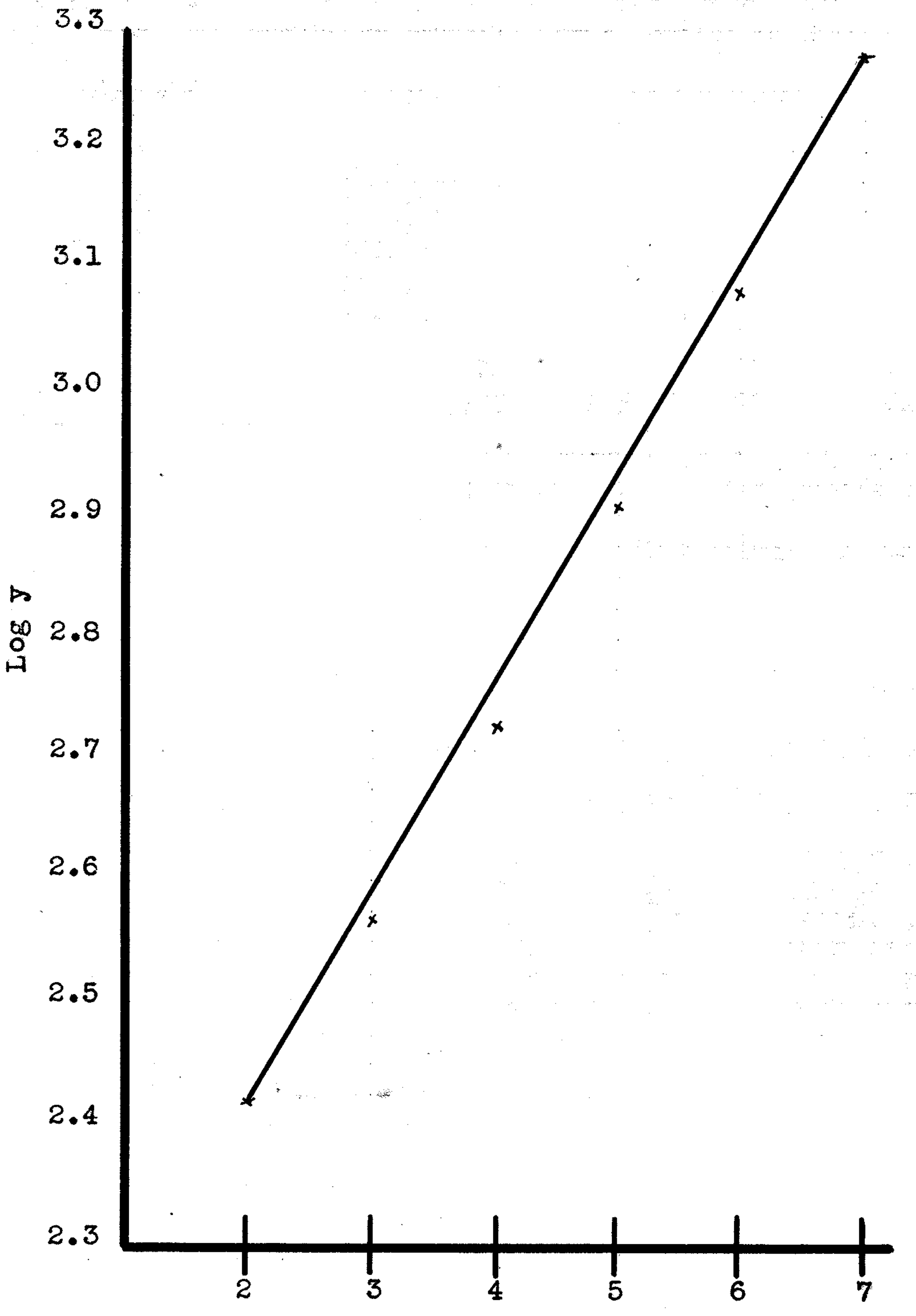
Difference $= 17.5$

$b_{yx} = 3.0012/17.5 = .1715$ $\bar{x} = 4.5$ $\bar{y} = 2.8299$

$a = \bar{y} - b\bar{x} = 2.8299 - .1715\times4.5 = 2.8299 - .7718 = 2.0581$

Log y_1 = 2.4011	y_1 = .2518
Log y_2 = 2.5726	y_2 = .3738
Log y_3 = 2.7441	y_3 = .5548
Log y_4 = 2.9156	y_4 = .8234
Log y_5 = 3.0871	y_5 = 1.222
Log y_6 = 3.2586	y_6 = 1.814

FIG. 14
CALCULATION OF LINEAR REGRESSION COEFFICIENT FOR ALL TERMINAL-FED LARVAE (DISREGARDING SEX)
(BASED ON AVERAGE WIDTH OF HEAD CAPSULE)



AVERAGE HEAD CAPSULE WIDTHS FOR ALL STAMINATE AND TERMINAL FED LARVAE OF THE 1940 FIELD COLLECTIONS

Head capsule widths plotted against instars.
Log of widths used instead of actual widths.

Actual Widths y	Log y	Instars x
267	2.426511	2
386	2.586587	3
569	2.755112	4
854	2.931458	5
1238	3.092721	6
1911	3.281261	7

x	2	3	4	5	6	7	$T_x = 27$
y	2.4265	2.5866	2.7551	2.9314	3.0927	3.2813	$T_y = 17.0736$

Σxy = 79.8155

$T_xT_y/N = 27 \times 17.0736/6 = 460.9872/6$ = 76.8312

Difference = $\Sigma(y-\bar{y})(x-\bar{x})$ = 2.9843

$\Sigma x^2 =$ = 139

$T_x^2/N = 27^2/6 = 729/6$ = 121.5

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

$b_{yx} = 2.9843/17.5 = .1705$

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

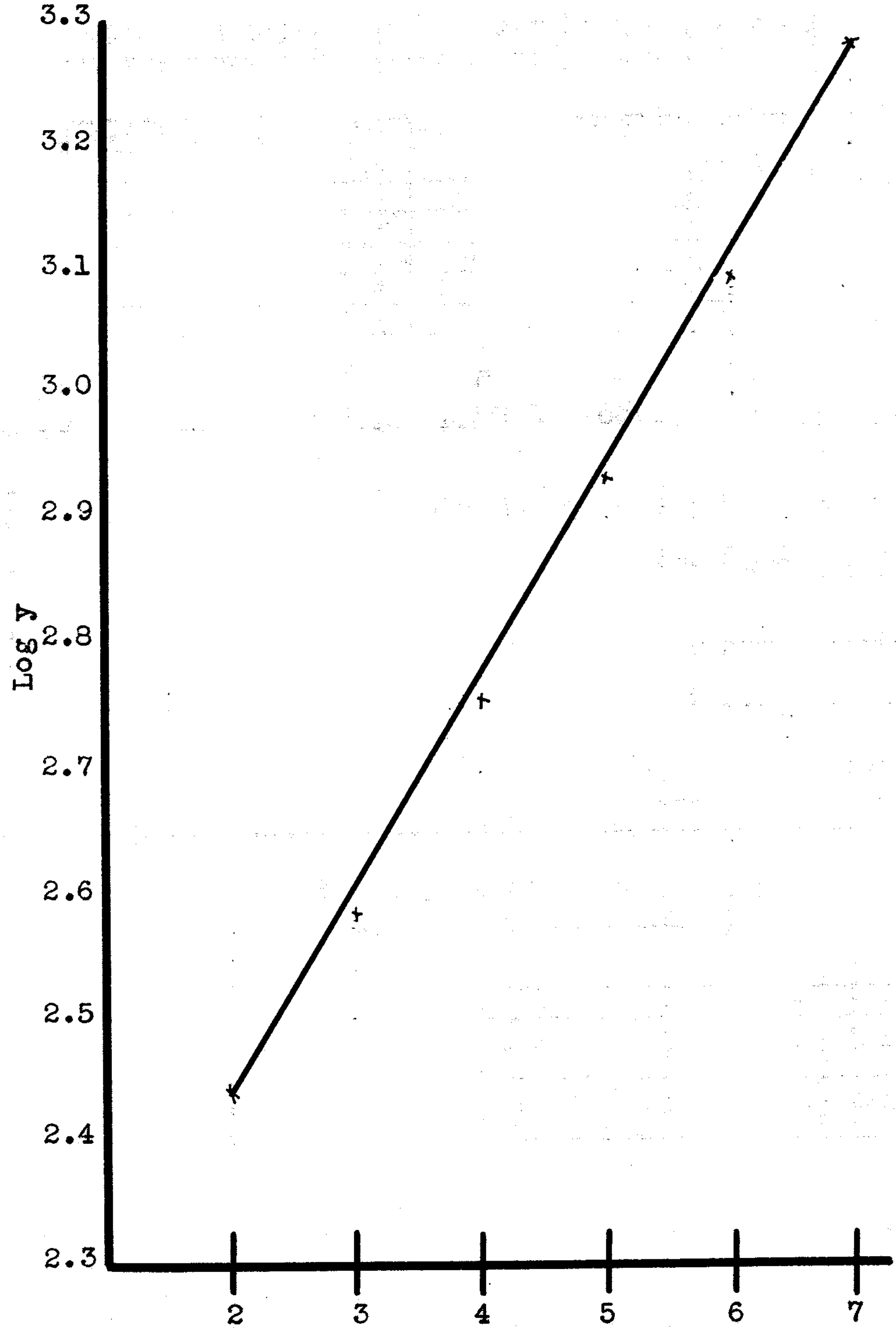
$\bar{y} = 17.0736/6 = 2.8456 - .1705 \times 4.5 = 2.8456 - .7672 = 2.0784$

$\text{Log } y_1 = a + bx = 2.0784 + .1705 \times 2 = 2.4194$

$\text{Log } y = 2.0784 + .1705 \times 7 = 3.2719$

Log y_1 = 2.4194	y_1 = .2627
Log y_2 = 2.5899	y_2 = .3890
Log y_3 = 2.7604	y_3 = .5760
Log y_4 = 2.9309	y_4 = .8530
Log y_5 = 4.1014	y_5 = 1.263
Log y_6 = 3.2719	y_6 = 1.870

FIG. 15
CALCULATION OF LINEAR REGRESSION COEFFICIENT FOR ALL STAMINATE- & ALL TERMINAL-FED LARVAE (DISREGARDING SEX)
(BASED ON AVERAGE WIDTH OF HEAD CAPSULE)



widths was obtained, for each category of larva. Thus, the method was similar to that used by Dyar in that a comparison is made of actual and calculated series of head capsule widths, thus proving the number of instars determined and the validity of the measurements obtained. However, in the Dyar method, the "calculated" series of measurements is based on the determination of a growth coefficient usually derived from dividing the head capsule width of one instar into that of the succeeding one. This procedure does not take into account the various changes occurring in all the stadia. The procedure adopted in this study of obtaining growth coefficients per stadium and averaging for all stadia tends to overcome this objection. However, by using the regression coefficient, a more accurate series of calculated measurements is obtained through the contribution of each of the actual measurements per instar.

The following are the regression coefficients obtained from the series of statistical analyses:

		Regression Coefficient
Staminate Larvae	Male	.1646
	Female	.1775
	Average	.1710
Terminal Larvae	Male	.1663
	Female	.1754
	Average	.1715
Average for No Sex and Food-type		.1705

As stated previously, the regression coefficient represents the average increase in size of head capsule from instar to instar, in terms of the slope of a line on a graph. On this basis, it is seen that some categories of larvae had a larger average increase of head capsule size than other categories of larvae. This represents, therefore, a more rapid rate of growth, more vigorous larvae and finally larger larvae. Thus, it is seen that female larvae on cones had the most rapid rate of growth, while male staminate larvae had the lowest rate of growth. On the basis of these regression coefficients, there was not very much difference in rate of growth between staminate and terminal larvae. However, from other analyses in this study and, as shown by growth coefficients, there was a valid difference between staminate and terminal larvae and thus various factors must have influenced the regression coefficient to the extent that no difference in rate of growth appeared, when considering a whole series of measurements for each category of larva.

From the formula, $Y = a + bx$, series of theoretical head capsule measurements, for each instar, were obtained for each category of larva. These are included, together with the actual series of measurements (as in Table 17) in the table below. The calculated series of measurements represent the theoretical distribution of head capsule sizes for each category of larva and also are the best possible fit to the observed data.

TABLE 18

COMPARISON OF ACTUAL & CALCULATED SERIES OF HEAD CAPSULE MEASUREMENTS OF BUDWORM LARVAE

INSTAR	STAMINATE						TERMINAL						AVERAGE (NO SEX OR FOOD)	
	MALE		FEMALE		AVGE. (NO SEX)		MALE		FEMALE		AVGE. (NO SEX)			
	Actual	Calc.	Actual	Calc.	Actual	Calc.	Actual	Calc.	Actual	Calc.	Actual	Calc.	Actual	Calc.
SECTION "A"														
Second	.268	.273	.270	.264	.269	.268	.265	.256	.262	.249	.263	.252	.267	.263
Third	.388	.400	.391	.396	.389	.397	.362	.375	.372	.373	.369	.374	.386	.389
Fourth	.603	.584	.594	.592	.597	.588	.543	.550	.530	.559	.534	.555	.569	.576
Fifth	.934	.854	.858	.887	.885	.872	.818	.807	.805	.836	.810	.823	.854	.853
Sixth	1.219	1.247	1.316	1.329	1.267	1.293	1.156	1.183	1.239	1.243	1.203	1.222	1.238	1.263
Seventh	1.778	1.821	2.051	1.992	1.928	1.917	1.776	1.735	1.977	1.876	1.889	1.814	1.911	1.870
Regression Coefficient		.1646		.1775		.1710		.1663		.1754		.1715		.1705
SECTION "B"														
Second	.268	.265	.270	.268	.269	.266	.265	.261	.262	.262	.263	.262	.267	.266
Third	.388	.397	.391	.397	.389	.397	.362	.373	.372	.373	.369	.373	.386	.389
Fourth	.603	.596	.594	.598	.597	.591	.543	.535	.530	.529	.534	.531	.569	.567
Regression Coefficient		.1761		.1712		.1731		.1558		.1525		.1538		.1643

In Table 18, Section "A," the actual and calculated series of measurements are recorded for each category of larva per instar. The regression coefficients are included in the last line of this section. In general, there appeared to be very little difference between the actual and the calculated series of measurements. This substantiates the validity of such measurements and provides conclusive evidence of the presence of 7 instars in the larval life of the budworm.

On the basis of regression coefficients, it was seen that terminal larvae seemed to be larger and possess a more rapid rate of growth. However, from other phases of this study, it was shown that this was not actually the case. Therefore, various factors must have influenced the average size of head capsule to such an extent that the effect of staminate feeding was masked in this statistical analysis. It was felt that migration especially would contribute towards such a condition; consequently, regression coefficients were determined for each category of larva only for the 2nd, 3rd and 4th instars. Thus, the effect of migration and other factors would be eliminated, as it was shown that migration, mortality, etc. do not become manifest until the 5th instar. The method of determination of regression coefficients for the 2nd to 4th instars was the same as used for all the instars. The following are the coefficients determined:

		Regression Coefficient (2nd to 4th instars)
Staminate Larvae	Male	.1761
	Female	.1712
	Average	.1731
Terminal Larvae	Male	.1558
	Female	.1525
	Average	.1538
Average for no Sex and Food-type		.1643

Here it is seen that the regression coefficient is larger, in all cases, for staminate larvae, than for terminal larvae. The average regression coefficient for staminate larvae was .1731, while that for terminal larvae was .1538. This difference is considerable when considering that the regression coefficient represents the average increase in size of head capsule from instar to instar (in terms of slope of a line). The greatest difference in regression coefficients was found between staminate males (.1761) and terminal males (.1558). Comparing the coefficients obtained here (for the 2nd, 3rd and 4th instars) with those on P. 221 for all instars, it is seen that staminate cones do contribute towards the greater growth and development of larvae. In the latter case, regression coefficients seemed to indicate the advantages in favour of terminal larvae. However, from conclusions in this study and from previous studies, it was shown that this was not the case. Further, from controlled studies, it was found that male larvae suffered the greatest retardation in growth when deprived of pollen.

This is borne out in the greater difference in regression coefficients between male larvae on the two food-types, in favour of the staminate males.

Thus, in analyzing the growth of larvae from the 2nd to 4th instars, on the basis of regression coefficients, a clearer insight into the actual effect of pollen-feeding is obtained then by considering all the instars together. This again demonstrates the effect of migration towards a heterogeneity of population in the field which tends to mask actual conditions and further indicates the importance of the early instars in the total growth and development of the larvae.

Using the regression coefficients of the 2nd to 4th instars and following the same procedure as used in compilation of Table 18, Section "A," a theoretical series of head capsule measurements was calculated. These, together with the regression coefficients, are included in Section "B" of Table 18. Here, considerably less variation is found between the series of actual and calculated head capsule measurements. This greater agreement between the two series of measurements on the basis of a regression coefficient for the 2nd to 4th instars as compared to a regression coefficient for all instars further establishes the validity of the former regression coefficient and also demonstrates the presence of a definite rate of growth in these instars which is distinct

TESTING THE SIGNIFICANCE OF DIFFERENCE IN MEAN HEAD CAPSULE SIZE OF BUDWORM LARVAE

MALE LARVAE

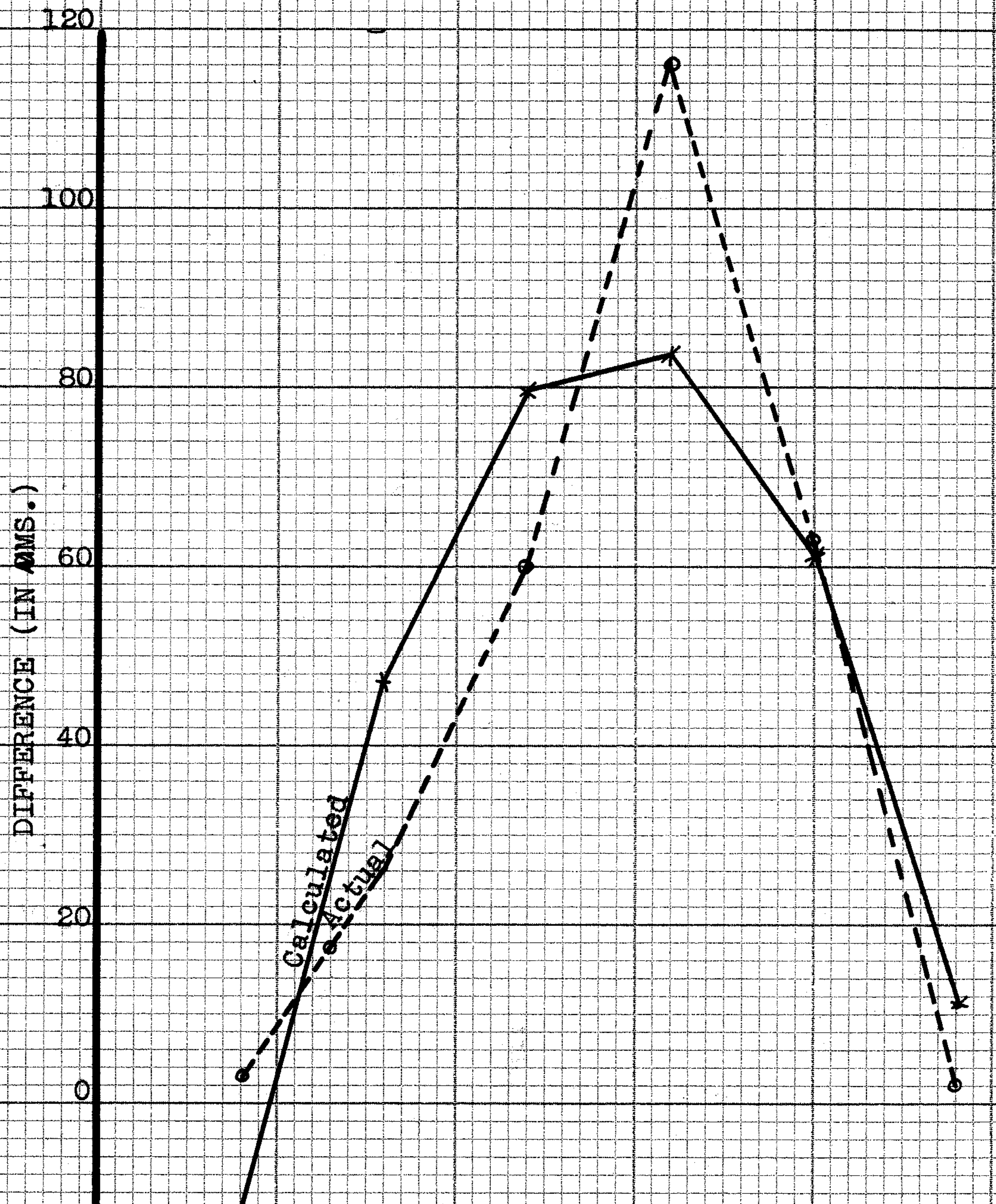
DIFFERENCES BETWEEN STAMINATE AND TERMINAL FED

		a	b	c	d	e
	x	y	1	2	3	4
	1	3	3	3	3	3
	2	26	29	32	35	38
	3	60	89	121	156	194
	4	116	205	326	482	676
	5	63	268	594	1076	1752
	6	2	270	864	1940	3692
1. S_1, S_2, etc.		270	864	1940	3692	6355
2. Divisor		6	21	56	126	252
3. a, b, c,		45.00	41.1428	34.6428	29.3016	25.2182
4. a^1, b^1, c^1,		45.00	3.8572	-9.1428	-1.9368	.3548
5. Squares		2025.00	14.8780	83.5908	3.7512	.1259
6. Factor		6.0	25.2	84.0000	352.8	2268.00
7. S(Sq.)		12150	374.9256	7021.6272	1323.4234	285.5412
8. $\Sigma(y)^2$		21714.0				
9. $\Sigma(Y_{r-1} - Y_r)^2$		12150	374.9256	7021.6272	1323.4234	285.5412
10. $\Sigma(y - Y_r)$		9564	9279.0744	2257.4472	934.0238	648.4826
11. DF(error)			4	3	2	1
12. v_1		12150	374.9	7022.	1323.	285.5
13. v_2			2319.7686	752.4824	467.0119	648.4826
14. F			.1616	9.332		
15. 5% point				10.13		

$$Y_1 = 1 \times (45.00 + 3 \times 3.8572 - 5 \times 9.1428) = 10.8576$$
$$D_1Y_1 = -1.2 \times (3.8572 - 5 \times 9.1428) = 50.2282$$
$$D^2Y_1 = 3.0 \times -9.1428 = -27.4284$$

x			
1			-12.28
2		-59.485	47.20
3		-32.057	79.26
4		-4.629	83.88
5		22.800	61.08
6	-27.4284	50.2282	10.8576

FIG. 16
TESTING THE SIGNIFICANCE OF DIFFERENCE IN MEAN HEAD CAPSULE SIZE BETWEEN STAMINATE- AND TERMINAL-FED MALE LARVAE



TESTING THE SIGNIFICANCE OF DIFFERENCE IN MEAN HEAD CAPSULE SIZE OF BUDWORM LARVAE

FEMALE LARVAE

DIFFERENCES BETWEEN STAMINATE AND TERMINAL FED

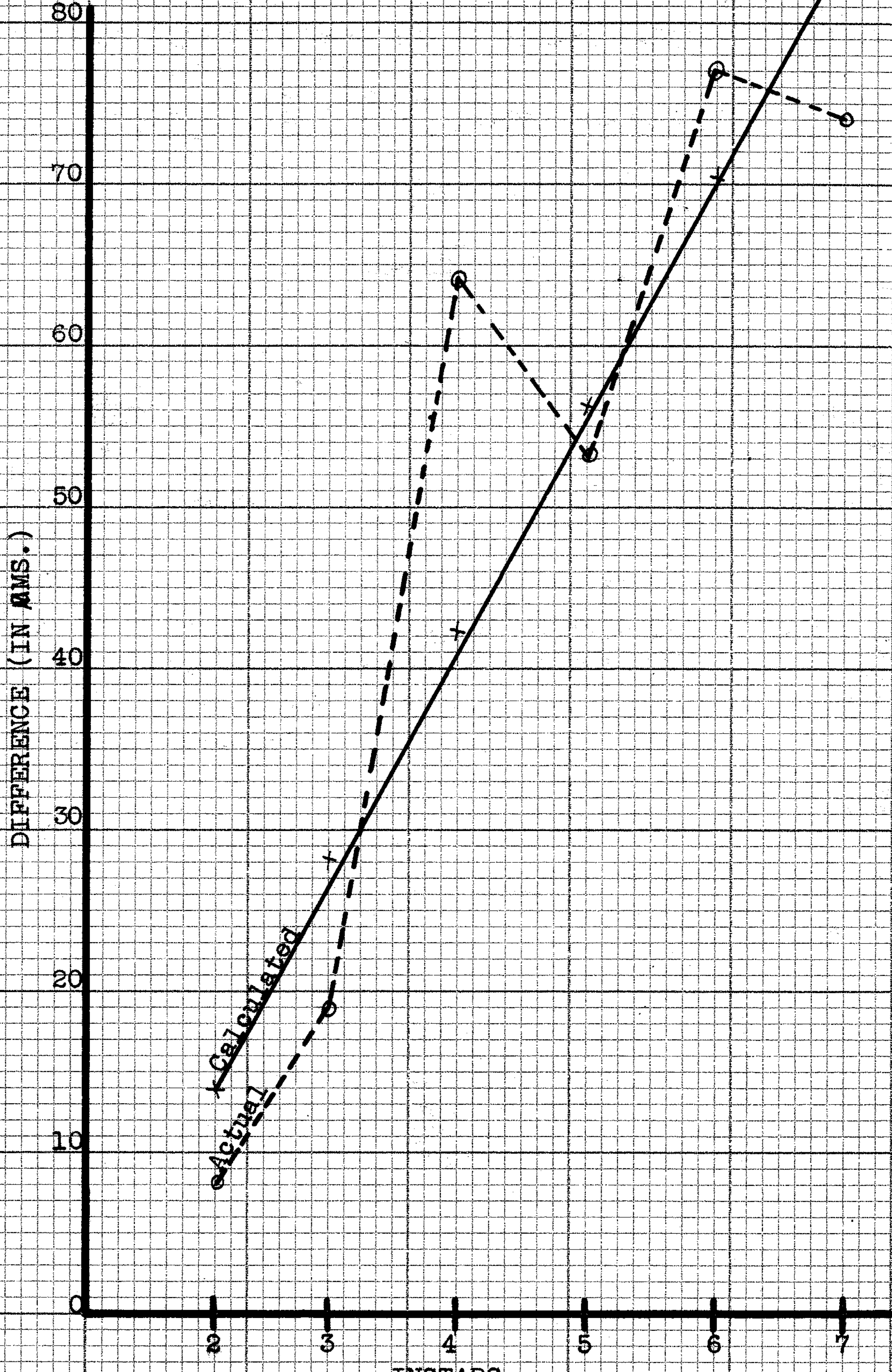
		a	b	c	d	e
	x	y	1	2	3	4
	1	8	8	8	8	8
	2	19	27	35	43	51
	3	64	91	126	169	220
	4	53	144	270	439	659
	5	77	221	491	930	1589
	6	74	295	786	1716	3305
1. S_1, S_2, etc.		295	786	1716	3305	5832
2. Divisor		6	21	56	126	252
3. a, b, c,		49.1667	37.4286	30.6428	26.2302	
4. a^1, b^1, c^1,		49.1667	11.7381	-1.8335	-.1279	
5. Squares		2417.3644	137.7830	3.3617	.0164	
6. Factor		6.0	25.2	84.0	352.8	
7. S(Sq.)		14504.1864	3472.1316	282.3828	5.7589	
8. $\Sigma(y)^2$		18735.0				
9. $\Sigma(Y_{r-1} - Y_r)^2$		14504.1864	3472.1316	282.3828	5.7589	
10. $\Sigma(y - Y_r)$		4230.8136	758.6820	476.2995	470.5406	
11. DF(error)			4	3	2	
12. v_1			3472.0	282.4000	5.7590	
13. v_2			189.6705	158.7665	235.2703	
14. F			18.30			
15. 5% point			7.71			

$$Y_1 = 1 \times (49.1667 + 35.2140) = 84.3807$$

$$D^1Y_1 = -1.2 \times (11.7381) = -14.0857$$

x		
1		13.9522
2		28.0379
3		42.1236
4		56.2093
5		70.2950
6	-14.0857	84.3807

FIG. 17
TESTING THE SIGNIFICANCE OF DIFFERENCE IN MEAN HEAD CAPSULE SIZE BETWEEN STAMINATE- AND TERMINAL-FED FEMALE LARVAE



TESTING THE SIGNIFICANCE OF DIFFERENCE IN MEAN HEAD CAPSULE SIZE OF BUDWORM LARVAE

ALL LARVAE (AVERAGED, NO SEX)

DIFFERENCES BETWEEN STAMINATE AND TERMINAL FED

	x	a	b	c	d	e
	x	y	1	2	3	4
	1	6	6	6	6	6
	2	20	26	32	38	44
	3	63	89	121	159	203
	4	75	164	285	444	647
	5	64	228	513	957	1604
	6	39	267	780	1737	3341
1. S_1, S_2, etc.		267	780	1737	3341	
2. Divisor		6	21	56	126	
3. a, b, c,		44.5	37.14286	31.0178	26.51587	
4. a^1, b^1, c^1		44.5	7.3571	-4.89298	-.7586	
5. Squares		1980.25	54.1269	23.94125	.57547	
6. Factor		6.0	25.200	84.0000	352.800	
7. S(Sq.)		11881.50	1363.9979	2011.06500	203.0258	
8. $\Sigma(y)^2$		15647				
9. $\Sigma(Y_{r-1} - Y_r)^2$		11881.50	1363.9979	2011.0650	203.0258	
10. $\Sigma(y-Y_r)$		3765.50	2401.5021	390.4371	187.4113	
11. DF(Error)			4	3	2	
12. v_1			1364.	2011.	203.0	
13. v_2			600.375	130.1457	93.7056	
14. F			2.27	15.45	2.166	
15. 5% point			7.71	10.13	18.51	

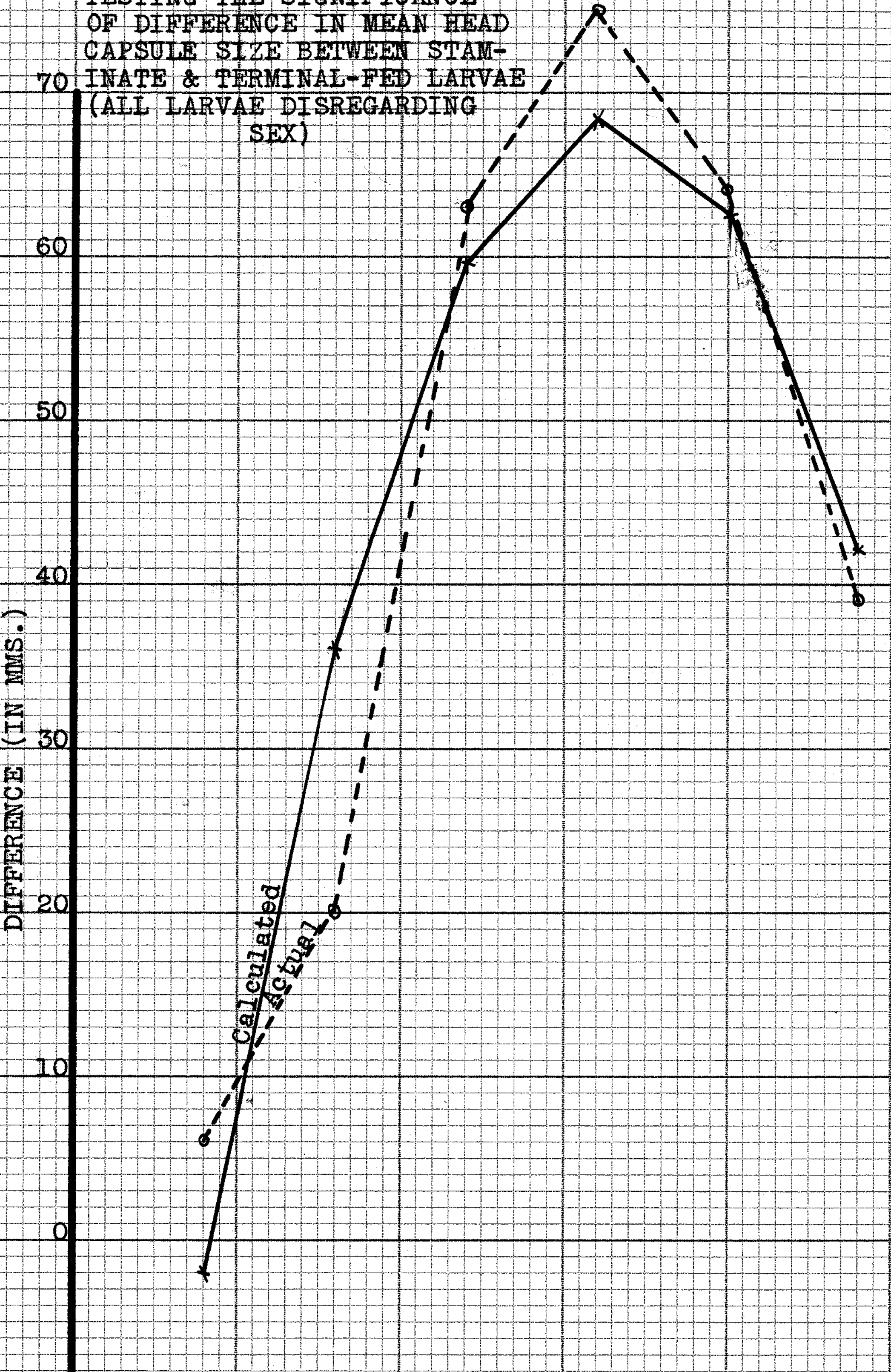
$$Y_1 = 1 \times (44.5 + 3 \times 7.3571 - 5 \times 4.8930) = 42.1063$$

$$D_1Y_1 = -1.2 \times (7.3571 - 5 \times 4.8930) = 20.5295$$

$$D^2Y_1 = 3.0 \times -4.8930 = -14.6790$$

x			
1			-2.03
2		-38.186	36.16
3		-23.507	59.66
4		-8.828	68.49
5		5.851	62.64
6	-14.6790	20.530	42.11

FIG. 18
TESTING THE SIGNIFICANCE OF DIFFERENCE IN MEAN HEAD CAPSULE SIZE BETWEEN STAMINATE & TERMINAL-FED LARVAE (ALL LARVAE DISREGARDING SEX)



for each category of larva. Thus, the effect of pollen is clearly demonstrated in its contribution towards the superiority of larvae with access to such food in a more rapid growth culminating in the maturation of larger, more vigorous and greater numbers of such individuals compared to larvae feeding on terminals.

The final analysis of this project was concerned with the testing for significance of the differences in head capsule size between staminate and terminal larvae. Towards this, statistics were applied to the mean head capsule sizes of larvae, using the Fisher's Summation Method of Fitting Polynomials, as described in Goulden, Pp. 234-239. The statistical procedures are complex and involved and need not be fully discussed here. The calculations consisted of testing the significance of difference between larvae of the same sex on different food types, using the table of mean head capsule widths. Thus, two variables were involved--amount of difference for each instar. In all, three tests were carried out; i.e., for male larvae on cones and on terminals, similarly female larvae and finally averages (disregarding sex) for larvae on cones and terminals. The procedure involved the determination of an "F" value which was then compared to a table of "F" values to determine significance.

It was found that the difference in size of head capsule for each of: Male larvae on cones and terminals, female larvae on cones and terminals and averages on cones and terminals was real and valid and always in favour of staminate-fed larvae. This was in consideration of all instars. The greatest significance was found for female larvae. That is, taking all instars into consideration, female larvae feeding on cones are nearly always larger than female larvae on terminals and this difference is somewhat greater than that between larvae (no sex) on cones and on buds and considerably greater than that between male larvae on cones and on buds.

It is to be remembered that these analyses were carried out on the average head capsule widths for each category of larvae for all the instars. Thus, such factors as migration, mortality, etc. are disregarded. It was shown that migration definitely affects the average size through mixture of the staminate and terminal types of larvae. The influence of staminate cones on the size, vigour, etc. of larvae was so great that it withstood the negative effect of migration and other factors contributing towards a heterogeneity of population to show a significant difference over terminal larvae in final analysis (considering all instars). This not only proves the superiority of staminate cones but also validates the differences in mean head capsule size of staminate and terminal larvae and thus all proofs, such as growth coefficients, regression coefficients, percentage differences, etc. based on this difference are also valid.

To further test the difference between larvae on cones and terminals, only the 2nd, 3rd and 4th instars were considered. The statistical procedures used here were somewhat different from those used for all the instars. In general, they comprised the determination of a regression coefficient which was then used in the calculation of the "standard error of estimates" and finally a "t" value determined which gave a test of the significance (See Goulden, P. 55). It was found for the 2nd, 3rd and 4th instars that the significance of the difference in mean size of head capsule between staminate and terminal larvae generally is infinity. The difference between female larvae on cones and terminals was greater than that between males. These differences are based on the assumption that under the usual field conditions the results derived here would obtain in from 90 out of every 100 cases (for males) to infinity (almost always) for staminate and terminal larvae generally. Thus, the results are real and valid and therefore there does exist in average size of staminate and terminal larvae a real and valid difference in favour of the former type of larvae.

Here again, the results were shown to be of greater validity and significance in the 2nd to 4th instars than when considering all instars. This indicates the status of larvae in the earlier instars and points further to the influence of pollen towards the development of larger larvae.

4. Summary

The complexity of insect growth was established and the considerable differences existing among various categories of larvae. Certain mathematical laws appear to govern the growth of insects and insect structures. As a result of this considerable complexity, it was difficult to analyze and compare the growth of larvae. Therefore, the attempt was made to reduce the many variables involved to some symbol or symbols as expressions of the many environmental factors operating in the development of the larvae and which could be used for purposes of comparison and analysis. Thus, growth was reduced to a mathematical consideration, using growth coefficients and regression coefficients.

On the basis of the close agreement between actual and calculated series of head capsule measurements, the presence of 7 instars was confirmed and the validity of the measurements established. Using statistical procedures, the significance of the difference in mean head capsule size between staminate and terminal larvae was tested. It was found that in general the difference in size between staminate and terminal larvae (head capsule)

for each of males, females and average (no sex) was real and valid and always in favour of the staminate-fed larvae, with the greatest significance amongst female larvae on the two food-types. Thus, the influence of pollen was shown in that, disregarding migration, mortality, etc.--all disturbing factors contributing towards a heterogeneity of population--and on the basis of all instars, those larvae having access to such food were significantly larger than larvae without. Considering only the 2nd, 3rd and 4th instars, the difference between staminate and terminal larvae was found to be even more significant. This indicated the importance of these instars in the total growth and development of the larvae.

The growth coefficient was selected as a mathematical representation of growth since by the very nature of its derivation it represents the sum total effect of the environment on the development of the larvae, expressed in terms of growth. From the separate measurement of some 1100 larvae, and then subdividing into sexes, instars and food-types, obtaining averages of head capsule size and finally determining growth coefficients, it was found that there was no difference in this computed coefficient for staminate, terminal or general types of larvae. This seemed to offer conclusive evidence that there exists for budworm larvae a uniform and standard rate of growth which is distinct only for sex. Changes in the coefficient in various instars, feeding habits, etc. can be directly correlated and thus allow for the determination of the various factors influencing growth and development of the larvae.

The method of treatment of the data seemed to indicate two to three apparent stages in budworm growth, aside from instars--pre-migration period, migration period and post-migration period. Coefficients of growth for these stages are distinct and, for males, higher in the first stage than the others, the reverse occurring for females. Staminate larvae possessed a much higher growth-coefficient than terminal larvae and indicated the effect of pollen-feeding in contributing towards the greater size and more rapid growth of larvae with access to such food.

Various statistical analyses, based on the statistic of regression coefficient, were carried out. This allowed for the treatment of the data as a whole. That is, the relationship between the various categories of larvae on the basis of average head capsule size per instar for the complete series of such measurements were analysed. In other words, a regression coefficient was derived which represented the average increase in size of head capsule from instar to instar on the basis of each of the mean head capsule sizes per instar. From all categories of larvae, the regression coefficient showed that female larvae generally had the more rapid rate of growth, while the most rapid rate of growth (in all categories) was amongst female larvae on cones.

Due to the interference of various factors, regression coefficients were calculated on the basis of 2nd, 3rd and 4th instars only, for each category of larvae. Here, it resulted in the determination of a significantly greater growth rate for staminate larvae than for terminal larvae, with the greatest growth rate for staminate males.

The regression coefficients were used in the calculation of a theoretical series of head capsule measurements for each category of larvae. Comparison of the actual and calculated series of measurements for all the instars and then for only the 2nd, 3rd and 4th instars showed generally that agreement was very close in the first case and even more so in the latter. These calculated series of head capsule measurements represented the theoretical distribution of head capsule sizes for each category of larvae and also the best possible fit to the observed data. Thus, the presence of 7 instars is substantiated and also the validity of the original measurements.

The mathematical analyses of growth have provided certain bionomical and statistical standards for the budworm feeding on Jack pine and this enables future comparisons and analyses into the status and trends of this insect infestation. The importance and effect of pollen-feeding is definitely indicated in its influence on larvae towards greater and more rapid growth, culminating in the successful development of greater numbers of more vigorous larvae. This is ultimately reflected in rise and fall of population densities and is an important factor in the epidemicity of the budworm.

Summary

The study attempted an analysis of the growth and development of budworm larvae under actual forest conditions to determine the various changes throughout the season of growth and also to arrive at an understanding of the various factors contributing to such changes and the relative importance of these. Such a procedure would result in the delineation of habits and preferences in the various stages reduced to bionomical standards and thus their influence weighed and calibrated.

In such a study, dealing with a living organism subjected to all the vagaries of an environment and the individual reactions of each to the environment, it is not to be expected to reduce life to simple mathematical terms. Further, in dealing with this insect, occurring as it does over considerable territory, many different types of habitat and environment are involved. Variations of considerable magnitude are to be expected. Further, the study of necessity must be based on different individuals taken at different times. Hence, there is no continuous story, but an aggregate, based on the analysis of averages. Therefore, it is these averages and the significance of difference between them that forms the bases for the study of the budworm population as a whole, moving from emergence in the spring

Fig. 19

DATES OF COLLECTION	NO. OF DAYS FROM EMERGENCE	NO. OF DAYS BETWEEN COLLECTIONS	MIGRATION, ON BASIS OF OBSERVATIONS & COUNTS	OCCURRENCE & DURATION OF INSTARS						SEX RATIO OF LARVAE		
				Second	Third	Fourth	Fifth	Sixth	Seventh	Staminate	Terminal	Average
May 29	0	-	Emergence of larvae in the field									
June 3	5	5								.61	.50	.59
June 10	12	7	No apparent migration							.55	.50	.55
June 20	22	10	First signs of migration							.59	.62	.59
June 22	24	2	Gen. migration of larvae							.52	.65	.59
June 26	28	4								.70	.76	.72
July 3	35	7	Heavy migration almost completed							.58	.58	.58
July 4	36	1								.64	.53	.58
July 8	40	4								.47	.79	.63
July 10	42	2	End of collections							.60	.64	.62

to pupation in mid-summer.

The study was based on the separate collection of 1095 larvae from the forest at 9 different times of the season. Collections comprised approximately 100 specimens, each, from staminate cones and terminal buds of Jack pine at Hawk Lake in 1940. These were preserved separately and microscopically examined, dissected and measured for sex and size of larva. Thus, the study was based on size and sex of larvae in relation to type of food.

Fig. 19 presents a summary of the study, in graphic form. The importance of migration and the close correlation of this phenomenon with occurrence and duration of instars and also sex-ratios is clearly shown. Migratory movements were determined by observations and counts from the field.

Population Distributions

The changes in density of population on cones and buds are treated for each date of collection and contributing influences are discussed. This established the preference for staminate cones, so much so that in the early part of the season the larval population is almost entirely concentrated on such sites. The presence or absence of this food resulted in various migratory movements, differences in size and sex-ratios, etc. of the developing larvae.

The distribution of population by instars dealt with the occurrence and duration of instars. Population distributions were discussed in the light of percentages of each instar contributing towards the total population at any particular time. Here, the more uniform development of larvae on cones was found as indicated by distribution of instars. Further, pollen in the diet caused an acceleration of growth, especially amongst males. This was further substantiated on the basis of time spent in each instar by each category of larva.

The duration of stadia was calculated mathematically, based on occurrence of instars in the field. The results here were only indicative, but served to show the influence of pollen in its effect on number of days spent in each stadium by each category of larva. The average duration of stadia ranged from a minimum of 2½ days (theoretical) to a maximum of 15 days, with an average of approximately 7 days. This indicated an average of some 45 days required, under actual field conditions, for the complete growth of a larva from emergence to pupation.

Sex-Ratios

Sex of larvae was established by microscopic examination of the gonad. Analyses of instar distributions and occurrence were made on the basis of sex and food-type, thus establishing in all 7 categories of larvae, for purposes of this study: Male and female larvae on cones, male and female larvae on terminals, "average" larvae (disregarding sex) on cones, "average" larvae on terminals, "average" larvae (disregarding sex and food).

Size Relationships

Here, the assumption was made that an instar of an insect could be characterized by a dimension of a sclerotized part of the body; i.e., head capsule. Measurements were accurate to .01 mms. with interpolations to .001 mms. The size of larvae was analyzed in relation to sex and food-type, also treating the various fluctuations in each category of larva throughout the period of growth and development. Certain important relationships were derived and the influence of pollen described.

Mathematical Expressions of Growth

The complexity of insect growth was established and the attempt was made to reduce the many variables involved to some symbol or symbols as expressions of the many environmental factors operating in the development of larvae, which could then be used for purposes of comparison and analyses. Considerable statistical analyses were carried out and the significance and validity of the original data definitely established. As expressions of growth, the "coefficient of growth" and "regression coefficient" were used. Important results were determined and the relation of food to the growth and development of larvae clearly indicated.

IV. THE EUROPEAN LARCH SAWFLY

A. Reconnaissance and F.I.S. Records for 1941

This sawfly represents an increasing hazard to the larch throughout central Canada. It has been located in incipient outbreaks from Schreiber, Ontario, to Alberta. Its greatest abundance occurs in Manitoba where, in certain regions, it is causing extreme anxiety .

The principal areas of infestation are Riverton, Twp. 21 to 27 from the principal meridian east to Lake Winnipeg, including Hecla Island; in the Riding Mountain National Park at the townsite of Wasagaming, on the Norgate Road 9 miles east of the townsite (Sec. 25, R. 18, Twp. 19); on the Lake Audy Road (S. 16, R. 19, T. 20); on S. 12, R. 19, T. 20; S. 29, R. 20, T. 20; S. 8, R. 21, T. 20; S. 31, R. 18, T. 20; and scattered lightly throughout the tamarack in the park; in the Spruce Woods Forest Reserve.

At Riverton and Riding Mountain, the defoliation for 1941 was extremely heavy, being almost 100% in the former and 30% in the latter. The defoliation in the Spruce Woods Forest Reserve was generally light and scattered, the infestation having subsided somewhat since 1939 and 1940.

Infestations of a sporadic nature also appeared as follows: Norway House, the Sandilands Forest

Upper left:	Duplicate of Kodachrome transparency at Mile 13, Audy Lake Road, Riding Mountain National Park, showing heavy defoliation.
Upper right:	Curled tips of defoliated larch caused by larch sawfly feeding in the Riding Mountain National Park.
Lower left:	General view of tamarack in the Epinette swamp, Spruce Woods Forest Reserve.
Lower right:	General view of tamarack in the Epinette swamp, Spruce Woods Forest Reserve.

Reserve, Island Lake, and Winnipeg, Manitoba; Hawk Lake, Island Lake, the vicinity of Sioux Lookout, Caribou Lake, and Black Sturgeon River, all in Ontario.

B. Parasite Liberations

During the summer of 1941, three lots of the dipterous parasite, Bessa selecta, were liberated in the Riding Mountain National Park and in the Riverton district where severe infestations of the European larch sawfly were causing grave concern to the Dominion and Provincial forest services. The date of liberation, number of parasites liberated and the liberation points of the three lots are shown in the following tabulation:

DATE OF LIBERATION	PARASITES LIBERATED			LIBERATION POINTS
	♂	♀	Total	
July 8, 1941.	1350	433	1783	Mile 7 Norgate Rd., Riding Mt. National Park.
July 10, 1941.	1454	1871	3325	Wasagaming townsite, Riding Mt. National Park.
July 11, 1941.	556	614	1170	S.W. quarter of Sec. 16, Twp.24, R.3E, Riverton district.
TOTALS	3360	2918	6278	

C. Experimental Work for 1941

1. Pupal Collections

With a view to establishing the efficacy and prevalence of natural control agents, particularly *Mesoleius tenthredinis* Mor., collections of larch sawfly cocoons were made at the Spruce Woods Forest Reserve and Riding Mountain National Park in the fall of 1941. In the latter area, much assistance in making the collections was received from the National Parks Branch of the Dominion Department of Mines and Natural Resources.

The collected cocoons were confined in cages one foot square, four inches deep and of wood construction. After the cocoons were carefully layered in moist sphagnum moss in the cages, the tops and bottoms were securely covered with wire screen. From two to four thousand cocoons were placed in each cage. All the Riding Mountain collections were forwarded to the Dominion Parasite Laboratory at Belleville, where they are being reared experimentally for the presence of parasites and disease.

(a) Riding Mountain National Park

The cocoons collected from the Riding Mountain National Park were carefully counted before packing and a record was made of (1) apparently sound cocoons, (2) cocoons destroyed by mice and (3) other cocoons, composed mainly of emerged and crushed cocoons. Only the sound cocoons were retained.

Cocoons were procured from four areas in the park. These have been designated Areas 1 to 4 and are located as follows:

Area 1. At the townsite of Wasagaming.

Area 2. Mile 7 on the Norgate Road.

Area 3. Sec. 12, R. 19, Twp. 20.

Area 4. Mile 13, Audy Lake road.

The various categories of cocoons collected and their source is shown in the tabulation below:

Area	Sound Cocoons		Moused		Others		Total No.
	No.	%	No.	%	No.	%	
1	3258	92.00	201	5.69	82	2.31	3541
2	7261	89.46	837	10.31	21	0.26	8119
3	4325	89.83	479	9.95	11	0.26	4815
4	8159	88.36	1078	11.67	0	0.00	9237
TOTALS	23003	89.45	2595	10.09		0.44	25712

It is perhaps significant that the percentage of cocoons destroyed by mice in Wasagaming townsite where efforts are undoubtedly made to keep the mouse population to a minimum is considerably lower than in the other three areas.

In addition to the above collections, efforts were made to secure quantitative information on cocoon populations in the different areas. A series of plots, 4 square feet in area, was laid out in areas 2, 3 and 4. The boundaries of the plots were defined with a wire marker 2 feet square. Trees were picked at random in the site to be sampled and the plot selected in the moss under that portion of the canopy in which the highest yield of cocoons was expected. The results of these counts were as follows:

AREA	No. of Samples	Sound Cocoons	Moused Cocoons	Total Cocoons	Average No. of Cocoons per sq.ft.
2	8	213	42	255	8.0
3	5	383	30	413	20.6
4	5	1262	95	1357	67.8
TOTALS	18	1858	167	2025	28.1

The infestation in Area 4 (Audy Lake Road) was extremely heavy, yielding 67.8 cocoons per square foot of moss. Larch in this area was defoliated about 80%. The infestation in Area 3 was moderately heavy, yielding 20.6 cocoons per square foot, while on the Norgate Road (Area 2) a relatively light infestation of 8.0 cocoons per square foot obtained.

(b) Spruce Woods Forest Reserve

A collection of cocoons was also made in this area in the fall of 1941, samples being obtained from two areas; i.e., the Epinette swamp and the Delta swamp of the Assiniboine River. The bulk of the collection was forwarded to the Belleville Parasite Laboratory and a smaller series was retained for experimental work at the Winnipeg Laboratory. Unfortunately, no record of the number of sound cocoons collected will be forthcoming until the rearings from both the Winnipeg and Belleville laboratories are completed. The number of moused, emerged and crushed cocoons obtained from each area was: (1) 865 from the Epinette swamp and (2) 718 from the Delta swamp.

2. Results from Collections

(a) Winnipeg Laboratory

The series of larch sawfly cocoons from the Spruce Woods Forest Reserve retained at Winnipeg was left outdoors layered in moss until October 29, 1941. On October 29, 1941, the cocoons were placed in a special hibernation box prepared for Forest Insect Survey material. On January 16, 1942, the cocoons were removed from the hibernation box and placed in a pail of ice water for 1 day. Then they were layered in moss and confined in screen-backed budworm pupal survey cages, modified to suit this particular type of material. The cages remained in the basement of the laboratory at room temperature (60-65° F.)

until January 19th, at which time they were placed in an incubator and the temperature was gradually increased to 72° F.; the relative humidity in the incubator at all times was approximately 90%. As far as possible, the temperature and relative humidity in the incubator was then held constant at 72° F. and 90%. When the emergence of sawflies commenced, the cages were removed from the incubator 7 hours daily to facilitate the removal of emerged material.

To date, from an unknown number of cocoons confined in 2 cages, 149 adult sawflies and 2 parasites believed to be Mesoleius tenthredinis Mor. have emerged and emergence is still continuing.

(b) Belleville Parasite Laboratory

Reports have been received at regular intervals from the Belleville Laboratory on the progress of experimental work on the larch sawfly cocoons collected in the Riding Mountain National Park and the Spruce Woods Forest Reserve in the fall of 1941. As it is not possible to assemble the results of this investigation in the form of a completed project at the present time, the excerpts from the Belleville reports dealing with this phase are quoted below in chronological order:

October 1-15, 1941.

"Collections of larch sawfly cocoons made in Manitoba and New Brunswick were received at Belleville on October 2nd.

"The shipment from Manitoba was collected in the Spruce Woods and Riding Mountain Forest Reserves and totalled approximately 100,000 cocoons."

December 16-31, 1941.

"The whole period has been devoted to dissections of samples of larch sawfly cocoons collected in Ontario and Manitoba. The following table shows the results of these dissections, 100 cocoons being used from each point.

	Sp.Woods Epinette Swamp	Sp.Woods Delta	R.M.N.P. Area 1	R.M.N.P. Area 2	R.M.N.P. Area 3
Perilampus sp.					1
Tritneptis klugii	1				
Bessa larvae			1		1
Mesoleius Dead pupae	1				1
Mesoleius Larvae	2	1	3	5	11
Mesoleius Eggs	1		13	21	22
Dead sawfly pupae					1
Empty cocoons	6	5	19		
Other dead larvae				3	14
Fungoid larvae	16	17	33		2

The specimen of Perilampus found in the collection from the Riding Mountain Park was attached to the sawfly larva externally within the cocoon, and is the first time the writer has ever found this parasite attacking the larch sawfly.

The species Tritneptis klugii is also new to dissections made from Manitoba collections, although it is quite plentiful at times in the Belleville district.

The re-appearance of Mesoleius in Manitoba collections is of extreme interest and importance."

January 1-15, 1942.

"The fourth and last dissection of 100 larch sawfly cocoons from the Riding Mountains National Park collections was made during the period with the following results:

2 empty cocoons
10 rotted sawfly larvae
19 sawfly larvae containing Mesoleius, 14 of which contained eggs and 5 larvae."

Note:--This refers to Area 4, Audy Lake Road.

January 16-31, 1942.

"Two lots of 100 cocoons each were brought out of storage from the collection of larch sawfly cocoons made in Area 2 of the Riding Mountain National Park, Man.

Both lots were put on moist sand, each cocoon under an individual vial, the one lot to be allowed to emerge; the other lot to be dissected, a few cocoons each day, to determine the status of the parasite eggs and first stage larvae found during former dissections. Eggs have been found unhatched after 5 days incubation at 65°-68°F."

February 1-15, 1942.

"The 100 cocoons collected in the Riding Mountains National Park and put out on January 26th for emergence of parasites have not yielded any parasites to date.

More than half of the second hundred cocoons put out under similar conditions have been dissected, a few each day, without any noticeable development of parasite eggs and larvae contained therein. It is possible that they were recovered from hibernation too soon."

February 16-28, 1942.

"A few cocoons have been dissected daily from a lot of 100 cocoons put out for emergence January 26th from a collection made in the Riding

Mountain National Park, Manitoba. The parasite eggs appearing in these collections from Manitoba have not hatched to date, yet, two full-grown larvae of Mesoleius tenthredinis have been found--the first February 21st and the other February 28th. It is possible that the cocoons were put out for emergence before the contained parasite eggs had been subjected to a sufficient length of time in hibernation."

The re-appearance of M. tenthredinis in the Spruce Woods and Riding Mountain districts is extremely interesting because there has been in the past some doubt as to the ability of this species to maintain itself in the intervals of low host density.

3. Sample Plot Work

In the fall of 1941, four permanent "sample plots" were established in four different larch stands in the Riding Mountain National Park. The object of these plots is to follow the larch sawfly infestation in these areas and to determine:

(1) the mortality of larch as a result of defoliation;

(2) what form of injury is inflicted on the surviving trees;

(3) if the larch reacts in any manner to counteract the harmful effects of defoliation.

In no case was a true sample plot laid out, but in each area a sufficient number of trees was selected at random to provide a representative sample. All trees recorded were tagged and conspicuously marked with white paint. The location of the first tree examined was definitely established with regard to some permanent land mark and each succeeding tree selected in such a manner that it could be seen and identified from the preceding tree. In cases where identification was more difficult, compass readings were taken.

The following data were recorded for each tree examined:

(1) tree number
(2) crown class
(3) shade
(4) condition of leader and terminals
(5) total current defoliation
(6) progress of leader replacement where applicable
(7) general condition of tree
(8) natural deformities

In addition, one Kodachrome and a duplicate black and white photograph was taken of one or a group of trees in each area to show the appearance of larch with various degrees of defoliation. These trees are to be photographed annually in late September or early October.

The location of each plot and the trees photographed are described below. For additional details regarding location, photographs and tree data, the reader is referred to the "Riding Mountain Larch Sawfly Sample Plots, 1941" field records. These are filed with the permanent Jack pine sample plots.

Plot 1:--Mile 13 Audy Lake road. The location of the first tree, No. 1419 is as follows:

Traverse 500 feet east on Audy Lake Road from the Mile 13 post; thence S, 40° E 100 feet (to big spruce at base of slope); Thence S, 25° E 100 feet; thence S, 32° E 300 feet to tree 1419.

Photograph:--camera faces N, 33° E and is placed near tree 1461 (about 10 feet N.E. of tree).

Plot 2:--Mile 7 Norgate Road. The location of the first tree, No. 1470, is 40 feet N, 60° W of the "CURVE" sign at Mile 7.

Photograph:--Camera approximately 30 feet W of the "CURVE" sign facing N, 35° E.

Plot 3:--Golf course, Riding Mountain National Park.

Traverse S, 20° E of the post at the junction of Highway 10 and the golf course road to tree No. 53.

Photograph:--Camera faces S, 85° W. Camera position is 150 feet west of tree 53. A small rock pile was built at the camera position to indicate the location.

Plot 4:--Wasagaming Townsite. A series of 15 larch trees tagged across the road from the camp next to McMorran Agency. The first tree, No. 72, is near the junction of the ditch and the road.

136 trees were tagged, 50 in Plot 1, 52 in Plot 2, 19 in Plot 3 and 15 in Plot 4.

In general, defoliation was heavy in Plot 1 and relatively light in the remaining plots. No mortality as a result of defoliation was apparent in any plot.

Top: Duplicate of Kodachrome transparency showing medium defoliation of tamarack at Mile 7 Norgate Road, Riding Mountain National Park.

Bottom: Duplicate of Kodachrome transparency showing undefoliated larch at the golf course in the Riding Mountain National Park.

Top: Heavily defoliated tamarack in the permanent sample plot at Wasagaming townsite, Riding Mountain National Park.

Bottom: Duplicate of Kodachrome transparency of the permanent sample plot at Wasagaming townsite, Riding Mountain National Park, showing defoliated tamarack.

D. Summary

1. Reconnaissance

The most severe areas of larch sawfly infestation in 1941 were located at Riverton, Twp. 21 to 27 from the principal meridian east to Lake Winnipeg, in several important larch swamps in the Riding Mountain National Park, and in the Spruce Woods Forest Reserve. Additional infestations of a sporadic nature were reported from four other areas in Manitoba and five in Ontario.

2. Parasite Liberations

During the summer of 1941, some 6,278 adults of *Bessa selecta* were liberated against the European larch sawfly in the Riding Mountain National Park and the Riverton district.

3. Experimental Work

In the fall of 1941, 25,712 sawfly cocoons were collected from four areas in the Riding Mountain National Park and forwarded to the Dominion Parasite Laboratory at Belleville for experimental work and parasite determinations. Of the cocoons collected, 89.45% were sound, 10.09% destroyed by mice and 0.44% crushed, emerged or obviously diseased. An additional unknown number of cocoons was collected in the Spruce Woods Forest Reserve. A large series of these cocoons was also shipped to Belleville and a smaller series retained for rearing studies at

Winnipeg.

Progress reports from the Belleville Parasite Laboratory indicate an average parasitism by Mesoleius tenthredinis Mor. of 25% in the Riding Mountain National Park and 2.5% in the Spruce Woods Forest Reserve.

Parasitism by this species was as high as 34% in area 3 of the Riding Mountain National Park. Mortality from all causes in this same area amounted to 53%. Some difficulty is being experienced in inducing many of the eggs of Mesoleius tenthredinis to hatch in the parasitised material. This is believed to be due to the early removal of the cocoons from hibernation.

Incubation and rearing studies conducted at Winnipeg on an unknown number of cocoons from the Spruce Woods Forest Reserve to date have yielded 149 adult sawflies and 2 parasites believed to be Mesoleius tenthredinis.

Quantitative population studies in the Riding Mountain National Park show cocoon populations per square foot of 8.0 in area 2, 20.6 in area 3, and 67.8 in area 4. The average for all samples was 28.1 cocoons per square foot.

4. Sample Plots

Four permanent sample plots, comprising a total of 136 larch trees, were established in the Riding Mountain National Park in the fall of 1941. The object of these plots is to follow the course of the infestation and its effect on the tamarack. All trees were tagged and data on crown class, shade, defoliation, deformities caused by insects and natural agents, and the general health and vigour procured for each tree. In addition, one Kodachrome and a duplicate black and white photograph were taken of a group of trees in each plot to show defoliation. These are to be rephotographed annually.

V. THE FOREST INSECT SURVEY

A. Forest Insect Reconnaissance Sioux Lookout Forest District, Ontario.

1. Introductory Statement

Work undertaken in this district extends the reconnaissance and personnel contact project into the second last area within the Winnipeg Laboratory territory. At the present time, the Eastern Forest District of Manitoba remains uncovered.

2. Ontario Forestry Branch

a. Sioux Lookout District and Subdivisions

This forest district extends from the Manitoba boundary on the west, easterly to an imaginary north-south line passing through Tashota. The actual area varies somewhat from season to season, being subject to annual revision.

The district is divided into four fire divisions: Sioux Lookout, Red Lake, Lake St. Joseph, and Armstrong.

b. Organization of Personnel

Until August, 1941, personnel was in charge of a District Forester whose responsibility was to the Toronto office. This arrangement was changed in such a manner that several district foresters are responsible to a Regional Forester, who is in turn responsible to Toronto. This arrangement places more responsibility on less men and provides greater agreement and flexibility.

Within the territory of the Winnipeg Laboratory, the districts of Sioux Lookout, Fort Frances, and Kenora are lumped into one Region; while that of Thunder Bay constitutes a Region unto itself.

The position of District Forester is retained, for each district, and, as formerly, he is assisted by a Crown Timber Officer and by Chief Fire Rangers for each fire division. The latter are assisted by Deputies in charge of Rangers, including pumpmen, gascar men, etc.

Aerial transport is furnished on requisition by the Provincial Air Service, planes being located at Sioux Lookout, Red Lake, Pickle Lake and Armstrong. It is expected that a plane will be stationed on Lake St. Joseph during 1942.

c. Personnel Contacted

The District Forester, J. B. Matthews (now Regional Forester, Thunder Bay District), was visited and, with K. Acheson, his successor, a plan was made for contacting crews in all Fire Divisions.

Before outlining the routes taken in this connection, a list of contacts will be given:

<u>(1) Sioux Lookout District Office</u>

J. B. Matthews, District Forester
(under transfer)
K. Acheson, Successor
B. Love, Crown Lands
Jackson, Clerk

(ii) Sioux Lookout Fire Division

G. Eady, Chief Fire Ranger
R. Hamilton, Deputy, Watcomb
J. Johnson, Ranger, Watcomb
W. Bell, Gascar operator, Sioux Lookout
R. Duff, Ranger, Sioux Lookout

(iii) Red Lake Fire Division

R. Taylor, Chief Fire Ranger
C. Florence, Deputy
J. Jackson, Clerk
R. Williams, Ranger
H. Husick, Ranger
Harper, Ranger
I. Keesic, Ranger
J. Rorke, Deputy, Lost Bay (Uchi Lake)
R. Coltron, Ranger, Lost Bay (Uchi Lake)
A. Burrow, Ranger, Lost Bay (Uchi Lake)
G. Cartier, Deputy, Swain's Lake
R. Berglund, Ranger, Swain's Lake

(iv) Lake St. Joseph Fire Division

V. Johnson, Deputy, Root Bay
G. Guertin, Deputy, Central Patricia (Pickle Lake)
O. Pentznick, Radio Operator, Root Bay
Freedman, Radio Operator, Central Patricia
J. Tait, Ranger, Root Bay
J. Wilson, Ranger, Root Bay
I. Keesic, Ranger, Root Bay

(v) Armstrong Fire Division

J. Ruxton, Chief Fire Ranger
O. Belmore, Senior Ranger
R. Swanson, Ranger
T. Belmore, Ranger
R. Bannister, Towerman
J. Bilski, Gascar operator
J. Wynd, Clerk
R. McNamara, Deputy, Savant Lake
J. Lawrence, Ranger, Savant Lake
T. Laird, Towerman, Savant Lake
K. Eckholm, Deputy, Sturgeon Lake
W. Lea, Ranger, Sturgeon Lake
W. Davidson, Ranger, Tashota (Robinson Lake)

W. Anderson, Deputy, Waboose Falls, Ogoki River
D. Drake, Ranger, Waboose Falls, Ogoki River
G. Oliver, Ranger, Linklater Lake
W. Fayles, Deputy, Caribou Lake
D. McMillan, Ranger, Jacobs (Fee's Spur)

In addition to the above members of the Ontario Forestry Branch, the following members of the Provincial Air Service were met in the course of events.

V. Gillard, in charge, Sioux Lookout District
G. Trussler, Pilot, Sioux Lookout
R. Parsons, Pilot, Red Lake
L. Pullin, Pilot, Central Patricia (Pickle Lake)
D. McDonald, Pilot, Armstrong, (Caribou Lake)
L. Fayles, Mechanic, Sioux Lookout
T. Mason, Mechanic, Sioux Lookout
W. Davidson, Mechanic, Red Lake
P. Farr, Mechanic, Pickle Lake
G. Robinson, Mechanic, Caribou Lake

3. General

a. Accommodation and Communication

In Sioux Lookout, there is a Railway Y.M.C.A. The Ontario Forestry Branch generously extend bunkhouse facilities wherever desired, and along the railway hotels are to be found in the more important points, as Savant Lake. Hotels are also located at Red Lake and Pickle Lake.

Communication is achieved by air mail, forestry radio, and C.N.R. telegraph.

b. Transportation

Aerial transportation is provided by the Provincial Air Service, on requisition by the Ontario Forestry Branch. In this District, one is required to sign a release. It is essential that a definite flying program be laid down before commencement of work, this program to be defined by the District Forester who will requisition such time as needed. Otherwise, the Department might be billed for such service.

The following is a list of flights made in pursuance of the work: (See Province of Ontario, Surveys Branch, Maps 23A and 24A)

(i) August 14th. From Sioux Lookout, northwest to the south shore of Lac Seul, thence west to the point where the Route River enters Lac Seul, thence south to halfway down Route Lake and west across the south half of Thaddeus Lake to Cedar Lake, thence south to centre of Mafeking Township and east across Gullwing Lake, cutting the highway at the south end of Pickerel Arm, thence north north east up Abram Lake to Sioux Lookout.

(ii) August 15th. (a) From Sioux Lookout northwesterly across the northeast corner of Indian Reserve 28 crossing Lac Seul at the narrow portion, thence angling across the western tip of Wapesi Lake to turn north and proceed to Whitemud River and north north west through the middle of Slate Lake and the middle of Earngey Township to Lost Bay Ranger Station.

(b) Lost Bay west to the south half of Joyce Lake, crossing the north half of Little Trout Lake and the middle of Ranger Lake to the Red Lake Ranger Station (directly south of the mid-point of Mackenzie Island).

<u>(iii) August 16th.</u> (a) Red Lake Ranger Station to townsite, thence east over Ranger, Little Trout and Joyce Lakes, northwest to Swain's Lake (northeast corner of Goodall township).

(b) Swain's Lake southeasterly to Lost Bay.

(c) Lost Bay, east south east to Jeanette Lake, angling towards Root Bay at the western end of Lake St. Joseph.

<u>(iv) August 18th.</u> Root River northeast across Lake St. Joseph to Pembina River, angling east north east over Carpenter Lake, south of Sky Lake and bearing towards Little Ochig Lake, thence north north east between Ochig Lake and the Transmission line of the Hydroelectric system running from Rat Rapids to Pickle Lake.

<u>(v) August 19th.</u> Pickle Lake south to Rat Rapids, angling so that plane passed directly over Osnaburgh House on Lake St. Joseph, thence south south west across Hughes Lake, across the western portion of Pashkokogan Lake and the extreme southwestern half of McCrea Lake, the west halves of Jabez, Neverfreeze, Elwood and Whimbrel Lakes to Stillar Bay, Savant Lake.

<u>(vi) August 20th.</u> (a) From Savant Lake south south west across Harold Lake to the north arm of Sturgeon Lake, landing near St. Anthony Mine.

(b) East from St. Anthony Mine over the east arm of Sturgeon Lake, north thirds of Vanessa and Sessaganaga Lakes, the south ends of Antler and Aldridge Lakes, thence angling east north east to McKenzie Lak e.

(c) McKenzie Lake north to Caribou Lake.

(vii) August 22nd. (a) Caribou Lake south to McKenzie Lake, east south east to Mt. St. John, across Lake Nipigon to Brittania Islands, south east to Ombabika Island, thence north east along Ombabika River to Robinson Lake.

(b) Robinson Lake northwest to Goode Lake, bisecting it in a northwest to southeasterly manner, thence north to the Height of Land and angling towards Tape Lake, north to Waboose Rapids on the Ogoki River.

(c) Waboose Rapids south west to median half of Mojikit Lake, skirting Snake Lake on the north shore, crossing Cliff Lake on its southern third and thence to north end of Linklater Lake.

(d) Linklater Lake south west to Caribou Lake and returning to Ranger Station and Air Base.

c. District Description

The District exhibits a certain amount of topographical and ecological variation in its various sections .

(i) Topography. Within the area of the Sioux Lookout, Savant Lake, and Sturgeon Lake triangle, the land is rough and rolling, with numerous lakes. The surface was strongly glaciated. Apparently, Lake Agassiz had no influence upon it, since glacial deposits are few, the soils being thin with occasional morainic ridges and much exposure of the Precambrian rock.

The Red Lake, Uchi Lake and Pickle Lake areas also possess thin soil-cover and are characterized by poor drainage conditions.

The rectangular area embracing Lake St. Joseph--Ogoki River--, Armstrong and Tashota, encloses a fairly level area characterized by extensive sand and gravel deposits, by low Precambrian outcrops and shallow, swampy depressions.

The area about Armstrong and the northern shores of, especially that to the east of, Lake Nipigon, is somewhat similar but rather more rolling, at the same time being low except for the occurrence here and there of dykes of diabase trap rock which remained uneroded by glaciation and sometimes attain a height of 400 feet above lake level. Glaciation laid down considerable areas of fine clay and sand, occupying large areas of the shoreline and extending up the river valleys. These deposits had their origin in Lakes Warren or Algonquin, the area being laid down under one of their arms.

(ii) Forest Types. The topography and drainage conditions have had considerable effect upon forest associations, but the inter-gradations are innumerable, due to modifications of topography in localized areas.

In the area containing Sioux Lookout, Savant Lake, Sturgeon Lake, Red Lake, Uchi Lake and Pickle Lake, the chief species are Jack pine and black spruce. The low, poorly drained areas predominate in poorly developed black spruce, mixed with Jack pine, on the drier, and tamarack on the wetter sites. Extensive fires in the northwestern parts of the area have aggravated the thin-soil conditions and have favoured the spread of Jack pine. On the deeper soils along lake shores and up the river valleys, white spruce, balsam fir, white birch, aspen and black poplar occur, forming stands of good growth. White birch is general, usually intimately associated with aspen. About Sioux Lookout and north to Lake St. Joseph, the occasional small group of red and sometimes white pine may be found. This is the limit of their ranges. However, cabins on Lake St. Joseph contain red pine logs of 20 inches and over in diameter, so their growth is by no means stunted by the latitude, although of course they may be very old.

White cedar is occasionally seen in most parts of the area.

d. Insect Conditions

(1) Jack pine Budworm. Jack pine is distributed on two chief types of sites--rocky ridges and sandy plains--although found in admixture with other species on the heavier soils.

Where seen, budworm activity was very light, and the species is probably endemic at points such as Red Lake, Sioux Lookout, Pickle Lake and Savant Lake, where individuals were recovered from tree beatings. At Yonde, and between miles 145 and 146 on the C.N.R. south line from Sioux Lookout to Port Arthur, evidence of slight feeding appeared. This latter area apparently suffered from the more general attack of 1939, since top-kill remains, in some cases as much as 2 feet of it. Total damage would be about 1%. In this connection, the ranger at Watcomb, R. Hamilton, reports that he noted from the air in 1939 that small areas of very brown Jack pine lay between Zarn Lake and the railroad. It is probable that the condition mentioned above may extend over a considerable area.

At Watcomb, on the same branch line, 1941 feeding was scattered but intense. Actual defoliation on affected trees (new growth) would amount to about 1/4%.

Other evidence of 1939 damage was observed on a ridge running northwesterly-southeasterly to the west of Trout Lake. Here a mortality estimated at 20% remains.

Along the C.N.R. west of Armstrong, the budworm becomes evident about 1/4 mile west of Jacobs and extends west to Harvey. Feeding has been very intense but is scattered over a considerable area. There is ample evidence that in 1939 and 1940 the trees were severely defoliated, as much as 75% in many instances, judging by present thinness of crowns. Particularly intense feeding occurred, apparently in 1940, producing very thin crowns on the trees between Jacobs and Cameole. Curiously, no top-kill whatsoever was in evidence and no mortality was noted. This area may be the northern limit of the infestation centering about Graham to the south. This fits the observation of J. Ruxton, Chief Fire Ranger, Armstrong, who noted from the air in 1940 that considerable redness of Jack pine was to be seen to the southernmost limits of his district, extending northwards to the railway.

Some slight top-kill was in evidence on Jack pine in association with black spruce near Root Bay, Lake St. Joseph.

<u>(ii). European Larch Sawfly.</u> Tamarack is not very widely or extensively distributed so as to be access-

ible to Ranger Stations.

Evidence of oviposition by Pristiphora was noted at Pickle Lake, Savant Lake and Waboose Rapids on the Ogoki River. A few actively feeding larvae were recovered from trees examined in 1939 by H.A. Richmond on the west arm of Caribou Lake, north of Armstrong. The infestation at that time was found quite heavy but at the present time is quite light and no mortality has resulted.

The most extensive and severe centre of sawfly attack begins along the C.N.R. about 3/4 mile east of Ogaki, extending to Jacobs, and in patches reaching as far as Allanwater. Greatest damage has been done in the vicinity of Ogaki and Fee's Spur and about the Ontario Forestry Branch tower at Jacobs. Apparently the attack extends deeply north and south of the railway, and some top-kill is appearing. This damage was first observed in 1939 by J. Ruxton, Chief Fire Ranger. Some 'control' by mice is operative, as "moused" cocoons bore evidence. A few cocoons showed emergence holes, presumably those of chalcids.

(iii) Birch Leaf Skeletonizer. The infestation of birch by this pest was almost total in the areas seen. By aerial observation, birches were seen to be affected as far as the eye could see, in the vicinity of the following points: Sioux Lookout, Red Lake, Swain's Lake, Lost Bay, Lake St. Joseph, Pickle Lake, Savant Lake, Sturgeon Lake, McKenzie Lake, Caribou Lake, Linklater Lake, Robinson Lake, Ogoki River. Canadian Airways pilots report that it extends to, and is more intense, 250 miles north of Pickle Lake.

As far as personal observation showed (and subsequent Departmental reports gave all eastern Canada to be affected), the infestation thinned out and became very scarce east of Tashota and northwesterly to the Ogoki River, that is, east of a line drawn joining these two points. The infestation was evident as far west as the Manitoba boundary, along the railroad.

In these infestations, the birch stands out reddish- or orange-brown against the clear green aspen with which it is intimately associated. The centre of infestation would be about Lake St. Joseph and its islands, extending north for a great distance, as noted above. The leaves in places were affected to such an extent that it was almost impossible to find a healthy one; even the coppice growth near ground-level was severely attacked.

A certain amount of natural control other than parasitism would appear to have been operative, since, wherever beatings were undertaken, large numbers of spiders were shaken down, as well as Pentatomids and Coccinellids.

<u>(iv) Bronze Birch Borer</u>. <u>Agrilus</u> work is evident wherever birch was approached on the ground. On both sides of the highway linking Sioux Lookout with the Trans-Canada, the damage is very serious; at least 75% of trees seen were dead and the tops had blown off some seasons previously. Branchless stubs up to 30 feet or more in height abound. There is also much top-kill of living trees, and those with their upper halves dead are common.

At the Red Lake Ranger Station, most of the birch about the buildings are affected, chiefly because the ground has been cleared and, being on a point of land exposed to strong winds, their susceptibility is likely high.

The chief danger to birch from this insect resolves itself around the potential increase of it as a result of the severe setback birch must have received by foliage loss from the birch leaf skeletonizer.

<u>Agrilus</u> was noted also at Watcomb Ranger Station, at Lost Bay, and at Savant Lake, where it was common and injurious, causing top-kill.

<u>(v) Other species</u>. Where tree beating was possible, it was undertaken, and the following is a list of recoveries:

PLACE	BOX NO.	HOST	SPECIES	FAMILY	RECORD NO.
Red Lake	67719	Black Spruce	(Tortricidae sp.)*, Eupithecia sp., Podisus serieventris Uhl.	Geometridae Pentatomidae	310
Red Lake	67720	Balsam	Argyrotaenia occultana Frmn., Protoboarmia porcelaria Gn., Palthis angulalis Hbn., (Tortricidae sp.)*, Ellopia fiscellaria Gn., Cleis picta Rand., Bellamira scalaris Say, Agrilus anxius Gory, Neodiprion abietis Harris, (Chalcidae sp.--ex.N.abietis Harr.).	Tortricidae Geometridae Phalaenidae Geometridae Chrysomelidae Cerambycidae Cerambycidae Tenthredinidae	306
Red Lake	67721	-----	Arachnida sp.	-----------	---
Red Lake	67722	Black Spruce	(Geometridae sp.)*, (Tortricidae sp.)* (Lepidoptera sp.)*, Pikonema alaskensis Roh., Cacoecia fumiferana Clem.	 Tenthredinidae Tortricidae	309
Red Lake	67725	White Birch	Croesus latitarsus Nort., Corythuca sp., Bucculatrix canadensisella Cham., Unknown leaf miners.	Tenthredinidae Tingidae Lyonettiidae	308
Red Lake	67726	Jack pine	(Tortricidae sp.)*,(Coleoptera sp.)*, Lucidota corrusca L., Cleis picta Rand.	 Lampyridae Chrysomelidae	307
Lake St. Joseph	67559	White Birch	Bucculatrix canadensisella Chamb., (Aphidae sp.)*	Lyonettiidae	325

* Classification already designated
by enclosure within brackets.

PLACE	BOX NO.	HOST	SPECIES	FAMILY	RECORD NO.
Lake St. Joseph	67562	White Birch	Bucculatrix canadensisella Chamb.,	Lyonettiidae	326
			Tropaea luna Linn.	Saturniidae	
Lake St. Joseph	67616	Larch	Olene plagiata Wlk.,	Liparidae	324
			Semiothisa sexmaculata Pack.,	Geometridae	
			Semiothisa granitata Gn.,	Geometridae	
			(Geometridae sp.)*,		
			Protoboarmia porcelaria Gn.,	Geometridae	
			Anoplonyx laricis Marl.	Geometridae	
Pickle Lake	67565	White Birch	Bucculatrix canadensisella Chamb.,	Lyonettiidae	339
			(Tenthredinidae sp.)*,		
			Acronicta innotata Grt.,	Phalaenidae	
			(Geometridae sp.)*.		
Pickle Lake	67617	White Spruce	Cacoecia fumiferana Clem.,	Tortricidae	338
			Chrysomyxa sp.,	(Fungus)	
			Eupithecia sp.	Geometridae	
Savant Lake	67563	Aspen	Pontania bozemani Cooley,	Tenthredinidae	327
			(Tortricidae sp.)*,		
			Meroptera pravella Grt.	Pyralidae	
Sturgeon Lake	67566	Balsam	Ellopia fiscellaria Gn.,	Geometridae	336
			(Tortricidae sp.)*,		
			(Phalaenidae sp.)*.		
Sturgeon Lake	67618	White Spruce	Ellopia fiscellaria Gn.,	Geometridae	340
			Camponotus pennsylvanicus de G.,	Formicidae	
			Protoboarmia porcelaria indicatoria Wlk.,	Geometridae	
			Physokermes piceae Schr.,	Coccidae	
			(Lepidoptera sp.)*.		
Armstrong	17251	Black Spruce	Pikonema alaskensis Roh.,	Tenthredinidae	334
			Pikonema dimmockii Cress.,	Tenthredinidae	
			Semiothisa granitata Gn.	Geometridae	

* Classification already designated by enclosure within brackets.

PLACE	BOX NO.	HOST	SPECIES	FAMILY	RECORD NO.
Armstrong	67573	Larch	*Anoplonyx laricis* Marl., *Semiothisa* sp.	Tenthredinidae Geometridae	347
Caribou Lake	67624	Poplar	*Chrysomela tremulae* Fab., *Pontania* sp., (*Hemiptera* sp.)*, *Calligrapha* sp., *Pemphigus rileyi* Steb., *Epistrophe* sp., (*Ichneumonidae* sp.)*.	Chrysomelidae Tenthredinidae Chrysomelidae Aphidae Syrphidae	342
Caribou Lake	67625	Larch	*Pristiphora erichsonii* Htg., *Anoplonyx laricis* Marl., *Semiothisa sexmaculata* Pack., *Protoboarmia porcelaria* Gn., (*Hemiptera* sp.)*, (*Lepidoptera* sp.)*.	Tenthredinidae Tenthredinidae Geometridae Geometridae	343
Tashota	67571	Larch	*Anoplonyx laricis* Marl., (*Geometridae* sp.)*, *Semiothisa granitata* Gn.	Tenthredinidae Geometridae	349
Tashota	67622	Black Spruce	*Pikonema dimmockii* Cress., *Ellopia fiscellaria* Gn.	Tenthredinidae Geometridae	350
Waboose Falls	67623	White Spruce	*Semiothisa granitata* Gn., *Chrysomyxa* sp.	Geometridae (Fungus)	352
Linklater Lake	67572	White Spruce	*Pikonema alaskensis* Roh.	Tenthredinidae	348
Jacobs (Tower)	67574	Larch	*Pristiphora erichsonii* Htg.	Tenthredinidae	351

* Classification already designated by enclosure within brackets.

In the vicinity of Watcomb Ranger Station, quite a number of aspen were found heavily attacked by round-headed borers, presumably Saperda. The trunks of the trees were black and oily, as though wiped over by a creosoted brush. Masses of frass were hanging about the exposed wounds.

No signs of forest tent caterpillar were noted, but a few historic facts concerning the insect were gathered. According to J. Johnson, Ranger in the Watcomb area, an exceedingly heavy attack occurred in 1936, egg masses being very common. In 1937, many of these were found not to have hatched, the spring being cold and wet. The outbreak accordingly subsided. He quoted an old trapper who had spent 30 years in the Sturgeon Lake area, who, in connection with this pest, said that in the early days it occurred in small local epidemics but never became extensive. However, huge fires swept over the area in 1916 and large areas succeeded as hardwoods, chiefly aspen. This had made an excellent nutritional environment for the forest tent caterpillar.

V. Johnson, Lake St. Joseph, reported that the forest tent caterpillar was present in enormous numbers in 1939, and previously in 1936. In the Savant Lake area, R. McNamara reports that the pest was epidemic between 1937 and 1939.

4. Summary

a. Personnel contacted.

The senior officers and field staff of the Ontario Forestry Branch in the Sioux Lookout Forest Division, comprising 6 executive and 39 staff individuals, were contacted between August 12th and August 25th, involving extensive travel and reconnaissance, chiefly by air, courtesy of the Provincial Air Service on requisition of the Ontario Forestry Branch. This amounted to approximately 795 miles of air travel, or about 10 hours flying time. At commercial rates, this cooperation would have a monetary value of several hundred dollars.

b. Insect Conditions.

No widespread infestations were encountered, with the exception of that of the birch leaf skeletonizer (*Bucculatrix canadensisella* Chamb.) which occurs on birch stands throughout the district. The area about Lake St. Joseph was found to be particularly heavily attacked.

The Jack pine budworm (*Cacoecia fumiferana* Clem.) was located at a number of points, being present endemically; in some places feeding was intense upon new growth, as: Watcomb, Savant Lake, and in the vicinity of Harvey.

The European larch sawfly (*Pristiphora erichsonii* Htg.) was recovered at a few points but only in the area between Ogaki and Allanwater was damage by it noted. In this area, a good deal of top-kill has resulted.

B. Cooperators' Summaries

In the fall of 1941, when returns from the cooperators were terminated, summaries showing the cooperator's name, the date of his return and the determinations of the insects submitted in each survey box were prepared and presented to the units represented. The distribution of collections among the cooperating units is tabulated in the Report of the Winnipeg Section, P. 382.

The detailed reports supplied to the cooperating units are set forth below:

FOREST INSECT LABORATORY - WINNIPEG

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941.

Collector	Locality	Box No.	Date Received	Contents
L. T. White	Winnipeg	51760	May 26	39 larvae of the fall cankerworm, *Alsophila pometaria* Harr.; 1 larva of a looper, *Geometridae* sp.; 1 larva of a leaf-roller, *Tortricidae* sp.; nymphs of an elm leaf curl aphid, *Eriosoma* sp.
H. A. Richmond	Winnipeg	Special	May 29	2 adults of the ground beetle, *Geopinus incrassatus* Dej.
H. A. Richmond	Winnipeg	Special	May 29	1 larva of a red-banded lepidoptera, *Tortricidae* sp.; 1 larva of the red-striped lepidoptera, *Sparganothis tristriata* Kearf.
H. A. Richmond	Winnipeg	Special	May 29	3 larvae of the aspen leaf-roller, possibly *Exentera oregonana* Wlshm.
L. T. White and D. N. Smith	Winnipeg	Special	June 3	9 larvae of a hazel leaf-roller, *Tortricidae* sp.; 1 larva of a climbing cutworm, *Phalaenidae* sp.
F. B. Rabkin	Winnipeg	55836	June 5	153 larvae of the cherry ugly nest tortrix, *Cacoecia cerasivorana* Fitch.
R. R. Lejeune	Winnipeg	55839	June 5	16 larvae of the leaf beetle, *Phytodecta americana* Schffr.; 4 adults of a plant lice, *Aphidae* sp.

Collector	Locality	Box No.	Date Received	Contents
R. R. Lejeune	Winnipeg	55850	June 5	6 larvae and 1 prepupa of the fir tortrix, *Tortrix packardiana* Fern.; 1 larva of a false webworm, *Pamphiliidae* sp.; 1 larva of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 larva of a looper, *Eupithecia* sp.; 1 larva of a looper, *Geometridae* sp.; 1 larva, *Lepidoptera* sp.; 1 gall caused by the spruce gall aphid, *Adelges abietis* L.
R. R. Lejeune and F. B. Rabkin	Winnipeg	55837	June 5	33 larvae of the orchard tent caterpillar, *Malacosoma americana* Fab.
R. R. Lejeune and F. B. Rabkin	Winnipeg	55840	June 5	7 larvae of a leaf-roller, possibly *Exentera oregonana* Wlshm.; 1 larva of a leaf-roller, *Tortricidae* sp.; 1 egg mass of a squash beetle, *Pentatomidae* sp.; 1 larva of a lady beetle, *Coccinellidae* sp.; 2 leaf galls on poplar; 1 red mite, *Acarina* sp.
R. R. Lejeune and F. B. Rabkin	Winnipeg	55838	June 5	9 larvae of a leaf-roller, *Tortricidae* sp.; 25 larvae of the small leaf-roller, *Dichomeris ligulella* Hbn.; 1 larva of the tortrix, *Argyrotaenia quercifolia* Fitch; 1 larva of a moth, *Lepidoptera* sp.

FOREST INSECT LABORATORY - WINNIPEG - CONT'D

Collector	Locality	Box No.	Date Received	Contents
R. R. Lejeune And F. B. Rabkin	Winnipeg	Special	June 5	250 larvae of the Spruce budworm, *Cacoecia fumiferana* Clem.; 2 larvae of the fir tortrix, *Tortrix packardiana* Fern.; 2 larvae of the spruce cone-worm, *Dioryctria reniculella* Gn.
R. R. Lejeune and F. B. Rabkin	Winnipeg	Special	June 5	250 larvae of the Spruce budworm, *Cacoecia fumiferana* Clem; 1 larva of the green-headed spruce sawfly, *Pikonema dimmockii* Cress.;
R. R. Lejeune and F. B. Rabkin	Winnipeg	Special	June 5	250 larvae of the Spruce budworm, *Cacoecia fumiferana* Clem.
R. R. Lejeune and F. B. Rabkin	Winnipeg	Special	June 5	250 larvae of the Spruce budworm, *Cacoecia fumiferana* Clem.
F. B. Rabkin	Winnipeg	55841	June 6	15 larvae of the Spruce budworm, *Cacoecia fumiferana* Clem.
H. A. Richmond	Winnipeg	Special	June 4,10	196 larvae of the Jack pine budworm, *Cacoecia fumiferana* Clem.
R. R. Lejeune and F. B. Rabkin	Winnipeg	55848	June 14	1 cocoon of the grey spruce tussock moth, *Olene plagiata* Wlk.; 2 larvae of a leaf-roller, *Tortricidae* sp.

FOREST INSECT LABORATORY - WINNIPEG - CONT'D

Collector	Locality	Box No.	Date Received	Contents
R. R. Lejeune and F. B. Rabkin	Winnipeg	55845	June 16	6 larvae of a false webworm, Pamphiliidae sp.; 1 larva of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 larva of a moth, Lepidoptera sp.
R. R. Lejeune and F. B. Rabkin	Winnipeg	55842	June 16	73 larvae of the red pine sawfly, Neodiprion resinosae Provis.
R. R. Lejeune and F. B. Rabkin	Winnipeg	55849	June 17	1 larva of a leaf-roller, Tortricidae sp.; 1 larva of a moth, Lepidoptera sp.; 1 egg mass of a lady beetle, Coccinellidae sp.
R. R. Lejeune and F. B. Rabkin	Winnipeg	55844	June 17	nymphs and adults of the plant lice, Chaitophorus populifoliae Oest.
R. R. Lejeune and F. B. Rabkin	Winnipeg	55843	June 17	2 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.
R. R. Lejeune and F. B. Rabkin	Winnipeg	Special	June 20	250 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 adult of the lacewing fly, Chrysopa plorabunda Fitch.
R. R. Lejeune and F. B. Rabkin	Winnipeg	Special	June 20	250 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.

Collector	Locality	Box No.	Date Received	Contents
R. R. Lejeune and F. B. Rabkin	Winnipeg	67482	June 24	1 larva and 1 pupa (foliage form) of the spruce cone-worm, Dioryctria reniculella Grt.
R. R. Lejeune and F. B. Rabkin	Winnipeg	67486	June 24	132 larvae of the European larch sawfly, Pristiphora erichsonii Htg.
R. R. Lejeune and F. B. Rabkin	Winnipeg	36768	June 24	49 larvae of the European larch sawfly, Pristiphora erichsonii Htg.; 5 larvae of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 1 pupa of the Spruce budworm, Cacoecia fumiferana Clem.
H. A. Richmond	Winnipeg	Special	June 24	many larvae of the Jack pine budworm, Cacoecia fumiferana Clem.
R. R. Lejeune and F. B. Rabkin	Winnipeg	Special	June 19-22	Male pupae of the spruce budworm, Cacoecia fumiferana Clem.
R. R. Lejeune and F. B. Rabkin	Winnipeg	Special	June 19-22	Female pupae of the spruce budworm, Cacoecia fumiferana Clem.
R. R. Lejeune and F. B. Rabkin	Winnipeg	Special	June 19-22	8 pupae of the spruce budworm, Cacoecia fumiferana Clem.

Collector	Locality	Box No.	Date Received	Contents
R. R. Lejeune and F. B. Rabkin	Winnipeg	Special	June 19-22	Female pupae of the spruce budworm, *Cacoecia fumiferana* Clem.
R. R. Lejeune and F. B. Rabkin	Winnipeg	Special	June 19-22	Male pupae of the spruce budworm, *Cacoecia fumiferana* Clem.
R. R. Lejeune and F. B. Rabkin	Winnipeg	Special	June 19-22	Female pupae of the spruce budworm, *Cacoecia fumiferana* Clem.
R. R. Lejeune and F. B. Rabkin	Winnipeg	Special	June 19-22	Male pupae of the spruce budworm, *Cacoecia fumiferana* Clem.
R. R. Lejeune and F. B. Rabkin	Winnipeg	Special	June 19-22	Female pupae of the spruce budworm, *Cacoecia fumiferana* Clem.
H. A. Richmond	Winnipeg	Special	June 25	2 larvae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 larva and 1 pupa of the brown-striped shoot moth, *Zelleria haimbacki* Busch.
F. B. Rabkin	Winnipeg	Special	June 27	specimens of the Jack pine scale, *Toumeyella numismaticum* P. & M.

FOREST INSECT LABORATORY - WINNIPEG - CONT'D

Collector	Locality	Box No.	Date Received	Contents
L. T. White	Winnipeg	67516	July 2	1 larva of a cutworm, Phalaenidae sp.; 1 larva of the grey spruce tussock moth, Olene plagiata Wlk.; 1 adult of the lady beetle, Neomysia subvittata Muls.
L. T. White	Winnipeg	67515	July 2	1 nest of the ugly nest cherry tortrix, Cacoecia cerasivorana Fitch.
L. T. White	Winnipeg	67503	July 2	1 larva 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.
H. A. Richmond	Winnipeg	55501	July 2	18 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.
F. B. Rabkin	Winnipeg	67480 67481	July 3	25 male and 16 female pupae of the Jack pine budworm, Cacoecia fumiferana Clem.
L. T. White	Winnipeg	Special	July 4	16 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.
L. T. White	Winnipeg	Special	July 4	1 larva of the European larch sawfly, Pristiphora erichsonii Htg.; 2 larvae of Marlatt's larch sawfly, Anoplonyx laricis Marl.

FOREST INSECT LABORATORY - WINNIPEG - CONT'D

Collector	Locality	Box No.	Date Received	Contents
R. R. Lejeune	Winnipeg	53771	July 5	124 larvae of the alder leaf beetle, Altica ambiens alni Harr.; 3 nymphs and 1 adult of a plant lice, Aphidae sp.; 2 larvae of a leaf-roller, Tortricidae sp.
R. R. Lejeune	Winnipeg	55770	July 5	1 larva of the Jack pine hairstreak, Incisalia niphon Hbn.; 2 larvae of a cutworm, Phalaenidae sp.
R. R. Lejeune	Winnipeg	Special	July 5	Male and female pupae of the Jack pine budworm, Cacoecia fumiferana Clem.
R. R. Lejeune	Winnipeg	55773	July 7	21 larvae of the red-headed Jack pine sawfly, Neodiprion dubiosus Schedl.
R. R. Lejeune	Winnipeg	55774	July 7	9 larvae of the Jack pine hairstreak, Incisalia niphon Hbn.; 1 adult of a leaf-miner, Recurvaria sp.(?); 1 pupa, Braconidae sp.
H. A. Richmond	Winnipeg	52004	July 10	91 larvae of the European larch sawfly, Pristiphora erichsonii Htg.
H. A. Richmond	Winnipeg	52002	July 10	74 larvae of the European larch sawfly, Pristiphora erichsonii Htg.

FOREST INSECT LABORATORY - WINNIPEG - CONT'D

Collector	Locality	Box No.	Date Received	Contents
H. A. Richmond	Winnipeg	52001	July 10	1 larva of a sphinx moth, *Sphingidae* sp.; 37 larvae of the European larch sawfly, *Pristiphora erichsonii* Htg.; 3 larvae of Marlatt's larch sawfly, *Anoplonyx laricis* Marl.; 1 nymph of a plant lice, *Aphidae* sp.
H. A. Richmond	Winnipeg	55899	July 10	55 larvae of the European larch sawfly, *Pristiphora erichsonii* Htg.
H. A. Richmond	Winnipeg	Special	July 12	106 larvae of the European larch sawfly, *Pristiphora erichsonii* Htg.
H. A. Richmond	Winnipeg	Special	July 12	13 male and 40 female pupae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 male and 2 female moths of the Jack pine budworm, *Cacoecia fumiferana* Clem.;
F. B. Rabkin	Winnipeg	67519	July 12	28 larvae and 2 pupae of the yellow-headed spruce sawfly, *Pikonema alaskensis* Roh.
F. B. Rabkin	Winnipeg	67539	July 14	1 nest with larvae of the ugly nest cherry tortrix, *Cacoecia cerasivorana* Fitch.
H. A. Richmond	Winnipeg	Special	July 30	Braconid parasite cocoons from galleries of *Ips integer* Eisch.

FOREST INSECT LABORATORY - WINNIPEG - CONT'D

Collector	Locality	Box No.	Date Received	Contents
E. A. Richmond	Winnipeg	Special	July 30	Bark beetles: *Ips integer* Eisch. *Trypodendron* *Orthotomicus vicinus* Lec. Borers: *Dicerca* Carpenter ants: *Camponotus herculaneus* var. *pennsylvanicus* DeG.
R. R. Lejeune	Winnipeg	55490	Aug. 7	8 larvae of the European larch sawfly, *Pristiphora erichsonii* Htg.
Miss L. Wiegand	Winnipeg	Special	Aug. 8	37 larvae of the yellow-necked datana, *Datana ministra* Wlk.
D. M. Smith	Winnipeg	67616	Aug. 20	1 larva of the grey spruce tussock moth, *Olene plagiata* Wlk.; 3 larvae of a looper, *Geometridae* sp.; 2 larvae of the green spruce looper, *Semiothisa granitata* Gn.; 2 larvae of the green larch looper, *Semiothisa sexmaculata* Pack.; 1 larva of the dotted line geometer, *Protoboarmia porcelaria* Gn.; 3 larvae of Marlatt's larch sawfly, *Anoplonyx laricis* Marl.

FOREST INSECT LABORATORY - WINNIPEG - CONT'D

Collector	Locality	Box No.	Date Received	Contents
D. N. Smith	Winnipeg	67559	Aug. 20	10 larvae and 46 pupae of the birch leaf skeletonizer, Bucculatrix canadensisella Chamb.; several nymphs of a plant lice, Aphidae sp.
D. N. Smith	Winnipeg	67563	Aug. 20	12 larvae and 1 cocoon of a leaf-rolling poplar sawfly, Pontania sp.(?); 1 larva of the leaf-roller, Meroptera pravella Grt.; 1 larva of a leaf-roller, Tortricidae sp.
D. N. Smith	Winnipeg	67618	Aug. 22	1 pupa of the hemlock looper, Ellopia fiscellaria Gn.; 1 adult, winged male, of the carpenter ant, Camponotus pennsylvanicus DeG.; 1 larva of the looper, Protoboarmia porcelaria indicatoria Wlk.; 10 scales of the spruce bud scale, Physokermes piceae Schr.; 1 larva of a leaf-roller, Tortricidae sp.; 1 pupa (empty) of a moth, Lepidoptera sp.
D. N. Smith	Winnipeg	67566	Aug. 22	1 larva of the hemlock looper, Ellopia fiscellaria Gn.; 1 larva of a cutworm, Phalaenidae sp.; 1 larva of a budworm, Tortricidae sp.

FOREST INSECT LABORATORY - WINNIPEG - CONT'D

Collector	Locality	Box No.	Date Received	Contents
D. N. Smith	Winnipeg	67624	Aug. 23	65 larvae of the leaf beetle, *Chrysomela tremulae* Fab.; 3 larvae of a leaf-rolling sawfly, *Pontania* sp.(?); 1 larva of a predaceous hover fly, *Syrphidae* sp.; 1 pupa of a parasitic wasp, *Ichneumonidae* sp.; several leaf galls, *Pemphigus rileyi* Steb.; 1 adult of a plant bug, *Hemiptera* sp.; 1 larva of the pyralid, *Tetralopha asperatella* Clem.
D. N. Smith	Winnipeg	67573	Aug. 25	27 larvae of Marlatt's larch sawfly, *Anoplonyx laricis* Marl.; 1 larva of a green spruce looper, *Semiothisa* sp.
D. N. Smith	Winnipeg	67623	Aug. 25	1 larva of the green spruce looper, *Semiothisa granitata* Gn.; *Chrysomyxa* leaf rust on needles.
L. T. White	Winnipeg	Special	Sept. 3	2 pupae of a woolly bear on willow, *Arctiidae* sp.
D. N. Smith	Winnipeg	Special	Sept. 13	1 larva of a cutworm on oak, *Phalaenidae* sp.

THE ONTARIO FORESTRY BRANCH

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
E. Rosborough	Ferland, Ontario.	67961	June 16	1 larva of the climbing cutworm, Autographa alias Ottol.
J. A. Troke	St. Anthony Mine, Ont.	67718	June 17	1 larva and 1 pupa of the Jack pine budworm, Cacoecia fumiferana Clem.; 10 adults of the leaf-roller, Clemensia albata Pack.; 2 adults of the 2-barred click beetle, Ludius propola Lec.; 2 adults of the 3-barred click beetle, Ludius triundulatus Rand.; 2 adults of the polished click beetle, Ludius nitidulus Lec.; 1 adult of the click beetle, Limonus aeger Lec.; 2 adults of the firefly, Pyractomena borealis Rand.
G. Oliver	Armstrong, Ontario.	67762	June 17	1 adult of the forest darkling beetle, Upis ceramboides L.; 1 adult of the carrion beetle, Silpha novaboracensis Forst.; 2 adults of the polished click beetle, Ludius nitidulus Lec.; 2 adults of the inky click beetle, Ludius appropinquans Rand.; 2 adults of the click beetle, Ludius insidiosus Lec.; 1 adult of the nigger click beetle, Limonus spinosus Lec.; 1 adult of the click beetle, Limonus aeger Lec.; 1 adult of the click beetle, Ampedus evansii Brown.

Collector	Locality	Box No.	Date Received	Contents
R. McNamara	Armstrong, Ontario.	67706	June 17	1 larva of the climbing cutworm, Autographa alias Ottol.; 2 adults of the 3-barred click beetle, Ludius triundulatus Rand.
D. MacMillan	Armstrong, Ontario.	67714	June 19	1 adult of the click beetle, Agriotes limosus Lec.
Rangers	Lawrence Lale , Ont.	67207	June 19	2 larvae of a looper, Eupithecia sp.; 1 larva of the dotted line geometer, Protoboarmia porcelaria Gn.; 2 larvae of a climbing cutworm, Phalaenidae sp.; 1 adult of the long horned borer, Anoplodera sanguinea Lec.; 1 adult of the inky click beetle, Ludius appropinquans Rand.; 1 adult of the 3-barred click beetle, Ludius triundulatus Rand.; 1 adult of the ground beetle, Plochionus timidus Hald.; Galls (old) caused by the spruce gall aphid, Adelges abietis L.
W. H. Fayle	Armstrong, Ontario.	67716	June 21	1 larva of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 larva of a leaf-roller, Tortricidae sp.
G. J. Dahlin	Fort Frances, Ont.	67263	June 21	6 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.

Collector	Locality	Box No.	Date Received	Contents
W. H. Fayle	Armstrong, Ontario.	67715	June 21	1 larva of a predaceous hover fly, Syrphidae sp.
E. Currier	Sioux Lookout, Ont.	51713	June 23	3 larvae and 2 empty pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 adult of the 2-barred click beetle, Ludius propola Lec.; 2 adults of the 3-barred click beetle, Ludius triundulatus Rand.; 2 adults of the inky click beetle, Ludius appropinquans Rand.; 1 adult of the long horn borer, Pogonochorus penicellatus Lec.; 1 adult of a caddis fly, Trichoptera sp.; 1 larva of a looper, Geometridae sp.; 1 larva of the green-striped spruce caterpillar, Feralia jocosa Gn.; 1 adult of a plant lice, Aphidae sp.; 1 pupa of a moth, Lepidoptera sp.
E. Currier	Sioux Lookout, Ont.	51712	June 23	7 larvae of the red pine sawfly, Neodiprion resinosae Provis.; 1 adult of a stone fly, Plecoptera sp.; 1 adult of the inky click beetle, Ludius appropinquans Rand.; 1 adult of the dun click beetle, Ludius medianus Germ.; 2 adults of the flower beetle, Eurypogon niger Mels.; 1 larva of a looper, Geometridae sp.; 1 egg sac of a spider, Arachnida sp.

Collector	Locality	Box No.	Date Received	Contents
E. Cartier	Sioux Lookout, Ont.	51715	June 23	1 larva and 1 prepupa of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 larva of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 5 larvae of a looper, Geometridae sp.; 2 adults of the click beetle, Limonus aeger Lec.; 1 larva of a leaf-roller, Tortricidae sp.; 1 adult of the firefly, Pyractomena borealis Rand.
E. Cartier	Sioux Lookout, Ont.	51714	June 23	1 larva and 1 pupa of the Jack pine budworm, Cacoecia fumiferana Clem.; 3 larvae of the red pine sawfly, Neodiprion resinosae Provis.; 1 larva of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 larva of the grey spruce tussock moth, Olene plagiata Wlk.; 1 larva of the pyralid, Hypoprepia miniata Kby.; 1 adult of the dun click beetle, Ludius medianus Germ.; 1 adult of the inky click beetle, Ludius appropinquans Rand.; 1 adult of the polished click beetle, Ludius nitidulus Lec.

THE ONTARIO FORESTRY BRANCH CONT'D

Collector	Locality	Box No.	Date Received	Contents
J. Sullivan	Fort Frances, Ont.	67287	June 24	69 larvae and 3 pupae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 larva of a parasitic fly, possibly *Nemorilla* sp.
J. M. Horn	Ignace, Ontario.	67242	June 25	10 larvae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 3 spiders, *Arachnida* sp.
F. Clark	Flanders, Ontario.	67267	June 26	12 larvae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 larva of a looper, *Nyctobia* sp.(?); 1 larva of the tussock moth, *Olene plagiata* Wlk.; 1 larva of the false hemlock looper, *Nepytia canosaria* Wlk.; 1 larva of a climbing cutworm, *Phalaenidae* sp.; 1 adult of the firefly, *Photurus pennsylvanica* deG.; old galls caused by the spruce gall aphid, *Adelges abietis* L.
Rangers	Beaverhouse Lake, Ont.	67256	June 28	9 pupae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 adult of a plant bug, *Hemiptera* sp.; 1 larva of a predaceous fly, *Syrphidae* sp.; 1 larva of a woolly aphid, *Aphidae* sp.; nymphs and adults of a plant lice, *Aphidae* sp.

Collector	Locality	Box No.	Date Received	Contents
W. Lunam	Ignace, Ontario.	67236	June 30	3 pupae and 1 larva of the Jack pine budworm, Cacoecia fumiferana Clem.; 3 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 larva of the black-headed budworm, Peronea variana Fern.; 1 larva of a leaf-roller, Tortricidae sp.; 2 larvae of the false hemlock looper, Nepytia canosaria Wlk.; 1 larva of a looper, Geometridae sp.; 3 larvae of a climbing cutworm, Phalaenidae sp.
W. Lunam	Ignace, Ontario.	67238	June 30	8 pupae and 12 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 larva of a climbing cutworm, Phalaenidae sp.; 1 larva of the Jack pine hairstreak, Incisalia niphon Hbn.
A. Longila	MacDiarmid, Ontario.	67368	June 30	1 cocoon of a sawfly, Neodiprion sp.; 1 adult of the firefly, Pyractomena borealis Rand.; 1 larva of a flat headed borer, Buprestidae sp.; balsam wood rot.

Collector	Locality	Box No.	Date Received	Contents
J.A. Bissonnette	Fort Frances, Ont.	67251	June 30	1 adult, 42 pupae and 17 larvae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 7 cocoons of a parasitic fly, possibly *Nemorilla* sp.; 2 larvae (dead) of a climbing cutworm, *Phalaenidae* sp.; 2 larvae and 1 cocoon of a sawfly, *Neodiprion* sp.(?); 1 adult of a spittle bug, *Aphrophora* sp.; 1 adult of a scarab beetle, *Dichelonycha* sp.
S. Roberts	Fort Frances, Ont.	67283	June 30	29 pupae and 9 larvae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 3 cocoons of a parasitic fly, possibly *Nemorilla* sp.
J. Youmans	Malachi, Ontario.	67230	June 30	19 larvae and 11 cocoons of the black-headed spruce sawfly, *Neodiprion abietis* Harr.; 1 adult of the tiger lady beetle, *Neomysia subvittata* Muls.; 1 adult of a ground beetle, *Bembidium* sp.; 1 adult of the darkling beetle, *Scaphidema aeneolum* Lec.
J. Youmans	Malachi, Ontario.	67231	June 30	3 adults of the inky click beetle, *Ludius appropinquans* Rand.; 1 adult of the tiger lady beetle, *Neomysia subvittata* Muls.

THE ONTARIO FORESTRY BRANCH CONT'D

Collector	Locality	Box No.	Date Received	Contents
E. Humphrey	Beardmore, Ontario.	67363	July 2	1 female adult, 4 pupae and 1 larva of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 7 larvae and 1 pupa of the green-headed spruce sawfly, *Pikonema dimmockii* Cress.; 1 larva of a false webworm, *Cephalcia* sp.; 1 pupa of a leaf-roller, *Tortricidae* sp.; 1 larva and 2 pupae of a predaceous hover fly, *Syrphidae* sp.; 1 pupa of the lacewing fly, *Chrysopa plorabunda* Fitch.; 1 pupa of the predator, *Hemerobius humulinus* Linn.
G. Jorgenson	Ignace, Ontario.	67239	July 2	considerable bark tunnelling and 1 adult of a small bark beetle, *Crypturgus atomus* Lec.; 1 larva of a flat-headed borer, *Buprestidae* sp.
G. Jorgenson	Ignace, Ontario.	67241	July 2	1 adult of a fish fly, *Hexagenia* sp.; 1 larva of a flat-headed borer, *Buprestidae* sp.
G. Jorgenson	Ignace, Ontario.	67240	July 2	bark infected with fungus rot, Possibly *Trametes pini*; 1 larva of a flat-headed borer, *Buprestidae* sp.

Collector	Locality	Box No.	Date Received	Contents
Fire Protection Service	MacDiarmid, Ontario.	67360	July 2	No insects found.
N. Ross	Fort Frances, Ont.	67255	July 2	4 larvae, 12 pupae and 1 adult of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 adult of the blister beetle, Macrobasis Fabricii Lec.; 1 adult of a parasitic wasp, Ichneumonidae sp.; 1 adult of the blister beetle, Podabrus modestus Say.
J.A.Bissonnette	Lac la Croix, Ont.	67252	July 8	214 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.(pupal survey).
P. Peltier	Kawene, Ontario.	67282	July 10	123 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.(pupal survey).
H. Craig	Northern Lights Lake, Ontario.	55502	July 4	2 larvae and 3 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 8 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 larva of the black-headed spruce budworm, Peronea variana Fern.; 1 larva of a predaceous hover fly, Syrphidae sp.; 1 egg mass (unknown).

Collector	Locality	Box No.	Date Received	Contents
J. Sullivan	Sturgeon Lake, Ont.	55757 to 55762 inc.	July 3-10	1090 pupae of the Jack pine budworm, Cacoecia fumiferana Clem. (pupal survey)
N. Ross	Beaverhouse Lake, Ont.	55751, 67257	July 2-4	161 pupae of the Jack pine budworm, Cacoecia fumiferana Clem. (pupal survey)
H. Craig	Northern Lights Lake, Ontario.	67390	July 7	18 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.
H. Craig	Northern Lights Lake, Ontario.	67395	July 7	2 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.
F. Clark	Calm Lake, Ontario.	67268 to 67270; 51609 to 51610.	July 4-14	1615 pupae of the Jack pine budworm, Cacoecia fumiferana Clem. (pupal survey)
D. C. White	Kakabeka, Ontario.	55511 to 55520	July 4-14	2011 pupae of the Jack pine budworm, Cacoecia fumiferana Clem. (pupal survey)
S. V. Roberts	Burke Lake, Ont.	55484 to 55488	June 30 to July 5	935 pupae of the Jack pine budworm, Cacoecia fumiferana Clem. (pupal survey)

THE ONTARIO FORESTRY BRANCH CONT'D

Collector	Locality	Box No.	Date Received	Contents
R. Mullan	Redditt, Ontario.	67224	July 9	10 larvae and 8 pupae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 larva of the balsam fir sawfly, Neodiprion abietis Harr.; 2 old sawfly cocoons; balsam leaf galls (cause unknown).
J. Dawson	Graham, Ontario.	29396, 67396, 67399, 67400, 55939.	July 6-12	810 pupae of the Jack pine budworm, Cacoecia fumiferana Clem. (pupal survey)
W. Coppard	Vermilion Bay, Ont.	51725	July 9	stem galls caused by the small fly, Phytophaga piceae Felt; egg cluster of a looper, Geometridae sp.
L. Hines	Vermilion Bay, Ont.	67211	July 10	6 larvae of the balsam fir sawfly, Neodiprion abietis Harr.; 4 larvae and 4 cocoons of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.
L. Hines	Vermilion Bay, Ont.	67212	July 10	nymphs of a spittle bug, Aphrophora sp.; 2 larvae of a leaf folding sawfly, Pontania sp.; 3 larvae of a leaf-miner, possibly Tineidae sp.; 1 nymph of a squash bug, Coreidae sp.

Collector	Locality	Box No.	Date Received	Contents
J. Rorke	Lost Bay, Ontario.	67971	July 11	1 adult of a plant lice, Aphidae sp.; 1 adult of a tree hopper, Jassidae sp.(?).
F. A. Cosco	Uchi Lake, Ontario.	67976	July 11	1 adult of a fish fly, Ephemeroptera sp.; 1 adult of a blister beetle, Podabrus sp.
R. W. Coltrin	Uchi Lake, Ontario.	67972	July 11	1 adult of the tiger beetle, Cicindela longilabris Say.; 1 adult of the flat-headed borer, Buprestis nuttali, var. consularis Gory.
G. Hornick	Garden Lake, Ontario.	55933	July 12	2 larvae, 12 pupae and 4 adults of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 pupa of a predaceous hover fly, Syrphidae sp.; 1 cocoon of a parasitic wasp, Braconidae sp.; 1 gall caused by the spruce gall aphid, Adelges abietis L.; 1 larva of a moth, Lepidoptera sp. (parasitised); 1 larva of a moth, Lepidoptera sp.; frost-killed spruce terminals.
J. M. Horn	Ignace, Ontario.	55741 to 55749	July 11- July 19	1536 pupae of the Jack pine budworm, Cacoecia fumiferana Clem. (pupal survey)

THE ONTARIO FORESTRY BRANCH CONT'D

Collector	Locality	Box No.	Date Received	Contents
T. Guerard	Savanne, Ontario.	55522 55523 55726 55729 to 55731	July 10 to July 19	3726 pupae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; (pupal survey) 1 adult of a harvest fly, *Cicadidae* sp.
P. Peltier	Kawene, Ontario.	67282	July 14	91 pupae and 36 adults of the Jack pine budworm, *Cacoecia fumiferana* Clem; 1 adult of the parasitic fly, *Ephialtes conquisitor* Say.; 1 adult of a plant bug, *Hemiptera* sp.
Rangers	Farlane, Ontario.	67223	July 15	5 larvae of the poplar borer, *Saperda calcarata* Say.; 1 adult of the milkweed beetle, *Chrysochus auratus* Fab.; 1 egg mass of a spider, *Arachnida* sp.; 1 larva (dead) of a moth, *Lepidoptera* sp.
J. M. Horn	Ignace, Ontario.	67243	July 17	5 larvae of Marlatt's larch sawfly, *Anoplonyx laricis* Marl.; 1 larva of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 adult of the forest soldier bug, *Podisus serieventris* Uhl.

THE ONTARIO FORESTRY BRANCH CONT'D

Collector	Locality	Box No.	Date Received	Contents
E. Rosborough	Ferland, Ontario.	67962	July 18	2 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 2 larvae of the balsam fir sawfly, Neodiprion abietis Harr.; 1 larva of a sphinx moth, Sphingidae sp.
W. Coppard	Vermilion Bay, Ont.	51728	July 19	specimens of galls caused by the gall midge, Phytophaga piceae Felt.
G. Oliver	Armstrong, Ontario.	67763	July 21	6 larvae and 2 pupae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 larva of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 adult of the polished click beetle, Ludius nitidulus Lec.; 4 adults of the 12-spotted lady beetle, Anisocalvia 12-maculata Gebl.; 1 adult of the forest darkling beetle, Upis ceramboides L.; 1 adult of the spittle bug, Aphrophora parallela Say.; 2 spiders, Arachnida sp.; 1 empty pupa case, Lepidoptera sp.
K. Ekhalm	St. Anthony Gold Mine, Ontario.	67760	July 21	4 larvae of the hemlock looper, Ellopia fiscellaria Gn.; 2 adults of the stink bug, Meadorus lateralis Say.; 1 adult of the 2-barred click beetle, Ludius propola Lec.; 1 empty pupal case, Lepidoptera sp.

THE ONTARIO FORESTRY BRANCH CONT'D

Collector	Locality	Box No.	Date Received	Contents
C.R.Richardson	Fort Frances, Ontario.	67259	July 21	Sawfly droppings; 1 adult of a leaf beetle, Chrysomelidae sp.
D. MacMillan	Fee's Spur, Ontario.	67712	July 21	1 portion of a 2-barred click beetle, Ludius propola Lec.; 1 larva of a leaf-roller, Tortricidae sp. (parasitised); 5 cocoons of a parasitic fly, Braconidae sp. (attached to Tortricid); 2 old empty pupa cases (unidentified).
P. Carter	Sioux Lookout, Ont.	51716	July 21	1 adult of the northern smoky moth, Lexis bicolor Grt.; 1 egg mass of the above; 1 adult of the ground beetle, Platynus sinuatus Dej.
P. Carter	Sioux Lookout, Ont.	51717	July 21	1 larva of the false hemlock looper, Nepytia canosaria Wlk.; 1 larva of a firefly, Lampyridae sp.
F. Clark	Flanders, Ontario.	51608	July 21	26 larvae and 21 pupae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.
W.E.Davidson	Tashota, Ontario.	67709	July 22	branch tip killed by borings of a small beetle, Anobiidae sp.(?).

THE ONTARIO FORESTRY BRANCH CONT'D

Collector	Locality	Box No.	Date Received	Contents
A. Longila	MacDiarmid, Ontario.	67367	July 23	30 larvae of a flat-head borer, *Buprestidae* sp.; 18 larvae of a darkling beetle, *Tenebrionidae* sp.; 1 larva, *Coleoptera* sp.
A. Longila	MacDiarmid, Ontario.	19233	July 23	1 adult of the black sawyer beetle, *Monochamus scutellatus* Say.
A. Longila	MacDiarmid, Ontario.	67366	July 23	2 adults of the black sawyer beetle, *Monochamus scutellatus* Say.
R. McNamara	Armstrong, Ontario.	67707	July 23	1 larva of the Jack pine hairstreak, *Incisalia niphon* Hbn.; 1 larva of a looper, *Geometridae* sp.; 1 prepupa of a moth, *Lepidoptera* sp.; 1 adult of a stonefly, *Plecoptera* sp.; 2 larvae and 3 pupae of the red pine sawfly, *Neodiprion resinosae* Provis.
W. H. Fayle	Armstrong, Ontario.	67717	July 24	1 pupa of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 4 adults of the spittle bug, *Aphrophora parallela* Say.; 1 larva of an aphis lion, *Chrysopidae* sp.; 3 larvae of a poplar leaf-folding sawfly, *Pontania* sp.; 1 larva of a leaf-roller, *Tortricidae* sp. 1 larva and 1 pupa of a leaf-curler, *Tortricidae* sp.

THE ONTARIO FORESTRY BRANCH CONT'D

Collector	Locality	Box No.	Date Received	Contents
C.R.Richardson	Fort Frances, Ontario.	67261	July 25	1 larva of a sphinx moth, *Sphingidae* sp.; 1 pupa of a blotch miner, *Microlepidoptera* sp.; small galls.
O.Frederickson	Kawene, Ontario.	67271	July 25	defoliation and cast larval skins of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 pupa of a small larval parasite, *Chalcidae* sp.
C.R.Richardson	Fort Frances, Ont.	67260	July 25	3 larvae of the yellow-headed spruce sawfly, *Pikonema alaskensis* Roh.; 2 egg sacs of a spider, *Arachnida* sp.; 1 gall caused by the spruce gall aphid, *Adelges abietis* L.
G. J. Dahlin	Fort Frances, Ont.	67265	July 26	1 adult of the forest soldier bug, *Podisus serieventris* Uhl.
P. Peltier	Kawene, Ontario.	Special	July 29	insects moulded beyond identification.
G. McLure	Graham, Ontario.	55937	August 2	1 larva of the large willow sawfly, *Cimbex americana* Leach; 1 larva and 1 pupa of a prominent moth, *Schizura* sp.(?); nymphs and adults of a plant lice, *Aphidae* sp.; 2 adults of a lace bug, *Corythuca* sp.

THE ONTARIO FORESTRY BRANCH CONT'D

Collector	Locality	Box No.	Date Received	Contents
G. McLure	Graham, Ontario.	67397	Aug. 2	1 adult of the fritillary butterfly, *Argynnis aphrodite* Fab.
R. Coltrin	Lost Bay, Ontario.	67973	Aug. 5	1 pupa of the giant silkworm, *Telea polyphemus*.
E. Humphrey	Beardmore, Ontario.	67362	Aug. 11	1 larva of a cutworm, *Phalaenidae* sp.; 1 larva of a looper, *Geometridae* sp.; 1 adult of the lacewing fly, *Chrysopa plorabunda* Fitch; 1 nymph of a plant lice, *Aphidae* sp. (parasitised); 3 larvae (dead, unidentified).
J. Basford	Port Arthur, Ontario.	67402	Aug. 11	2 larvae of a budworm, *Tortricidae* sp.
W. E. Davidson	Tashota, Ontario.	67710	Aug. 11	1 larva of a shoot miner, *Anobiidae* sp.(?).
E. W. Rosborough	Ferland, Ontario.	67963	Aug. 15	1 larva of the yellow-headed spruce sawfly, *Pikonema alaskensis* Roh.; 1 larva of the green-headed spruce sawfly, *Pikonema dimmockii* Cress.; 4 larvae of cutworms, *Phalaenidae* sp.; 1 larva of a looper, *Eupithecia* sp.; 1 larva of a brown-headed budworm, *Tortricidae* sp.

THE ONTARIO FORESTRY BRANCH CONT'D

Collector	Locality	Box No.	Date Received	Contents
Ranger Station	Red Lake, Ontario.	67720	Aug. 18	3 larvae of the dotted line geometer, *Protoboarmia porcelaria* Gn.; 1 pupa of the hemlock looper, *Ellopia fiscellaria* Gn.; 1 larva of the cutworm, *Palthis angulatis*; 1 adult of the leaf beetle, *Cleis picta Rand*.; 1 adult of the long horn borer, *Bellamira scalaris* Say.; 1 adult of the bronze birch borer, *Agrilus anxius* Gory; 1 pupa of a sawfly, *Neodiprion* sp. (parasitised); 3 larvae of a small leaf-roller, *Tortricidae* sp.; 1 larva of a budworm, *Tortricidae* sp.
Ranger Station	Red Lake, Ontario.	67725	Aug. 18	6 larvae of the sawfly, *Croesus latitarsus* Nort.; 40 larvae and 2 pupae of the birch leaf skeletonizer, *Bucculatrix canadensisella* Chamb.; 5 nymphs and 1 adult of a lacebug, *Corythuca* sp.; 2 larvae of a leaf miner, *Tortricidae* sp.

Collector	Locality	Box No.	Date Received	Contents
Ranger Station	Red Lake, Ontario.	67726	Aug. 18	1 larva of a budworm, Tortricidae sp.; 1 adult of the firefly, Lucidota corrusca L.; 1 adult of a small leaf-roller, Tortricidae sp.; 1 adult of the darkling beetle, Scaphidema aeneolum Lec.; 1 adult of the leaf beetle, Cleis picta Rand.; 1 adult of a predaceous beetle, Coleoptera sp.
Ranger Station	Red Lake, Ontario.	67722	Aug. 18	1 larva of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 larva and 1 pupa of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 larva of a looper, Geometridae sp.; 1 larva of a budworm, Tortricidae sp.; 1 pupa of a moth, Lepidoptera sp. (parasitised).
Ranger Station	Red Lake, Ontario.	67719	Aug. 18	1 larva of a looper, Eupithecia sp.; 3 larvae of a budworm, Tortricidae sp.; 1 adult of the forest soldier bug, Podisus serieventris Uhl.

Collector	Locality	Box No.	Date Received	Contents
G. Oliver	Armstrong, Ontario.	67764	Aug. 18	1 adult of the lacewing fly, Chrysopa plorabunda Fitch; 2 adults of the 12-spotted lady beetle, Anisocalvia 12-maculata Gebl.; 2 adults of the lady beetle, Anisocalvia 14-guttata L.; 5 larvae and 2 pupae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 adult of a leaf hopper, Membracidae sp.; several spiders, Arachnida sp.; several needles with spruce needle rust, Chrysomyxa sp;
Ranger Station	Red Lake, Ontario.	67721	Aug. 18	1 spider, Arachnida sp.
R. McNamara	Armstrong, Ontario.	67708	Aug. 18	1 larva of a prominent moth, Schizura sp.(?); work of birch leaf skeletonizer, Bucculatrix canadensisella Chamb.

THE ONTARIO FORESTRY BRANCH CONT'D

Collector	Locality	Box No.	Date Received	Contents
K. Ekhalm	St. Anthony Mine, Ont.	67761	Aug. 18	1 adult of the large spruce weevil, Hypomolyx piceus DeG.; 1 adult of the forest darkling beetle, Upis ceramboides L.; 1 larva of a cutworm, Phalaenidae sp.; 1 larva of a leaf-roller, Tortricidae sp.; 2 larvae of a budworm, Tortricidae sp.; 3 larvae and 1 adult of the leaf beetle, Chrysomela tremulae Fab.; 1 larva of a leaf beetle, Chrysomelidae sp.; 1 nymph and 2 adults of a plant lice, Aphidae sp.
V. Johnson	Lake St. Joseph, Ont.	67562	Aug. 20	1 cocoon of the giant silkworm, Tropoea luna L.; 4 larvae and 3 pupae of the birch leaf skeletonizer, Bucculatrix canadensisella Chamb.
P. Peltier	Kawene, Ontario.	55722	Aug. 20	1 adult of a hornet, Vespidae sp.; 3 ants, Formicidae sp.; nymphs and aphids of a plant lice, Aphidae sp.; 3 eggs of a lacewing fly, Chrysopidae sp.

THE ONTARIO FORESTRY BRANCH CONT'D

Collector	Locality	Box No.	Date Received	Contents
Ranger Station	Armstrong, Ontario.	17251	Aug. 22	5 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 2 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 2 larvae of the green spruce looper, Semiothisa sp.
Ranger Station	Central Patricia P.O.	67564	Aug. 22	Insects escaped in transit.
Ranger Station	Central Patricia P.O.	67617	Aug. 22	1 larva and 1 prepupa of a looper, Eupithecia sp.; 1 empty pupa of the Jack pine bud-worm, Cacoecia fumiferana Clem.; needles with spruce rust pustules, Chrysomyxa sp.
Ranger Station	Central Patricia P.O.	67565	Aug. 22	pupae of the birch leaf skeletonizer, Bucculatrix canadensisella Chamb.; 1 larva and 3 cocoons of a sawfly, Tenthredinidae sp.; 1 larva of a cutworm, Phalaenidae sp.; 1 larva of a looper, Geometridae sp.
W. H. Fayle	Armstrong, Ontario.	67625	Aug. 23	1 pupa and 7 larvae of the European larch sawfly, Pristiphora erichsonii Htg.; 94 larvae of Marlatt's sawfly, Anoplonyx laricis Marl.; 4 larvae of a green looper, Eupithecia sp.; 1 larva of the dotted line geometer, Protoboarmia porcelaria Gn.; 1 adult of a plant bug, Hemiptera sp.; 1 pupa of a moth, Microlepidoptera sp.

THE ONTARIO FORESTRY BRANCH CONT'D

Collector	Locality	Box No.	Date Received	Contents
D. MacMillan	Fee's Spur, Ontario.	67713	Aug. 23	Insects escaped in transit.
G. Oliver	Armstrong, Ontario.	67572	Aug. 25	1 larva of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.
W. E. Davidson	Tashota, Ontario.	67571	Aug. 25	8 larvae of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 2 larvae of the green spruce looper, Semiothisa granitata Gn.; 1 larva of a looper, Geometridae sp.
W. E. Davidson	Tashota, Ontario.	67622	Aug. 25	1 larva of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 larva of the hemlock looper, Ellopia fiscellaria Gn.
J. Ruxton	Armstrong, Ontario.	67574	Aug. 25	1 larva and 27 cocoons of the European larch sawfly, Pristiphora erichsonii Htg.
R. Berglund	Swain Lake, Ontario.	67560	Aug. 25	1 larva of a small leaf-roller, Tortricidae sp.; 6 scales of the spruce bud scale, Physokermes piceus Schr.; 1 empty cocoon of a lacewing fly, Chrysopidae sp.; several spiders, Arachnida sp.

THE ONTARIO FORESTRY BRANCH CONT'D

Collector	Locality	Box No.	Date Received	Contents
R. Berglund	Swain Lake, Ontario.	67561	Aug. 25	2 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 adult of the hemlock Looper, Ellopia fiscellaria Gn.; 1 adult of the lady beetle, Hippodamia 5-signata Kby.; 2 adults of the larder beetle, Dermestes larderius L.; 1 adult of a weevil, Curculionidae sp.; leaves eaten by the birch leaf skeletonizer, Bucculatrix canadensisella Chamb.; several spiders, Arachnida sp.
J. Basford	Port Arthur, Ontario.	67402	Aug. 29	3 larvae of the birch leaf skeletonizer, Bucculatrix canadensisella Chamb.
J. P. Bilski	Armstrong, Ontario.	67969	Sept. 2	1 larva of a climbing cutworm, Phalaenidae sp.
W. H. Fayle	Armstrong, Ontario.	Parcel	Sept. 5	1 adult of a horntail, Siricidae sp.
P. Peltier	Kawene, Ontario.	55723	Sept. 6	1 adult of the grey sawyer beetle, Monochamus notatus Dru.; 1 adult of the sawyer beetle, Monochamus titillator Fab.
W. E. Davidson	Tashota, Ontario.	67967	Sept.15	1 adult of the lacewing fly, Chrysopa californica Coq.; 1 empty egg sac of a spider, Arachnida sp.

MANITOBA FOREST SERVICE

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Collector	Locality	Box No.	Date Received	Contents
H. L. Kendrick	Riverton, Manitoba.	67830	May 30	6 larvae of a leaf roller, Tortricidae sp.; 25 larvae of the leaf beetle, Phytodecta americana Schffr.; nymphs and adults of a plant lice, Aphidae sp.
H. L. Kendrick	Riverton, Manitoba.	67829	June 2	26 adults of the leaf beetle, Phytodecta americana Schffr.
J. J. Wright	Sprague, Manitoba.	67801	June 4	8 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.
J. J. Wright	Sprague, Manitoba.	67802	June 4	Jack pine scale, Toumeyella numismaticum P. & M.; 1 adult of an ant, Formicidae sp.
J. J. Wright	Sprague, Manitoba.	67925	June 6	1 larva of a brown looper, Paraphia piniata Pack.
H. L. Kendrick	Riverton, Manitoba.	67827	June 16	11 adults of the scarab beetle, Dichelonycha elongata Fab.
H. L. Kendrick	Riverton, Manitoba.	67828	June 16	2 adults of the ladybird beetle, Anatis mali Say.

MANITOBA FOREST SERVICE CONT'D

Collector	Locality	Box No.	Date Received	Contents
A. Sinclair	Cross Lake, Manitoba.	52013	June 16	2 adults of the 2-barred click beetle, *Ludius propola* Lec.; 2 adults of the leaf beetle, *Chrysomela tremulae* Fab.; 1 adult of the leaf beetle, *Synosa pylosa* Brown; 1 adult of the click beetle, *Ludius nitidulus* Lec.
J. Kokindovich	Woodridge, Manitoba.	67866	June 17	1 adult of the weevil, *Lapyrus palustris* Scop.; nymphs and adults of a plant lice, *Aphidae* sp.
J. J. Wright	Sprague, Manitoba.	51980	June 17	nymphs and adults of a plant lice, *Aphidae* sp.
J. J. Wright	Sprague, Manitoba.	51979	June 17	nymphs and adults of a plant lice, *Aphidae* sp.; 3 larvae of the Jack pine budworm, *Cacoecia fumiferana* Clem.
C. H. Patterson	Grandview, Manitoba.	67841	June 18	4 adults of the 2-barred click beetle, *Ludius propola* Lec.; 1 adult of the click beetle, *Ludius resplendens* Esch.

MANITOBA FOREST SERVICE CONT'D

Collector	Locality	Box No.	Date Received	Contents
C. H. Patterson	Grandview, Manitoba.	67842	June 18	1 adult of the 3-barred click beetle, *Ludius triundulatus* Rand.
C. H. Patterson	Grandview, Manitoba.	67843	June 18	6 adults of the 2-barred click beetle, *Ludius propola* Lec.; 1 adult of the 3-barred click beetle, *Ludius triundulatus* Rand.; 1 adult of the click beetle, *Ludius stricklandi* Brown; 1 gall of the spruce gall aphid, *Adelges abietis* L.; several frost-killed terminals; Chrysomyxa leaf rust on white spruce needles.
C. H. Patterson	Grandview, Manitoba.	67899	June 18	2 galls caused by a plant lice, *Eriophyes* sp.; nymphs and adults of a plant lice, *Aphidae* sp.; 23 larvae of the leaf beetle, *Phytodecta americana* Schffr.; 1 adult of the large weevil, *Lepyrus palustris* Scop.; 1 adult of a weevil, *Ceutorhynchus* sp.; 1 larva of a leaf-rolling poplar sawfly, *Pontania* sp.; 7 larvae of a predator fly, *Syrphidae* sp.

MANITOBA FOREST SERVICE CONT'D

Collector	Locality	Box No.	Date Received	Contents
G. V. Evans	Gods Lake, Manitoba.	51821	June 19	1 adult of the large spruce weevil, Hypomolyx piceus De G.; 1 adult of the little brown click beetle, Agriotes limosus Lec.; 1 adult of the click beetle, Limonus aeger Lec.; 1 red spider, Paratetranychus ununguinis Jac.
P. W. Durant	Norway House, Manitoba.	67859	June 21	1 adult of the inky click beetle, Ludius appropinquans Rand.; 2 adults of the dun click beetle, Ludius medianus Germ.; 1 adult of the polished click beetle, Ludius nitidulus Lec.; 1 adult of the click beetle, Limonus aeger Lec.; 1 adult of a stone fly, Plecoptera sp.

MANITOBA FOREST SERVICE CONT'D

Collector	Locality	Box No.	Date Received	Contents
A. Sinclair	Cross Lake, Manitoba.	52011	June 22	1 larva of the dotted line geometer, Protoboarmia porcelaria Gn.; 1 pupa of a ladybird beetle, Coccinellidae sp.; 1 adult of the weevil, Notaris aethiops Fab.; 1 adult of a blister beetle, Podabrus sp.; 2 adult flies, Diptera sp.; 5 adults of the 2-barred click beetle, Ludius propola Lec.; 3 adults of the 3-barred click beetle, Ludius triundulatus Rand.; 1 adult of the polished click beetle, Ludius nitidulus Lec.; 3 adults of the click beetle, Ludius watsoni Brown; 1 larva of a fly, Diptera sp.
C. Dunlop	Deepdale, Manitoba.	67893	June 23	1 adult of the 2-barred click beetle, Ludius propola Lec.

MANITOBA FOREST SERVICE CONT'D

Collector	Locality	Box No.	Date Received	Contents
F. R. de Delley	Douglas, Manitoba.	67824	June 23	nymphs and adults of a plant lice, *Aphidae* sp.
J. C. Thompson	Whitemouth, Manitoba.	67885	June 24	15 needles with eggs of the Jack pine sawfly.
H. L. Kendrick	Riverton, Manitoba.	55635	June 24	11 larvae of the Jack pine budworm, *Cacoecia fumiferana* Clem.
R. Nelson	Winnipegosis, Manitoba.	67488	June 25	1 larva of a cutworm, *Phalaenidae* sp.; 1 larva of the shoot moth, *Zeiraphera ratzburgiana* Sax.; 6 spiders, *Arachnida* sp.
J. Kokindovich	Woodridge, Manitoba.	67825	June 26	nymphs of the Jack pine scale, *Toumeyella numismaticum* P. & M.; 6 larvae of the coccinellid predator, *Hyperaspis binotatus* Say.; 2 adults of the leaf beetle, *Galeruca externa* Say.; 1 adult of the ground beetle, *Carabus taedatus* Fab.

MANITOBA FOREST SERVICE CONT'D

Collector	Locality	Box No.	Date Received	Contents
H. L. Kendrick	Riverton, Manitoba.	55634	June 26	9 larvae of the European larch sawfly, Pristiphora erichsonii Htg.; 1 needle, leaf rust, Chrysomyxa sp.
H. L. Kendrick	Riverton, Manitoba.	55631	June 28	1 larva of a cutworm, Phalaenidae sp.; 4 adults of the Jack pine budworm, Cacoecia fumiferana Clem.; 4 egg masses of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 larva of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 4 needles, leaf rust, Chrysomyxa sp.
R. Bell	Dauphin, Manitoba.	67891	June 30	2 cocoons of the forest tent caterpillar, Malacosoma disstria Hbn.
B. Emes	Richer, Manitoba.	67817	July 5	1 nodule (old) of a pitch-pine nodule maker, possibly Petrova albicapitana Busch.

MANITOBA FOREST SERVICE CONT'D

Collector	Locality	Box No.	Date Received	Contents
Bjorn Balchen	Pine Falls, Manitoba.	67834	July 5	1 larva (dead) of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 3 pupae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 pupa of a dipterous parasite of the budworm.
R. Nelson	Winnipegosis, Manitoba.	67489	July 7	2 larvae and 2 pupae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 cocoon of a parasitic fly, *Diptera* sp.; 1 larva of the brown-headed budworm, *Sparganothis tristriata* Kearf.
F. R. de Delley	Douglas, Manitoba.	67821	July 11	1 nodule made by a pine nodule maker on Scotch pine, *Petrova* sp.
A. R. Sutherland	Island Lake, Manitoba.	52014	July 12	2 larvae(dead), unidentifiable.
F. Imrie	Barrows, Manitoba.	67492	July 14	1 adult of a sphinx moth, *Sphingidae* sp.

MANITOBA FOREST SERVICE CONT'D

Collector	Locality	Box No.	Date Received	Contents
H. L. Kendrick	Riverton, Manitoba.	55634	June 26	9 larvae of the European larch sawfly, *Pristiphora erichsonii* Htg.; 1 needle, leaf rust, *Chrysomyxa* sp.
H. L. Kendrick	Riverton, Manitoba.	55631	June 28	1 larva of a cutworm, *Phalaenidae* sp.; 4 adults of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 4 egg masses of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 larva of the yellow-headed spruce sawfly, *Pikonema alaskensis* Roh.; 4 needles, leaf rust, *Chrysomyxa* sp.
R. Bell	Dauphin, Manitoba.	67891	June 30	2 cocoons of the forest tent caterpillar, *Malacosoma disstria* Hbn.
B. Emes	Richer, Manitoba.	67817	July 5	1 nodule (old) of a pitch-pine nodule maker, possibly *Petrova albicapitana* Busch.

MANITOBA FOREST SERVICE CONT'D

Collector	Locality	Box No.	Date Received	Contents
Bjorn Balchen	Pine Falls, Manitoba.	67834	July 5	1 larva (dead) of the Jack pine budworm, Cacoecia fumiferana Clem.; 3 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 pupa of a dipterous parasite of the budworm.
R. Nelson	Winnipegosis, Manitoba.	67489	July 7	2 larvae and 2 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 cocoon of a parasitic fly, Diptera sp.; 1 larva of the brown-headed budworm, Sparganothis tristriata Kearf.
F. R. de Delley	Douglas, Manitoba.	67821	July 11	1 nodule made by a pine nodule maker on Scotch pine, Petrova sp.
A. R. Sutherland	Island Lake, Manitoba.	52014	July 12	2 larvae(dead), unidentifiable.
F. Imrie	Barrows, Manitoba.	67492	July 14	1 adult of a sphinx moth, Sphingidae sp.

MANITOBA FOREST SERVICE CONT'D

Collector	Locality	Box No.	Date Received	Contents
C. J. Ritchie	Whiteshell, Manitoba.	52332	July 21	2 pupae of a sawfly, possibly *Neodiprion abietis* Harr.
Bjorn Balchen	Pine Falls, Manitoba.	67835	July 21	considerable leaf rust on spruce, *Chrysomyxa* sp.
A. Sinclair	Cross Lake, Manitoba.	52012	July 21	1 adult of the forest tent caterpillar, *Malacosoma disstria* Hbn.; 1 adult of the cutworm moth, *Panthea furcilla* Pack.; 1 adult of a Pyraustid moth; 1 adult of a Pyralid moth; 1 adult of a fish-fly, *Trichoptera* sp.; 3 larvae of the hemlock looper, *Ellopia fiscellaria* Gn.; 1 larva of the looper, *Nyctobia limitaria* Wlk.; 1 larva of a looper, *Geometridae* sp. 3 larvae of the green-headed spruce sawfly, *Pikonema dimmockii* Cress.; 2 larvae of the balsam fir sawfly, *Neodiprion abietis* Harr.; 1 larva of the brown-headed budworm, *Peronea variana* Fern.; 1 larva of a tussock moth, *Liparidae* sp.

Collector	Locality	Box No.	Date Received	Contents
A. Sinclair (Cont'd)				1 adult and 1 pupa of the ladybird beetle, Cleis picta Rand.; 1 nymph of a plant lice, Aphidae sp.; 1 nymph of a plant bug, Hemiptera sp.; 1 pupa of a 2-winged fly, Diptera sp.; 1 adult of a small moth, Microlepidoptera sp.
G. J. Evans	Gods Lake, Manitoba.	51819	July 24	1 adult of the large spruce weevil, Hypomolyx piceus De G.; 3 spiders, Arachnida.
A.R. Sutherland	Island Lake, Manitoba.	52016	July 24	2 adults of the red admiral butterfly, Vanessa atalanta L.; 1 adult of the 2-striped grass-hopper, Melanoplus bivittatus; 1 adult of the forest darkling beetle, Upis ceramboides L.; 1 adult of a spider, Arachnida sp.

MANITOBA FOREST SERVICE CONT'D

Collector	Locality	Box No.	Date Received	Contents
W. L. Hislop	Wabowden, Manitoba.	52018	July 25	5 larvae of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 1 larva of a looper, Geometridae sp.; heavy leaf rust, Chrysomyxa sp.
J. W. Wedge	Thicket Portage, Man.	51825	July 25	9 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 5 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 2 larvae of the balsam fir sawfly, Neodiprion abietis Harr.; 2 larvae of a sphinx moth, Sphingidae sp.; 1 larva of a looper, Geometridae sp.; 1 adult of a crane fly, Tipulidae sp.; 1 adult of an ant, Formicidae sp.; 1 adult of a spider, Arachnida sp.; extensive Chrysomyxa leaf rust.

Collector	Locality	Box No.	Date Received	Contents
J. W. Wedge	Thicket Portage, Man.	51823	July 25	11 larvae and 4 pupae of the sawfly, Pikonema alaskensis Roh.; 1 spider, Arachnida sp.; heavy leaf rust, Chrysomyxa sp.
P. W. Durant	Norway House, Manitoba.	67855	July 28	1 adult of a bark louse, Corrodentia sp.
C. Dunlop	Deepdale, Manitoba.	67865	July 28	2 adult spiders, Arachnida sp.
E. Marner	Garland, Manitoba.	67847	July 29	nymphs and adults of the spruce gall aphid, Adelges abietis L.
T. P. Williams	Carberry, Manitoba.	29231	August 5	1 nodule caused by and 1 larva of a pitch nodule maker, Petrova sp.
T. B. Vermilyea	Rennie, Manitoba.	67902	Aug. 11	needles with leaf rust pustules, Chrysomyxa sp.
A.R. Sutherland	Island Lake, Manitoba.	52243	Aug. 14	6 larvae and 3 cocoons of the European larch sawfly, Pristiphora erichsonii Htg.; 1 adult of the stink bug, Podisus serieventris Uhl.; 1 adult of the stink bug, Podisus modestus Dahl.; 1 larva of a looper, Geometridae sp.; 1 pupa of a moth, Lepidoptera sp.

MANITOBA FOREST SERVICE CONT'D

Collector	Locality	Box No.	Date Received	Contents
T. P. Williams	Carberry, Manitoba.	-------	Aug. 14	1 adult of the darkling beetle, Tenebrio picipes Hbst.
J. Kokindovich	Woodridge, Manitoba.	67816	Aug. 18	10 adults and 6 larvae of the white pine weevil, Pissodes strobi Peck.; 10 larvae of a parasitic fly, Diptera sp.; 1 larva of a predator, Coleoptera sp.
J. G. Somers	Dauphin, Manitoba.	52025	Aug. 19	41 pupae and 2 larvae of the birch leaf skeletonizer, Bucculatrix canadensisella Chamb.
T. Ewens	The Pas, Manitoba.	67852	Aug. 20	4 empty cocoons of the forest tent caterpillar, Malacosoma disstria Hbn.; 10 larvae of the leaf-roller, Meroptera pravella Grt.
T. Ewens	The Pas, Manitoba.	67854	Aug. 20	2 adults of the firefly, Lucidota corrusca L.; twigs showing borings as of a twig borer in terminals.

MANITOBA FOREST SERVICE CONT'D

Collector	Locality	Box No.	Date Received	Contents
T. Ewens	The Pas, Manitoba.	67853	Aug. 22	3 cones with borings of a coneworm, probably Dioryctria reniculella Grt.; 2 larvae of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 1 adult of a stone fly, Plecoptera sp.
T. P. Williams	Carberry, Manitoba.	------	Aug. 23	2 adults of the stink bug, Chlorochroa uhleri Stahl.
A. Sinclair	Cross Lake, Manitoba.	51951 (Bottle 3)	Aug. 25	2 nymphs, 3 adults of the stink bug, Elasmostethus cruciatus Say.; 1 larva of the dotted line geometer, Protoboarmia porcelaria Gn.; 1 larva of a looper, Geometridae sp.; 1 larva of a looper, Geometridae sp.; 1 larva of a looper, Geometridae sp.; 3 larvae of a looper, Geometridae sp.; 3 nymphs of a plant lice, Aphidae sp.; 2 larvae of a sawfly, Tenthredinidae sp.; 20 larvae of the birch leaf skeletonizer, Bucculatrix canadensisella Chamb.; 1 adult of a stone fly, Plecoptera sp.;

Collector	Locality	Box No.	Date Received	Contents
A. Sinclair (Cont'd)				3 larvae of a leaf-roller, Tortricidae sp.; 1 larva of a ladybird beetle, Coccinellidae sp.
A. Sinclair	Cross Lake, Manitoba.	52236	Aug. 25	10 larvae and 36 pupae of the birch leaf skeletonizer, Bucculatrix canadensisella Chamb.; 1 larva of a green spruce looper, Semiothisa sp.
R. Nelson	Winnipegosis, Manitoba.	67490	Aug. 25	numerous spiders, Arachnida sp.
G. W. Malaher	Rennie, Manitoba.	67914	Aug. 28	1 larva of a banded leaf miner, probably Recurvaria sp.; terminal frost damage on black spruce; considerable leaf rust, Chrysomyxa sp.
W. L. Hislop	Wabowden, Manitoba.	52019	Aug. 29	4 larvae of the fall webworm, Hyphantria cunea Dru.; 1 larva of the green spruce looper, Semiothisa granitata Gn.; 1 larva of the birch leaf skeletonizer, Bucculatrix canadensisella Chamb.; considerable skeletonizing by the above.

MANITOBA FOREST SERVICE CONT'D

Collector	Locality	Box No.	Date Received	Contents
A.R. Sutherland	Island Lake, Manitoba.	52017	Sept. 2	3 pupae of the birch leaf skeletonizer, Bucculatrix canadensisella Chamb.; 2 larvae of the birch sawfly, Cimbex americana Leach; 1 adult of the forest darkling beetle, Upis ceramboides L.; elytron of the 3-barred click beetle, Ludius triundulatus Rand.; portion of tipulid wing.
A. R. Harvey	The Pas, Manitoba.	51810	Sept. 3	1 larva of a climbing cutworm, Phalaenidae sp.; 2 larvae of a looper, Geometridae sp.; 1 larva of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 1 larva of a predator fly, Syrphidae sp.
F. R. de Delley	Douglas, Manitoba.	67822	Sept. 8	nymphs and adults of the plant lice on Russian willow, Lachnus salignus Gmelin.
T. P. Williams	Carberry, Manitoba.	------	Sept. 13	1 larva of a prominent moth, Notodontidae sp.

MANITOBA FOREST SERVICE CONT'D

Collector	Locality	Box No.	Date Received	Contents
J. J. Wright	Sprague, Manitoba.	67803	Sept. 15	14 adults of the eastern pine engraver beetle, _Ips pini_ Say.
A. Sinclair	Cross Lake, Manitoba.	26771	Sept. 23	5 adults of the soldier bug, _Elasmostethus cruciatus_ Say.; 1 adult of the flower beetle, _Cyphon variabilis_ Thumb.; 1 adult of a parasitic wasp, _Hymenoptera_ sp.; 1 adult of a caddice fly, _Trichoptera_ sp.; 1 larva of the dotted line geometer, _Protoboarmia porcelaria_ Gn.
T. P. Williams	Carberry, Manitoba.	------	Oct. 2	1 adult of the long horned borer, _Merium proteus_ Kby.

DEPARTMENT OF NATURAL RESOURCES - SASKATCHEWAN

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
J. A. Suffern	Yonker, Sask.	55830	June 17	1 larva of a leaf roller, Tortricidae sp.; 1 larva of a small moth, Lepidoptera sp.; several nymphs of a plant lice, Aphidae sp.; 1 adult parasite of an aphid nymph, Braconidae sp.
C. T. Dell	Kamsack, Sask.	55826	June 18	7 cocoons of the forest tent caterpillar, Malacosoma disstria Hbn.
C. T. Dell	Kamsack, Sask.	5582-	June 18	1 larva of a predaceous fly, Syrphidae sp. (?); considerable damage by a leaf roller, Tortricidae sp.
L. S. Horne	Kinistino, Sask.	67510	June 23	3 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 larva of the green-striped caterpillar, Feralia jocosa Gn.; 1 scale of the pine tortoise scale, Toumeyella numismaticum P. & M.; woolly aphids on Jack pine, Aphidae sp.; 2 larvae of a predator fly (on aphids), Diptera sp.; woolly mass enclosing parasitic flies, Braconidae sp.; nymph of a spittle bug, Aphrophora sp.

Collector	Locality	Box No.	Date Received	Contents
H. E. Tanner	Gronlid, Sask.	67506	June 23	6 larvae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 Jack pine tortoise scale, *Toumeyella* numismaticum P. & M.
L. S. Horne	Kinistino, Sask.	67541	June 24	1 larva of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 larva of the green-striped caterpillar, *Feralia jocosa* Gn.; 2 larvae of the leaf-miner, *Zelleria haimbachi* Busch.; 1 larva of a moth, *Lepidoptera*.
H. D. Long	Prince Albert, Sask.	67122	June 25	1 adult of the polished click beetle, *Ludius nitidulus* Lec.; 4 adults of the 2-barred click beetle, *Ludius propola* Lec.; 2 adults of the 3-barred click beetle, *Ludius triundulatus* Rand.; 1 adult of the leaf beetle, *Syneta pilosa* Brown; 1 adult of the weevil, *Hylobius congenei* D.T.; 2 larvae of a sawfly, possibly *Neodiprion* sp.; 4 adult dragon flies, *Odonata* sp.

DEPARTMENT OF NATURAL RESOURCES - SASKATCHEWAN - CONT'D

Collector	Locality	Box No.	Date Received	Contents
H. D. Long	Prince Albert, Sask.	67121	June 25	1 adult of the black sawyer beetle, Monochamus scutellatus Say.; 1 adult of a parasitic wasp, Ichneumonidae sp.; 1 adult of a leaf beetle, Chrysomelidae sp.
H. D. Long	Prince Albert, Sask.	67120	June 25	2 adults of the black sawyer beetle, Monochamus scutellatus Say.; 2 adults of a long horn beetle, Graphisurus sp.; 1 adult of the polished click beetle, Ludius nitidulus Lec.; 2 adults of the click beetle, Adelocera brevicornis Lec.; 1 adult of the pine dicerca, Dicerca tenebrosa Kby.; 1 adult of a firefly, Silis sp.; 1 adult of a sawfly, Tenthredinidae sp.; 2 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 pupa of a hover fly, Syrphidae sp.; 1 larva of a ladybird beetle, Coccinellidae sp.
T. A. James	Lizard Lake, Sask.	67601	June 26	3 cocoons of the forest tent caterpillar, Malacosoma disstria Hbn.; 1 large spider, Arachnida sp.
G. Smith	Warmley, Sask.	67160	June 30	about 50 larvae of the cherry ugly nest tortrix, Cacoecia cerasivorana Fitch.

DEPARTMENT OF NATURAL RESOURCES - SASKATCHEWAN - CONT'D

Collector	Locality	Box No.	Date Received	Contents
H. E. Tanner	Gronlid, Sask.	67527	July 2	51 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.
H. E. Tanner	Gronlid, Sask.	67526	July 2	16 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.; 2 pupae of a parasitic fly, possibly Nemorilla maculosa Meigh.; Male and female scales of the pine tortoise scale, Toumeyella numismaticum P. & M.; Sooty fungus accompanying scale, Capnoidae sp.; 1 larva of the pitch pine nodule maker, Petrova albicapitana Busch.
R. T. Pike	Meadow Lake, Sask.	67155	July 5	9 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 pupa case of a moth, Lepidoptera sp.; 1 pupa case of a wasp, Hymenoptera sp.; 1 adult of a fly, possibly Nemorilla sp.; terminal galls caused by plant lice, Aphidae.
F. Mitchell	Loon Lake, Sask.	67143	July 7	1 larva of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 3 cast skins of a plant lice, Aphidae sp.
F. Mitchell	Loon Lake, Sask.	54120	July 7	7 larvae and 5 pupae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.

Collector	Locality	Box No.	Date Received	Contents
F. Mitchell	Loon Lake, Sask.	67144	July 7	10 larvae of the yellow-headed spruce sawfly, *Pikonema alaskensis* Roh.; 1 larva of the green-headed spruce sawfly, *Pikonema dimmockii* Cress.
L. S. Horne	Kinistino, Sask.	67533	July 9	1 pupa of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 larva of a climbing cutworm, *Phalaenidae* sp.; 1 adult of a ladybird beetle, *Exochmus* sp.; 1 egg mass of a plant bug, possibly kissing bug, *Reduviidae* sp.
H. E. Tanner	Gronlid, Sask.	67530	July 10	spruce twigs killed by late spring frosts.
H. E. Tanner) L. S. Horne) T. Forsythe)	Kinistino, Sask.	special	July 8, 9, 14, 15.	2809 pupae of the Jack pine budworm, *Cacoecia fumiferana* Clem. (pupal survey)
M. Hitchcock	Maple Creek, Sask.	67164	July 14	1 larva of a caterpillar, *Nymphalidae* sp.; 3 skins and 3 pupae of a parasitic wasp, *Chalcidae* sp.; 1 adult of a parasitic wasp, *Chalcidae* sp.
M. Hitchcock	Maple Creek, Sask.	67165	July 14	nymphs and adults of a plant bug, *Miridae* sp.; 1 larva of a ladybird beetle, *Coccinellidae* sp.; 1 larva of a predaceous fly, *Syrphidae* sp.

DEPARTMENT OF NATURAL RESOURCES - SASKATCHEWAN - CONT'D

Collector	Locality	Box No.	Date Received	Contents
M. Hitchcock	Maple Creek, Sask.	67166	July 14	nymphs and adults of a plant lice, *Aphidae* sp.; 3 adults of the ladybird beetle, *Hippodamia 5-signata* Kby.; 1 larva of a ladybird beetle, *Adalia* sp.; 3 larvae and 1 pupa of a predaceous fly, *Syrphidae* sp.
T. Pugh	Meadow Lake, Sask.	16036	July 21	dead needles (cause of death not insects).
H. E. Tanner	Gronlid, Sask.	67655	July 22	28 pupae and 4 adults of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 adult of a parasitic fly, *Diptera* sp.; 1 pupa of a parasitic fly, possibly *Nemorilla* sp.; 15 larvae of the yellow-headed Jack pine sawfly, *Neodiprion dubiosus* Schedl.
L. S. Horne	Kinistino, Sask.	67656	July 29	9 pupae of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 3 larvae and 5 pupae of a parasitic fly, possibly *Nemorilla* sp.; terminal killing, due to a spittle bug or mite(?).

DEPARTMENT OF NATURAL RESOURCES - SASKATCHEWAN - CONT'D

Collector	Locality	Box No.	Date Received	Contents
R. D. Symons	Maple Creek, Sask.	67170	Aug. 5	6 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.
F. W. Redhead	Prince Albert, Sask.	16200	Aug. 13	nymphs and adults of a plant lice, Aphidae sp.; 2 larvae and 1 pupa of the ladybird beetle, Coccinella perplexa Muls.; 8 larvae and 1 pupa of a predaceous fly, Syrphidae sp.; 8 pupae of a small parasitic fly, Diptera sp.; 8 cocoons of a parasitic wasp, Braconidae sp.

RIDING MOUNTAIN NATIONAL PARK - MANITOBA

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
D. B. Binkley	Crawford Park, Manitoba.	67334	June 30	1 larva of a ladybird beetle, Coccinellidae sp.; 1 adult of the firefly, Lucidota corrusca L.; 1 adult of the polished click beetle, Ludius nitidulus Lec.; portion of abdomen of the European larch sawfly, Pristiphora erichsonii Htg.; 4 nymphs of a plant lice, Aphidae sp.
R. T. Hand	Dauphin, Manitoba.	67339	July 11	27 larvae of the leaf-roller, Meroptera pravella Grt.; leaf galls due to a plant lice, Aphidae sp.; 1 pupa of a small moth, Lepidoptera sp.; 2 larvae of a predaceous fly, Syrphidae sp.
R. T. Hand	Dauphin, Manitoba.	67340	July 12	aspen stem swellings, probably due to borings of a small cerambycid, Oberea sp.

RIDING MOUNTAIN NATIONAL PARK - MANITOBA - CONT'D

Collector	Locality	Box No.	Date Received	Contents
D. B. Binkley	Crawford Park, Manitoba.	67333	July 16	18 larvae and 12 pupae of the European larch sawfly, Pristiphora erichsonii Htg.; 2 larvae of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 2½" length of stem and 46 larvae and 8 pupae of the white pine weevil, Pissodes strobi Peck.; 1 adult of the large spruce weevil, Hypomolyx piceus DeG.; 1 adult of the apple ladybird beetle, Anatis mali Say.; 1 gall caused by the spruce gall aphid, Adelges abietis L.
O. E. Heaslip	Wasagaming, Manitoba.	Special	July 14-18	1,965 pupae of the Jack pine budworm, Cacoecia fumiferana Clem. (pupal survey collections)
J. Hyska	Rossburn, Manitoba.	67350	July 21	5 larvae of the European larch sawfly, Pristiphora erichsonii Htg.; 15 pupae of the European larch sawfly, Pristiphora erichsonii Htg.; 1 egg nest of a spider, Arachnida sp.
R. D. McKinnon	Oatseed, Manitoba.	67344	Aug. 21	1 larva of a budworm, Tortricidae sp.; several nests of a spider, Arachnida sp.

RIDING MOUNTAIN NATIONAL PARK - MANITOBA - CONT'D

Collector	Locality	Box No.	Date Received	Contents
J. Hyska	Rossburn, Manitoba.	35324	Sept. 2	99 cocoons of the European larch sawfly, *Pristiphora erichsonii* Htg.; 1 pupa of a moth, *Lepidoptera*.
J. Hyska	Rossburn, Manitoba.	34922	Sept. 2	58 cocoons of the European larch sawfly, *Pristiphora erichsonii* Htg.
J. Hyska	Rossburn, Manitoba.	34929	Sept. 19	143 cocoons of the European larch sawfly, *Pristiphora erichsonii* Htg.

PRINCE ALBERT NATIONAL PARK - SASKATCHEWAN

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
Frank Jervis	Big River, Sask.	67306	May 30	woolly mass enclosing parasitic wasps, Braconidae.
Frank Jervis	Big River, Sask.	67305	June 20	30 larvae (unidentifiable) of a moth, Lepidoptera.
W. Schermerhorn	Waskesiu, Sask.	67298	June 21	3 adults of the 2-barred click beetle, Ludius propola Lec.; 3 adults of the polished click beetle, Ludius nitidulus Lec.; 2 adults of the little brown click beetle, Agriotes limosus Lec.; 1 adult of Slosson's lantern bug, Epiptera slossoni Van D.
Roy Hubel	Waskesiu, Sask.	67326	June 23	1 adult of the long-horn beetle, Anoplodera mutabilis Newn.; 1 adult of a sawfly, Tenthredinidae; 3 adults of a plant lice, Aphidae; 7 spiny leaf galls; several leaves infected with a leaf-rust fungus.
Frank Jervis	Big River, Sask.	67304	July 11	10 larvae and 2 pupae of the cherry ugly nest tortrix, Cacoecia cerasivorana Fitch.; 2 pupae of a parasitic fly, Diptera sp.
E. L. Willard	Cookson, Sask.	67311	July 11	23 larvae and 5 pupae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.

PRINCE ALBERT NATIONAL PARK - SASKATCHEWAN CONT'D

Collector	Locality	Box No.	Date Received	Contents
E. L. Millard	Cookson, Sask.	67312	July 11	considerable tunnelling by the white pine weevil, Pissodes strobi Peck.; 9 larvae and 1 pupa of the white pine weevil, Pissodes strobi Peck.; 2 adults of the leaf beetle, Phytodecta americana Schffr.; 1 adult of the large weevil, Lepyrus palustris Scop.
E. L. Millard	Cookson, Sask.	67314	July 12	1 larva of the mourning cloak butterfly, Nymphalis antiopa L.; leaf galls caused by a plant lice, Aphidae.
E. L. Millard	Cookson, Sask.	67313	July 15	galls caused by the spruce gall aphid, Adelges abietis L. (nymphs and adults emerging from gall)
W. Anderson	Cookson, Sask.	67315	July 19	2 larvae and 1 adult of the yellow-headed sawfly on spruce, Pikonema alaskensis Roh.; 1 larva of an aphid lion, Chrysopidae sp.
G. L. Holden	Waskesiu, Sask.	67319	July 25	1 adult of a caddice fly, Trichoptera sp.; 7 adults of a ladybird beetle, Adalia sp.; 2 adults of the spittle bug, Aphrophora signoretti Fitch; 2 pupae of the lace bug, Chrysopa plorabunda Fitch; 1 larva of a sawfly, Neodiprion sp.; 3 pupae of a hover fly, Syrphidae,

PRINCE ALBERT NATIONAL PARK - SASKATCHEWAN - CONT'D

Collector	Locality	Box No.	Date Received	Contents
G. L. Holden (Cont'd)				2 adults of an ant, Formicidae sp.; 1 adult of a small moth, Tineidae sp.; 1 adult of a parasitic wasp, Hymenoptera sp.; 4 cones with old borings of the spruce cone worm, Dioryctria reniculella Grt.
W. Schermerhorn	Waskesiu, Sask.	67295	July 23	3 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 larva of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 adult of the darkling beetle, Scaphidema aeneolum Lec.; 1 pupa of a moth, Lepidoptera sp.
Roy Hubel	Waskesiu, Sask.	67324	Aug. 11	adults and nymphs of a plant lice, Aphidae sp.; 1 daddy-long-legs, Arachnida sp.
Roy Hubel	Waskesiu, Sask.	67323	Aug. 20	4 adults, 4 pupae, 3 larvae and considerable boring of the white pine weevil, Pissodes strobi Peck.; 6 larvae of a parasitic fly, Diptera sp.
G. L. Holden	Waskesiu, Sask.	67320	Aug. 20	15 larvae of the leaf-roller, Meroptera pravella Grt.; 1 larva of an aphis lion, Chrysopidae sp.; several spiders, Arachnida sp.

PRINCE ALBERT NATIONAL PARK - SASKATCHEWAN - CONT'D

Collector	Locality	Box No.	Date Received	Contents
Roy Hubel	Waskesiu, Sask.	Special	August 21	1 adult of a harvest fly, Cicadidae; 1 larva of the large willow sawfly, Cimbex americana L.
W. Schermerhorn	Waskesiu, Sask.	67296	August 21	2 larvae and 1 prepupa of a sawfly, Tenthredinidae sp.; 1 larva of the leaf-roller, Meroptera pravella Grt.; 1 larva (shrivelled), possibly Tenthredinidae sp.
E. L. Millard	Cookson, Sask.	67328	Sept. 2	1 larva and 1 cocoon of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 larva of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 larva of the leaf-roller, Meroptera pravella Grt.; 1 larva of a hover fly (predaceous), Syrphidae sp.
S. C. Genge	Prince Albert	67507	Sept. 6	nymphs of the box elder bug, Leptocorus trivittatus Say.
W. Anderson	Cookson, Sask.	67317	Sept. 20	1 adult of the ladybird beetle, Coccinella trifasciata L.; 1 prepupa of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 larva of the green larch looper, Semiothisa sexmaculata Pack.

DOMINION FOREST SERVICE

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
V. H. Phelps	Wasagaming, Manitoba.	26833	June 23	3 larvae of a wireworm, Elateridae sp.; 2 lepidoptera pupae; portion of a millepede; 2 mutilated larvae (unidentifiable).
V. H. Phelps	Wasagaming, Manitoba.	26834	June 23	3 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 female pupa of the Jack pine budworm, Cacoecia fumiferana Clem.
V. H. Phelps	Wasagaming, Manitoba.	26835	June 23	1 larva of the looper, Nyctobia limitaria Wlk.; 2 larvae of a brown looper, Geometridae sp.; 1 larva of a leaf-roller, Tortricidae sp.; 1 larva of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 needle with needle-rust fungus, Chrysomyxa sp.
G. Tunstell	Wasagaming, Manitoba.	67330	Aug. 14	1 larva of the poplar borer, Saperda calcarata Say.
G. Tunstell	Wasagaming, Manitoba.	67329	Aug. 13	6 adults, 5 pupae and 1 larva of the white pine weevil, Pissodes strobi Peck.

DOMINION FOREST SERVICE / CONT'D

Collector	Locality	Box No.	Date Received	Contents
A. L. Best	Wasagaming, Manitoba.	11545	Aug. 14	1 adult of the 2-barred click beetle, Ludius propola Lec.; 1 larva of the green-headed spruce sawfly, Pikonema dimmockii Cress.
V. H. Phelps	Wasagaming, Manitoba.	11546	Aug. 14	31 pupae of the European larch sawfly, Pristiphora erichsonii Htg.; 1 larva and 1 prepupa of a cutworm, Phalaenidae sp.; 1 larva of a cutworm, Phalaenidae sp.; 1 larva of a cutworm, Phalaenidae sp.
V. H. Phelps	Wasagaming, Manitoba.	26928	Aug. 14	41 pupae of the European larch sawfly, Pristiphora erichsonii Htg.
H. D. McKinnon	Oatseed, Manitoba.	67344	Aug. 21	1 larva of a budworm, Tortricidae sp.; several nests of a spider, Arachnida sp.

HUDSON'S BAY COMPANY - CANADA - CONT'D

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.		Contents
J. R. Patience	Ogoki, Ontario.	52058	(Bottle 1)	2 adults of the carpenter ant, Camponotus herculaneus pennsylvanicus de G.
J. R. Patience	Ogoki, Ontario.		(Bottle 2)	1 larva of a round-head borer, Monochamus sp.(?).
J. R. Patience	Ogoki, Ontario.		(Bottle 3)	1 larva of a round-head borer, Monochamus sp.(?).
J. R. Patience	Ogoki, Ontario.		(Bottle 4)	1 adult of the carrion beetle, Ostoma ferruginea L.
W. A. Smith	Nipigon House, Lake Nipigon, Ontario.	51970	(Bottle 1)	1 larva of the hemlock looper, Ellopia fiscellaria Gn.; 2 pupae of the Jack pine budworm, Cacoecia fumiferana Clem.; 1 pupa of a leaf-roller, Tortricidae sp.; 2 nymphs and 1 adult of a soldier bug, Podisus sp.; 1 adult of a leaf beetle, Coccinellidae sp.; 1 adult of the ground beetle, Platynus sinuatus Dej.; 1 adult of a lantern bug, Fulgoridae sp.; 1 adult of a 2-winged fly, Diptera sp.; 1 adult of a leaf beetle, Chrysomelidae sp.; 1 nymph of a spittle bug, Cercopidae sp.
W. A. Smith	Nipigon House		(Bottle 2)	3 larvae of a 4-footed butterfly, Nymphalidae sp.
W. A. Smith	Nipigon House		(Bottle 4)	1 larva of a 4-footed butterfly, Nymphalidae sp.

HUDSON'S BAY COMPANY - CANADA - CONT'D

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Contents
W.S. Carson	Stony Rapids, Sask.	55695	1 adult of the stink bug, Elasmostethus cruciatus Say.; 9 adults of a leaf-hopper, Membracidae sp.; 6 larvae of a sawfly, Selandrinae sp.; 4 larvae of a sawfly, Nematus sp.; 1 larva of a leaf-roller, Tortricidae sp.; 1 pupa of a leaf blotch miner, Gracilariidae sp.(?); 1 larva of a climbing cutworm, Autographa sp.
W.S. Carson	Stony Rapids, Sask.	55696	1 pupa of a looper, Geometridae sp.; 1 adult of a moth, Noctuidae sp.; 1 adult of the forest darkling beetle, Upis ceramboides L.; several spiders, Arachnida sp.
W.S. Carson	Stony Rapids, Sask.	55697	1 larva of a sawfly, Nematus sp.; 1 larva of a sawfly, Tenthredinidae sp.; 1 adult of the leaf beetle, Cleis picta Rand.; 1 adult of the darkling beetle, Scaphidema aeneolum Lec.; 1 adult of a weevil, Curculionidae sp.
W.S. Carson	Stony Rapids, Sask.	55694	3 nymphs and 29 adults of the stink bug, Elasmostethus cruciatus Say.; 1 nymph and 2 adults of the modest soldier bug, Podisus modestus Dall.
H. Leaman	Makkovick, Labrador.	67643 (Bottle 1)	1 larva of a rove beetle, Staphylinidae sp.; portion of a darkling beetle, Tenebrionidae sp.
H. Leaman	Makkovick, Labrador.	(Bottle 3)	1 earthworm, Lumbricus sp.

HUDSON'S BAY COMPANY - CANADA - CONT'D

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Contents
R.W. Shaw	Hudson's Hope, B.C.	51948 (Bottle 3)	1 large spider, Arachnida sp.
R.W. Shaw	Hudson's Hope, B.C.	(Bottle 4)	1 adult of the flat-head borer, Dicerca prolongata Lec.
A. Millar	Split Lake, Manitoba.	51910	1 nymph of a plant bug, Hemiptera sp.; 1 harvest-man, Arachnida sp.; 1 adult of a May fly, Ephemeroptera sp.
F. Reid	Cumberland House, Sask.	55666	2 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 2 larvae of the false hemlock looper, Nepytia canosaria Wlk.; 2 larvae of a leaf-roller, Tortricidae sp.; 1 adult of a wasp parasitic on spider eggs(?), Ichneumonidae sp.; 2 adults of a spider, Arachnida sp.; 1 adult of an ant, Formicidae sp.
F. Reid	Cumberland House, Sask.	55667	8 adults of the leaf beetle, Calligrapha verucosa Suffr.; 3 empty cocoons of the forest tent caterpillar, Malacosoma disstria Hbn.; 1 larva of a fly parasitic on the forest tent caterpillar, Sarcophaga sp.; 4 galls on willow leaves caused by a sawfly, Pontania pisum (?); 2 larvae of a sawfly, Pontania pisum (?).
E.J. Leslie	Green Lake, Sask.	55657	1 spider (crushed), Arachnida sp.

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.		Contents
A.B. McIvor	Kississing P.O., Man.	52064	(Bottle 3)	4 larvae of the balsam fir sawfly, Neodiprion abietis Harr.; 1 adult of a crane fly, Tipulidae sp.; 2 adults of the click beetle, Limonus aeger Lec.; 1 adult of the polished click beetle, Ludius nitidulus Lec.; 2 adults of an assassin bug, Reduviidae sp.; 1 adult of the aphid, Cinara lasiocarpae G. & P.; 14 nymphs of a plant lice, Cinara lasiocarpae G. & P.
A.B. McIvor	Kississing P.O., Man.		(Bottle 4)	3 adults of the metallic click beetle, Ludius resplendens Esch.; 2 adults of the polished click beetle, Ludius nitidulus Lec.; 1 adult of a ground beetle, Carabidae sp.; 7 nymphs and 3 adults of a plant lice, Cinara sp.; 1 adult of a blister beetle, Meloidae sp.
S.R. Crone	Mistassinny Lake, P.Q.	52073		1 adult of a caddis fly, Tricoptera sp.
R.W. Shaw	Hudson's Hope, B.C.	51948	(Bottle 1)	1 adult of the stink bug, Elasmostethus cruciatus Say.; 1 adult of the long horn beetle, Merium proteus Kby.; 1 spider, Arachnida sp.
R.W. Shaw	Hudson's Hope, B.C.		(Bottle 2)	1 adult of a stone fly, Plecoptera sp.; 1 adult of a moth, Tortricidae sp.; 1 adult of a scarab beetle, Scarabaeidae sp.; 1 larva of a June beetle, Phyllophaga sp.

HUDSON'S BAY COMPANY - CANADA - CONT'D

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box no.	Contents
A.W. Scott	Lac Seul, Ontario.	67612	2 larvae of the woolly bear, Arctia caia L.
A.W. Scott	Lac Seul, Ontario.	67615	2 adults of the luna moth, Tropoea luna; 1 adult of the polyphemus moth, Telea polyphemus.
A. Millar	Split Lake, Manitoba.	51909	1 larva of a climbing cutworm, Autographa sp.; 1 spider, Arachnida sp.
A.B. McIvor	Kississing P.O., Man.	52064 (Bottle 1)	1 adult of the black sawyer beetle, Monochamus scutellatus Say.; 1 adult of the metallic click beetle, Ludius resplendens Esch.; 1 adult of the furrowed click beetle, Ludius aratus Lec.; 1 adult of a weevil, Curculionidae sp.; 1 adult of the parasitic wasp, Ephialtes conquisitor Say.; 1 adult of a wasp, Chalastogastra sp.; 1 adult of an assassin bug, Reduviidae sp.; 1 adult of the lady beetle, Anisocalvia 14-guttata L.; 1 nymph of a plant bug, Cercopidae sp.; 1 nymph of a leaf-hopper, Cicadellidae sp.; 1 larva of the balsam fir sawfly, Neodiprion abietis Harr.
A.B. McIvor	Kississing P.O., Man.	(Bottle 2)	3 larvae of the forest tent caterpillar, Malacosoma disstria Hbn.; 1 nymph of a leaf-hopper, Cicadellidae sp.; 1 adult of a wasp, Chalastogastra sp.; 1 adult of a fungus gnat, Mycetophilidae sp.

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Contents
A.W. Scott	Lac Seul, Ontario.	67611	1 larva of a tussock moth, Olene sp.; 1 adult of the lady beetle, Neomysia subvittata Muls.; 1 adult of the rove beetle, Staphilinidae sp.; 1 larva of a black-headed sawfly, Neodiprion sp.; 1 larva of the predaceous fly, Metasyrphus lapponicus Zett.; 1 pupa of the predaceous fly, Metasyrphus lapponicus Zett.
A.W. Scott	Lac Seul, Ontario.	67614	4 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 4 larvae of the Jack pine budworm, Cacoecia fumiferana Clem.; 2 larvae of the black-headed budworm, Peronea variana Fern; 1 larva of a lady beetle, Coccinellidae sp.; 1 adult of a lacewing fly, Chrysopidae sp.; 1 larva of a leaf-roller, Tortricidae sp.; 1 larva of a looper, Geometridae sp.; 9 larvae and 1 pupa of the predaceous fly, Metasyrphus lapponicus Zett.; 6 cocoons of the syrphid, Allographa obliqua Say.
A.W. Scott	Lac Seul, Ontario.	67613	1 adult of a blue bottle fly, Calliphora sp.; 1 larva and 1 pupa of the leaf-roller, Sciaphila duplex Wlsm.; 4 larvae of the case maker, Acrobasis betulella Hbt.

HUDSON'S BAY COMPANY - CANADA

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Contents
A.W. Scott	Lac Seul, Ontario.	52051 (Bottle 1)	2 adults of the 2-barred click beetle, Ludius propola Lec.; 1 adult of the inky click beetle, Ludius appropinquans Rand.; 1 larva, Lepidoptera sp.; 2 nymphs of a leaf-hopper, Membracidae sp.; 1 green fly, Dolichopodidae sp.; 1 black fly, Diptera sp.
A.W. Scott	Lac Seul, Ontario.	(Bottle 2)	16 larvae of a Jack pine sawfly, Neodiprion sp.; 1 adult of the firefly, Lucidota corrusca L.; 1 adult of the 3-barred click beetle, Ludius triundulatus Rand.; 1 adult of a lace bug, Tingidae sp.; 1 larva of a small looper, Geometridae sp.; 1 larva of the northern aphid eater, Metasyrphus lapponicus Zett.; 1 adult of a lady beetle, Coccinellidae sp.; 1 adult of a squash bug, Coreidae sp.
A.W. Scott	Lac Seul, Ontario.	(Bottle 3)	1 larva of a tussock moth, Olene sp.; 1 adult of the scarab beetle, Dichelonycha subvittata Lec.; 1 adult of the soldier bug, Meadorus lateralis Say; 1 adult of the 3-barred click beetle, Ludius triundulatus Rand.; 1 larva of a moth, Lepidoptera sp.; 1 adult of the lady beetle, Cleis picta Rand.
A.W. Scott	Lac Seul, Ontario.	(Bottle 4)	1 adult of the 2-barred click beetle, Ludius propola Lec.

MANITOBA PAPER COMPANY LIMITED, PINE FALLS.

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
G. Dean	Pine Falls, Manitoba.	67075	May 26	1 adult of the apple lady beetle, Anatis mali Say.; 1 adult of the 3-barred click beetle, Ludius triundulatus Rand.; 1 adult of the pine weevil, Pissodes Fiskei Hopk.; 1 adult of the weevil, Hylobius congener D.T.; 2 nymphs of a mealy bug, Coccidae sp.; black spruce cones with old borings.
G. Bayly	Pine Falls, Manitoba.	67071	June 3	1 cocoon of Marlatt's larch sawfly, Anoplonyx laricis Marl.; 1 larva of a cutworm, Autographa sp.; 1 adult of the white pine weevil, Pissodes strobi Peck.; 1 adult of the 3-barred click beetle, Ludius triundulatus Rand.; 1 adult of a click beetle, Elateridae sp.; 3 adults of the predaceous lady beetle, Hyperaspis signata Oliv.; 3 adults of a leaf hopper, Membracidae sp.; 1 adult of a sawfly, Tenthredinidae sp.; 1 cocoon, parasitised (unknown); 1 adult of a small moth, Microlepidoptera sp.(broken).

MANITOBA PAPER COMPANY LIMITED, PINE FALLS, CONT'D

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
G. Dean	Pine Falls, Manitoba.	67077	June 20	3 larvae of a brown spruce looper, Eupithecia sp.; 1 larva of an orange looper, Geometridae sp.; 1 pupa of a moth, Lepidoptera sp. (parasite emerged); 1 larva, dead and shrivelled, Malacosoma sp. (?); 3 larvae of a predaceous hover fly, Syrphidae sp.; 1 adult of a click beetle, Elateridae sp.; 2 adults of the ground beetle, Platynus quadripunctatus Dej.; 1 larva of a leaf-roller, Tortricidae sp.; 1 dipterous cocoon (unknown).
R.J. Rigg	Pine Falls, Manitoba.	67078	June 23	3 aggregations of the spruce gall aphid, Adelges abietis L.; 23 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.
G. Dean	Pine Falls, Manitoba.	67076	July 3	1 larva of the grey spruce tussock moth, Olene plagiata Wlk.; 4 larvae of the green-headed spruce sawfly, Pikonema dimmockii Cress.; 1 adult (dead) of a yellow jacket, Vespa sp.; 1 larva of a leaf-roller, Tortricidae sp.; 1 adult of the inky click beetle, Ludius appropinquans Rand.; 1 scale insect, Coccidae sp.; 4 galls caused by the spruce gall aphid, Adelges abietis L.; 1 sample of spruce needle rust, Chrysomyxa sp.;

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
G. Dean (Continued)				2 larvae of the black-headed fir sawfly, Neodiprion abietis Harr.; 3 larvae of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 larva (dead) of a looper, Geometridae sp.; 1 adult of a lace bug, Tingidae sp.; 1 adult of the white pine weevil, Pissodes strobi Peck.; 1 larva of a lady beetle, Coccinellidae sp.; 3 adults of the flat-head borer, Anthaxia aenogaster Cast.; 1 adult of a bark beetle, Ipidae sp.; 6 larvae of the false hemlock looper, Nepytia canosaria Wlk.; 1 larva of a looper, Geometridae sp.
R.J. McLeod	Pine Falls, Manitoba.	67079	July 8	1 larva of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.
R.J. Rigg	Pine Falls, Manitoba.	55715	July 28	1 larva of a sphinx moth, Sphingidae sp.
G.R. Halpin	Pine Falls, Manitoba.	67074	July 26	1 larva of the hemlock looper, Ellopia fiscellaria Gn.; 1 adult of the 2-barred click beetle, Ludius propola Lec.; 1 adult of a click beetle (broken), Ludius sp.(?); 1 adult of a plant bug, Hemiptera sp.

MANITOBA PAPER COMPANY LIMITED, PINE FALLS, CONT'D

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
G.R. Halpin	Pine Falls, Manitoba.	67080	August 28	3 adults of a budworm, Tortricidae sp.; 1 adult of a leaf hopper, Membracidae sp.; 1 adult of a predaceous hover fly, Syrphidae sp.; 1 larva of the green spruce looper, Semiothisa granitata Gn.; 1 larva of the dotted line geometer, Protoboarmia porcelaria Gn.; 2 larvae of a cutworm, Phalaenidae sp.; 1 adult of the beetle, Calopteron terminala Say.

THE GREAT LAKES PAPER COMPANY LIMITED, FORT WILLIAM.

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
H.J. Johnstone	Fort William, Ont.	67767	Aug. 12	2 larvae and 2 cocoons of the yellow-headed spruce sawfly, *Pikonema alaskensis* Roh.
C.R. Silver-sides	Fort William, Ont.	67768	Aug. 12	5 larvae, 2 pupae and 15 adults of the white pine weevil, *Pissodes strobi* Peck.

DRYDEN PAPER CO. LIMITED

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
O. Jackson) D. Horn) W. Wiggle) K. Sheridan)	Dryden, Ont.	39393-35394 67421-67425 67453-67455 (10 boxes)	July 4 to July 12	1,680 pupae of the Jack pine budworm, *Cacoecia fumiferana* Clem. (Pupal Survey)
O. S. Jackson	Dryden	35395	July 14	54 larvae of the red-headed Jack pine sawfly, *Neodiprion dubiosus* Schedl.
O. S. Jackson	Dryden	35390	July 21	50 larvae of the willow sawfly, *Arge virescens* Klug.
O. S. Jackson	Dryden	35388	Aug. 2	44 larvae of the willow sawfly, *Arge virescens* Klug.

PIGEON TIMBER CO. LIMITED, NEYS.

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
O. Nordlander	Neys, Ont.	67408	July 16	2 adults of the ground beetle, *Platynus sinuatus* Dej.; 1 adult of the tiger lady beetle, *Neomysia subvittata* Muls.; 1 nymph of a plant bug, *Hemiptera* sp.; 1 larva of a predaceous lady beetle, *Coccinellidae* sp.

PROVINCIAL PAPER CO. LIMITED, PORT ARTHUR.

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
A.G. Pounsford	Port Arthur, Ont.	67171	August 5	3 larvae of the mourning cloak butterfly, Aglais antiopa L.
A.G. Pounsford	Port Arthur, Ont.	67173	August 13	1 larva of the large willow sawfly, Cimbex americana Leach; 49 larvae of the willow sawfly, Trichocampus viminalis Fall.

D. A. CLARKE & COMPANY

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
C. Sjolander	Nipigon, Ont.	67440	July 14	29 larvae and 1 pupa of the yellow-headed spruce sawfly, Pikonema alaskensis Roh.; 1 larva of a leaf-roller, Tortricidae sp.; 1 nymph (dead) of a plant lice, Aphidae sp. (parasite emerged)

GENERAL TIMBER COMPANY LIMITED, PORT ARTHUR

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
E. Lehtinen	Peninsula	67053	June 21	1 adult of a parasitic wasp, Ichneumonidae sp.
A. Lahti	Peninsula	67055	June 23	1 larva of a wireworm, Elateridae sp.; 1 adult of a ground beetle, Pytha sp.; 1 adult of the white pine weevil, Pissodes strobi Peck.; 1 adult of the two-barred click beetle, Ludius propola Lec.; 1 pupa of a predaceous hover fly, Syrphidae sp.
R. Feely	Peninsula	67059	July 15	1 egg mass of a spider, Arachnida sp.; 1 adult of the leaf beetle, Phyllodecta americana Schffr.
E. Usenik	Port Arthur	67056	August 15	1 cocoon of the giant silkworm, Telea polyphemus Cram.

ABITIBI POWER & PAPER COMPANY, LIMITED, PORT ARTHUR

FOREST INSECT SURVEY REPORT FOR THE YEAR 1941

Collector	Locality	Box No.	Date Received	Contents
W. Hagan	Port Arthur, Ont.	67953	June 18	2 larvae of a cutworm, *Phalaenidae* sp.; 2 cocoons of a leaf-roller, *Tortricidae* sp.; 1 larva of a looper, *Geometridae* sp.; 15 nymphs of a mealybug, *Aphidae* sp.; 1 spider, *Arachnida* sp.; 1 cocoon of a predaceous hover fly, *Syrphidae* sp.
W. Hagan	Port Arthur, Ont.	67951	June 18	1 gall of the spruce gall aphid, *Adelges abietis* L.; 1 larva of the shoot moth, *Zeiraphera ratzburgiana* Sax.; 1 egg sac of a spider, *Arachnida* sp.
W. Hagan	Port Arthur, Ont.	67952	June 18	2 larvae and 1 old pupa of the Jack pine budworm, *Cacoecia fumiferana* Clem.

OTHER CO-OPERATING UNITS

FORVEST INSECT SURVEY REPORT FOR 1941

Department of Agriculture: Canada: Field Crop Insects.

Collector	Locality	Box No.	Date Received	Contents
R.D. Bird	Brandon, Man.	Special	June 28	hatched egg masses of aphid on spruce, Aphidae sp.; 1 cocoon of a parasitic wasp, Ichneumonidae sp.
R.D. Bird	Brandon, Man.	Special	August 8	25 larvae of the aspen leaf-roller, Meroptera pravella Grt.; 2 empty cocoons, forest tent caterpillar, Malacosoma disstria Hbn.; 1 larva of a leaf-roller, Tortricidae sp.

Department of Agriculture: Canada: Extension Service.

Collector	Locality	Box No.	Date Received	Contents
F.W.Anderson	Teulon, Man.	Special	August 11	adults of and tunnels caused by the bark beetle, Ips perturbatus Eich.

Department of Agriculture: Canada: Plant Protection Service.

Collector	Locality	Box No.	Date Received	Contents
W.A. Cumming	Winnipeg, Man.	67024	July 12	15 larvae and 1 pupa of the European larch sawfly, Pristiphora erichsonii Htg.

FOREST INSECT SURVEY REPORT FOR 1941

Department of Highways: Saskatchewan.

Collector	Locality	Box No.	Date Received	Contents
N.E. Kilgour	Brockington, Sask.	67511	July 8	2 adults of a digger wasp, *Sphecidae* sp.;
N.E. Kilgour	Brockington, Sask.	67517	July 12	1 adult of a digger wasp, *Sphecidae* sp.

Ontario Provincial Air Service.

Collector	Locality	Box No.	Date Received	Contents
E.C. Burton	Fort Frances, Ont.	67258	August 2	numerous spiders, *Arachnida* sp.

OTHER CO-OPERATING UNITS CONT'D

FOREST INSECT SURVEY REPORT FOR 1941

Individuals Co-operating.

Collector	Locality	Box No.	Date Received	Contents
R.L. Stevenson	Indian Residential School Norway House, Manitoba.	51984	September 22	165 cocoons of the European larch sawfly, *Pristiphora erichsonii* Htg.
C.F. Pentland	Lac du Bonnet, Manitoba.	Special	July 21	10 galls caused by the spruce gall aphid, *Adelges abietis* L.; webbing and cast larval skins of the Jack pine budworm, *Cacoecia fumiferana* Clem.; 1 larva of the brown-headed budworm, *Sparganothis tristriata* Kearf.; 1 larva of a predaceous hover fly, *Syrphidae* sp.; 1 spider, *Arachnida* sp.
C.F. Pentland	Winnipeg, Manitoba.	55721	August 5	30 galls (old) caused by the spruce gall aphid, *Adelges abietis* L.; several spider nests, *Arachnida* sp.
S. Malkin, M.D.	Pine Falls,	51981	August 21	2 larvae of a sawfly, *Pontania* sp.; 2 adults of the Banasa stink bug, *Banasa dimidiata* Say.; 3 adults of a darkling beetle, *Paratenetus* sp.; 1 ant, *Formicidae* sp.; several nymphs and adults, causing leaf curl, *Eriosoma* sp.

C. Report of the Winnipeg Section

All available records obtained from samples received and from material reared at Winnipeg have been included in the following section. The more important insects for the year bear augmented summaries showing distribution and mortality in addition to the customary tabulations of life history and parasite data.

Certain of the tables, herewith presented, are not complete. It was deemed advisable, however, to include all data at present available in the Annual Report. Thus, the specific name of certain parasites was not available but has been indicated under major groupings. When tables of parasites are prepared, the determinations of the indicated parasites may be interpolated among the tables which follow.

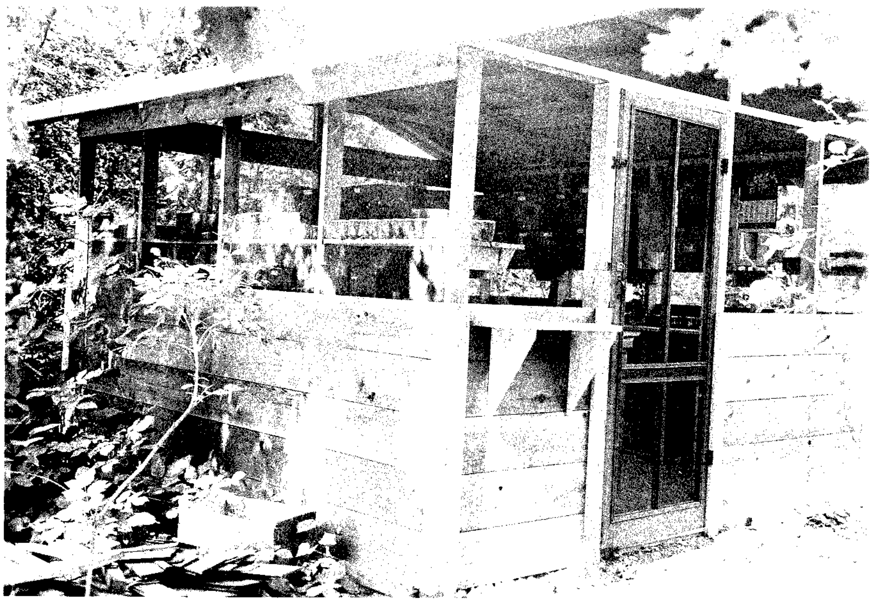
THE FOREST INSECT SURVEY
REPORT OF THE WINNIPEG SECTION

By
L. T. White, Winnipeg.

During 1941, the Dominion Entomological Laboratory at Winnipeg, Manitoba, undertook the work of the Forest Insect Survey in central Canada. The territory covered included the forested regions of Saskatchewan, Manitoba, and that part of northwestern Ontario west of a line projected northward from Heron Bay of Lake Superior. All collections submitted by the Hudson's Bay Company posts were handled at Winnipeg.

The methods used were similar to those employed at Ottawa, although a few changes were necessary, owing to the heavy infestations of the Jack pine budworm and the spruce budworm in the area administered by the Winnipeg Laboratory. Large collections of larvae and pupae were made by co-operating services and officers of the laboratory in representative localities within the budworm range. These collections were reared in specialized containers designed for this purpose. Separate records of these rearings were maintained, but the data so recorded were incorporated among the regular survey records.

In this initial year of the Forest Insect Survey at Winnipeg, a total of 472 samples was received from the co-operating units listed on the following page:



Small insectary constructed at the Winnipeg Laboratory by members of the staff. Used for rearing work in conjunction with the Forest Insect Survey.

	No. of Samples
Ontario:	
Ontario Forestry Branch	153
Private companies	24
Manitoba:	
Manitoba Forest Service	66
Private companies	9
Saskatchewan:	
Saskatchewan Dept. of Mines and Resources ...	40
Dominion Division of Entomology	85
Other Dominion Departments	
Prince Albert National Parks	20
Riding Mountain National Parks	28
Dominion Forest Service	8
Miscellaneous Services	4
Hudson's Bay Company	29
Miscellaneous Co-operators	6
	472

Insect samples were segregated and reared in an insectary constructed for that purpose at the Winnipeg laboratory. The following organization was required to handle the material:

L. T. White, in charge, directed by H. A. Richmond;
Scientific Staff:- D. N. Smith, F. B. Rabkin (part time);
* Rearing Staff:- Miss Wiegand, Miss Dupuis.

* Loaned by Dominion Seed Branch during July and August.

Of the 472 samples received, 105 were collections made in connection with the budworm pupal survey. Large daily samples were provided through the co-operation of the Ontario Forestry

Branch, the Dryden Paper Company, the Saskatchewan Department of Mines and Resources, the "Conscientious Objectors" camps supervised by officials of the Riding Mountain National Park, as well as by members of the Division of Entomology. In all, 23,756 pupae were reared. Much of this exacting work was handled by Mr. F. B. Rabkin, assisted by Miss Dupuis.

In central Canada, the spring of 1941 was characterized by an early break-up. The fine weather set in early and the spring was dry and without the customary drawn out intermediate period. Insect activity seems thus to have begun earlier in the year and to have been sustained by the fine succeeding weather.

The principal forest insects in central Canada for the year were the Jack pine budworm, the spruce budworm, the larch sawfly, the Jack pine scale, the forest tent caterpillar and the birch leaf skeletonizer. Discussions of these follow, along with other forest insects submitted during 1941. Rearing data are included in the tables herewith presented.

Cacoecia fumiferana Clem.

The Jack Pine Budworm

Distribution & Infestation:

The Jack pine budworm continues to be of prime importance as a forest pest in central Canada. It occurred in severe proportions in the La Corne forest of northern Saskatchewan, the Spruce Woods Reserve in Manitoba, and in regions of the Fort Frances and Port Arthur areas in northwestern Ontario. It occurred in increasing numbers in one new area; namely, the Riding Mountain National Park of Manitoba. A serious situation might occur in this area in the near future. Elsewhere in its range, it was of much lesser intensity than in previous years, such regions being the Sandilands Forest Reserve in Manitoba and the Kenora-Ignace country of Ontario and some districts in the Fort Frances territory. The following summarizes the situation for the current year:

RECENT INFESTATION (increasing in 1941)--Norgate Road, Riding Mountain National Park, Manitoba.

RECENT INFESTATION (no increase for 1941)--on Transcanada Highway between Beardmore, and Jellico, Ontario.

CONTINUED INFESTATION (severe)--Beaverhouse Lake, Lac la Croix, Ontario; Riverton, Manitoba, 8 miles north of Twp. line 24, worst at S. 1, Twp. 25, R. 2E; Fort La Corne Forest, Saskatchewan.

CONTINUED INFESTATION (moderate)--Raven Lake, Jacob to Harvey on C.N.R., Savant Lake, Sioux Lookout, Lake St. Joseph, Watcomb, Sturgeon Narrows, Basswood Lake, Calm Lake, Dryden, Ignace, Northern Lights Lake, Mac, Savanne, all in Ontario; at point one-half mile north Arnes on Lake Winnipeg, and Twp. 24, R. 2 and 3 (approximately) E., in the Riverton country of Manitoba.

CONTINUED INFESTATION (very light)--Sandilands Forest Reserve, Manitoba; Red Lake, Pickle Lake, Sturgeon Lake, Yonde on C.N.R. south of Sioux Lookout, Kenora, Hawk Lake, Minaki, Nestor Falls, Off Lake, Sphene Lake, Vermilion Bay, all in Ontario.

Losses vary with the locality, ranging from 1% to 65% mortality of the timber affected. The heaviest killing has occurred in the Kenora district. Damage resulting from this insect is represented not only by dead trees but also by partly killed and weakened stock of which an increasing number are being attacked by wood borers and bark beetles, particularly in the Kenora region. The increased fire hazard caused by dead or partly dead trees adds to its depredation in these forests.

<u>Life Cycle</u>:

In general, budworm activity during 1941 commenced two weeks earlier than usual. The date on which second instar larvae emerged from their hibernacula varied considerably in different parts of the budworm range. Commencement of activity was earliest in the western and southern portions of the territory. Thus, at Sandilands Forest Reserve, Manitoba, larvae appeared about May 10th; at Hawk Lake, Ontario, about May 15th; but in Fort a la Corne, Saskatchewan, and Fort Frances, Ontario, about May 18th, while, in the Port Arthur, Ontario, area, they appeared about 4 days later. Again, in the Riding Mountain National Parks, Manitoba, larvae did not appear until about the 24th of May.

Larval stadia required roughly 45 days and pupae appeared in Sandilands, Manitoba, about June 20th; at Hawk Lake, on about June 24th; at Fort Frances, Ontario, and Fort a la Corne, Saskatchewan, about June 28th; at Port Arthur, Ontario, about July 4th; and in the Riding Mountain National Parks, about July 16th. The pupation period extended over roughly three weeks' time.

Emergence of adults occurred about ten days after pupation. Here, too, there was a wide range of dates from different samples. Emergences ranged from July 1st to August 8th, dependent upon the pupation date.

Mortality and Parasites:

Larval mortality under rearing conditions was not high--75% of the larvae pupated. Developmental failures among very young larvae accounted for the greatest part of the larval mortality. Some larval parasitism was caused by *Meteorus trachynotus* Vier. Mortality in the pupal stage was rather high--only 47% of the pupae produced adults. A considerable mortality was attributed to developmental failure. This was probably due in part to handling in collection and rearing rather than to a deterioration of strain. Parasitism, however, was recorded as 31% in the pupal survey and 24% for the entire rearing. In older areas, where the infestation had abated, parasitism was generally on the decline. In areas of new infestation, parasitism seems to be increasing in the Riding Mountains and in the Spruce Woods Forest Reserve, the percentage parasitism being about 15 to 20%. In those areas where budworm infestation is still heavy, the parasitism seems to be keeping pace with the infestation. Parasitism at Kakabeka, Ontario, was 64% and at Ignace, Ontario, 40%.

Ephialtes (*Itoplectis*) *conquisitor* Say., and *Phaeogenes hariolus* Cress. seem to be the main Ichneumons parasitizing budworm pupae. Of these, Phaeogenes hariolus appears the more specific. Among the Diptera, Nemorilla maculosa Meigh. was a general parasite. Chalcids commonly present were Amblymerus verditor Nort. and Syntomosphyrum esurus Riley. The parasite, Atrometus clavipes Davis, was present in large numbers in the Fort a la Corne Forest, but insignificant elsewhere.

The yearly averages for the various parasites (pupal survey) were:

Ephialtes conquisitor Say.	13.4%
Phaeogenes hariolus Cress.	6.6%
Diptera	6.3%
Chalcids	4.7%
Miscellaneous	0.3%
TOTAL	31.3%

The following is a list of all parasites recovered from the Jack pine budworm:

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

JACK PINE BUDWORM

Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
11	Wampum, Manitoba	Jun.25-Jy.1	July 7-18	7/8	6/7	Jack pine	None
26	Sandilands Forest Reserve	Unknown	July 1-11			Jack pine	[illegible] (16)
34A	Hawk Lake, Ont.	July 4-16	July 16	1/1	1/1	Jack pine	None
42	Hawk Lake, Ont.	July 1-4	July 12	1/2	1/1	Red pine	None
52	Sprague, Manitoba.	June 27	July 8	1/3	1/1	Jack pine	Diptera (1) Braconid (1)
58	Lake of Bays, Ont. Ct.P Block 8	Unknown	Unknown	0/1	0/0	Jack pine	Braconid (1)
62	Hawk Lake, Ont.	Unknown	July 11-28	104/147	104/104	Jack pine	Braconids (4) Diptera (4)
63	Hawk Lake, Ont.	Unknown	July 11-24	102/114	99/102	Jack pine	Braconids (12) Diptera (1)
74	Sphene Lake, Ont.	June 24-Jy.8	July 7-22	6/6	6/6	Jack pine	None
80	Crooked Rapids, Ont. English River	July 1-4	July 11	2/3	2/2	Spruce	None
81A	Pelican Falls, Ont. English River	July 29	August 7	1/1	1/1	Spruce	None

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JACK PINE BUDWORM CONT'D

-1941-

Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
83	Riding Mountain National Park T19R17S34	July 9	July 25	1/3	1/1	Jack pine	None
85	Kinistino, Sask. Sec.27-48-19W2	July 1-4	July 12-14	3/3	3/3	Jack pine	None
87A	Crooked Rapids, Ontario. English River	June 27	July 4	1/1	1/1	Jack pine	None
88A	Pelican Falls, Ont. English River	Unknown	Unknown	0/1	0/0	Jack pine	None
89	Gronlid, Sask. Sec.27-48-19W2	Jun.25-Jy.4	July 8-15	5/6	3/5	Jack pine	Diptera (1)
92	Kinistino, Sask. S17-49-16W2	Unknown	Unknown	0/1	0/0	Jack pine	None
96	Pt. a la Corne Forest Reserve English Cabin, Sask.	Unknown	July 9-24	69/132	68/69	Jack pine	Hyplectes (1) Braconids (43) chalcids (1) Diptera (7) Actia
105	Port Frances, Ont.	Jun.24-Jy.18	July 4-23	29/69	24/29	Jack pine	None
107	Ignace, Ontario.	Jun.28-Jy.12	July 8-16	8/10	8/8	White pine	None
?? 112	Spruce Woods Forest Reserve	July 3-8	July 16-21	2/2	2/2	Jack pine	None
117	Calm Lake, Ont. South shore	Jun.28-Jy.3	July 8-22	6/12	3/6	Jack pine	Diptera (1)
120	Beaverhouse Lake, Ontario.	June 28	July 12		1/8	White pine	Ephialtes [illegible] (1) Diptera (?) Nemorilla
121	Ignace, Ontario.	June 30	July 11-14		3/4	White spruce	Diptera (1)

JACK PINE BUDWORM CONT'D

-1941-

Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
122	Ignace, Ontario.	Jun.30-Jy.10	July 11-21	17/20	10/17	Jack pine	None
125	Lac la Croix, Ont. McAree Lake	June 30	Jun.30-Jy.21	43/59	25/43	Jack pine, Red pine, White pine, Spruce.	Diptera (7)
126	Basswood Lake, Ont.	Jun.30-Jy.4	July 2-22	32/38	15/32	Jack pine	None
126A	Basswood Lake, Ont.	Unknown	Unknown	0/4	0/0	Jack pine	Diptera (3)
146	Gronlid, Sask. 21-22T48R19W2	July 2-16	July 17-28	12/16	9/12	Jack pine	Diptera (4) /Zenillia Ichneumonid (2)
147	Beaverhouse Lake N.W. end Quetico Park	June 2	Jun.2-Jy.7	12/16	2/12	Jack pine	None /Ephialtes
148 (♂)	Sandilands Forest Reserve	(Pupal Survey)	July 1-22	Unknown	258/550	Jack pine	Ephialtes conquisitor Say (44) Phaeogenes hariolus Cress. (16) Other Ichneumonids (90) chalcid swarms (3) Diptera (12) Developmental failures (118)
148 (♀)	Sandilands Forest Reserve	(Pupal Survey)	July 1-22	Unknown	331/669	Jack pine	Ephialtes conquisitor Say (65) Phaeogenes hariolus Cress. (10) Other Ichneumonids (57) chalcid swarms (3) Diptera (64) Developmental failures (139)

JACK PINE BUDWORM CONT'D

-1941-

Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
150B	Northern Lights Lake, Ontario.	July 4-15	July 14-25	5/5	3/5	White spruce	None
151(♂)	Beaverhouse Lake, Ontario.	(Pupal Survey)	July 4-25	Unknown	253/609	Jack pine	Ephialtes conquisitor Say (42) Phaeogenes hariolus Cress (74) chalcid swarms (58) Diptera (20) Developmental failures (162)
151(♀)	Beaverhouse Lake, Ontario.	(Pupal Survey)	July 4-25	Unknown	437/982	Jack pine	Ephialtes conquisitor Say (44) Phaeogenes hariolus Cress (66) chalcid swarms (45) Diptera (20) Developmental failures (370)
155(♂)	Dryden, Ontario.	(Pupal Survey)	July 5-25	Unknown	238/546	Jack pine	Ephialtes conquisitor Say (45) Phaeogenes hariolus Cress (92) other Ichneumons (3) chalcid swarms (47) Diptera (5) Developmental failures (116)
155(♀)	Dryden, Ontario.	(Pupal Survey)	July 7-28	Unknown	466/881	Jack pine	Ephialtes conquisitor Say (108) Phaeogenes hariolus Cress (92) other Ichneumons (3) chalcid swarms (28) Diptera (17) Developmental failures (164)

JACK PINE BUDWORM CONT'D

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Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
156(♂)	Hawk Lake, Ont.	(Pupal Survey)	July 5-24	Unknown	462/593	Jack pine	Ephialtes conquisitor Say (15) Phaeogenes hariolus Cress. (31) other Ichneumons (4) chalcid swarms (36) Diptera (3) Developmental failures (42)
156(♀)	Hawk Lake, Ont.	(Pupal Survey)	July 5-23	Unknown	450/584	Jack pine	Ephialtes conquisitor Say (33) Phaeogenes hariolus Cress. (16) other Ichneumons (18) chalcid swarms (17) Diptera (6) Developmental failures (44)
160	Pine Falls, Man. S17T18R8-E	July 5	July 7-15	3/3	2/3	Jack pine	Diptera (1) 1 Zenillia
161	Winnipegosis, Man. S32T42R15	July 7-14	July 17-23	3/4	2/3	Jack pine	Diptera - (2) 1 Zenillia 1 Phorocera
163	Northern Lights Lake, Ontario.	July 7	Unknown	0/0	0/2	Jack pine	None
167(♂)	Calm Lake, Ont.	(Pupal Survey)	July4-23	Unknown	156/489	Jack pine	Ephialtes conquisitor Say (40) Phaeogenes hariolus Cress. (31) other Ichneumons (47) chalcid swarms (77) Diptera (21) Developmental failures (117)

JACK PINE BUDWORM CONT'D

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Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
167(♀)	Calm Lake, Ont.	(Pupal Survey)	July 4-24	Unknown	734/1176	Jack pine	Ephialtes conquisitor Say (84) Phaeogenes hariolus Cress. (32) chalcid swarms (60) Diptera (32) Developmental failures (234)
169(♂)	Kakabeka, Ont.	(Pupal Survey)	July 10-28	Unknown	142/999	Jack pine	Ephialtes conquisitor Say (213) Phaeogenes hariolus Cress. (6) other ichneumons (1) chalcid swarms (15) Diptera (43) Developmental failures (557)
169(♀)	Kakabeka, Ont.	(Pupal Survey)	July 11-26	Unknown	216/1062	Jack pine	Ephialtes conquisitor Say (210) Phaeogenes hariolus Cress. (12) other ichneumons (3) chalcid swarms (17) Diptera (76) Developmental failures (488)
170(♂)	Basswood Lake, Ontario.	(Pupal Survey)	July 7-22	Unknown	130/392	Jack pine	Ephialtes conquisitor Say (14) Phaeogenes hariolus Cress. (18) chalcid swarms (9) Diptera (15) Developmental failures (206)

JACK PINE BUDWORM CONT'D

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Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
170(♀)	Basswood Lake, Ontario.	(Pupal Survey)	July 7-21	Unknown	139/557	Jack pine	Ephialtes conquisitor Say (13) Phaeogenes hariolus Cress (2) chalcid swarms (2) Diptera (26) Developmental failures (375)
175(♂)	Graham, Ont.	(Pupal Survey)	July 9-29	Unknown	237/412	Jack pine	Ephialtes conquisitor Say (52) Phaeogenes hariolus Cress (18) chalcid swarms (2) Diptera (6) Developmental failures (97)
175(♀)	Graham, Ont.	(Pupal Survey)	July 9-24	Unknown	222/496	Jack pine	Ephialtes conquisitor Say (60) Phaeogenes hariolus Cress (6) chalcid swarms (3) Diptera (6) Developmental failures (199)
176	Kinistino, Sask. S3-T49-R21W2	July 9	Unknown	0/0	0/0	Jack pine	None
193(♂)	Pt. a la Corne, Sask.	(Pupal Survey)	July 14-28	Unknown	681/1406	Jack pine	Ephialtes conquisitor Say (109) Phaeogenes hariolus Cress (42) other Ichneumons (84) chalcid swarms (36) Diptera (167) Developmental failures (286)

JACK PINE BUDWORM CONT'D

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Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
193(♀)	Ft. a la Corne, Sask.	(Pupal Survey)	July 14-29	Unknown	683/1384	Jack pine	Ephialtes conquisitor Say (88) Phaeogenes hariolus Cress. (7) other Ichneumons (58) chalcid swarms (8) Diptera (202) Developmental failures (338)
195	Riverton, Man. N. of Shorncliff P.O.	July 12	July 12-18	0/0	40/53	Jack pine	Diptera (8) chalcids (5) 13 A. tortricis.
196	Garden Lake, Ont.	July 12	July 12-21	16/18	12/16	Jack pine, Black spruce, Balsam.	Braconids (2)
200(♂)	Ignace, Ontario.	(Pupal Survey)	July 14-Aug.8	Unknown	123/589	Jack pine	Ephialtes conquisitor Say (22) Phaeogenes hariolus Cress. (95) other Ichneumons (27) chalcid swarms (43) Diptera (3) Developmental failures (276)
200(♀)	Ignace, Ontario.	(Pupal Survey)	July 14-28	Unknown	342/920	Jack pine	Ephialtes conquisitor Say (34) Phaeogenes hariolus Cress. (87) other Ichneumons (5) chalcid swarms (20) Diptera (8) Developmental failures (424)

JACK PINE BUDWORM CONT'D

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Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
201(♂)	Savanne, Ont.	(Pupal Survey)	July 12-28	Unknown	681/1478	Jack pine	Ephialtes conquisitor Say (301) Phaeogenes hariolus Cress. (58) chalcid swarms (41) Diptera (18) Developmental failures (379)
201(♀)	Savanne, Ont.	(Pupal Survey)	July 12-30	Unknown	1190/2546	Jack pine	Ephialtes conquisitor Say (408) Phaeogenes hariolus Cress. (44) chalcid swarms (42) Diptera (29) Developmental failures (833)
206	N. Kaweme, Ont. S. side of Crooked Pine Lake.	July 14	July 14-17	127/128	96/127	Jack pine, Norwaypine.	Ephialtes conquisitor Say (2) chalcids (145) (1) Itoplectis Diptera (19)
217A	Ignace, Ontario. T40	Unknown	Unknown	0/1	0/0	Larch	None
219(♂)	Riding Mountain National Park	(Pupal Survey)	Jul.16-Aug.1	Unknown	367/741	Jack pine	Ephialtes conquisitor Say (52) Phaeogenes hariolus Cress. (21) other ichneumons (54) chalcid swarms (14) Diptera (50) Developmental failures (183)

JACK PINE BUDWORM CONT'D

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Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
219(9)	Riding Mountain National Park	(Pupal Survey)	Jul.16-Aug.2	Unknown	752/1176	Jack pine	Apanteles conquisitor Say (57) Phaeogenes hariolus Cress (17) other Ichneumonidae (1) chalcid [illegible] (9) Diptera (28) Developmental failures (262)
239	Lac du Bonnet M5, Pine Falls Rd.	Unknown	Unknown	0/1	0/0	White spruce	None
240	Gronlid, Sask. S27-49-19W2	July 22	July 22	32/33	4/32	Jack pine	Diptera (2) chalcids (6) } 8 A. tortricis 1 Nemorilla
251	Caribou Lake, Ont.	July 24	July 28	1/1	1/1	Jack pine	None
253	Kaweme, Ontario. Vicinity Eva Lake.	Unknown	Unknown			White spruce	chalcid [illegible]
268	Kinistino, Sask. S28-48-19W2	July 29	Unknown	9/9	0/9	Jack pine	Diptera (8) Braconid (1) chalcids (4) } 9
309	Red Lake, Ont. W-OFB, H.Q.	Unknown	Unknown	0/1		Black spruce	None
338	Pickle Lake, Ont.	Unknown	Unknown	1/1	1/1	White spruce	None
384	Gull Bay, Ont. H. B. Company	Unknown	Unknown	2/2	0/2	Spruce	None

JACK PINE BUDWORM CONT'D
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Larval Survival Ratio - 664/886 or 74.9%
Pupal Survival Ratio - 10,250/21,946 or 46.7%
Pupal Parasitism - 5211 /21,946 or 23.7 %
Larval " - 79/886 or 8.9 %

SUMMARY OF JACK PINE BUDWORM PUPAL SURVEY REARING DATA

Adults recovered	9,690
Diptera recovered	932
Ephialtes conquisitor Say. recovered	2,193
Phaeogenes hariolus Cress. recovered	893
Other Ichneumonidae recovered	458
Chalcid swarms recovered	641
Developmental failures	6,408
TOTAL	21,215

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Cacoecia fumiferana Clem.

The Spruce Budworm

Distribution and Infestation:

In Manitoba, serious defoliation was caused to spruce (*Picea glabra*) and to larch (*Larix laricina*) by the spruce budworm. Severe infestation continued in the Spruce Woods Forest Reserve, Manitoba. Small samples were received from northwestern Ontario at Sturgeon Lake, Lac Seul, and Caribou Lake from white and black spruce.

Life Cycle:

Larvae of the spruce budworm in Manitoba appear to have started their activity about May 1st, earlier than records of the Jack pine budworm. The rate of development was more rapid and pupation occurred as early as June 10th, but continued until July 22nd. Emergence of adults began about June 18th and last emergence occurred on July 29th.

Mortality and Parasites:

Larval mortality was approximate to that of the Jack pine strain. 73% of the larvae pupated. Mortality among pupae was not as high as among Jack pine budworm and 67% produced adults. Pupal parasitism was recorded as 12.4%. Parasites were in the main the same as those recovered from the Jack pine budworm. The Ichneumonid, *Phaeogenes hariolus* Cress., was almost absent in the Spruce Woods Forest Reserve. Total parasitism of pupae recovered from larch was much lower than that of pupae recovered from spruce. Percentage figures were 9.5% and 21.5% respectively. Diptera parasites were uniform for pupae from each host, but Ephialtes conquisitor Say. and several chalcids were responsible for the higher parasitism among pupae picked from larch.

The following is a list of parasites recovered from spruce budworm:

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SPRUCE BUDWORM

Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
16	Spruce Woods Forest Reserve	Unknown	Unknown	—	—	W.Spruce	None
21	Spruce Woods Forest Reserve	June 16-30	June 18-Jy.9	140/202	121/140	W.Spruce (lower)	[illegible] Glypta [illegible]
22	Spruce Woods Forest Reserve	June 17-28	June 20-Jy.8	123/148	95/123	W.Spruce (upper)	[illegible]
23	Spruce Woods Forest Reserve	Jun.20-Jy. 22	Jun.20-Jy.29	134/175	119/134	Larch (upper)	[illegible] (23) [illegible]
24	Spruce Woods Forest Reserve	Jun.20-Jy.9	Jun.19-Jy.24	114/170	98/114	Larch (lower)	[illegible] (18) [illegible]
43	Sturgeon Lake, Ont.	June 17-24	July 1	2/2	1/2	W.Spruce B.Spruce	None
47	Lac Seul, Ontario.	June 19-24	June 24-27	3/4	3/3	Spruce	None
70	Caribou Lake, Ont.	Unknown	Unknown	0/1	0/0	Spruce	None
95B	Spruce Woods Forest Reserve	June 24	June 26	0/0	1/1	Larch	None

SPRUCE BUDWORM CONT'D

-1941-

Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
97 (♂)	Spruce Woods Forest Reserve	(Pupal Survey)	Jun.24-Jy. 3	Unknown	200/272	W.Spruce	Ephialtes conquisitor Say (14) Diptera (6) Other Ichneumons (15) Chalcid species (4) Developmental failures (33)
98 (♀)	Spruce Woods Forest Reserve	(Pupal Survey)	Jun.24-Jy. 10	Unknown	248/373	W.Spruce	Ephialtes conquisitor Say (17) Diptera (23) Developmental failures (85)
99 (♂)	Spruce Woods Forest Reserve	(Pupal Survey)	June 24-30	Unknown	190/246	W.Spruce	Ephialtes conquisitor Say (5) Other Ichneumons (13) Chalcid species (3) Diptera (6) Developmental failures (29)
100(♀)	Spruce Woods Forest Reserve	(Pupal Survey)	Jun.24-Jy. 2	Unknown	185/281	W.Spruce	Ephialtes conquisitor Say (8) Chalcid species (2) Diptera (5) Other Ichneumons (16) Developmental failures (65)

SPRUCE BUDWORM CONT'D

-1941-

Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
101(♂)	Spruce Woods Forest Reserve	(Pupal Survey)	Jun.24-Jy.3	Unknown	242/465	Larch	Ephialtes conquisitor Say (40) Other Ichneumons (16) chalcid swarms (19) Diptera (14) Developmental failures (134)
102(♀)	Spruce Woods Forest Reserve	(Pupal Survey)	Jun.24-Jy.2	Unknown	150/248	Larch	Ephialtes conquisitor Say (17) Phaeogenes hariolus Cress. (3) chalcid swarms (4) Diptera (12) Developmental failures (62)
103(♂)	Spruce Woods Forest Reserve	(Pupal Survey)	Jun.24-Jy.2	Unknown	180/263	Larch	Ephialtes conquisitor Say (5) Other Ichneumons (3) chalcid swarms (15) Diptera (9) Developmental failures (51)
104(♀)	Spruce Woods Forest Reserve	(Pupal Survey)	Jun.24-Jy. 14	Unknown	224/393	Larch	Ephialtes conquisitor Say (14) Other Ichneumons (2) chalcid swarms (52) Diptera (15) Developmental failures (86)

SPRUCE BUDWORM CONT'D

-1941-

Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
106	Riverton, Manitoba. T25-2/3-5½	Jun.26-Jy.5	Jy.7-Jy.21	6/12	6/6	Jack pine	Diptera (2)
113	Spruce Woods Forest Reserve	June 25	June 25-27		19/34	Black Spruce	Ephialtes conquisitor Say (4) Diptera (3)
119	Riverton, Manitoba. T21R4ES5½	June 28	June 28		4/6	Spruce	[illegible] (1) A. tortricis
132	Beardmore, Ont.	July 2-8	July 2-8	5/5	4/5	W.Spruce Balsam	None

Larval Parasitism - 85/[illegible] or [illegible]%
Larval Survival Ratio - 529/721 or 73.4%
Pupal Survival Ratio - 2090/3101 or 67.4%
Pupal Parasitism - [illegible]/3101 or [illegible]%

SUMMARY OF SPRUCE BUDWORM PUPAL SURVEY REARING DATA

Adults recovered	1,619
Diptera recovered	90
Ephialtes conquisitor Say. recovered	120
Phaeogenes hariolus Cress. recovered	3
Other Ichneumonidae recovered	65
Chalcid swarms recovered	99
Developmental failures	545
TOTAL	2,541

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Pristiphora erichsonii Htg.

The European Larch Sawfly

Distribution & Infestation:

This sawfly represents an increasing hazard to the larch throughout central Canada. It has been located in incipient outbreaks from Schreiber, Ontario, to Alberta. Its greatest abundance occurs in Manitoba where, in certain regions, it is causing extreme anxiety.

The principal areas of infestation are Riverton, Twp. 21 to 27 from the principal meridian east to Lake Winnipeg, including Hecla Island; in the Riding Mountain National Park at the townsite of Wasagaming, on the Norgate Road 9 miles east of the townsite (Sec. 25, R. 18, Twp. 19); on the Lake Audy Road (S. 16, R. 19, T. 20); on S. 12, R. 19, T. 20; S. 29, R. 20 T. 20; S. 8, R. 21, T. 20; S. 31, R. 18, T. 20; and scattered lightly throughout the tamarack in the park; in the Spruce Woods Forest Reserve.

At Riverton and Riding Mountain, the defoliation for 1941 was extremely heavy, being almost 100% in the former and 30% in the latter. The defoliation in the Spruce Woods Forest Reserve was generally light and scattered, the infestation having subsided somewhat since 1939 and 1940.

Infestations of a sporadic nature also appeared as follows: Norway House, the Sandilands Forest Reserve, Island Lake, and Winnipeg, Manitoba; Hawk Lake, Island Lake, the vicinity of Sioux Lookout, Caribou Lake, and Black Sturgeon River, all in Ontario.

Mortality & Parasites:

The pupal mortality of cocoons collected in 1940 and from which emergences occurred in 1941 was high--only 39.1% of the cocoons produced adults. Parasitism was only 2.7%, being due mainly to the Ichneumonid, *Mesoleius tenthredinis* Mor. Also present among parasite emergences were 1 male and 1 female *Agrothereutes slossonae* Cush. and 1 adult called *Holmgrenia* sp.

Larvae received during 1941 showed a high larval mortality under rearing conditions, only 36.9% surviving to form cocoons. A large series of cocoons was collected in the fall of 1941 and many of these were shipped to Belleville, Ontario, for rearing and experimental work; the remainder were reared at Winnipeg. Although neither of these rearings are completed, progress reports from Belleville indicate that an average parasitism of 25% in the Riding Mountain National Park and 2.5% in the Spruce Woods Forest Reserve was caused by *Mesoleius tenthredinis* Mor. It is reported that some difficulty was experienced in inducing eggs of *M. tenthredinis* to hatch, due, it is suggested, to the early removal of cocoons from hibernation. The reader is referred to the Annual Report of the

Winnipeg Laboratory (1941-1942) for a more concise report on the status of the European larch sawfly in the Riding Mountain National Park and in the Spruce Woods Forest Reserve, Manitoba.

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TENTHREDINIDAE CONT'D

Year	Record No.	Locality	Cocooning	Emergence Date	Emergence Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
			Pristiphora erichsonii Htg.						
	12	Riding Mountain National Park, Manitoba.	Cocoons collected Aug.-'40.	Mar.3-Apr.15, 1941.	28-71 days	---	107/276	Larch	Agrothereutes slossonae Cush. [illegible] Atlagrimus sp. [illegible] Agrothereutes slossonae Cush. [illegible]
	12	Riding Mountain National Park, Manitoba.	Cocoons collected Aug.-'40.	Jun.4-Jun.24, 1941.	14-34 days	---	164/329	Larch	Mesoleius tenthredinis Mor. [illegible]
	12	Riding Mountain National Park, Manitoba.	Cocoons collected Aug.-'40.	Jul.11-Jul.18, 1941.	reared outside	---	33/173	Larch	None
1941	94	Spruce Woods Forest Reserve, Manitoba.	July 5-9	Feb.7	5 days	39/122	1/39	Larch	Tritneptis klugii Chalcids [illegible]
	95	Spruce Woods Forest Reserve, Manitoba.	July 8-11	----	----	4/44	0/4	Larch	Chalcids [illegible]
	116	Riverton, Man. (T25:R8E)	(larvae received June 26-'41.)			0/6	0/0	Larch	None
	135	Sandilands (Marchand, Man.)	(larvae collected July 2-'41.)			0/1	0/0	Larch	None

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

TENTHREDINIDAE CONT'D

Year	Record No.	Locality	Cocooning	Emergence Date	Emergence Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
		***Pristiphora erichsonii* Htg. Cont'd**							
1941	152	Fort Garry, Man. (F.I.S. Lab.)	(larva collected July 4-'41.)			0/1	0/0	Larch	None
	179	Riding Mountain National Park, Man. (North shore road)	July 14-21	----	----	24/74	0/24	Larch	[illegible]
	180	Riding Mountain National Park, Man. (Vicinity Refuse area)	July 14-25	----	----	26/55	0/26	Larch	Tritneptis
	181	Riding Mountain National Park, Man. (Norgate Road)	July 16-25	----	----	5/37	0/5	Larch	Tritneptis
	182	Wasagaming, Man. (For. Exp. Sta.)	July 14-21	----	----	34/91	0/34	Larch	Tritneptis
	194	Riverton, Man. (Shorncliffe P.O.)	July 15-28	----	----	40/106	0/40	Larch	Tritneptis
	199	Dropmore, Man.	July 12-17	Feb.12	10 days	6/15	1/6	Larch	Tritneptis
	215	Riding Mountain National Park, Man. (28:20:20)	July 16	Feb.17	15 days	12/30	1/12	Larch	Tritneptis

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

TENTHREDINIDAE CONT'D

Year	Record No.	Locality	Cocooning	Emergence Date	Emergence Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
			Pristiphora erichsonii Htg. Cont'd						
1941	229	Riding Mountain National Park, Man. (11:25:22)	July 21	----	----	15/20	0/15	Larch	Tritneptis klugii Ratz.
	276	Riding Mountain National Park, Man. (19:22:24)	Aug. 5	----	----	22/51	0/22	Larch	—
	279	Riding Mountain National Park, Man. (Vicinity Spruce Lake)	Aug. 5-14	Feb. 20-26	18-24 days	23/37	4/23	Larch	Tritneptis
	284	Hawk Lake, Ont. (Vicinity Subway)	Aug. 12-18	----	----	6/8	0/6	Larch	
	299	Island Lake, Man.	Aug. 14	----	----	2/10	0/2	Larch	
	302	Wasagaming, Man. (12:20:19)	Cocoons collected Aug. 14	----	----	---	0/41	Larch	
	303	Wasagaming, Man. (29:19:18)	Cocoons collected Aug. 14	Feb. 9-24	7-22 days	---	6/42	Larch	Tritneptis

TENTHREDINIDAE CONT'D

Year	Record No.	Locality	Cocooning	Emergence Date	Emergence Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
		Pristiphora erichsonii Htg. Cont'd							
	343	Caribou Lake, Ontario.	Aug.23-26	----	----	1/8	0/1	Larch	None
	351	Jacobs, Ontario. (O.F.B. Tower)	Aug. 25	----	----	8/8	0/8	Larch	Tritneptis 2- Bessa
	353	Norway House, Man.	Old egg-niches collected Aug.22-'41.	----	----	---	---	Larch	------------
	367	Riding Mountain National Park, Man.	Cocoons collected Sept. 2	----	----	---	0/99	Larch	Tritneptis
	368	Riding Mountain National Park, Man.	Cocoons collected Sept. 2	Mar.2	28 days	---	1/58	Larch	
	378	Riding Mountain National Park, Man. (24:26:22)	Cocoons collected Sept. 19	----	----	---	0/143	Larch	Tritneptis
	380	Norway House, Man. (Indian School)	Cocoons collected Sept. 22	----	----	---	0/143	Larch	Tritneptis klugii

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TENTHREDINIDAE CONT'D

Year	Record No.	Locality	Cocooning	Emergence Date	Emergence Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
			Pristiphora erichsonii Htg. Cont'd						
1941	388(a)	Spruce Woods Forest Reserve, Man.(Epinette Swamp)	Cocoons collected Sept. 16	Feb.12- Mar.28	33-67 days	---	106/	Larch	
	(b)	Spruce Woods Forest Reserve, Man.(Delta Swamp)	Cocoons collected Sept. 17	Feb.13- Mar.28	34-67 days	---	68/	Larch	

Larval Survival - 267/724 or 36.9%
Pupal Survival - 492/ or %

Parasitism -

Malacosoma disstria Hbn.

The Forest Tent Caterpillar

Distribution and Infestation:

Infestation by the forest tent caterpillar has been of varying degrees of intensity in the forest regions of central Canada.

Forest tent caterpillars were numerous for a third year over a large area in middle eastern Saskatchewan. Infestation extended from the Qu'Appelle River, between Lemberg and Stockholm, northward to at least Sub Rosa and Canora. The westward extension of this area was bounded by a line joining Lemberg, Lestock and Kandahar. In this area, caterpillars were very abundant at Lemberg, Neudorf, Killaly, Melville, Willowbrook, Yorkton, Waldron, Dubuc and Stock holm on June 1st. On July 4th, cocoons were numerous at Lemberg, Neudorf, Killaly, Melville, Springside, Willowbrook, Theodore, Leslie, Elfros, Wynyard and Kandahar. Defoliations were very severe and ran as high as 100% in numerous native aspen stands, with aspen, willow, cherry and dogwood being preferred in the order named and balsam, poplar and Manitoba maple left almost untouched. Serious, but localized, damage to apple trees and other orchard fruits also took place.

In addition to severely re-infesting the above mentioned area, the forest tent caterpillar also extended its distribution southward to lightly infest the area south of the Qu'Appelle River to at least Indian Head, Sintaluta, Wolseley, Grenfell, Broadview and Whitewood, where clusters of caterpillars were quite noticeable in June and cocoons moderately commonplace in July, but where, except for a plantation of ash at Indian Head, very little serious defoliation occurred.

In western Saskatchewan, the infestation was extremely severe in the Keppel Provincial Forest at Ranger Lake, where the defoliation was almost 100%.

Elsewhere in Saskatchewan, infestation was light and localized.

In Manitoba, the heaviest attack occurred in the Duck Mountains and on the south slope of the Porcupine Mountains.

Life Cycle:

All live specimens received in the survey were in the pupal stage. Emergences occurred between June 29th and July 7th and, since the period spent in cocoons averages about two weeks, cocooning must have been general about the third week of June.

Mortality and Parasites:

Mortality among pupae in cocoons was low--91.7% emerged from the cocoons. No parasitism was recorded from the pupae received.

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<u>Malacosoma</u> <u>disstria</u> Hbn. (Lasiocampidae)

Year	Record No.	Locality	Cocooning	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	53	Kamsack, Sask. (28:30:30W1)		Jun. 29-Jul. 3		6/7	Poplar and Birch	None
	114	Keppel F.R., Sask. (10:40:14W3)		Jul. 1-3		3/3	*Rosa* sp.	None
	123	Dauphin, Man. (20:32:25WPM)		July 7		2/2	?	None
	141	Pukatawagan, Man. (Kississing P.O.) (H.B. Co.)	(3 larvae received Jul.2--liquid collection)				Poplar	-----
	236	Cross Lake, Man. (T64:R5WPM)	(1 adult received Jul.21--pinned)				Cocoon on Balsam	-----
	262	Cumberland Post, Sask. (H. B. Co.)	(3 empty cocoons received Jul.26)				-----	-----
	321	The Pas, Man. (32:57:24WPM)	(4 empty cocoons received Aug.20)				Birch	-----

Pupal Survival Ratio - 11/12 or 91.7%

Pupal Parasitism - 0/12 or 0.0%

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Malacosoma americana Fab. (Lasiocampidae)

Year	Record No.	Locality	Cocooning	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	17	Spruce Woods Forest Reserve, Manitoba.	June 20- July 7	July 7-17	19/40	17/19	Cherry	

Larval Survival Ratio - 19/40 or 47.5%

Pupal Survival Ratio - 17/19 or 89.5%

Larval Parasitism - 10/40 or 25.0%

Pupal Parasitism - 2/19 or 10.5%

Bucculatrix canadensisella Chamb.

The Birch Leaf Skeletonizer

Distribution and Infestation:

This insect appears to be approaching the peak of a cycle of abundance. It occurs, no doubt, throughout practically all of central Canada in greater or lesser intensity. Heavy infestations were reported from widely separated regions. In Manitoba, widespread injury occurred throughout the Duck Mountain Reserve, at Cross Lake, Manitoba, and at Wabowden, Manitoba. In northwestern Ontario, the insect occurred from the Manitoba boundary eastward to Tashota, Ontario. Here, the infestation was very light on the eastern and western extremities and disappeared east of Tashota on a line running northwest to Ogoki Lake and Mojikit Lake. It was especially heavy near Pickle Lake, Ogoki Lake, Linklater Lake, Caribou Lake, near Armstrong, and McKenzie Lake; where 98% of the birch was attacked. Canadian Airways fliers reported damage to be more intense 250 miles north of Pickle Lake, Ontario.

Life Cycle:

The small caterpillars appeared in late summer and caused extensive skeletonizing before pupating in small, ribbed, boat-like cocoons. Cocoons were received from August 18th to September 2nd. These cocoons were overwintered. Emergences from incubated cocoons commenced on February 2nd and continued until March 3rd.

Parasitism & Mortality:

Some natural control was effected by predators. It is reported that numerous larval, nymphal and adult Coccinellidae and Pentatomidae were present in the area near Pickle Lake, Ontario. These, and many spiders, no doubt accomplished some control. The species were not submitted for identification.

Pupal survival was slightly over 40%. In many cases of developmental failure, the pupae were found to be covered with fungus hyphae, but in more cases the pupae were dried and brittle.

Pupal parasitism was approximately 14%. All but 1.3% of this was due to Braconid parasites. This small percentage (1.3%) was due to Chalcid parasites. Two species of Braconidae were recovered. These were identified as   and   .

                                        was slightly more effective than   , the percentage parasitism being 1.6% and 5.1% respectively. The Chalcid parasites were identified as: .

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Bucculatrix canadensisella Chamb. (Lyonetiidae)

Year	Record No.	Locality	Cocooning	Emergence Date 1942	Emergence Incubation	Ratio Larval	Ratio Pupal	Parasites
1941	308A	Red Lake, Ont.	Cocoons & larvae recd. Aug. 18-'41	Feb.17	15 days	---	1/2	
	308B	Red Lake, Ont.	August 22-'41	Feb.23	21 days	1/2	1/1	None
	313	Savant L., Ont. (Poisson Twp.)	(skeletonized leaves only)*			---	---	----
	320	Duck Mt. For. Res., Man. (Dauphin-T31:R24W1)	Cocoons received Aug. 19-'41	Feb.5-Mar.2	3-28 days	---	8/18	None
	325	Lake St. Joseph, Ontario.	Cocoons received Aug. 20-'41	Feb.5-12	3-10 days	---	10/44	
	326A	Lake St. Joseph, Ontario.	August 25-'41	Feb.11-13	9-11 days	1/4	4/4	None
	339	Pickle Lake, Ontario.	Cocoons received Aug. 22-'41	Feb. 2-23	1-21 days	---	61/130	
	345	Cross Lake, Manitoba. (T65:R3WPM)	(20 larvae received August 25-'41--liquid collection)			---	---	----
	346	Cross Lake, Manitoba. (T65:R3WPM)	Cocoons received August 25-'41	Feb. 4-13	2-11 days	---	15/35	

Bucculatrix canadensisella Chamb. (Lyonetiidae) (Cont'd)

Year	Record No.	Locality	Cocooning	Emergence Date	Incubation	Ratio Larval	Pupal	Parasites
1941	356	Swain Lake, Ont. (Narrow L. P.O.)	(Skeletonized leaves only)*			---	---	----
	360	Wabowden, Man.	(1 larva received Aug. 29-'41--discarded)			---	---	----
	361	Pardee Twp.,Ont. (Thunder Bay)	------------	----	----------	0/3	---	None
	364	Island Lake,Man.	(Cocoons rec. Sept. 2-'41)	----	----------	---	0/3	None

* Leaves are identified by presence of larval moulting tents.

Note: Host in all cases was birch.

SUMMARY

Larval Survival not ascertained.
Pupal Survival - 100/237 or 42.2%
Pupal Parasitism - 33/237 or 13.9%

PARASITES

Braconidae.	1.	- 18/237 or 7.6%
	2.	- 12/237 or 5.1%
Chalcidae.	1.	- 3/237 or 1.3%
	TOTAL	13.9%

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<u>Pamphiliidae</u> spp.

Year	Record No.	Locality		Host Tree	Parasites
1941	16A	Spruce Woods Forest Reserve, Manitoba.	(1 larva received June 5-- developmental failure)	White Spruce	-----
	34	Hawk Lake, Ontario.	(6 larvae received June 16-- developmental failures)	Jackpine	-----
	56	Gt. P. Block 8, Ontario. (Lake of Bays Region)	(2 larvae received June 18-- developmental failures)	Balsam	-----
	80A	Crooked Rapids, English River, Ontario.	(1 larva received June 23-- developmental failure)	Spruce	-----
	85A	Kinistino, Saskatchewan. (27:48:19W2)	(1 larva received June 23-- developmental failure)	Jack Pine	-----
	132B	Beardmore, Ontario.	(1 larva received July 2-- developmental failure)	Spruce	-----

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Neodiprion abietis Harr. (Tenthredinidae)

Year	Record No.	Locality	Cocooning	Emergence	Larval	Pupal	Host Tree	Parasites
1941	128) 128A)	Malachi, Ontario.	Jn.30-Jy.8 Jn.30-Jy.2	Jy.21-Sep.6 Aug.2-29	19/24 5/6	16/19 4/5	Black Spruce	[illegible] None
	140	Pukatawagan, Man. (Kississing P.O. H.B.C.)	(1 larva received July 2-liquid collection)				-----	-----
	142	Pukatawagan, Man. (Kississing P.O. H.B.C.)	(4 larvae received July 2-liquid collection)				Balsam	-----
	174	Redditt, Ontario.	July 9	Jy.28-Sep.3	7/7	6/7	Balsam	[illegible]
	183	Bee Lake, Ont. (T.40-N.E.shore)	Jy.14-16	Jy.30-Aug.1	6/6	6/6	Black Spruce	None
	183A	Bee Lake, Ont. (T.40-N.E.shore)	-------	Aug.25-28	3/7	3/3	Black Spruce	None
	218A	Ferland, Ont.	Aug. 1	------	1/2	0/1	Black Spruce	—
	222	Cookson, Sask. (T.53:R.4W3)	-------	July 19	---	1/1	White Spruce	None
	236	Cross Lake, Man. (T.64:R.5WPM)	(2 larvae received July 21-liquid collection)				Balsam	-----
	225	W.Hawk L., Man.	(2 pupae(old) received July 21--dead)				Balsam	-----
	256C	Thicket Portage, Man.(T.73:R.1&2WPM)	July 28	Aug. 11-14	3/3	2/3	White Spruce	[illegible]
	306	Red Lake, Ontario.	(1 cocoon & 2 chalcids recd. Aug.18)			0/1	Balsam	[illegible]

Larval survival ratio - 44/55 or 80.0%
Pupal survival ratio - 38/46 or 82.6%
Pupal parasitism: (Fall emergents - 1/46 or 2.2%
(Spring emergents - /46 or %
Total - or %

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Neodiprion resinosae Provis. (Tenthredinidae)

Year	Record No.	Locality	Cocooning	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	39	Willard Lake, Ont.	July 3-15	Jy.15-Aug.21	48/61	43/48	Red Pine	[illegible]
	87	Crooked Rapids English River, Ont.	July 2	August 4	1/2	1/1	Jack Pine	None
	87B	Crooked Rapids English River, Ont.	July 3	August 18	1/1	1/1	Jack Pine	None
	88	Pelican Falls English River, Ont.	Jn.25-Jy.9	July 15-18	5/5	4/5	Jack Pine	[illegible]
	125A	Lac la Croix, Ont.	------	Sep. 6	---	1/1	Jack Pine	None
	247	Savant Lake, Ont. (Poisson Twp.)	Jy.23-Aug.5	------	4/5	0/4	Jack Pine	[illegible]

Larval Survival - 58/73 or 79.5%

Pupal Survival - 49/59 or 83.1%

Larval Parasitism - 3/73 or 4.1%

Pupal Parasitism (Fall emergents - 0%
(Spring emergents - /59 or %

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TENTHREDINIDAE CONT'D

Year	Record No.	Locality	Cocooning	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
				Neodiprion rugifrons Midd.					
1941	171	Hawk Lake, Ontario.	July 17-30	Feb.10-16	8-14 days	19/21	12/19	Jack Pine	
	204	Dryden, Ontario. (Lot 23;Con.10: Zealand)	July 16-Aug. 1	Feb.2-9	1-9 days	36/39	32/36	Jack Pine	

Larval Survival - 55/60 or 91.6%
Pupal Survival - 45/55 or 81.8%
Larval Parasitism- 1/60 or 1.6%
Pupal Parasitism -

Year	Record No.	Locality	Cocooning	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
				Pikonema alaskensis Roh.					
	79	Pine Falls, Man.	July 8	----	----	2/20	0/2	White Spruce	
	119A	Riverton, Man. ($S\frac{1}{2}$T21:R4EPM)	July 11	----	----	1/1	0/1	Spruce	
	144	Gronlid, Sask. (32:47:17W2	July 7	----	----	6/51	0/6	White Spruce	None

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TENTHREDINIDAE CONT'D

Year	Record No.	Locality	Cocooning	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
				Pikonema alaskensis **Roh. Cont'd**					
1941	145	Schreiber, Ont. (15mi. W. on Hwy.)	July 28-Aug. 7	Feb.27	25 days	2/12	1/2	Black Spruce	None
	149	Pine Falls, Man. (25:18:9EPM)	(1 larva received July 3--preserved)					Black Spruce	----
	149C	Pine Falls, Man. (25:18:9EPM)	----	----	-----	0/3	---	Black Spruce	None
	150	Northern Lights Lake, Ontario.	July 7	----	----	1/7	0/1	White Spruce	None
	153	U. of Manitoba Site, Fort Garry, Manitoba.	July 15	----	----	1/16	0/1	White Spruce	None
	159	Cochin, Sask. (Meadow Lake)	(9 dead larvae received July 5)					White Spruce	----
	162	Northern Lights Lake, Ontario.	Aug. 1	----	----	0/18	---	White Spruce	None
	165	Loon Lake, Sask. (23:58:22W3)	July 7	----	----	4/12	0/4	White Spruce	None
	166	Loon Lake, Sask. (23:58:22W3)	(10 dead larvae received July 7)					White Spruce	----

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TENTHREDINIDAE CONT'D

Year	Record No.	Locality	Cocooning	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941		*Pikonema alaskensis* Roh. Cont'd							
	173	Pine Falls, Man. (8:19:11EPM)	----			0/1	---	Black Spruce	None
	174A	Redditt, Ontario.	(10 larvae and 1 pupa received July 9)			0/10	0/1	Spruce	None
	186	Cookson, Sask. (T53:R4W3)	July 11	Mar.16	42 days	5/28	1/5	White Spruce	None
	202	Nisbett Block No. 1, Ontario. (6:47:1W3)	July 14-26	Mar.2-3	31-32 days	5/30	2/5	White Spruce	None
	207	Nipigon Village, Ontario.	July 14-Aug. 5	----	----	3/30	0/3	White Spruce	None
	222	Cookson, Sask. (20:53:3W3)	Aug.18-20	----	----	2/2	0/2	White Spruce	None
	224	Linklater Lake,	July 21	----	----	2/8	0/2	Spruce	[illegible]
	231B	Unknown	(July 21--1 pupa received)			---	0/1	White Spruce	None
	237	Calm Lake, Ont.	(47 larvae received July 21)			21/47	0/21	White Spruce	[illegible] Tritneptis

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TENTHREDINIDAE CONT'D

Pikonema alaskensis Roh. Cont'd

Year	Record No.	Locality	Cocooning	Emergence Date	Emergence Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	245A	Crean Lake Dist. 2, Waskesiu, Sask.	----	----	----	0/2	---	White Spruce	
	254	Calm Lake, Ont.	Aug. 8	----	----	1/3	0/1	Spruce	None
	256A	Thicket Portage, Man. (T73:R1&2WPM)	July 25	Feb.23	21 days	2/6	1/2	White Spruce	
	256B	Thicket Portage, Man. (T73:R1&2WPM)	----	----	----	0/3	---	White Spruce	None
	257	Thicket Portage, Man. (T73:R1&2WPM)	July 25	Feb.16	14 days	6/15	1/6	Spruce	
	295	Press Lake, Ont. (English River)	Aug. 13	----	----	1/4	0/1	Black Spruce	
	305	Perland, Ontario.	----	----	----	0/1	---	White Spruce	None
	309	Red Lake, Ont.	Aug. 18	Mar.11	39 days	2/2	1/2	Black Spruce	
	334	Oatseed, Manitoba.	Sept. 15			4/5	/4	Black Spruce	

TENTHREDINIDAE CONT'D

Year	Record No.	Locality	Cocooning	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
			Pikonema alaskensis Roh. Cont'd						
1941	348	Linklater Lake, Ontario.	Sept. 15	----	----	1/1	0/1	White Spruce	1 *Bessa*
	363A	Cookson, Sask. (T54:R4W3)	----(Developmental failure)			0/1	---	White Spruce	None

Larval Survival - 72/329 or 21.9%
Pupal Survival - 7/73 or 9.6%
Larval Parasitism - 1/329 or 0.3%
Pupal Parasitism -
Fall emergents - 5/73 or 6.8%
Spring emergents - /73 or %

TOTAL

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TENTHREDINIDAE CONT'D

Year	Record No.	Locality	Cocooning	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941			*Pikonema dimmockii* Cress.						
	22A	Spruce Woods Forest Reserve, Manitoba.	----	----	----	0/1	---	White Spruce	----
	47A	Lac Seul, Ontario. (H.B.C.)	June 27	----	----	1/4	0/1	Spruce	[illegible]
	81	Pelican Falls, English R, Ont.	----	----	----	0/1	---	Black Spruce	[illegible] ; *Hylemia*
	110	Montreal Lake, Sask.	----	----	----	0/2	---	White Spruce	---- [illegible]
	121B	White Otter Lake, Ontario.	----	----	----	0/3	---	White Spruce	---- [illegible]
	132A	Beardmore, Ont. (McComber Twp.)	(larvae and pupa received July 2)			0/7	0/1	White Spruce	----
	149	Pine Falls, Man. (25:18:9EPM)	Jy.28-Aug. 25	----	----	3/4	0/3	Black Spruce	[illegible]
	166	Loon Lake, Sask. (23:58:22W3)	(1 dead larva received July 7)					White Spruce	----
	218	Ferland, Ontario.	----	----	----	0/2	---	Black	----

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TENTHREDINIDAE CONT'D

Year	Record No.	Locality	Cocooning	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
				Pikonema dimmockii Cress. Cont'd					
1941	224A	Linklater L., Ont.	Aug. 19	Feb.25	23 days	1/1	1/1	Black Spruce	None
	236	Cross Lake, Man. (T64:R5WPM)	(3 larvae received July 21--liquid collection)					Black Spruce	----
	245	Waskesiu, Sask. (Crean Lake, Dist.2)	Aug. 25	Mar.10	36 days	1/3	1/1	White Spruce	None
	256	Thicket Portage, Manitoba. (T73:R1 & 2WPM)	Aug.14-18	Feb.9-10	7-8 days	2/4	2/2	White Spruce	[illegible]
	260	Cumberland Post, Sask. (H.B.C.)	Aug.1-25	Feb.5	3 days	2/2	1/2	Black Spruce	None
	282	Battle Creek Sta., Sask.(36:7:27W3)	Aug.28-Sept.12	----	----	3/5	0/3	White Spruce	Tritneptis [illegible]
	301	Wasagaming, Man. (6:20:18)	Sept.17	----	----	1/1	0/1	White Spruce	None
	305	Ferland, Ontario.	----	----	----	0/1	---	White Spruce	----
	311	Linklater L.,Ont.	Aug.18-Sept.13			4/5	/4	Black Spruce	[illegible]

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TENTHREDINIDAE CONT'D

Year	Record No.	Locality	Cocooning	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
				Pikonema dimmockii Cress. Cont'd					
1941	334A	Savant Lake, Ont. (At 7th base line)	Aug.28- Sept.15	----	----	2/2	0/2	Black Spruce	None
	350	Robinson Lake, Ont. (Tashota)	----	----	----	0/1	---	Black Spruce	None
	356	Swain Lake, Ont. (Washagansas L.)	Sept.15	----	----	2/2	0/2	Black Spruce	None
	363	Cookson, Sask. (T54:R4W3)	Sept.2-29	----	----	2/2	0/2	White Spruce	[illegible]
	381	Cookson, Sask. (20:53:2W3)	Sept.22	----	----	1/1	0/1	White Spruce	None

Larval Survival - 25/54 or 46.3%
Pupal Survival - 5/24 or 20.4%
Larval Parasitism- 2/54 or 3.7%
Pupal Parasitism -
Summer emergents - 0%
Spring emergents - 3/54 or 5.6%

TENTHREDINIDAE CONT'D

Year	Record No.	Locality	Cocooning	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
		Anoplonyx laricis Marl.						
1941	8A	Pine Falls, Man.	----	----	0/1	---	Larch	----
	95A	Spruce Woods Forest Reserve, Manitoba.	July 8	July 12	1/5	1/1	Larch	None
	135A	Sandilands Forest Reserve, Manitoba.	----	----	0/1	---	Larch	----
	152A	Forest Insect Laboratory, Winnipeg.	----	----	0/2	---	Larch	----
	164	Loon Lake, Sask. (22:58:22W3)	----	----	0/1	---	Larch	----
	181B	Riding Mountain National Park, Man. (Norgate Road)	July 28	----	1/3	0/1	Larch	None
	215B	Riding Mountain National Park, Man. (Audy Lake)	----	----	0/2	---	Larch	----
	217	Ignace, Ontario. (T24)	----	----	0/5	---	Larch	----
	255	Wabowden, Man.	----	----	0/5	---	Larch	----

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-1941-
WINNIPEG, MANITOBA.

TENTHREDINIDAE CONT'D

Year	Record No.	Locality	Cocooning	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
			Anoplonyx laricis Marl. Cont'd					
1941	324E	Lake St. Joseph, Ontario. (Root Portage)	----	----	0/3	---	Larch	----
	335A	The Pas, Manitoba. (S17:56:26WPM)	----	----	0/2	---	Larch	----
	347	Armstrong, Ont. (O.F.B. H.Q.)	----	----	2/27	0/2	Larch	None
	349	Tashota, Ont. (O.F.B. H.Q.)	----	----	0/8	---	Larch	----
	366	The Pas, Man.	----	----	1/1	0/1	Larch	None

Larval Survival - 5/66 or 7.6%
Pupal Survival - 1/5 or 20.0%

FORBST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

TENTHREDINIDAE

Year	Record No.	Locality	Cocooning	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
				Cimbex americana Leach					
1941	273	Mill Lake, Ont. (Near Mack on C.N.R.)	Aug. 4	----	----	0/1	0/0	Birch	——
	297A	Port Arthur, Ont. (Mill yd. of Provincial Paper Co.)	Sept. 12	----	----	1/1	0/1	Willow	[illegible]
	330	Waskesiu, Sask. (P.A.N.P. Dist. No.10)	(1 larva received Aug. 21--preserved)						----
	364A	Eland Lake, Man.	(4 dead larvae received Oct. 2-preserved 2 parasites larvae stored)						

Larval Survival - 1/2 or 50%
Pupal Survival - 0/1 or 0%
Larval Parasitism - 0/2 or 0%
Pupal Parasitism - 1/1 or 100%

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

<u>Arge</u> <u>virescens</u> Klug. (Tenthredinidae)

Year	Record No.	Locality	Cocooning	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	227	Dryden, Ontario. (Townsite)	(50 larvae received July 21--preserved)				Willow	-----
	272	Dryden, Ontario. (Townsite)	Aug. 4-14	Aug. 18-26	20/22	14/20	Willow	

Larval Survival Ratio - 20/22 or 90.9%
Pupal Survival Ratio - 14/20 or 70.0%
Pupal Parasitism - 1/20 or 5.0%

<u>Arge</u> sp. probably <u>macleayi</u> Leach (Tenthredinidae)

Year	Record No.	Locality		Host Tree	Parasites
1941	332	Prince Albert National Park, Saskatchewan. (Crean Lake District)	(3 larvae received Aug.21--preserved)	Birch	-----
	345	Cross Lake, Manitoba. (T65:R3WPM)	(1 larva received Aug.25--liquid collection)	Birch	-----

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Croesus latitarsus Nort. (Tenthredinidae)

Year	Record No.	Locality		Host Tree	Parasites
1941	308	Red Lake, Ont.	(1 larva received Aug. 18--preserved; 5 larvae developmental failures.)	White Birch	None

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FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Hyphantria textor Harr. (Arctiidae)

Year	Record No.	Locality	Pupation	Emergence Date	Emergence Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	360	Wabowden, Manitoba.	Sept. 20	----	------	3/4	0/3	Birch	
	387	Spruce Woods Forest Reserve, Manitoba.	Collected as pupa	Feb.6	4 days	---	1/1	Under Larix	None

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Lexis bicolor Grt. (Arctiidae)

Year	Record No.	Locality		Host Tree	Parasites
1941	234	Pelican Falls Portage, English River, Ontario.	(1 adult received July 21--pinned)	Spruce	-----

Arctia caia L. (Arctiidae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	50	Lac Seul, Ont.(H.B.Co.)	July 1	July 25	1/2	1/1	Birch	None

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Autographa alias Ottol. (Phalaenidae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasitism
1941	33	Ferland, Ontario.	(Pupa received VI-16)	June 27	....	1/1	Spruce	None
	46	Savant Lake, Ont.	June 20	July 1	1/1	1/1	Spruce	None

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Autographa sp.

Year	Record No.	Locality		Host Tree	Parasites
1941	67	Split Lake, Ont. (H.B.C.) (M279 H.B.C. Rlwy.)	(1 larva received June 20-- development failure)	Birch	
	319B	Stony Rapids, Sask. (H.B.C.)	(1 larva received Aug. 10-- liquid collection)	Willow	
	8	Pine Falls, Man. (5½ 13:19:11EPM)	(1 larva received June 3-- preserved)		

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FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

<u>Panthea</u> <u>furcilla</u> Pack. (Phalaenidae)

Year	Record No.	Locality	Host Tree	Parasites
1941	236	Cross Lake, Manitoba. (1 adult received July 21) (T64:R5WPM)	Jack pine	

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

__Palthis angulalis__ Hbn. (Phalaenidae)

Year	Record No.	Locality	Host Tree	Parasites
1941	305	Ferland, Ontario. (1 larva received Aug. 15-preserved)	White Spruce	
	306	Red Lake, Ontario. (1 larva received Aug. 18- ")	Balsam	

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Zanclognatha minoralis Sm. (Phalaenidae)

Year	Record No.	Locality	Host Tree	Parasites
1941	359	Bissett, Manitoba. (1 larva received Sept.15-preserved) (13:24:13)	Black spruce	

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

PHALAENIDAE

Year	Record No.	Locality	Cocooning	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
				Panthea acronyctoides Wlk.					
1941	305B	Ferland, Ontario.	Aug. 20	Feb.16	14 days	1/1	1/1	White Spruce	None
				Acronicta innotata Gn.					
	339B	Pickle Lake, Ont.	Sept. 6	Mr.11	37 days	1/1	1/1	Birch	None
				Zale largera Sm.					
	176A	Kinistino, Sask.	Jul. 22	Feb.4	2 days	1/1	1/1	Jack Pine	None

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Phalaenidae sp.

(Possibly *Feralia jocosa* Gn.)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasitism
1941	66	Lawrence Lake, Ont. (Fox Point)	July 21	-----	1/2	0/1	Spruce	-----
	111	Lake Winnipegosis, Man.	-----	-----	0/1	---	Black Spruce	-----
	117	Flanders, Ontario. (S. shore Calm Lake)	July 22	-----	1/1	0/1	Jack Pine	Developmental failure
	119B	Riverton, Manitoba. (S½T21:R43)	-----	-----	0/1	---	Spruce	Developmental failure
	121A	White Otter Lake, Ont. (Ignace)	July 21	-----	1/2	0/1	White Spruce	Developmental failure
	122A	White Otter Lake, Ont. (Ignace)	-----	-----	0/1	---	Jack Pine	Developmental failure
	125	McAree, Ontario. and L. la Croix, Ont.	(2 dead larvae received June 30)				Jack Pine	-----
	133	Sandilands Forest Reserve, Manitoba.	July 15		1/1	/1	Jack Pine	
	157A	Hawk Lake, Ontario.	July 14	-----	2/2	0/2	Jack Pine	
	288	Beardmore, Ontario. (Summers Twp.)	(larva received Aug.11)		0/1	---	Spruce	Developmental failure

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Olene plagiata Wlk. (Liparidae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	32A	Hawk Lake, Ont.		June 30		1/1	Jack pine	None
	87C	Crooked Rapids, English River, Ont.	July 1	July 17	1/1	1/1	Jack pine	None
	117B	Flanders, Ont. S. shore Calm Lake			0/1		Jack pine	[illegible]
	133A	Sandilands Forest Reserve, Manitoba.	July 23	August 2	1/1	1/1	Jack pine	None
	149B	Pine Falls, Man. 25:18:9EPM	July 10	July 24	1/1	1/1	White spruce	None
	324	Lake St. Joseph, Ont. Root Portage			/1		Larch	[illegible]

Larval Survival Ratio - 3/4 or 75%

Pupal Survival Ratio - 4/4 or 100%

Pupal Parasitism - 0/4 or 0%

Larval Parasitism - 1/4 or 25%

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Olene spp. (Liparidae)

Year	Record No.	Locality	Host Tree	Parasites
1941	29	Lac Seul, Ont. (1 larva received June 10-liquid collection) (H.B. Co.)	Black spruce	------
	38	Lac Seul, Ont. (1 larva received June 16-liquid collection) (H.B. Co.)	Jack pine	------
	236	Cross Lake, Manitoba. (T64:R5WPM) (1 larva received July 21-liquid collection)	Black spruce	------

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Ellopia fiscellaria Gn. (Geometridae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	56	Gt.P. Block 8, Ont. (Lake of Bays)	(1 larva received June 18--preserved)				Balsam	-----
	228	St. Anthony Mine, Ont.	Jul.28-29	Aug.14-16	2/4	2/2	Balsam	None
	231	Unknown	Jul.21-Aug.11	Aug.8-Sep.3	3/3	3/3	White Spruce	None
	236	Cross Lake, Man. (T64:R5WPM)	(3 larvae received Jul. 21--liquid collection)				Balsam	-----
	266	Manitoba Paper co., Block F. (18:24:12EPM)		Jul. 24		1/1	Balsam	None
	306	Red Lake, Ont.	(1 destroyed pupa received Aug. 18--discarded)				Balsam	-----
	336	St. Anthony Mine, Ont.	(1 larva received Aug. 22--preserved)				Balsam	-----
	340	St. Anthony Mine, Ont.		Sep.3		1/1	White Spruce	None
	350	Robinson Lake, Ont. (Tashota)	(1 crushed larva received Aug.25--discarded)				Black Spruce	-----
	384	Gull Lake Ind. Res., Ont. (Lake Nipigon)	(1 larva collected June 30, received Sep.15--preserved)				Black Spruce	-----

Larval Survival Ratio - 5/7 or 71.4%
Pupal Survival Ratio - 7/7 or 100%
Pupal Parasitism - 0/7 or 0.0%

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FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

<u>Nepytia</u> <u>canosaria</u> Wlk. (Geometridae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	117	Flanders, Ontario. (Calm Lake)	(1 larva received June 26--preserved)				Jack Pine	-----
	121D	White Otter Lake, Ont.	Jul. 7-Aug. 1	September 5	2/2	2/2	White Spruce	None
	149A	Pine Falls, Manitoba. (25:18:9EPM)	Jul. 4-Aug. 9	Aug.9-Sep.5	5/6	5/5	Black Spruce	None
	231A	Unknown	Jul.21-Aug.11	Aug.8-Sep.3	3/3	3/3	White Spruce	None
	235	Pelican Falls Portage; English R., Ont.	August 11	September 9	1/1	1/1	Balsam	None
	260B	Cumberland Post (H.B.C.) Sask.	July 28		1/2	0/1	Black Spruce	

Larval Survival Ratio - 12/14 or 86.7%
Pupal Survival Ratio - 11/12 or 91.7%
Pupal Parasitism - 0/12 or 0.0%

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Ectropis crepuscularia Schiff. (Geometridae)

Year	Record No.	Locality	Host Tree	Parasites
1941	236	Cross Lake, (1 larva received July 21-liquid collection) Manitoba. (T64:R5WPM)	Balsam	-----

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

<u>Protoboarmia</u> <u>porcelaria</u> <u>indicataria</u> Wlk. (Geometridae)

Year	Record No.	Locality		Host Tree	Parasites
1941	77	Cross Lake, Manitoba. (T65:R3WPM)	(1 larva received June 21--preserved)	?	-----
	340	St. Anthony Mine, Ont.	(1 larva received August 22--preserved)	White Spruce	-----
	343	Caribou Lake, Ontario.	(1 larva received August 23--preserved)	Larch	-----
	345	Cross Lake, Manitoba. (T65:R3WPM)	(2 larvae received August 25--liquid collection)	Larch	-----

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Nyctobia limitaria Wlk. (Geometridae)

Year	Record No.	Locality	Host Tree	Parasites
1941	84	Wasagaming, Man. (36:18:17) (1 larva received June 23--preserved)	White Spruce	
	236	Cross Lake, Man. (T64:R5WPM) (1 larva received July 21--liquid collection)	White Spruce	

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Semiothisa sp., possibly oweni Swett. (Geometridae)

Year	Record No.	Locality	Host Tree	Parasites
1941	255	Wabowden, (1 larva received July 25--preserved) Sask.	Larch	-----

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

<u>Caripeta</u> <u>divisata</u> Wlk. (Geometridae)

Year	Record No.	Locality		Host Tree	Parasites
1941	288	Beardmore, Ont. (Summers Twp.)	(1 larva received August 11--preserved)	Spruce	------
	305	Ferland, Ont.	(1 larva received August 15--preserved)	White Spruce	------

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Amphidesis cognataria Gn. (Geometridae)

Year	Record No.	Locality	Host Tree	Parasites
1941	256D	Thicket Portage, Man. (T73:R1WPM) (1 larva received June 25--preserved)	White Spruce	-----

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Paraphia piniata Pack. (Geometridae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	20	Menisino, Man. (32:1:11EPM)	June 14	June 27	1/1	1/1	Larch	None

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

GEOMETRIDAE

Year	Record No.	Locality	Pupation	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
				Eupithecia palpata Pack.					
1941	121D	White Otter Lake, Ontario.	Aug. 5	Feb.6	4 days	1/1	1/1	White Spruce	None
				Semiothisa sexmaculata Pack.					
	324A	Root Portage, Lake St. Joseph, Ont.	Sept. 4	Feb.16	14 days	2/2	1/2	Larch	
	324B	Root Portage, Lake St. Joseph, Ont.	Aug. 26-Sept. 13	Feb.16	14 days	2/2	1/2	Larch	
	324D	Root Portage, Lake St. Joseph, Ont.	(2 larvae received Aug. 20-preserved)					Larch	
	343A	Caribou Lake, Ont.	Aug. 26-Sept. 18	Feb. 5	3 days	2/3	1/2	Larch	
	345	Cross Lake, Man. (T65:R3WPM)	(1 larva received Aug. 25-liquid collection)					Larch	
	346A	Cross Lake, Man. (T65:R3WPM)	Sept. 6	----	----	1/1	0/1	Larch	
	347A	Armstrong, Ontario.	Sept. 15	----	----	1/1	0/1	Larch	
	349A	Tashota, Ontario.	Sept.5-Sept.15	----	----	2/2	0/2	Larch	

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

GEOMETRIDAE CONT'D

Year	Record No.	Locality	Pupation	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
				***Semiothisa sexmaculata* Pack. Cont'd**					
1941	360A	Wabowden, Sask.	Sept. 15	Feb.16	14 days	1/1	1/1	Larch	None

Larval Survival - 11/12 or 91.7%
Pupal Survival - 4/11 or 36.4%
Pupal Parasitism - 2/11 or 18.2%

Semiothisa granitata Gn.

Year	Record No.	Locality	Pupation	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
	334B	Savant Lake, Ont.	Sept. 15	----	----	2/2	0/2	Black Spruce	None
	352	Waboose Rapids, Ogoki River, Ont.	Sept. 15	----	----	1/1	0/1	White Spruce	None
	359	Bissett, Manitoba. (13:24:13)	Sept. 4	----	----	1/1	0/1	Spruce	[illegible]
	381	Cookson, Sask.	(1 larva(dead) received Sept. 20- preserved)					White Spruce	----

Pupal Parasitism - 1/4 or 25%

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

GEOMETRIDAE CONT'D

Year	Record No.	Locality	Pupation	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
				***Eupithecia* spp.**					
1941	16	Spruce Woods Forest Reserve, Manitoba.	(1 larva received June 5--preserved)					White Spruce	----
	47	Lac Seul, Ontario. (H. B. C.)	(1 larva received June 19--preserved)					Black Spruce	----
	66	Lawrence Lake, Ont.	(2 larvae received June 19--preserved)					Black Spruce	----
	310A	Red Lake, Ontario.	Aug. 25	----	----	1/1	0/1	Black Spruce	
	338	Pickle Lake, Ont.	Aug. 28-Sept. 15	----	----	2/2	0/2	White Spruce	
				***Protoboarmia porcelaria* Gn.**					
	66	Lawrence Lake, Ont.	(1 larva received June 19--preserved)					Spruce	----
	306	Red Lake, Ont.	(3 larvae received Aug. 18--preserved Feb. 20, 1942.)					Balsam	----
	324C	Lake St. Joseph, Ont.	(1 larva received Aug. 20--preserved Feb. 20, 1942.)					Larch	----
	359B	Bissett, Manitoba. (13:24:13)	(1 larva received Aug. 28--preserved Feb. 20, 1942.)					Spruce	----
	382	Cross Lake, Manitoba.	(1 larva received Sept. 23)					Spruce	----

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

GEOMETRIDAE CONT'D

Year	Record No.	Locality	Pupation	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
				***Alsophila pometaria* Harr.**					
1941	1	Winnipeg, Manitoba.	June 27	Sept.11	------	11/34	3/11	Elm	[illegible]
	1A	Winnipeg, Manitoba.	June 7- June 14	----	------	5/5	0/5	Elm	----

Larval Survival - 16/39 or 41.03%
Pupal Survival - 3/16 or 18.75%

Year	Record No.	Locality	Pupation	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
				***Palaeacrita vernata* Peck.**					
	1	Winnipeg, Manitoba.	(1 larva collected May 26--preserved)					Elm	----

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Dioryctria reniculella Grt. (Pyralidae)

(Foliage Form)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	21B	Spruce Woods Forest Reserve, Manitoba.	June 17	June 27-28	2/2	2/2	White Spruce	None
	93	Spruce Woods Forest Reserve, Manitoba.	June 24-26	July 3-9	2/2	2/2	White Spruce	None
	151C	Beaverhouse Lake, Ontario.	(1 larva dead, discarded-received July 8)				From Jack Pine	

Field notes show foliage form to be predaceous on budworm larvae. This fact is substantiated by F. B. Rabkin.

Larval Survival Ratio - 4/4 or 100%

Pupal Survival Ratio - 4/4 or 100%

Pupal Parasitism - 0/4 or 0%

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

<u>Dioryctria</u> <u>reniculella</u> Grt. (Pyralidae)

(Cone Form)

Year	Record No.	Locality		Host Tree	Parasites
1941	242	Prince Albert National Park, Saskatchewan. (Meridian Cabin)	(old cones showing characteristic boring)	White Spruce	

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Dioryctria abietella D. & S. (Pyralidae)

Year	Record No.	Locality	Host Tree	Parasites
1941	335	The Pas, Manitoba. (1 larva received Aug.22--preserved) (17:56:26)	White Spruce	

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FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Acrobasis betulella Hbt. (Pyralidae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	49A	Lac Seul, Ontario. (H.B.C.)	June 19-25	July 3-7	4/4	4/4	Birch	None

Larval Survival	-	4/4	-	100%
Pupal Survival	-	4/4	-	100%
Pupal Parasitism	-	0/4	-	0%

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

PYRALIDAE

Year	Record No.	Locality	Cocooning	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
				Meroptera pravella Grt.					
1941	189	Riding Mountain National Park, Man.	July 31	Feb.18- Feb.23	17-21 days	2/13	2/2	Aspen	
	251B	Caribou Lake, Ont.	Aug. 8	Mar.2	28 days	1/1	1/1	Poplar	None
	285	Swan River, Man. (Brandon to The Pas)	Aug. 23	----	----	4/25	0/4	Aspen	None
	321	The Pas, Manitoba. (32:57:24WPM)	----	----	----	0/10	---	Birch	
	327B	Lake St. Joseph, Ontario.	(1 larva received Aug. 20--preserved)			---	---	Aspen	----
	328	Prince Albert National Park, Sask. (Sandy L.-5:54:1W3)	Sept. 15	Feb.23	21 days	13/15	1/13	Poplar	None
	332A	Prince Albert National Park, Sask. (Crean L. Dist. 2)	(1 larva(dead) received Aug. 21--discarded)			---	---	Birch	----

Larval Survival - 20/64 or 31.3%
Pupal Survival - 4/20 or 20.0%

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

PYRALIDAE CONT'D

Year	Record No.	Locality	Cocooning	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
			Tetralopha asperatella Clem.						
1941	342	Caribou Lake, Ont.	(1 dead larva received Sept. 2-- preserved)					White Spruce	----

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Zeiraphera ratzeburgiana Sax. (Olethreutidae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	57	Gt. P. Block No.8, Ont. Lake of Bays Region	July 4	Aug. 4	1/1	1/1	Spruce	None
	111A	Lake Winnipegosis, Man. (Fox Point)	July 8	Aug. 1	1/1	1/1	Black Spruce	None

Larval Survival Ratio - 2/2 or 100%

Pupal Survival Ratio - 2/2 or 100%

Pupal Parasitism - 0/2 or 0%

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Petrova albicapitana Busch. (Olethreutidae)

Year	Record No.	Locality		Host Tree	Parasites
1941	146	Gronlid, Sask. (32:47:17W2)	(1 larva received July 2--escaped)	Jack Pine	-----
	158	Richer, Man. (5:7:11E1)	(old nodule received July 5)	Jack Pine	-----
	188	Douglas, Man. (32:7&10:16W1)	(1 larva received July 11--preserved)	Scots Pine	-----
	283	Carberry, Man.	(1 larva received Aug. 5--preserved)	Lodgepole Pine	-----

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FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Cacoecia cerasivorana Fitch (Tortricidae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	14	Spruce Woods Forest Reserve, Manitoba.	July 7-...	July 10-30	136/138	133/136	Cherry	[illegible]
	131	Warmley, Sask.	July 11-...	July 24-29	33/37	19/33	Cherry	[illegible]
	134	Sandilands Forest Reserve, Manitoba.		July 21- Aug. 2	52/60	35/52	Cherry	[illegible]
	185	Big River, Sask. (18:57:5W3)	July 11-25	Aug. 4	2/10	1/4	Cherry	[illegible]
	205	Fort a la Corne, Sask.	July 21-...	July 28- Aug. 5	28/39	21/28	Cherry	[illegible]

Larval Survival Ratio - 251/284 or 88.4%

Pupal Survival Ratio - 219/253 or 86.6%

Pupal Parasitism - [illegible] /253 or [illegible] %

FOREST INSECT SURVEY
-1941
WINNIPEG, MANITOBA.

Tortrix packardiana Fern. (Tortricidae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	16	Spruce Woods Forest Reserve, Manitoba.	June 9-19	June 23-24	6/7	3/6	White Spruce	None
	21A,C	Spruce Woods Forest Reserve, Manitoba.	June 16-20	June 24-July 2	1/1	2/2	White Spruce	None

Larval Survival Ratio - 7/8 or 87.5%

Pupal Survival Ratio - 5/8 or 62.5%

Pupal Parasitism - 0/8 or 0.0%

FOREST INSECT SURVEY
-1941
WINNIPEG, MANITOBA.

Peronea variana Fern. (Tortricidae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	47B	Lac Seul, Ontario.	July 1	July 23	2/2	2/2	Spruce	None
	121C	Ignace, Ontario.	July 7		1/1	0/1	White Spruce	None
	150A	Northern Lights Lake, Ontario.	July 25	Aug. 4	1/1	1/1	White Spruce	None
	236	Cross Lake, Man. (T64:R5WPM)	(1 larva received July 21--liquid collection)				Spruce	None

Larval Survival Ratio - 4/4 or 100%

Pupal Survival Ratio - 3/4 or 75%

Pupal Parasitism - 0/4 or 0%

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Sparganothis tristriata Kearf (Tortricidae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	4	Hawk Lake, Ont.	July 9	July 22	1/1	1/1	Jack Pine	None
	161A	Winnipegosis, Man. (32:42:15)	July 9	July 21	1/1	1/1	Jack Pine	None
	239	Lac du Bonnet,Man.	(1 larva received July 22, escaped)				White Spruce	

Larval Survival Ratio - 2/2 or 100%

Pupal Survival Ratio - 2/2 or 100%

Pupal Parasitism - 0/2 or 0%

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

<u>Sciaphila duplex</u> Wlsm. (Tortricidae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	49	Lac Seul, Ontario. (H.B.C.)	June 17	June 20	0/1	1/1	Poplar	None

Pupal Survival - 100%

Pupal Parasitism - 0%

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Argyrotaenia quercifolia Fitch. (Tortricidae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	190	Spruce Woods Forest Reserve, Manitoba.	June 10	June 21	1/1	1/1	Oak	None

Larval Survival - 1/1 or 100%

Pupal Survival - 1/1 or 100%

Pupal Parasitism - 0/1 or 0%

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Dichomeris ligulella Hbn. (Gelechiidae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	19A	Spruce Woods Forest Reserve, Manitoba.	June 25	July 7-31	4/25	3/4	Oak	None

Larval Survival Ratio - 4/25 or 16.0%

Pupal Survival Ratio - 3/4 or 75.0%

Pupal Parasitism - 0/4 or 0.0%

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Zelleria haimbachi Busch (Yponomeutidae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	92A	Kinistino, Sask. (17:49:16W2)	June 28	July 15	1/1	1/1	Jack Pine	None
	92B	Kinistino, Sask. (17:49:16W2)	June 26	July 11	1/1	1/1	Jack Pine	None
	112A	Riding Mountain National Park, Manitoba. (Norgate Road)	--------	July 10	0/1	1/1	Jack Pine	None

Larval Survival Ratio - 2/3 or 66%

Pupal Survival Ratio - 3/3 or 100%

Pupal Parasitism - 0/3 or 0%

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

TORTRICIDAE

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
			Clemensia albata Pack.					
	43A	St. Anthony Mine, Ontario.	(Pupae received June 17)	June 24-27	---	3/10	Black Spruce	
			Argyrotaenia occultana Frmn.					
				Emergence / Incubation				
	306A	Red Lake, Ontario.	Sept. 3	Feb.4 / 2 days	1/1	1/1	Balsam	None

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Hypoprepia miniata Kby. (Lithosiidae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	87D	Crooked Rapids English River, Ontario.	June 24	July 7	1/1	1/1	Jack Pine	None

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Celerio gallii intermedia Kby. (Sphingidae)

Year	Record No.	Locality		Host Tree	Parasites
1941	264	Pine Falls, Manitoba.	(1 la rva received (dead) July 28--preserved)	Vine	-----

Cressonia juglandis S. & A.* (Sphingidae)

Year	Record No.	Locality		Host Tree	Parasites
1941	218B	Ferland, Ontario.	(1 larva received (dead) July 17--preserved)	?	-----

* Usual host hickory, walnut and related trees. These do not occur near Ferland.

Celerio lineata Fab. (Sphingidae)

Year	Record No.	Locality	Pupation	Emergence	Larval	Pupal	Host Tree	Parasites
1941		Agricultural College Garden, University of Manitoba.	Jun.29-30	September 3	5/9	2/5	Purslane	----- (fungus?)

Larval Survival Ratio - 5/9 or 55.5%
Pupal Survival Ratio - 2/5 or 40.0%
Pupal Parasitism - 2/5 or 40.0% (apparently due fungus)

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

<u>Sphinx gordius</u> Cram. (Sphingidae)

	Record			Emergence		Ratio			
Year	No.	Locality	Pupation	Date	Incubation	Larval	Pupal	Host Tree	Parasites
1941	181A	Riding mountain National Park, Manitoba. (Norgate Road)	Aug. 7	Feb.6	4 days	1/1	1/1	Tamarack	None

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

<u>Acronycta</u> <u>americana</u> Harr. (Noctuidae)

Year	Record No.	Locality	Host Tree	Parasites
1941	372	Carberry, Manitoba. (1 larva received Sep.13--preserved)	?	------

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Aglais antiopa L. (Nymphalidae)

Year	Record No.	Locality	Pupation	Emergence	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	197	Cookson, Sask. (T53:R4W3)	---------	---------	0/1	-----	Poplar	
	277	Port Arthur, Ont. (Provincial Paper Company yard)	Aug. 5	---------	0/2	0/1	Willow	

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Argynnis aphrodite L. (Nymphalidae)

Year	Record No.	Locality	Date Received	Host	No. of Individuals
1941	274	Mill Lake, Ontario. (Near Mac on C.N.R.)	August 2	In flight	1 (of hundreds flying)

Vanessa atalanta L. (Nymphalidae)

Year	Record No.	Locality	Date Received	Host	No. of Individuals
1941	249	Island Lake, Manitoba.	July 24	Poplar Birch	2 adults

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Incisalia niphon clarki Frmn.

Year	Record No.	Locality	Pupation	Emergence Date	Emergence Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	122B	White Otter Lake, Ontario.	July 14	----	----	1/1	0/1	Jack Pine	
	157	Hawk Lake, Ont.	July 10	----	----	1/1	0/1	Jack Pine	
	172	Hawk Lake, Ont.	July 14-21	Jan.27	0 days	9/9	2/9	Jack Pine	
	247A	Savant Lake, Ont. (Poisson Twp.)	Aug. 8	Feb. 6	4 days	1/1	1/1	Jack Pine	None

Pupation: July 10-August 8
Emergence: January 27-February 4
(0-4 days incubation)

Larval Survival - 12/12 or 100.0%
Pupal Survival - 3/12 or 25.0%
Pupal Parasitism - 8/12 or 66.6%

Parasites:

Ichneumonidae:

3/12 or 25.0%

Chalcidae:

5/12 or 41.6%

66.6%

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

<u>Schizura</u> <u>leptinoides</u> Grt. (Notodontidae)

Year	Record No.	Locality	Cocooning	Emergence Date	Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	273A	Mill Lake, Ont. (Graham)	Sept. 12	Feb.25	23 days	1/1	1/1	Birch	None

485

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

<u>Drepana</u> <u>bilineata</u> <u>levis</u> Hud. (Drepanidae)

Year	Record No.	Locality	Cocooning	Emergence Date	Emergence Incubation	Ratio Larval	Ratio Pupal	Host Tree	Parasites
1941	273A	Mill Lake, Ontario. (Graham)	Pupa recd. Aug. 2	Feb.27	25 days	---	1/1	Birch	None
	313	Savant Lake, Ontario.	Aug. 26	Feb.11	9 days	1/1	1/1	Birch	None

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Chrysomyxa spp. (Fungus Disease)

Year	Record No.	Locality	Date Received	Host
1941	60	Grandview, Man. (13&24:27:24W1)	June 18	White Spruce
	84	Wasagaming, Man. (36:18:17W1)	June 23	White Spruce
	116	Riverton, Man. (T25R3E1)	June 26	Larch
	119	Riverton, Man. (S½T21:R43)	June 28	Black Spruce
	223	Pine Falls, Man. (25:18:9E1)	July 21	Colorado Spruce-heavy.
	233	Pine Falls, Man. (Townsite)	July 21	Colorado Spruce-heavy.
	255	Wabowden, Manitoba.	July 25	Larch
	256	Thicket Portage, Man. (T73R1&2W1)	July 25	White Spruce
	257	Thicket Portage, Man. (T73R2W1)	July 25	Black Spruce
	292	Rennie, Man. (30:10:15E1)	Aug. 11	Black Spruce
	338	Pickle Lake, Ont.	Aug. 22	White Spruce
	352	Waboose Rapids (Ogoki River, Ont.)	Aug. 25	White Spruce
	358	Rennie, Man. (19:10:15E1)	Aug. 25	Black Spruce

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

MISCELLANEOUS SPECIMENS RECEIVED

	No. of Species	No. of Individuals
Hemerobiidae	2	2
Chrysopidae	2	7
Pentatomidae	7	[illegible]
Aphidae	5	[illegible]
Coccidae	2	—
Cercopidae	2	5
Fulgoridae	2	4
Coleoptera:		
Cicindelidae	1	1
Carabidae	7	12
Silphidae	2	2
Coccinellidae	12	59
Dascyllidae	1	2
Heloidae	1	1
Elateridae	16	112
Buprestidae	8	7
Lampyridae	7	15
Melyridae	1	2
Scarabaeidae	2	12
Cerambycidae	11	26
Chrysomelidae	7	257
Tenebrionidae	4	14
Meloidae	1	1
Rhynchophora:		
Curculionidae	7	125
Scolytidae	8	—
Arthropoda	1	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Hemerobius humulinus Linn. (Hemerobiidae)

Record No.	Locality	Date Received	Number
132E	Beardmore, Ont. (McComber Twp.)	July 14	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Micromus angulatus Steph. (Hemerobiidae)

Record No.	Locality	Date Received	Number
382	Cross Lake, Manitoba.	Sep. 23	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

CHRYSOPIDAE

Record No.	Locality	Date Received	Number
	Chrysopa plorabunda Fitch		
62	Hawk Lake, Ontario.	Aug. 18	1
132E	Beardmore, Ont. (McComber Twp.)	July 14 (date emerged)	1
242	Prince Albert National Park, Saskatchewan. (District No. 8)	July 28 (date emerged)	2
288	Beardmore, Ont. (Summers Twp.)	Aug. 11	1
311	Linklater Lake, Ontario.	Aug. 18	1
			6
	Chrysopa plorabunda californica Coq.		
373	Tashota, Ontario. (½ mi. W.)	Sept. 13	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

PENTATOMIDAE

Record No.	Locality	Date Received	Number
	***Elasmostethus cruciatus* Say.**		
258	Hudson's Hope, B.C. (T81:R26W6) (H.B.C.)	July 25	1
317	Stony Rapids, Sask. (H.B.C.)	Aug. 19	29 + 3 nymphs
319	Stony Rapids, Sask. (H.B.C.)	Aug. 19	1
345	Cross Lake, Manitoba. (T65:R3W1)	Aug. 25	3 + 2 nymphs
382	Cross Lake, Manitoba.	Sept. 23	1
			40
	***Podisus serieventris* Uhl.**		
217	Ignace, Ontario. (T24)	July 17	1
261	Sphene Lake, Ontario.	July 26	1
299	Island Lake, Manitoba.	Aug. 14	1
310	Red Lake, Ontario.	Aug. 18	1
			4
	***Meadorus lateralis* Say.**		
29	Lac Seul, Ontario. (H.B.C.)	June 10	1
228	St. Anthony Gold Mine, Ontario.	July 21	2
317	Stony Rapids, Sask. (H.B.C.)	Aug. 19	2 + 1 nymph
			6

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

PENTATOMIDAE CONTINUED

Record No.	Locality	Date Received	Number
	Banasa dimidiata Say.		
331	Pine Falls, Manitoba.	Aug. 21	2
	Leptocorus trivittatus Say.		
370	Prince Albert, Saskatchewan.	Sept. 6	numerous nymphs
	Podisus modestus Dahl.		
299	Island Lake, Manitoba.	Aug. 14	1
	Chlorochroa uhleri Stuhl.		
341	Carberry, Manitoba.	Aug. 22	2

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

APHIIDAE

Record No.	Locality	Host Tree	Date Received
	Cinara lasiocarpae G. & P.		
142	Pukatawagan, Manitoba. (H.B.C.)	Balsam	July 2
	Cinara spp.		
52	Sprague, Manitoba.	Jack pine	June 17
90	Shilo, Manitoba.	Jack pine	June 23
143	Pukatawagan, Manitoba. (H.B.C.)	Black spruce	July 2
	Periphyllus populicola Thomas		
5	Riverton, Manitoba.	Poplar	May 29
15	Spruce Woods Forest Reserve, Manitoba.	Poplar	June 5
61	Grandview, Manitoba.	Poplar	June 18
329	Crooked Pine Lake, Ontario.	Poplar	Aug. 20
	Periphyllus negundinis Thomas		
211	Maple Creek, Saskatchewan.	Manitoba maple	July 14
	Chaitophorus populifoliae Oest.		
41	Hawk Lake, Ontario.	Poplar	June 17

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

APHIIDAE CONT'D

Record No.	Locality	Host	Date Received
	Macrosiphum pisi Kalt.		
187	Waskesiu, Saskatchewan.	Sweet pea	Aug. 11
	Aphis maculatae Oest.		
294	Clark Lake, Saskatchewan.	Poplar	Aug. 19
	Rhopalosiphum prunifoliae Fitch		
331	Pine Falls, Manitoba.	Cranberry	Aug. 21
	Lachnus salignus Gmelin		
371	Shilo Nursery, Manitoba. (Nymphs received Sept.8--preserved)	Russian willow	
379	Shilo Nursery, Manitoba. (Nymphs and adults received Sept. 15--preserved)	Russian willow	

Pineus sp. (Adelgidae)

Record No.	Locality	Host Tree	Date Received
212	Cookson, Saskatchewan.	White spruce	July 15
267	Garland, Manitoba.	White spruce	July 29

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Adelges abietis L.* (Adelgidae)

Record No.	Locality	Date Received	Host	No. of Galls	Remarks
16	Spruce Woods Forest Reserve, Man.	June 5	White spruce	1	
46	Savant Lake, Ontario.	June 17	Spruce	2	
57	Gt. P. Block 8, Ontario. (Lake of Bays Region)	June 18	Spruce	1	
60	Grandview, Manitoba. (13,24:27:24WPM)	June 18	White spruce	1	
66	Lawrence Lake, Ontario.	June 19	Spruce	several	
79A	Pine Falls, Manitoba.	June 23	White spruce	3	
196	Garden Lake, Ontario.	July 12	Spruce	1	
215	Riding Mountain National Park-- Audy Lake, Manitoba. (Crawford Park)	July 16	White spruce	1	
239	Lac du Bonnet, Manitoba. (Mi.5-Pine Falls Road)	July 22	White spruce	10	
254	Calm Lake, Ontario.	July 25	Spruce	1	
281	Winnipeg, Manitoba.	Aug. 5	White spruce	30	

* These may include also *Pineus* sp.

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Toumeyella numismaticum P. & M. (Coccidae)

Year	Record No.	Locality	Date Recd.	Host Tree	Remarks
1941	13	Sprague, Manitoba. (1:2:12EPM)	June 4	Jack Pine	
	85	Kinistino, Sask. (27:48:19W2)	June 23	Jack Pine	
	89	Gronlid, Sask. (27:48:19W2)	June 23	Jack Pine	
	115	Sandilands Forest Reserve, Manitoba. (29:4:10E1)	June 26	Jack pine	
	118	Sandilands Forest Reserve, Manitoba. (H.Q. Area)	June 27	Jack Pine	
	146	Gronlid, Sask. (21, 22:48:19W2)	July 2	Jack Pine	

Predators: *Hyperaspis signata* Oliv. = *H. binotata* Say.

Parasites: Diptera:

Chalcids:

Braconids:

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Physokermes piceae Schr. (Coccidae)

Year	Record No.	Locality	Date Received	Host Tree	No. of Specimens
1941	340	St. Anthony Mine, Ontario.	Aug. 22	White Spruce	10
	355	Washagansas Lake, Ontario. (Swain Lake)	Aug. 25	Spruce	6
					16

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

CERCOPIDAE

Record No.	Locality	Date Received	Number
	Aphrophora parallela Say.		
224	Linklater Lake, Ontario.	July 21	1
251	Caribou Lake, Ont. (7 miles north west of Armstrong)	July 24	2
	Aphrophora signoretti Fitch		
242	Prince Albert National Park, Sask. (District No. 8)	July 23	2

500

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

FULGORIDAE

Record No.	Locality	Date Received	Number
	Epiptera slossoni Van D.		
73-	Waskesiu, Sask. (Crean L.,Dist.2)	June 21	1
	Epiptera brittoni Metc.		
231	Unknown	July 21	2
311	Linklater Lake, Ontario.	Aug. 18	1
			3

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Cicindela longilabris Say. (Cicindelidae)

Record No.	Locality	Date Received	Number
192	Lost Bay, Ontario. (Uchi P.O.)	July 11	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

CARABIDAE

Record No.	Locality	Date Received	Number
	Geopinus incrassatus Dej.		
3	Spruce Woods Forest Reserve, Man.	May 29	2
	Plochionus timidus Hald.		
66	Lawrence Lake, Ontario.	June 19	1
	Platynus quadripunctatus Dej.		
69	Pine Falls, Manitoba. (25:18:9E1)	June 20	2
	Platynus sinuatus Dej.		
216	Neys, Ont. Camp 71 (34 mi.N.ofC.N.R.)	July 16	2
234	Sioux Lookout, Ont.(Pelican Falls Portage)	July 21	1
384	Gull Bay I.R., Lake Nipigon, Ont.	June 30 (date collected)	1
			4
	Pytha sp.		
78	Peninsula, Ont. (Big Pic River)	June 23	1
	Carabus taedatus Fab.		
115	Sandilands Forest Reserve, Man. (29:4:10E1)	June 26	1

503

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

CARABIDAE CONT'D

Record No.	Locality	Date Received	Number
	Bembidium sp.		
128	Malachi, Ontario.	June 30	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

SILPHIDAE

Record No.	Locality	Date Received	Number
	Silpha noveboracensis Forst		
44	Linklater Lake, Ontario.	June 17	1
	Ostoma ferruginea L.		
377	Ogoki, Ontario. (H.B.C.)	Sept. 15	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

COCCINELLIDAE

Record No.	Locality	Date Received	Number
	***Neomysia subvittata* Muls.**		
38	Lac Seul, Ontario. (H.B.C.)	June 16	1
128	Malachi, Ontario.	June 30	1
130	Malachi, Ontario.	June 30	1
133	Sandilands Forest Reserve, Man.	July 2	1
216	Neys, Ontario. (Camp 71)	July 16	1
	***Anatis mali* Say.**		
2	Pine Falls, Man. (25:18:9EPM)	May 26	1
36	Riverton, Man. (32:24:2E1)	June 16	2
182	Wasagaming, Manitoba.	July 14	1
215	Crawford Park (Audy Lake), Man.	July 16	1
	***Anisocalvia duodecimmaculata* Gebl.**		
224	Linklater Lake, Ontario.	July 21	4
311	Linklater Lake, Ontario.	Aug. 18	2

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

COCCINELLIDAE CONT'D

Record No.	Locality	Date Received	Number
	Anisocalvia quattuordecimguttata L.		
140	Pukatawagan, Man. (Kississing P.O.) (H.B.C.)	July 2	1
311	Linkla ter Lake, Ontario.	Aug. 18	2
	Hippodamia 5-signata Kby.		
211	Maple Creek, Saskatchewan(23:9:23W3)	July 14	3
356	Swain Lake, Ontario. Collected at Narrow Lake.	Aug. 25	1
	Adalia spp.		
211	Maple Creek, Saskatchewan(23:9:23W3)	July 14	1
242	Prince Albert National Park, Sask.	July 23	7
382	Cross Lake, Manitoba. (H.B.C.)	Sep. 23	1

COCCINELLIDAE CONT'D

Record No.	Locality	Date Received	Number
	Cleis picta Rand.		
29	Lac Seul, Ontario. (H.B.C.)	June 10	1
236	Cross Lake, Man. (T64:R5WPM)	July 21	1
306	Red Lake, Ontario.	Aug. 18	1
307	Red Lake, Ontario.	Aug. 18	1
316	Stony Rapids, Sask. (H.B.C.)	Aug. 19	1
340	St. Anthony Gold Mine, Ont.	Aug. 22	1
	Coccinella trifasciata Steph.		
294	Clark Lake, Sask. (32:63:6W3)	Aug. 13	1
381	Cookson, Sask. (20:53:2W3)	Sep. 20	1
	Exochmus sp.		
176	Kinistino, Sask. (3:49:21W2)	July 9	1
	Hyperaspis signata Oliv.		
8	Pine Falls, Man. (SE½13:19:11EPM)	June 3	3
115	Sandilands Forest Reserve, Man. (29:4:10EPM)	June 26	6 larvae
118	Sandilands Forest Reserve, Man.	June 30	6 larvae

FORESTA INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

COCCINELLIDAE CONT'D

Record no.	Locality	Date Received	Number
	Phytodecta americana Schffr.		
213	Peninsula, Ont. (Camp 37, Big Pic River)	July 15	1

Record No.	Locality	Host Tree	Parasites
	Adalia bipunctata L.		
210	Maple Creek, Sask. (1 larva received July 14-- preserved)	Poplar	------
345	Cross Lake, Man. (T63:R3WPM) (1 larva received Aug. 25-- liquid collection)	Birch	-----

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WINNIPEG, MANITOBA.

Eurypogon niger Mels. (Dascyllidae)

Record No.	Locality	Date Received	Number
83	Pelican Falls, English R.,Ont.	June 23	2

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Cyphon variabilis Thunb.

(Helodidae)

Record No.	Locality	Date Received	Number
382	Cross Lake, Manitoba.	Sept. 23	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Ludius propola Lec. (Elateridae)

Record No.	Locality	Date Received	Number
27	Lac Seul, Ont. (H.B.C.)	June 10	2
37	Cross Lake, Man. (T65:R3WPM)	June 16	2
43	St. Anthony Gold Mine, Ont.	June 17	5
55	Grandview, Man. (13:27:24W1)	June 18	4
60	Grandview, Man. (24:27:24W1)	June 18	6
73	Waskesiu, Sask. (Crean Lake District 2)	June 21	3
77	Cross Lake, Man. (T65:R3WPM)	June 21	5
78	Peninsula, Ont. (Big Pic River)	June 23	1
80	Crooked Rapids, English River, Ontario.	June 23	1
86	Deepdale, Man. (14:30:28WPM)	June 23	1
108	Montreal Lake, Sask. (T59:R25)	June 25	4
228	St. Anthony Gold Mine, Ont.	July 21	1
232	Fee's Spur, Ont.	July 21	(portion of adult)
266	Manitoba Paper Company (18:24:12EPM)	July 28	1
301	Wasagaming, Man. (6:20:18)	Aug. 14	1
			38

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WINNIPEG, MANITOBA.

Ludius triundulatus Rand. (Elateridae)

Record No.	Locality	Date Received	Number
2	Pine Falls, Man. (25:18:9E1)	May 26	1
8	Pine Falls, Man. (S½13:19:11E1)	June 3	1
28	Lac Seul, Ont. (H.B.C.)	June 10	1
29	Lac Seul, Ont. (H.B.C.)	June 10	1
43	St. Anthony Gold Mine, Ont.	June 17	2
46	Savant Lake, Ont.	June 17	2
59	Grandview, Man. (24:27:24W1)	June 18	1
60	Grandview, Man. (13:27:24W1)	June 18	1
66	Lawrence Lake, Ont.	June 19	1
77	Cross Lake, Man. (T65:R3W1)	June 21	2
80	Crooked Rapids, English River, Ont.	June 23	2
108	Montreal Lake, Sask. (T59:R25)	June 25	2
364A	Island Lake, Man.	Oct. 2	portion of elytron
			18

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Ludius resplendens Esch. (Elateridae)

Record No.	Locality	Date Received	Number
55	Grandview, Man. (13:27:24W1)	June 18	1
140	Pukatawagan, Man. (Kississing P.O.)(H.B.C.)	July 2	1
143	Pukatawagan, Man. (Kississing P.O.)(H.B.C.)	July 2	3
			5

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

ELATERIDAE

Ludius appropinquans Rand.

Record No.	Locality	Date Received	Number
27	Lac Seul, Ontario. (H.B.C.)	June 10	1
44	Linklater Lake, Ontario.	June 17	2
66	Lawrence Lake, Ontario.	June 19	1
71	Norway House, Man. (Playjam Lake)	June 21	1
80	Crooked Rapids, English River, Ont.	June 23	1
87	Crooked Rapids, English River, Ont.	June 23	1
130	Malachi, Ontario.	June 30	3
149	Pine Falls, Man. (25:18:9EPM)	July 3	1
231	Unknown	July 21	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

ELATERIDAE

Ludius nitidulus Lec.

Record No.	Locality	Date Received	Number
37	Cross Lake, Manitoba.	June 16	1
43	St. Anthony Gold Mine, Ont.	June 17	1
44	Linklater Lake, Ontario.	June 17	2
71	Norway House, Man. (Playjam Lake)	June 21	1
73	Waskesiu, Sask.(CreanL.,Dist.2)	June 21	3
77	Cross Lake, Manitoba.	June 21	1
108	Montreal Lake, Sask.(T59:R25)	June 25	1
110	Montreal Lake, Sask.(T59:R25)	June 25	1
142	Pukatawagan, Man. (Kississing P.O.) (H.B.C.)	July 2	2
143	Pukatawagan, Man. (Kississing P.O.) (H.B.C.)	July 2	2
224	Linklater Lake, Ontario.	July 21	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

ELATERIDAE

Record No.	Locality	Date Received	Number
	Limosus aeger Lec.		
43	St. Anthony Gold Mine, Ont.	June 17	1
44	Linklater Lake, Ontario.	June 17	1
65	Gods Lake, Manitoba.	June 19	1
71	Norway House, Man. (Playjam Lake)	June 21	1
81	Pelican Falls, English River, Ont.	June 23	2
142	Pukatawagan, Man. (Kississing P.O.) (H.B.C.)	July 2	1
	Limosus spinosus Lec.		
44	Linklater Lake, Ontario.	June 17	1
	Ampedus evansi Brown		
44	Linklater Lake, Ontario.	June 17	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

ELATERIDAE

Record No.	Locality	Date Received	Number
	***Ampedus* sp.**		
8	Pine Falls, Man. (S½13:19:11E1)	June 3	2
	***Adelocera brevicornis* Lec.**		
110	Montreal Lake, Sask. (T60:R25)	June 25	2
	***Ludius insidiosus* Lec.**		
44	Linklater Lake, Ontario.	June 17	2
	***Ludius medianus* Germ.**		
71	Norway House, Man. (Playjam Lake)	June 21	2
87	Crooked Rapids, English River, Ont.	June 23	1
88	Pelican Falls, English River, Ont.	June 23	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

ELATERIDAE

Record No.	Locality	Date Received	Number
	Ludius aratus Esch.		
140	Pukatawagan, Man. (Kississing P.O.) (H.B.C.)	July 2	1
	Ludius splendens Zeig.		
88	Pelican Falls, English River, Ont.	June 23	1
	Ludius watsoni Brown		
77	Cross Lake, Man. (T65:R3W1)	June 21	
	Ludius stricklandi Brown		
60	Grandview, Man. ($\frac{13}{24}$:27:24W1)	June 18	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

BUPRESTIDAE

Record No.	Locality	Date Received	Number
	Dicerca tenebrosa Kby.		
110	Montreal Lake, Sask. (T60:R25)	June 25	1
	Dicerca prolongata Lec.		
258	Hudson's Hope, B.C. (T81:R26W6)	July 25	1
	Buprestis nuttali var. *consularis* Gory		
192	Lost Bay, Uchi, Ontario.	July 11	1
	Agrilus anxius Gory		
306	Red Lake, Ontario.	Aug. 18	1
	Anthaxia aeneogaster Cast.		
149	Pine Falls, Manitoba. (25:18:9EPM)	July 3	3

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FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

LAMPYRIDAE

Record No.	Locality	Date Received	Number
	Lucidota corrusca L.		
28	Lac Seul, Ontario. (H.B.C.)	June 10	1
127	Riding Mountain National Park (Crawford Park)	June 30	1
307	Red Lake, Ontario.	Aug. 18	1
322	The Pas, Man. (20:54:26W1)	Aug. 20	2
			5
	Pyractomena borealis Rand.		
43	St. Anthony Mine, Ontario.	June 17	2
81	Pelican Falls, English River, Ont.	June 23	1
124	McDiarmid, Ont. (Jackfish Lake)	June 30	1
			4
	Photurus pennsylvanica DeG.		
117	Flanders, Ont. (S. shore Calm Lake)	June 26	1
	Podabrus modestus Say.		
147	Beaverhouse Lake, Ontario.	July 2	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

LAMPYRIDAE CONT'D

Record No.	Locality	Date Received	Number
	Podabrus spp.		
77	Cross Lake, Manitoba.	June 21	1
191	Uchi, Ontario.	July 11	1
			2
	Calopteron terminale Say.		
359	Bissett, Manitoba.	Aug. 28	1
	Silis sp.		
110	Montreal Lake, Sask. (T60:R25)	June 25	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

<u>Hoppingiana</u> <u>hudsonica</u> Lec.

(Melyridae)

Record No.	Locality	Date Received	Number
109	Montreal Lake, Sask.(T60:R25)	June 25	1
318	Stony Rapids, Ontario. (H.B.C.)	Aug. 19	1
			2

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

SCARABAEIDAE

Dichelonycha subvittata Lec.

Record No.	Locality	Date Received	Number
29	Lac Seul, Ontario. (H.B.C.)	June 10	1

Dichelonycha elongata Fab.

Record No.	Locality	Date Received	Number
35	Riverton, Manitoba. (32:24:2E1)	June 16	11

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

CERAMBYCIDAE

Record No.	Locality	Date Received	Number
	Anoplodora sánguinea Lec.		
66	Lawrence Lake, Ontario.	June 19	1
	Anoplodera canadensis Fab.		
231	Not known	July 21	1
	Anoplodera mutabilis Newm.		
76	Waskesiu Lake, Sask. (T56:R1W3)	June 21	1
	Pogonocherus penicellatus Lec.		
80	Crooked Rapids, English River, Ont.	June 23	1
	Graphisurus sp.		
110	Montreal Lake, Sask. (T60:R26)	June 25	2
	Merium proteus Kby.		
258	Hudson's Hope, B.C. (T81:R26W6) (H.B.C.)	July 25	1
383	Carberry, Manitoba.	Sep. 25	1
			2

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

CERAMBYCIDAE CONT'D

Record No.	Locality	Date Received	Number
	Monochamus scutellatus		
109	Montreal Lake, Sask. (T60:R25)	June 25	1
110	Montreal Lake, Sask. (T60:R25)	June 25	2
140	Pukatawagan, Man. (Kississing P.O.)(H.B.C.)	July 2	1
231	Unknown	July 21	1
244	Pangloss Lake, Ont. (S.W. Lake Nipigon)	July 23	2
246	Pangloss Lake, Ont. (S.W. Lake Nipigon)	July 23	1
			8
	Saperda calcarata Say.		
214	Farlane, Ont.	July 15	5 larvae
293	Wasagaming, Man.	Aug. 14	1 larva
			6 larvae
	Monochamus titillator Fab.		
369	Crooked Pine Lake, Ont.	Sept. 6	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

CERAMBYCIDAE CONT'D

Record No.	Locality	Date Received	Number
	Monochamus notatus Dru.		
250	Vicinity Carberry, Manitoba.	July 24	1
369	Crooked Pine Lake, Ontario.	Sept. 6	1
			2
	Bellamira scalaris Say.		
306	Red Lake, Ontario.	Aug. 18	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

CHRYSOMELIDAE

Record No.	Locality	Date Received	Number
	Galerucella externa Say.		
115	Sandilands Forest Reserve, Manitoba.	June 26	1
	Syneta pylosa Brown		
37	Cross Lake, Manitoba. (T65:R3WPM)	June 16	1
108	Montreal Lake, Sask. (T59:R25)	June 25	1
			2
	Altica ambiens alni Harr.		
154	Hawk Lake, Ontario.	July 5	83 larvae
	Chrysochus auratus Fab.		
214	Farlane, Ontario.	July 15	1
	Calligrapha verrucosa Suffr.		
262	Cumberland Post, Sask. (H.B.C.)	July 26	8

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

CHRYSOMELIDAE CONTINUED

Record No.	Locality	Date Received	Number
	Phytodecta americana Schffr.		
5	Riverton, Manitoba. (S½T24:R3&2E1)	May 30	25 larvae
7	Riverton, Manitoba. (S½T25:R2E1)	June 2	26
15	Spruce Woods Forest Reserve, Man.	June 5	15 larvae
61	Grandview, Manitoba. (13:27:24W1)	July 3	23 larvae
187	Cookson, Sask. (T53:R4W3)	July 11	2
			91
	Chrysomela tremulae Fab.		
37	Cross Lake, Man. (T65:R3W1)	June 16	2
315A	St. Anthony Gold Mine, Ontario.	Aug. 18	1 and 3 larvae
342	Caribou Lake, Ontario.	Aug. 23	13 larvae
342A	Caribou Lake, Ontario.	Aug. 23	52 larvae
			71

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-1941-
WINNIPEG, MANITOBA.

TENEBRIONIDAE

Record No.	Locality	Date Received	Number
	Upis ceramboides L.		
44	Linklater Lake, Ontario.	June 17	1
224	Linklater Lake, Ontario.	July 21	1
249	Island Lake, Manitoba.	July 24	1
315	St. Anthony Gold Mine, Ontario.	Aug. 18	1
318	Stony Rapids, Sask. (H.B.C.)	Aug. 19	1
364	Island Lake, Manitoba.	Sept. 2	1
			6
	Tenebrio picipes Hbst.		
300	Carberry, Manitoba. (T9R13W)	Aug. 14	1
	Scaphidema aeneolum Lec.		
128	Malachi, Ontario.	June 30	1
245	Waskesiu, Sask. (Crean L., Dist. 2)	July 23	1
307	Red Lake, Ontario.	Aug. 18	1
316	Stony Rapids, Sask. (H.B.C.)	Aug. 19	1
			4
	Paratenetus sp.		
331	Pine Falls, Manitoba.	Aug. 21	3

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

Macrobasis Fabricii Lec. (Meloidae)

Record No.	Locality	Date Received	Number
147	Beaverhouse Lake, Ontario.	July 2	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

CURCULIONIDAE

Record No.	Locality	Date Received	Number
	Hylobius congener D.T.		
2	Pine Falls, Man. (25:18:9E1)	May 6	1
108	Montreal Lake, Sask. (T59:R25)	June 25	1
	Lepyrus palustris Scop.		
45	Woodridge, Man. (27:4:10E1)	June 17	1
61	Grandview, Man. (13:27:24W1)	June 18	1
187	Cookson, Sask. (T53:R4W3)	July 11	1
	Hypomolyx piceus DeG.		
65	Gods Lake, Manitoba.	June 19	1
215	Crawford Park (Audy Lake), Man.	July 16	1
248	Vicinity Gods Lake, Man.	July 24	1
315	St. Anthony Mine, Ontario.	Aug. 18	1
	Pissodes fiskei Hopk.		
2	Pine Falls, Man. (25:18:9EPM)	May 26	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

CURCULIONIDAE CONT'D

Record No.	Locality	Date Received	Number
	***Pissodes strobi* (group)**		
8	Pine Falls, Man. (SE½13:19:11EPM)	June 3	1
78	Peninsula, Ontario. (Big Pic River)	June 23	1
85	Kinistino, Sask. (27:48:19W2)	June 23	1
149	Pine Falls, Man. (25:18:9EPM)	July 5	1
187	Cookson, Sask. (T53:R4W3)	July 24	10
215A	Crawford Park (Audy Lake), Man.	July 28	54
296	Press Lake, English River, Ont.	Aug. 12	22
298	Prince Albert National Park (M.13, Waskesiu Highway, Sask.)	Aug. 13	12
323	Prince Albert National Park, Sask.	Aug. 20	11
	***Ceutorhynchus* sp.**		
61	Grandview, Man. (13:27:24W1)	June 18	1
	***Notaris aethiops* Fab.**		
77	Cross Lake, Man. (T65:R3WPM)	June 21	1

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

SCOLYTIDAE

Record No.	Locality	Date Received	Number
	Crypturgus atomus Lec.		
136	Lower Scotch Lake, Ontario.	July 2	1
	Scolytus piceae Sw.		
149	Pine Falls, Man. (25:18:9EPM)	July 3	1
	Ips integer Eisch.		
271	Pasquia, Sask. (6:51:5W2)	July 30	(collection of H.A. Richmond)
	Ips perturbatus Eisch.		
291	Teulon, Manitoba.	Aug. 11	larvae & adults
	Ips pini Say.		
376	Sprague, Man. (26:1:12EPM)	Sept. 15	14 adults
	Orthotomicus vicinus Lec.		
271	Pasquia, Sask; (6:51:5W2)	July 30	(collection of H.A. Richmond)

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FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

SCOLYTIDAE CONT'D

Record No.	Locality	Date Received	Number
	Trypodendron		
271	Pasquia, Sask. (6:51:5W2)	July 30	(collection of H.A. Richmond)
	Conophthorus resinosae Hopk.		
241	Tashota, Ontario.	July 22	2
290	Tashota, Ontario	Aug. 11	2
			4

FOREST INSECT SURVEY
-1941-
WINNIPEG, MANITOBA.

<u>Melanoplus</u> <u>bivittatus</u> Say. (Arthropoda)

Record No.	Locality	Date Received	Number
249	Island Lake, Manitoba.	July 24	1

D. Insectary & Rearing Procedures

During the first year of operation at Winnipeg, the Forest Insect Survey was conducted along the general lines outlined at Ottawa. Certain adjustments were necessary to adapt these methods to local conditions. In addition, certain difficulties and omissions arose which resulted in unnecessary repetition and tedium. Refinements inaugurated to promote greater efficiency are outlined below as a working guide for future operations.

1. The Forest Insect Survey

(a) Preparation of Material and Record Sheets

(i) Box is opened and contents are segregated into rearing jars. (One box at a time avoids mixing).
*Insects are double counted for accuracy.
*Each jar receives a slip of paper and a card. A contents record must be maintained on this card.

(ii) Identifications are entered on the tab attached to the enclosure slip.
*A, B, C, etc. is entered opposite each reared species in ink. Incidental material is entered in pencil.
Use the form: No., Stage, Common Name, Scientific Name.

(iii) Record sheets are made out for each rearable species and the incidental material is entered on the first sheet for its record number.
*Unusual material must be indicated by a size diagram(⊢——┼⊣) and each is carefully described for the rearing staff; viz., Minute! Very small! With care!
*Special rearing instructions are entered in "Remarks" and staff should be instructed to peruse "Remarks" for these instructions. These instructions should include observations on feeding as well as methods of handling nests of insects such as Cacoecia cerasivorana or wood borers.
Descriptions of larva should be appended wherever possible.

(iv) Enclosure slips are placed in a basket in the Forest Insect Survey office.

(v) Record sheets accompany jars to the insectary.

(vi) Adult material received is pinned at once and is tabbed with its record number and date received. When complete, these are submitted to the Forest Insect Survey office for segregation and listing.

(vii) When time permits, and shipments are large enough, permanent liquid and blown larval collections of rarer insects are obtained. Removal for this purpose is shown on the record sheet.

(b) Insectary Practice

(i) Rearing: Jelly jars are used. Food is replenished when wilted, especially for hardwood foliage feeders.

Larvae: Each jar must contain:

(a) Single species
(b) Record label described above*
(c) Food
(d) Record number in wax pencil on lid

* This label showing F.I.S. No. and contents must be maintained so that it, contents and record sheet agree at all times.

As larvae pupate, they are removed to a new jar.

Pupae: Each jar must contain:

(a) Pupae from jar of same record number.
(b) Record label (as for larvae)
(c) Cotton-batting or sand on the bottom.
(d) Curled paper for emergents to crawl up to distend wings.
(e) Record number on jar lid.

* Exceptions: Certain larvae pupate in sand at bottom of jelly jar. Those so inclined will be shown on record sheet and pupae will be allowed to remain in jar and will not be transferred to a new jar.

* Jars should never be allowed to remain in direct sunlight.

(ii) Feeding: Fresh food should be regularly supplied for larvae. This is particularly necessary for insects feeding on hardwood foliage. The least hardy of these should be provided with a twig of foliage kept fresh in water by means of a special arrangement. Fresh food is supplied even when larvae are sluggish and do not seem to eat.

* All food should be closely scrutinized to avoid carrying foreign insects into the jars. This scrutiny should also be used on discarding old food, since some experiments will involve exceedingly small insects. These may be present in curls of leaves, axils of leaves and needles, etc.

(c) Emergents)

(i) Emergents are killed as they appear and are fully expanded.
A separate killing bottle is used for each record number to avoid any mixing of records.

(ii) All emergents * are pinned and labelled. Lepidoptera of all but commonest species (e.g., Jack pine budworm) must be carefully spread, since the taxonomic department objects to broken specimens and thus records may be incomplete.

Sawflies, parasites, etc. may be pinned and labelled with record number and emergence date. Moths are to be carefully retained to avoid rubbing. In each case, the insects are submitted to the officer in charge of the insectary along with the record sheet which is checked and returned to the insectary.

Checked, entered emergents are submitted to the Forest Insect Survey office for tabulation and boxing. Any completed record sheets accompany these emergents.

* If time is too pressing, chalcid swarms may be layered but in all cases a representative sample (at least 5) should be pointed as examples of the swarm's species.

Insects which manage to escape during collection from jars must be captured and killed. This will prevent outbreaks on the property and district. Parasites may be allowed to escape on rare occasions, but are to be counted and entered in the suitable column.

Exception: In the pupal survey, it may be found desirable to liberate certain of the parasites which emerge. In this instance, only known parasites are so treated. All miscellaneous species or unknown species are treated in the usual manner.

(See also Pupal Survey Methods).

(d) Keeping Records

Complete and accurate records must be maintained so that data may be completely summarized.

(i) Larvae and pupae are counted daily and constantly checked against the slip in the jar to ensure a complete life history.

(ii) The marginal column, "Remarks," should be extensively used. Reason for any change in the number of specimens must be shown in this column. No specimens may be discarded without the permission of the Forest Insect Survey personnel and reason for such discarding must be shown. The numbers of larvae and pupae entering the record number are double checked before they go to the insectary and the material being reared must agree with this figure.

2. Insectary Operation of Budworm Pupal Survey

(a) All sealers should be examined twice daily. Emergents should be handled thus:

(i) If moths and parasites are present, apply an ether plug. When all are quiescent, segregate moths into killing bottle with an enclosure slip showing the Forest Insect Survey number and date. Then segregate parasites into species as known, i.e., *Ephialtes*, *Phaeogenes*, or Diptera, and into sexes. Any species not known should be killed and pinned with a slip showing F.I.S. number and date. Known parasites are retained alive for liberation (See (b) below.).

(ii) If parasites or moths are in sealers, treat as indicated.

(b) Place known parasites while anaesthetised into tins and record the total number as to species and sex. Use a separate can for each major species.

(c) Enter all data on the forms provided. These are special forms and should be checked to see that all data required are obtained.

(d) Twice a day moisten the cloth bands on parasite tins with cold water. At this time, sprinkle a sugar solution onto the inner surface of wire gauze on can sides, using a hypodermic needle.

(e) Once a day spray one hypodermic-ful of water into each pupa box, guarding against escape of moths.

VI. WOOD BORERS

VI. REPORT ON BORERS IN PASQUIA FOREST, SASKATCHEWAN.

This memorandum covers the results of an inspection of fire-burned areas in the Pasquia Provincial Forest, Saskatchewan. This examination, made at the request of the Director of Forests for the province, was conducted between July 23, and July 25, 1941, inclusive, the object being the determination of the extent of injury, time of attack and the insects concerned in the deterioration of fire-burned timber.

Two areas were visited. The first, Sec. 29, Twp. 51, R5, was burned between June 28, and July 15, 1941, the perimeter of the burn being approximately six miles. While still smouldering on this latter date, the greatest conflagration was terminated shortly after July 7th. The stand comprised spruce and poplar, all of which was burned to a greater or lesser degree. Of those trees still standing, some were completely charred, although the bark was intact; some were charred on one side only, with the remaining bark and foliage in a healthy condition; while others suffered nothing more than partly burned roots. Every standing tree was infested, as discussed in detail later.

The second area examined, Sec. 6, Twp. 51, R6, was burned in 1937 and reburned in 1940. Only a small amount of wood remained, but surrounding this was a large amount of dead timber killed as a result of the second fire in 1940. All of the standing dead timber was infested, being a duplication of the attack on the first area advanced a year.

The first burn was some 2 to 3 weeks old when examined, but even then the infestation was 100%. Although several species of insects were present, of greatest importance from the standpoint of salvage are the wood borers. Of the various wood borers, none was so prevalent as the flat-headed borer of the family Buprestidae. This family is composed of metallic-coloured oval beetles. The white, legless, flat-headed larvae give the common name to the family. Eggs are laid in the crevices of the bark and the resulting larvae mine the inner bark, eventually penetrating the wood. With the completion of development, the tunnel widens into a large pupal cell near the outer surface. From here, the new adult beetle emerges after the larva has matured and transformed in the pupal cell.

The adult beetles feed to an appreciable extent on the bark of twigs and evidence of such feeding was most prominent on the windfalls in the area of the new burn.

In the 1940 burned area, all trees examined were heavily infested even where no outside entrance holes were evident. Such borers had worked their way from some other point of entry. Illustrative of this, a dry tree showing no external evidence of borer attack was examined at breast height over an area of 4½ square feet. At a depth of one inch, there were 18 larval tunnels; at 2 inches, 22 tunnels; and at 3 inches, 27 tunnels.

The attack of these borers in the current burned area commenced almost immediately the fire was suppressed. While in some instances the larvae were extremely small when examined, in others they had reached a length of one-half inch and had penetrated the wood to a depth of one-quarter inch. Counts of their population showed them to run as high as 400 larvae per square foot. Similar counts of completed entrance holes in the old burn gave an average figure of four per square foot, which would indicate either a very heavy natural mortality or a great increase in this borer's population. This lower figure, however, is ample to completely ruin a log in short time.

The heaviest attack by these borers occurred in the basal portions of the tree, but the attack continued beyond the middle. Likewise, there was a greater abundance of borers under scorched bark, but their attack was also progressing in the green, and apparently healthy, portion of the trunk where no burning had occurred.

The only other wood borer in noticeable quantity was the ambrosia beetle, _Trypodendron_ sp. These beetles enter the bark and bore immediately into the sapwood and heartwood. Their galleries are of the same diameter throughout and black, appearing as though made by a red hot wire. These blackened walls are caused by a fungus which the beetle cultivates in the burrows as food for the young. The name, "ambrosia," is associated with the fungus whence comes the common name of this insect. The damage by these borers is caused almost entirely by the adult beetles, as the larvae, until mature, remain in the original cell excavated by the female and are fed the ambrosia by the beetles themselves.

Damage from these beetles is restricted to green wood, and logs cut or trees injured during the period of adult activity are liable to attack. While the holes produced are relatively small, they greatly decrease the grade of finished lumber. At the time of examination of the current burn, this beetle had already produced considerable damage. Galleries penetrated to a depth of 2 inches. This insect, however, was of much less abundance than the others and some trees showed no signs of attack.

The round-headed borers, _Monochamus scutellatus_ and _M. notatus_, were present in the new burn, but as yet had shown little evidence of boring. The adult beetles of this group are characterized by their long antennae arising from prominent tubercles on the front of the head. The larvae are elongate, cylindrical, creamy white creatures with well developed heads. Unlike the Buprestids, the head and anterior segments of the body are not conspicuously larger than those that follow. Generally speaking, the work and habits of these insects are much the same as those previously described. Considerable feeding on the bark of twigs by Monochamus adults was noted throughout the 1941 burn.

Additional to the borers, much activity of the bark beetles, Ips integer and Orthotomicus ornatus, was noted. The former is a relatively large beetle, measuring 4 to 5 mm. in length, while the latter is much smaller. Boring through the bark, the female excavates an egg gallery, along the sides of which she deposits her eggs. Upon hatching, the larvae mine between the wood and bark until their growth is completed. They then bore to the outside.

No special injury is done to the wood of infested trees, their main work being the killing of green timber. Like all bark beetles, this insect prefers dying, weakened, or newly cut trees in which to bore where the lessened pitch flow favours their work. They are, therefore, a secondary forest enemy, their attack being usually preceded by a primary weakening agent. While of little concern in the deterioration of fire-burned timber, they do constitute a menace to adjacent green trees. Under the ideal breeding conditions afforded by the fire, their numbers may become so increased as to enable them to successfully attack healthy trees. It was from this standpoint that these insects were examined.

Ips integer appears to be the only bark beetle that presents this danger. An examination of the surrounding green timber at the 1940 burn does not indicate that any great danger exists from this source. An occasional healthy spruce was found infested and in the process of dying. Such, however, is not uncommon, for changed conditions that might alter a tree's environment frequently affect it sufficiently to make it susceptible to beetle attack. There was no indication of a widespread outbreak by bark beetles. Bark beetles, however, constitute a continual hazard and, in association with wood borers, deserve watching.

A parasite of bark beetles was found to be quite abundant under the bark of spruce actively infested with *Ips*. This parasite was in its capsule-like cocoon and, therefore, a definite identification was not possible. It belongs to the family Braconidae and probably to the genus *Coeloides* which has been an important contributor to the control of bark beetles in other parts of the Dominion.

The work of carpenter ants in the 1937 burn is most noticeable. These ants bore through the spring wood at the heart of the tree. While they prefer those wherein rot has commenced to develop, their borings extend throughout the sound wood. Their borings commence at ground level and extend upward a distance of 4 to 6 feet. In that their work is usually restricted to the older dead trees in a limited basal area, they do not assume the same significance as the wood borers previously discussed.

From the above examinations, it would appear that the various insects responsible for the deterioration of fire-killed or damaged timber commence almost immediately the fire has been extinguished. The flat-headed borers, Buprestidae, appear to be the most prevalent and precede the other borers in the attack. Ambrosia or pin-hole borers create the earliest damage, although the majority of the total eventual injury is created by wood-boring larvae, Buprestidae and Cerambycidae. The total extent of injury created during a single season cannot be appraised without further inspection, for developmental data in this region have never been recorded. For this reason, the time available for salvage operations following fire injury cannot be stated accurately. It seems fairly safe to say, however, that such operations should be completed within the current year. This point could be stated more accurately following a further examination this fall.

Bark beetles, wood borers and ambrosia beetles are extremely prevalent throughout the forests of northern

Saskatchewan. Accumulated cull logs and extensive areas of dying timber constitute a potential reservoir for attack on other weakened timber. Forest sanitation through adequate brush disposal, burning of cull logs and salvage of dying timber should be so handled as to remove the breeding grounds before the insect population has developed.

Residual spruce remaining after being subject to forest fire June 28, and July 15, 1941. Despite scorched roots and trunks, many trees still possess green foliage but all were in the process of wood borer attack. Areas of this type present a big salvage problem. (Pasquia Provincial Forest, Saskatchewan.)



Wood borers (Buprestidae) attacked immediately after these trees were injured by fire between June 28th and July 15th. Examined on July 25th, larval populations ran as high as 400 per square foot. Photo at top shows a badly burned basal section of tree, with only patches of charred bark. Sufficient bark remains, however, to satisfy oviposition and subsequent larval development, as seen where pieces of bark have been removed. Other trees but slightly scorched at roots with bark and foliage in a healthy appearance were also attacked. Initial excavations of larvae evident in lower right.

A dead forest, the result of a 1937 fire. Areas as these become a total loss unless salvaged before the destruction caused by wood borers.

VII. MISCELLANEOUS PHOTOGRAPHS

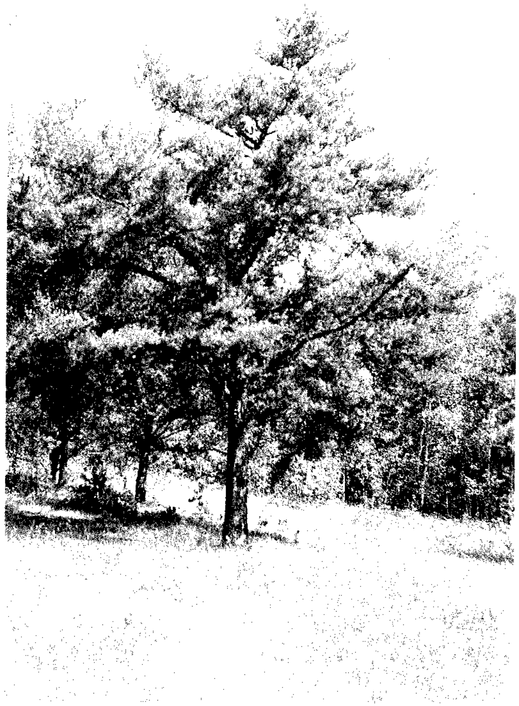
ANNUAL PHOTOGRAPHS OF THE PERMANENT JACK PINE SAMPLE PLOTS IN ONTARIO

Upper left: Recovered Jack pine at the old Henderson campsite, Hawk Lake, Ontario.

Upper right: Tree No. 1, plot 1, Hawk Lake, showing excellent recovery.

Lower left: General view of plot 6, Hawk Lake, from the south southwest.

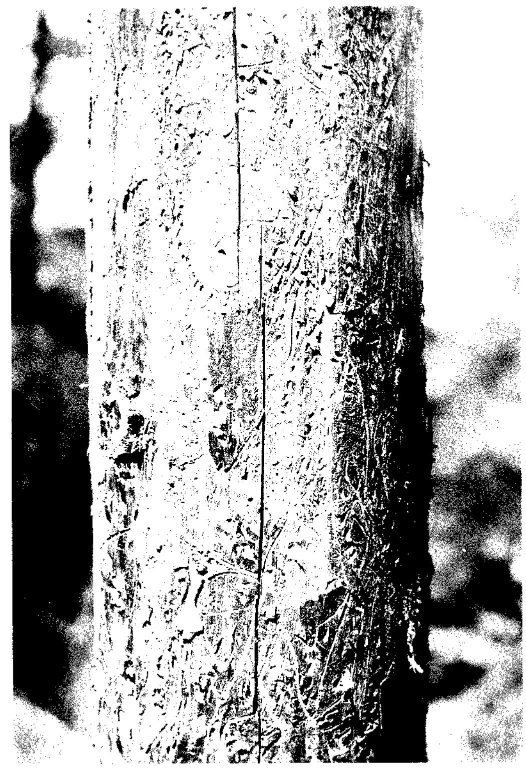
Lower right: Sample plot 9, Hawk Lake.




Upper left:	General view of plot 11, Hawk Lake, looking west and a little north. Camera opposite centre of the plot.
Upper right:	General view of plot 11, looking into the plot from the west.
Lower left:	General view of plot 11, looking across the plot from the south southwest.
Lower right:	Plot 4, Willard Lake, Ontario.




Upper left:	New *Ips* egg galleries and larval mines in Jack pine.
Upper right:	One year old *Ips* galleries on Jack pine showing nuptial chambers, egg niches, larval mines and pupal niches.
Lower left:	Entrance and exit holes of *Ips pini* in Jack pine.
Lower right:	Duplicate of Kodachrome transparency showing red foliage of a Jack pine killed by *Ips pini* (no differentiation of foliage apparent in the monochrome).



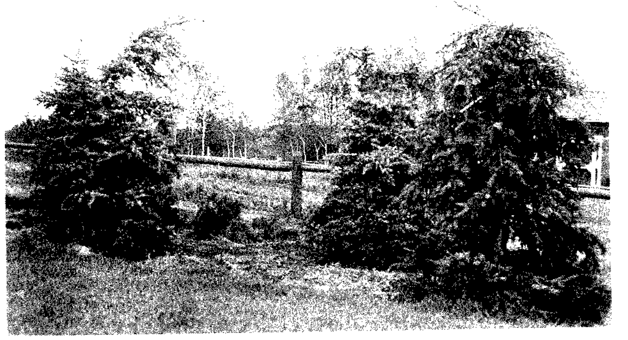
Upper left: Oviposition holes of *Monochamus* sp. in Jack pine.

Upper right: Frass, larval galleries and entrance holes of *Monochamus* sp.

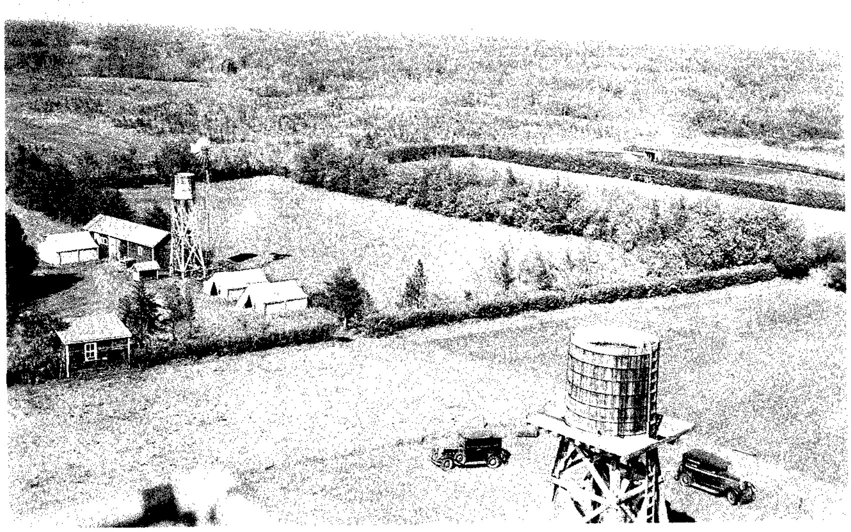
Lower centre: Emergence holes of *Monochamus* sp. in Jack pine.

Small forest nursery operated in conjunction with the Winnipeg Laboratory.
RIGHT - Jack pine seedlings;
LEFT - white spruce and lodgepole.

The effects of over-stimulated growth of white spruce resulting in an abnormal terminal development and a subsequent drooping.



Manitoba Forest Service nursery operated at Shilo, Manitoba.



VIII. LIST OF EQUIPMENT & SUPPLIES

WINNIPEG LABORATORY, DIVISION OF FOREST INSECTS

INVENTORY OF SUPPLIES AND EQUIPMENT UNDER CHARGE OF THIS LABORATORY AS OF MAR. 31, 1942.

SUMMARY

Scientific Equipment	$ 555.40
Books	51.35
Office Equipment & Supplies	1294.85
Ocular Equipment	687.87
Meteorological Equipment	263.00
Field Instruments	269.25
Photographic Equipment and Supplies	497.03
Chemicals	74.55
Transportation Equipment	3196.96
Camp Equipment	677.27
Camp Utensils	36.65
Groceries	3.16
Insectary Supplies	138.05
Laboratory Maintenance Equipment	43.53
Tools	124.96
TOTAL	$7913.88*

*NOTE: This is not the actual total value. The value of goods (marked * in the following lists) that were sent from Ottawa is not included, as prices are not known.

It is hereby certified that this is a true list of all the equipment, supplies, stores, stationery, etc., the property of His Majesty at the Forest Insect Laboratory, Winnipeg, as at March 31, 1942.

Dominion Entomologist

In Charge of Laboratory

Chief of the Division

WINNIPEG LABORATORY, DIVISION OF FOREST INSECTS

INVENTORY OF SUPPLIES AND EQUIPMENT UNDER
CHARGE OF THIS LABORATORY AS OF MAR. 31, 1942.

SCIENTIFIC EQUIPMENT

	Value
3300 Corks	$ 13.70
28 Rubber Stoppers	1.15
3 Packages Filter Paper	1.63
5 Instrument Cases containing a total of:	
10 Straight Probes	
5 Curved Probes	
4 Metal Needles	
5 Spear Points	
5 Scalpels	
4 Straight Scissors	
5 Bent Scissors	
5 Heavy Scissors	
7 Straight Forceps	
5 Curved Forceps	
5 Flat Forceps	
5 Pipettes	23.10
8 Pair Curved Scissors, various sizes	6.16
4 Curved Forceps	2.40
6 Straight Forceps	3.00
4 Spears (2 full, 2 one-half)	1.32
13 Straight Probes	3.90
7 Curved Probes	2.10
3 Flattened Probes	.90
4 Special Hooked Probes	1.20
5 Needle Handles	1.10
1 Set Laboratory Scales	10.95
1 Set Weights for Same	2.00
1 Electric Hot Plate	4.95
2 Alcohol Burners	8.10
1 Counter Hand Tally	6.00
2 Calipers	4.50
1 Mortar & Pestle	.80
1 Schreibler Desiccator & Plate	3.59
2 Tripods	1.00
2 Concentric Rings	1.70
3 Clamping Iron Rings	.60
2 Iron Supports, rectangular bases	1.30
Carried Forward	$107.15

Inventory Winnipeg Laboratory Continued

SCIENTIFIC EQUIPMENT CONT'D

	Value
Brought Forward	$107.15
4 Test Tube Clamps	.20
4 Dish Clamps	.60
1 Burette Clamp	.37
2 Crucible Clamps	.50
4 Triangles	1.20
4 Casseroles, 50 mm.	2.12
*6 Metal Rules (6" & mm.)	
1 Hypo Syringe	2.00
20 Needles	3.50
1 Horn Spoon	.20
1 Cork Gauge	.20
1 Cork Borer Set	2.50
2 Glass Cutters	.70
2 Cylinder Brushes	1.25
2 Burette Brushes	.98
4 Test Tube Brushes	1.24
1 Punch Point	5.67
6 Pinning Blocks	3.30
7 Pin Blocks	4.55
1 Pinning Forceps	.70
1 Pinning Forceps	4.95
1 Pinning Forceps, Bent Points	.60
*2000 Insect Pins, No. 1	
*2000 Insect Pins, No. 2	
*1000 Insect Pins, No. 3	
1 Scissor Forceps	3.00
4 Riker Mounts, 4x5	.90
8 Riker Mounts, 6½x8½	2.88
9 Riker Mounts, 8x12	4.13
2 Incubators (Sent from Belleville)	
38 Tinned Boxes, 3 oz.	2.00
18 Tinned Boxes, 8 oz.	1.50
122 Shell Vials, 15x45 mm.	1.21
77 Shell Vials, 12x50 mm.	.73
76 Shell Vials, Size B	1.19
45 Shell Vials, Size C	.85
77 Shell Vials, Size D	1.82
57 Shell Vials, Size E	2.04
86 Shell Vials, Size F	3.22
50 Shell Vials, Size G	1.87
Carried Forward	$171.82

Inventory Winnipeg Laboratory Continued

SCIENTIFIC EQUIPMENT CONT'D

	Value
Brought Forward	$171.82
46 Homeo Vials, 1 dram	.69
220 Homeo Vials, 2 dram	4.22
238 Homeo Vials, 4 dram	7.14
238 Homeo Vials, 6 dram	8.93
53 Bottles, Screw Cap. 8 oz., Squat, Wide Mouth	8.83
35 Bottles, Screw Cap, 8 oz., Tall, Wide Mouth	4.61
50 Bottles, Screw Cap, 2 oz., Wide Mouth	4.67
140 Bottles, Screw Cap, 1 oz., Square	8.81
34 Bottles, Screw Cap, ¾ oz., Tall, Wide Mouth	2.16
97 No. 2 Capsule Bottles, Screw Cap, 68x22 mm.	10.10
4 Balsam Bottles, 50 ml.	1.40
6 Dropping Bottles, 60 ml.	1.68
10 Weighing Bottles, 25 mm.	2.20
10 Weighing Bottles, 40 mm.	3.00
4 Reagent Bottles, 80 oz.	3.16
2 Reagent Bottles, 2000 ml.	3.54
1 Reagent Bottle, 1000 ml.	1.03
6 Reagent Bottles, 500 ml.	3.84
7 Tincture Bottles, 250 cc.	2.10
12 Tincture Bottles, 4 oz.	3.78
1 Beaker, 300 cc.	.23
2 Beakers, 5 cc.	.44
2 Beakers, 30 cc.	.34
2 Beakers, 100 cc.	.36
2 Pyrex Beakers, 500 ml.	.60
1 Pyrex Beaker, 1500 ml.	.78
2 Bell Jars, 18" x 9"	9.00
2 Bell Jars, Small	2.00
3 Graduated Cylinders, 250 cc., Tall	3.60
1 Graduate, 500 ml.	.72
4 Flasks, Narrow Mouth, 2000 cc.	2.56
1 Burette Dispensing, 500 cc.	4.40
2 Pipettes, 100 cc.	2.38
2 Graduated Cylinders, 250 cc., Squat	2.70
1 Funnel, 75 mm.	.22
1 Funnel, 200 mm.	.70
Carried Forward	$288.74

Inventory Winnipeg Laboratory Continued

SCIENTIFIC EQUIPMENT CONT'D

	Value
Brought Forward	$288.74
12 Staining Dishes	4.80
20 Pipettes, Straight	.58
16 Pipettes, Curved	.45
24 Petri Dishes, Sizes A,B,C,D,E	7.00
10 Watch Glasses, 3" Diameter	4.00
1 Insect Collecting Apparatus	1.00
4 Insect Collecting Nets, Richardson Type	18.00
4 Insect Spreading Boards, Adjustable	11.20
7 Insect Spreading Boards, Fixed	7.68
2 Plant Presses	5.00
1 Inflating Apparatus	6.51
64 Schmitt Boxes	168.32
1 Moth Trap	3.00
2 Hand cultivators	.30
2 Hand cultivators	1.30
12 Trays for preserved specimens	14.30
1 Cork Press	2.80
1 Pyrex Glass Condenser	5.08
10 Lengths low melting glass rods	.93
72 Feet of Glass Tubing	2.56
3 Yards of Rubber Tubing	1.85
TOTAL	$555.40

Inventory Winnipeg Laboratory Continued

CAMP EQUIPMENT

	Value
*4 Tents, 10x12	
1 Tent, 10x12	$ 30.78
1 Tent, 12x16x4	38.00
1 Tent, 12x16x4	51.84
1 Auto Tent, Shiek Silk	32.40
1 Auto Tent, Brown Treated	20.00
*3 Flies, 10x12	
1 Fly, 10x12	13.30
1 Fly, 12x16	13.60
1 Fly, 12x16	23.49
1 Fly, 12x16	10.00
3 Asbestos Rings	3.00
4 Tent Pockets, Canvas	2.00
1 Ground Sheet, 7x9, Treated Duck	4.40
1 Ground Sheet, 9x12, 9 oz. Treated Duck	8.00
2 Ground Sheets, 12x16, 12 oz. Treated Duck	26.90
6 Beating Sheets, 7x9, Treated Canvas	18.00
1 Beating Sheet, 10x10, Untreated Split Canvas	5.00
1 Camp Stove (Airtight)	6.00
1 Camp Stove (Airtight)	6.91
1 Camp Stove (Cooking)	17.95
3 Camp Stoves (Coleman Vagabond)	15.75
4 Lanterns, Coleman 1 Burner	22.20
*3 Pack Sacks, Treated Canvas, 1'x3'x4'	
8 Haversacks, S.S. Holden No. 12	18.00
*3 Field Bags	
5 Steel Cots	22.50
2 Canvas Cots, Khaki	9.00
2 Canvas Cots, Red	8.00
6 Mattresses, Stuffed	15.90
6 Mattresses, Air	28.00
*4 Sleeping Bags	
2 Sleeping Bags, Woods, Arctic 3-Star	76.00
*6 Pair Blankets	
1 Pair Blankets	9.45
6 Folding Arm Chairs	35.40
5 Tower Slickers	37.50
1 First Aid Chest	1.95
3 First Aid Kits	1.00
2 Water Buckets, Canvas	2.20
2 Thermos Jugs, 1/2 Gal.	2.76
Carried Forward	$637.18

Inventory Winnipeg Laboratory Continued

CAMP EQUIPMENT CONT'D

		Value
Brought Forward		$637.18
2 Four-man Aluminum Cooking Sets		35.00
2 Coleman Funnels		1.00
1 Mirror		.50
3 Gas Tins		3.59
	TOTAL	$677.27

Inventory Winnipeg Laboratory Continued

TOOLS	Value
1 Wheelbarrow	$ 5.25
2 Shovels, long handle	2.04
2 Shovels, short handle	1.20
3 Hand Axes	3.33
3 Hand Axes	3.60
1 Double-bit Axe	2.20
1 Field Hoe	.80
1 Turnip Hoe	.75
1 Grub Maddock Hoe	1.40
1 Garden Rake	.75
1 Garden Rake	.90
1 Garden Rake	.80
1 Tree Pruners, 10'	1.40
2 Nail Hammers	1.25
2 Nail Hammers	1.81
1 Machinist's Hammer	.90
3 Tack Hammers	1.87
1 Sledge Hammer	2.85
2 Disston Hand Saws	5.75
1 Hand Saw	1.25
1 Rip Saw	2.75
1 Hack Saw Frame	.65
1 Cross-cut Saw	5.95
1 Swede Type Saw	2.45
1 Nest of Saws	1.71
1 Mitre Saw	3.25
1 Set Square	.71
1 Set Square	2.00
1 Adjustable Square	.65
1 Screw Driver	.48
1 Screw Driver	.60
1 Jack Plane	4.35
1 Brace	2.75
1 Wood Bit	.55
1 Wood Bit	.36
1 Wood Bit, 2 Blades	1.73
1 Wood Bit	.60
2 Wood Bits	.80
1 Wood Bit	.56
2 Screw Driver Bits	.56
1 Counter Sink Bit	.68
6 Bits, Push Drill	.72
Carried Forward	$ 74.96

Inventory Winnipeg Laboratory Continued

TOOLS CONT'D

	Value
Brought Forward	$ 74.96
1 Wood Chisel, 3/4"	.95
1 Wood Chisel, 3/8"	.75
3 Cold Chisels	1.09
1 Wood Rasp	.46
1 Mitre Box, Spring Clip	10.50
1 Wood Spirit Level, 24"	.75
1 Push Drill, including 6 drills	3.35
1 Star Drill	.30
1 Pair Wood Clamps, 6"	1.28
1 Clamp	2.50
1 Metal Snips	1.50
1 Scraper	.60
1 Nail Set, large	.25
1 Marking Gauge	1.35
1 Blow Torch	4.85
1 Soldering Copper	.64
1 Soldering Iron	.25
1 Pair Pliers	.28
1 Pair Pliers	2.95
1 Steel Tape	1.20
1 Crescent Wrench	.90
1 Trowel	.32
1 Vice	9.00
1 Vice Screw	1.32
2 Oil Cans	1.06
2 Carborundums	1.30
1 Wrecking Bar	.30
TOTAL	$124.96

Inventory Winnipeg Laboratory Continued

BOOKS

	Value
"Manual of Entomological Equipment and Methods," Pt. I, A. Peterson	$ 4.00
"Manual of Entomological Equipment and Methods," Pt. II, A. Peterson	4.85
"General Textbook of Entomology," A.D. Imms, 3rd Ed.	9.50
"An Introduction to Entomology," J.H. Comstock	5.00
"Insects of Western North America," E.O. Essig	9.00
"Entomophagous Coleoptera," W.V. Balduf	4.00
"Principles of Insect Morphology," R.E. Snodgrass	6.00
"Biological Control of Insects," H.L. Sweetman	5.00
*"Canadian Government Editorial Style Manual"	
*"Statistical Methods for Research Workers," R.A. Fisher	
*"Canada Official Postal Guide" (1938-39)	
*"The Concise Oxford Dictionary"	
*"Field Book of Insects," 3rd Ed. F.E. Lutz, 1935.	
*"A Glossary of Entomology" Revised and rewritten by J.R. Torre-Bueno, 1937.	
Carried Forward	$ 47.35

Inventory Winnipeg Laboratory Continued

BOOKS CONT'D

	Value
Brought Forward	$ 47.35
*"Animal Ecology," C. Elton, 1936.	
*"Entomology with Reference to its Ecological Aspects," Folsom & Wardle, 4th ed.	
*"Animal Ecology with Especial Reference to Insects," R.N. Chapman, 1931.	
*"Forest Insects, a Textbook, etc.," Doane, Van Dyke, Chamberlain & Burke, 1936.	
*"The Chemistry & Toxicology of Insecticides," H.H. Shepard.	
*"Insects and Diseases of Ornamental Trees and Shrubs," Felt and Rankin.	
*"Destructive and Useful Insects," Metcalf and Flint, 2nd ed.	
*"Principles of Forest Entomology," A.R. Graham, 2nd ed.	
*"Methods of Insect Control, Part I," Isely Dwight, 2nd ed., revised.	
*"Insect Pests of Farm, Garden and Orchard," L.M. Peairs, 4th ed., 1941.	
"Entoma," 4th ed., 1941.	1.00
"A Generic Classification of the Nearctic Sawflies (Hymenoptera, Symphyta)," U. of Ill. Bull. Vol. XXIV, July 23, 1937. No. 94, Herbert H. Ross	2.00
"Important Tree Pests of the Northeast" (A revision of Tree Pest Leaflets Nos. 1-50) Mass. Forest and Park Assoc., no author.	1.00
Carried Forward	$ 51.35

Inventory Winnipeg Laboratory Continued

BOOKS CONT'D

	Value
Brought Forward	$ 51.35
*"Canadian Forest Insects" (17 copies) Dom. Dept. of Agriculture, Division of Forest Insects.	
*"Short Course of Instruction on Forest Insects" (50 copies) Dom. Dpt. of Agriculture, Division of Entomology, Forest Insect Investigations.	
TOTAL	$ 51.35

Inventory Winnipeg Laboratory Continued

OFFICE EQUIPMENT & SUPPLIES

Value

*6 Shannon Board Files
* 490 Office Specialty Direct Vision Guides, 5x3, ½ cut
*3700 Office Specialty Guides, 5x3, 1/3 cut
*1000 Office Specialty Guides, 5x8, 1/3 cut
*5 Boxes Office Specialty Direct Vision Tab Guides, 11¾x9½
*3 Boxes Office Specialty Cardboard Guides, 11¾x9½, 1/3 cut
*98 Sheets cardboard folding inserts for Office Specialty Direct Vision Tabs, 3½"
*15 Sheets cardboard folding inserts for Office Specialty Direct Vision Tabs, 3"
*100 Sheets cardboard folding inserts for Office Specialty Direct Vision Tabs, 1¾ "
*275 Manilla Filing Folders, 11¾x9½
*72 No. 1 Pads, plain
*105 No. 3 Pads, plain
*5 Rolls Gummed Paper, 2"
*3 Rolls Gummed Paper, 1"
*4 Rolls Gummed Linen, 1"
*8 Rolls Cellulose Tape
*7900 Index Cards, 5x3, ruled
*2900 Index Cards, 5x8, ruled
*8 Stenographer's Notebooks
*150 Ruled Pads, No. 6
*147 Ruled Pads, No. 7
*3300 Envelopes, Brown, 7½x10½
*750 Envelopes, Brown, 9½x15
*1625 Envelopes, Brown, 9½x12
*250 Envelopes, White, 10½x6½
*6700 Envelopes, White, Plain, 4x9
*6500 Envelopes, White, "Dominion Entomologist", 4x9
*5 Bottles Carter's "Great Stickist" Mucilage (4 small, 1 large)
*6 Tins LePage's Glue
*12 Bottles Gripspreader Mucilage
*7 Boxes Gummed Labels, No. 2003, "Dominion Entomologist"
*1 Box Gummed Labels, No. 239
*5 Boxes Gummed Labels, No. 209
*2 Boxes Gummed Labels, No. 2001
*3 Boxes Gummed Labels, No. 201
*1 Box Gummed Labels, No. 259
*1 Box Gummed Labels, No. 203

Inventory Winnipeg Laboratory Continued

OFFICE EQUIPMENT & SUPPLIES CONT'D

Value

*1 oz. Rubber Bands, No. 16, Stokes
*1 oz. Rubber Bands, Assorted, Viceroy
*½ lb. Rubber Bands, No. 63, Govt. Standard
*19 Boxes Aico Index Tabs
*12 Bottles Higgins Waterproof Ink, ¾ oz.
*1 oz. Carter's Hectograph Ink
*2 Bottles Sheaffer's Skrip Ink, 32 oz.
*46 Large Sheets Blotting Paper
*13 Erasers, Viceroy, No. 242
*8 Erasers, Artgum
*200 Round Head Fasteners, No. 4
*100 Round Head Fasteners, No. 3
*100 Round Head Fasteners, No. 5
*100 Round Head Fasteners, No. 6
*100 Round Head Fasteners, No. 7
*22000 Staples
*36 Doz. Drawing Pins, Brass, ½ in.
*5 Doz. Drawing Pins, Brass, ¾ in.
*1200 Mapping Pins, Assorted colours
*50 Thumb Tacks, 5/8 in.
*48 Shipping Tags, Linen
*6 Boxes Pins, ¼ lb., No. 4
*13 Typewriter Ribbons, Royal, Black & Red
*5 Pencils, Venus 6H
*24 Pencils, Venus 4H
*54 Pencils, Venus 2H
*132 Pencils, Govt. of Canada, HB
*180 Pencils, Govt. of Canada, B
*84 Pencils, Venus H
*19 Marking Pencils, Blaisdell, Red
*32 Marking Pencils, Govt. of Canada, Red
*20 Colored Pencils, Eberhard Faber
*9 Colored Pencils, Dixon
*2 Doz. Pencils, Govt. of Canada, Indelible
*26 Penholders
*2 Drawing Penholders
*48 Pen nibs, Lithographic
*1 Box Pen Nibs, Assorted
*1 Box Pen Nibs, Imperial No. 128
*3 Doz. Pen Nibs, Govt. of Canada, No. 16
*2700 Paper Clips, No. 1
*2600 Paper Clips, No. 3

Inventory Winnipeg Laboratory Continued

OFFICE EQUIPMENT & SUPPLIES CONT'D

Value

*8000 Sheets Writing Paper, 8x10
*1800 Sheets Writing Paper, 8x13
*19500 Sheets Typewriter Paper, Glazed, 8x10
*6500 Sheets Typewriter Paper, Glazed, 8x13
*10000 Sheets Letterhead, 8x10
*2000 Sheets Letterhead, Glazed, 8x10
*10 Boxes Carbon Paper, Medium Weight, 8x10
*19 Boxes Carbon Paper, Light Weight, 8x10
*6 Boxes Carbon Paper, Medium Weight, 8x13
*6 Boxes Carbon Paper, Light Weight, 8x13
*1000 Mimeographed Project Cost Forms
*150 Extra Labour Forms (A-106)
*14 Dominion Dept. of Agriculture Voucher Pads
*100 Leave of Absence Application Forms
*150 Reconciliation Statement Forms (Imprest Acct.)
*1100 Canadian Insect Pest Survey Forms
*9 Pads Expense Account Forms
*600 Car Mileage Forms
*150 Ledger Sheets
*125 Outstanding Cheque Statement Forms (Imprest Acct.)
*20 F.I.S. Survey of Infestation Status of Canadian Forest Insect Forms
*2000 F.I.S. Acknowledgment Forms
*100 Phenological Observation Cards
*30 Manpower Survey Forms
*15 Physician's Certificates
*400 Car Account Forms (A. 101B)
*50 Requisition for Stamps Forms
*40 Postage Stamp Account Forms
*150 Imprest Advance Account Forms
*179 Forest Insect Survey Boxes
*200 Sheets Brown Wrapping Paper, Small
*425 Sheets Brown Wrapping Paper, Large
*313 Experiment Notebooks, 5x8
*25 Experiment Notebooks, 5x3
*32 Balls No. 5 Polished Twine
*4 Balls String
*9 Balls Heavy Twine
*3 Balls Hemp Rope
*102 Zenith Looseleaf Report Covers
*26 Binders, Zenith Style "A," No. Sp. 1107
*1 Doz. Report Covers, lacing type
*1 Looseleaf Ring Binder

Inventory Winnipeg Laboratory Continued

OFFICE EQUIPMENT & SUPPLIES CONT'D

	Value
*1 Part Roll Profile Paper, 20" wide	
*1 Part Roll Tracing Linen	
*1 Part Roll Drawing Paper (Detail)	
*1 Part Roll Transparent Paper	
*1 Part Roll Cross-section Paper, 10 divisions per in.	
*1 Part Roll Cross-section Paper, 20 divisions per in.	
*17 Pads Plain Squared Paper	
*17 Pieces Cardboard, 22" x 28"	
*1 Stamp Sponge & Bowl	
*35 Lowe-Martin File Boxes	
*42 Pamphlet Cases	
*32 Black File Boxes for 5x8 Cards	
*58 Black File Boxes for 5x3 Cards	
*38 Metal Followers, large.	
*52 Metal Followers, small.	
*1 Tube each Marshall's Transparent Oils: Vermilion, violet, green, yellow, blue, orange, neutral, viridian, brown.	
*2 Tubes Marshall's medium	
*500 Photograph Negative Envelopes	
*6 Pair Metal Book Ends	
*1 Doz. Fold-back clips, 1 1/4 inches	
*15 Rubber Stamps	
*6 Stamp Pads	
*2 Ink Pads for Bates Numbering Machine	
*2 Paper Fasteners, Bostitch	
*1 Small Brief Case	
*6 Binders, Gripfast, 5½x8½, Board	
*6 Binders, Gripfast, 6x9½, Metal	
*5 Binders, Gripfast, 6 x 6 1/4, Metal	
*2 Pair Scissors, 6"	
*2 Pair Office Scissors, 7"	
*1 Punch, Improved Hummer, including 3 No. 272 heads	
1 No. 272 Head for Punch	2.55
1 No. 270 Head for Punch	3.80
1 No. 268 Head for Punch	10.20
*6 Desk Pads	
*2 Hand Desk Blotters	
*5 Paper Knives	
*5 Metal Holders for Desk Calendar Pads	
*2 Sets Letter Stencils (A to Z)	
*2 Sets Number Stencils (0 to 9)	
*4 Double Deck Wire Letter Baskets	
*6 Shallow Wire Letter Baskets	
Carried Forward	$ 16.55

Inventory Winnipeg Laboratory Continued

OFFICE EQUIPMENT & SUPPLIES CONT'D

	Value
Brought Forward	$ 16.55
*2 Boston Self-Feeder Pencil Sharpeners	
*1 Letter Scales, 8 oz.	
*1 Parcel Scales, 15 lb.	
*5 Inkwells	
*1 Ohdner Calculator	
*2 Account Books, Looseleaf, 11x12	
*1 Portfolio Looseleaf Binder, Approx. 31" x 24½"	
*1 Triumph Hand Punch	
*4 Wastepaper Baskets	
*1 Ledger, The Canadian Line, No. 1430	
*1 Visitors Book, Govt. of Canada, No. 202	
1 Typewriter, Royal Portable	67.50
1 Typewriter, Royal Standard	137.70
2 Desk Lamps, Brass	5.50
2 Desk Lamps, Gooseneck	6.40
1 Desk Lamp	3.16
2 Wastepaper Baskets	2.40
2 Brief Cases, Black Leather	20.88
1 Line-A-Time, Remington	24.30
1 List Finder, Bates	1.25
1 Number Machine, Bates	20.63
1 Pair Scissors, 12" all over	1.75
2 Pair Scissors, 10" all over	3.72
1 Paper Trimmer	8.50
85 Rolls Toilet Paper	7.61
2 Soap Dispensers	7.50
	$335.35

Office Furniture

7 Side Chairs
3 Arm Chairs
1 Typewriter Chair
5 Tilter Chairs
1 Draughting Stool
1 Steel Filing Cabinet
1 Steel Plan Section and Base
2 Steel Card Posting Units, including 30-5x3 Trays and 12-5x8 trays

Carried Forward $335.35

Inventory Winnipeg Laboratory Continued

OFFICE EQUIPMENT & SUPPLIES CONT'D

	Value
Brought Forward	$335.35

Office Furniture Cont'd

1 Steel Posting Desk Section
1 Steel Storage Cabinet (8 Shelves, Lock)
1 Steel Letter Cabinet (3 Drawer, Lock)
1 Steel Cabinet for 5x3 Cards
1-15 Box Steel Drawer Section
1- 3 Box Steel Drawer Section
1 Steel Top
1 Steel Base
4 Desk Trays and Supports
1 Mapping Table
2 Tables
1 Typewriter Desk
5 Flat-top Desks, 60" x 34"
1 Bookcase (4 Sections, 1 Top, 1 Base)
1 Telephone Stand

TOTAL COST OF OFFICE FURNITURE	959.50
TOTAL	$1294.85

Inventory Winnipeg Laboratory Continued

DRAFTING EQUIPMENT

*2 Engineers' Scales, Celluloid Edge
*2 Architects' Scales, Celluloid Edge
*1 Straight Edge Steel Rule
*1 Wooden Drawing Board
*1 Set Square (45°)
*1 Set Square (30°-60°)
*1 Transparent Protractor
*1 French Curve
*1 T. Square (30")
*1 Drafting Compass(6")

Inventory Winnipeg Laboratory Continued

OCULAR EQUIPMENT

			Value
1 Zeiss Binocular Microscope		$108.00	
Accessories:			
1 Paired Objectives, 2X	$12.60		
1 Paired Objectives, 4X	13.50		
1 Pair Eyepieces, 10X	5.40		
1 Pair Wide Field Eyepieces, Bi. 6X, complete with sleeves	28.20	59.70	167.70
1 Zeiss XDA Microscope		82.35	
Accessories:			
1 Pair Eyepieces, 10X	5.40		
1 Pair Eyepieces, Bi. 6X	27.90		
1 Paired Objective, 2X	12.60		
1 Paired Objective, 4X	13.50		
1 Paired Objective, 6X	13.50		
1 XA Stand with Hand Rests	46.35	119.25	201.60
1 Compound Microscope		62.75	
Accessories:			
1 Condenser with Iris Diaphragm	13.25		
1 Triple Nosepiece	7.95		
1 Achromatic Objective, 8X	7.95		
1 Achromatic Objective, 10X	15.90		
1 Achromatic Objective, 40X	16.75		
1 Achromatic Objective, 90X	26.50		
1 Pair Huygen's Eyepieces	5.40		
1 Mechanical Stage, graduated	20.70	114.40	177.15
1 Microscope Lamp and Accessories			37.80
2 Squared Micrometer Discs			7.25
2 Zeiss Hand Lenses, Nickel, 6X			12.00
2 Zeiss Hand Lenses, Composition, 8X			10.00
2 "Turmon" Field Glasses & 1 Aux Lens			63.00
5 Single Depression Slides			.50
670 Microscope Slides			.97
2 Microscope Slide Boxes			2.40
30 Microscope Slide Cells			2.70
1 oz. each Cover Glasses, Sizes A,B,C,D			4.80
TOTAL			$687.87

Inventory Winnipeg Laboratory Continued

METEOROLOGICAL EQUIPMENT

	Value
2 Sets Maximum & Minimum Thermometers	$ 40.00
2 Pocket Thermometers, 0°-110° F.	6.00
1 Soil Thermometer	1.75
1 Thermometer, 50°-400° F.	3.25
1 Wet & Dry Bulb Thermometer	4.00
1 Sling Psychrometer	12.00
2 Fuess Hygrothermographs	160.00
1 Pickering Evaporimeter	20.00
2 Rain Gauges, each with 2 measuring cylinders in cu. in.	16.00
TOTAL	$263.00

Inventory Winnipeg Laboratory Continued

FIELD INSTRUMENTS

		Value
2 Pocket Aneroid Barometers		$ 70.00
2 Staff Compasses		70.00
1 Box Compass		7.50
1 Silva Compass		9.00
2 Topographic Abney Levels		48.00
1 Increment Borer		7.00
2-24" Tree Calipers		21.00
1-33" Diameter Tape		7.75
2-100' Steel Chains		22.00
1-50' Steel Tape		7.00
	TOTAL	$269.25

Inventory Winnipeg Laboratory Continued

PHOTOGRAPHIC EQUIPMENT & SUPPLIES

		Value
2 Zeiss Tropical Adora Cameras:		
2 Cameras	$167.00	
2 Leather Cases	18.00	
2 Film Pack Adapters	4.40	$189.40
1 Weston Exposure Meter		26.50
1 Photometer (Ilford)		16.15
1 Photometer (Instoscope)		6.30
2 Sky Filters, Yellow, and Clips		4.50
1 Sky Filter, Adjustable, and Clip		5.00
2 Filters, Medium Yellow, for Zeiss Adora, 9x12 cm.		9.00
1 Set Filters, Light Red, Green, for Zeiss		5.25
1 Green Filter (B) to fit Zeiss Adora		2.50
2 Metal Tripods		6.00
1 Wood Tripod for Adora		10.00
2 Tilting Tripod Heads		6.00
1 Kodak Safe Lamp		3.25
4-5x7 Wratten Safelights		3.00
1 Adjustable Film Tank		13.25
34 Film Clips		5.44
1 Print Washer, Ingento No. 3		8.65
4 Print Tongs		1.00
4 Trays, 5x7		2.88
4 Trays, 11x14		9.60
4 Trays, 16x20		17.60
2 Trays, 8x10		1.99
1 Eastman Printer, No. 2		27.32
6 Ferrotype Plates		5.40
1-12" Double Print Roller		6.03
1 Interval Timer		5.25
12 Plate Holders		7.80
18 Cut Film Adapters		3.60
1 Photoflood Bracket and Reflector		3.25
4 Agfa Superpan Press 9x12 cm. Film Packs		2.40
5 Agfa Superpan Supreme 9x12 cm. Film Packs		3.00
½ Doz. Daylight Kodachrome 9x 12 cm.		6.00
4 Agfa Supersensitive Plenachrome 9 x 12 cm. Film Packs		2.32
Carried Forward		$425.63

Inventory Winnipeg Laboratory Continued

PHOTOGRAPHIC EQUIPMENT & SUPPLIES CONT'D

		Value
Brought Forward		$425.63
7 Doz.	Agfa Safety Process Cut Film, 9x12 cm.	4.16
3 Doz.	Agfa Isopan Cut Film, 9x12 cm.	1.74
2 Doz.	Agfa Super Plenachrome 9x12 cut film	1.16
1 Doz.	Sheets Dufaycolor	5.40
11 Doz.	Eastman Lantern Slide Plates	4.63
11 Doz.	Eastman Lantern Slide Covers	2.49
12 Tins	Photographic Tape	4.11
2 Doz.	Gevaert Contact Paper, K3S, 8x10	1.12
2 Doz.	Gevaert Contact Paper, K3M, 8x10	1.12
2 Doz.	Gevaert Contact Paper, K3, 8x10	1.12
14 Doz.	Selo Gaslight Paper, S.W., Vigorous, 8x10	5.72
24 Doz.	Selo Gaslight Paper, S.W., Normal, 8x10	9.84
10 Doz.	Selo Gaslight Paper, S.W.,Soft, 8x10	4.20
1 Doz.	Selo Gaslight Paper, D.W., Normal, 8x10	.50
6 Doz.	Selo Gaslight Paper, S.W., Normal, Satin, 8x10	2.46
3 Doz.	Selo Gaslight Paper, S.W., Soft, Satin, 8x10	1.23
5 Doz.	Agfa Brovira, D.W., Medium, 8x10	3.60
1 Doz.	Agfa Brovira, D.W., Soft, 8x10	.72
2 Doz.	Agfa Brovira, D.W., Hard, 8x10	1.44
4 Doz.	Kodabromide, S.W., No. 1 Glossy, 8x10	2.12
12 Doz.	Kodabromide, S.W., No. 2 Glossy, 8x10	5.15
2 Doz.	Kodabromide, D.W., No. 2 Glossy, 8x10	1.34
4 Doz.	Kodabromide, D.W., No. 3 Glossy, 8x10	2.68
5 Doz.	Kodabromide, D.W., No. 4 Glossy, 8x10	3.35
	TOTAL	$497.03

Inventory Winnipeg Laboratory Continued

CHEMICALS

		Value
3 oz. Tartaric Acid		.30
4 oz. Sodium Benzoate		.40
1/4 lb. Sodium Arsenite		.50
1/2 lb. Ble's Fixative		.75
3/4 lb. Petrunkevitch's Fixative A-		.60
1/4 lb. Petrunkevitch's Fixative B		.30
1/2 lb. Petrunkevitch's Fixative B modified		.50
1½ lbs. Bouin's Solution		1.15
1 oz. Motor Ether		.15
1 oz. Canada Balsam		.33
2 lbs. Paraffin Wax, 54.5° C.		1.04
*1 Gal. 95% Alcohol		
1 lb. Plaster of Paris		.15
62 lbs. Sodium Hyposulphite		6.30
3/4 lb. Metol		2.67
4 lbs. Sodium Bisulphite		.76
½ lb. Potassium Ferricyanide		.60
½ lb. Mercury Bichloride		2.00
1/4 lb. Ammonium Persulphate		.35
1½ lbs. Potassium Bromide		1.02
1 lb. Potassium Bichromate		.38
1 lb. Kodalk		.25
5 lbs. Sodium Sulphite		.90
2 lbs. Hydroquinone		2.68
5 lbs. Borax		.80
2 lbs. Potassium Alum		.30
5 lbs. Sodium Carbonate		.80
11 lbs. Sodium Silico Fluoride		12.32
5 oz. Hematoxylin Solution		.80
(½ gal. Xylol		
(3 oz. Red Eosine		
(1 lb. Sheet Gelatine		
(1 lb. Linseed Oil, sulphonated		
(1 lb. Rosin, G		
(4 oz. Fuchsin Basic		
(3 oz. Fuchsin Acid		
(1 lb. Hydrochloric Acid		
(1 lb. Carbolic Acid, Crystals		
(4 oz. Methylene Blue		
(1 lb. Sulphuric Acid		
(2 lbs. Potassium Hydroxide Flakes		
(1/4 lb. Picric Acid		
(2 oz. Formaldehyde	Total	12.00
2 lbs. Acetone		1.00
1 lb. Amyl Acetate		1.20
	Carried Forward	$ 53.30

Inventory Winnipeg Laboratory Continued

CHEMICALS CONT'D

	Value
Brought Forward	$ 53.30
1½ lbs. Ammonia Solution	.30
4 lbs. Boric Acid	1.40
1/4 lb. Benzene	.30
1/4 lb. Anhydrous Sodium Carbonate	.10
2 lbs. Chrome Alum	.42
2 lbs. Glycerin	.36
½ lb. Iron & Ammonium Sulphate	.70
2 oz. Powdered Alum	.80
1 lb. Potassium Iodide	3.00
1 lb. Potassium Cyanide	.80
2 lbs. Potassium Permanganate	1.64
1 lb. Potassium Thiocyanate	3.00
8 oz. Sodium Bromide	.50
1 lb. Sodium Hydrosulfite	.85
2 lbs. Sodium Hydroxide	1.60
1 lb. Sodium Sulphide	.20
1/4 lb. Glycin Photo	2.00
2 lbs. Copper Sulphate	.90
2 lbs. Nitric Acid	2.38
TOTAL	$ 74.55

Inventory Winnipeg Laboratory Continued

TRANSPORTATION EQUIPMENT

	Value
1-1938 Ford Coach	$886.18
1-1939 Chevrolet Sedan Delivery Truck	893.53
1-1940 Ford Coach	923.55
2 Car Heaters	41.00
1 Canoe, Peterboro Freighter, includes 2 paddles	99.00
1 Canoe, Prospector	86.00
1 Outboard, Johnson Sea Horse, LTL	126.45
1 Outboard, LTL	120.00
1 Canoe Carrier	19.50
1 Padlock	1.50
1 Gas Funnel	.25
TOTAL	$3196.96

Inventory Winnipeg Laboratory Continued

CAMP UTENSILS

	Value
1 Double Boiler	$ 1.00
3 Potato Pots	2.40
5 Saucers	.15
8 Soup Bowls	.70
8 Dinner Plates	.70
6 Cups	.60
8 Cups	.65
2 Butcher Knives	1.39
12 Table Knives	1.30
9 Table Forks	1.14
5 Dessert Spoons	.60
8 Teaspoons	.50
2 Can Openers, Daisy	1.58
1 Can Opener, Rotary	.15
7 Dishups	1.47
2 Spatulas	.30
1 Potato Masher	.20
1 Soup Ladle	.20
2 Egg Cups	.10
3 Pair Salt & Pepper Shakers	.60
2 Coffee Pots	2.00
2 Teapots	1.50
5 Tin Plates	.50
2 Enamel Plates	.20
1 Cookie Sheet	.25
1 Fry Pan, Short Handle	.35
2 Fry Pans, Large	.72
3 Kettles	2.16
2 Griddles	1.90
3 Pails, Galvanized	1.20
1 Washtub, Square	1.14
1 Washboard, Zinc	.75
1 Gas Tin (1 Gal.)	.75
1 Cream Can (10 Gal.)	6.50
1 Dishpan	.40
1 Wash Basin	.20
2 Dippers	.40
TOTAL	$ 36.65

Inventory Winnipeg Laboratory Continued

GROCERIES

	Value
8 Jello Powders	.30
1 Pkg. Prunes	.12
1 Pkg. Tapioca	.15
1 Tin Lima Beans	.10
2 Tins Macaroni & Cheese	.22
1 Tin Pork & Beans	.08
3 Tins (Large) Milk	.25
1 Tin Soup	.10
2 Tins Plums	.12
1 Tin Peas	.12
4 Tins Tomatoes	.56
6 Tins Spaghetti	.54
1 Tin Corn	.10
4 Tins Green Beans	.09
1 Tin Pilchards	.11
TOTAL	$ 3.16

Inventory Winnipeg Laboratory Continued

INSECTARY SUPPLIES

		Value
1	Flytox Gun	$ .25
1	Hand Sprayer, Pressure	9.50
1-1	Pint Sprayer	.20
1	Flytox Gun	.15
1	Small Hand Sprayer	.20
33	Lantern Chimneys (Squat)	2.80
12	Lantern Chimneys (High)	1.00
19	Candy Jars	3.50
53	Pint Sealers	4.34
*50	Rearing Cans, Zinc	
*50	Jelly Jars (Wire Gauze Covers)	
39	Insect Rearing Cages NOTE: 25 of these 3454 made by the Bergman & Nelson Lumber Company, Kenora, at a cost of $31.25. The remainder were made in the lab.	47.50
1008	Jelly Jars	40.39
504	Tops for Jelly Jars	27.22
1	Circular Screen Cage	1.00
	TOTAL	$138.05

Inventory Winnipeg Laboratory Continued

LABORATORY MAINTENANCE EQUIPMENT

	Value
1 Fly Sprayer	$ .20
1 Dustpan	.60
1 Window Cleaner	1.00
1 Window Cleaner	.20
1 Garbage Can	1.10
1 Furnace Scoop	.65
4 Snow Shovels	3.80
1 Toilet Brush	.30
1 Mop, O'Cedar	1.10
1 Eagle Wringer Mop	4.30
2 Mops, Ohio	2.30
16 Flower Pots, 4"	.66
3 Flower Pots, 3"	.10
12 Flower Pots, 8"	2.40
14 Flower Pot Saucers, 4"	.40
3 Flower Pot Saucers, 5"	.15
1 Scrub Brush	.25
1 Push Broom, Jamaica	1.20
1 Push Broom, Keystone	6.25
6 Dusters	.72
2 Coco Mats	3.20
1 Coco Mat	.60
1 Garden Hose & Accessories	8.65
1 Manure Fork	1.50
*2 Fire Extinguishers	
1 Watering Can	1.90
TOTAL	$ 43.53

Inventory Winnipeg Laboratory Continued

BUILT-IN LABORATORY FIXTURES
(Not supplied by Dept. of Public Works)

1 Cabinet 12'x7'x4' of 5 compartments with individual doors for use as lockers for the storage of official equipment issued individuals. Compartments are divided one from the other by wire netting.

1 Cabinet 9'x7'x4' of 3 compartments with three doors for storage of camp utensils, surplus stationery and field equipment.

1 Pigeon-hole type Cabinet 12'x7'x4' without doors for storage of tents, mattresses, ground sheets, etc.

1 Carpentry tool Cabinet 7' high and 4' wide composed of cupboard above with two swinging doors for storage of tools and 17 drawers below for storage of nails and miscellaneous hardware.

1 Table 7' long and 2½' wide and 3' high with compartments below for storage of wrapping paper, excelsior, etc. This table is used for packing equipment to be shipped to the field and for unpacking equipment and supplies arriving at the laboratory.

1 Carpentry Work Bench with wood vice, 10'x3'x3'.

1 Rack for shovels, axes, brooms, etc.

1 Pigeon-hole type Cabinet 14'x8'x2½" for storage.

1 Work Bench in the dark room.

1 Furnace Room. Partitions built around furnace and coal bin to separate same from the rest of the basement.

IX. FINANCIAL STATEMENT & PROJECT COSTS

<u>FINANCIAL STATEMENT AND PROJECT COSTS</u>

<u>1941-1942.</u>

	GENERAL ADMINISTRATION	FOREST INSECT SURVEY	SPRUCE BUDWORM	LARCH SAWFLY	TIMBER CRUISE	CARPENTER ANT	LAB. IMPROVEMENTS	LAB. MAINTENANCE	CAPITAL	GROUNDS	PHOTOGRAPHY	TOTALS
A1 Permanent Salaries	2540.85	89.80	23.85	3.50	2.00							2660.00
A2 Temporary Salaries	670.95	3351.44	2715.89	314.36		20.70	166.98					7240.32
A3 Wages								402.47				402.47
F. Express & Frt., Ctge.	38.36	.75	6.83	9.02			.35					55.31
J. Miscellaneous	3.00							51.98				54.98
R. Supplies	70.26	10.42	185.00	16.15			114.66	53.72	409.42	46.20	142.58	1048.41
S. Telegraph, Telephone and Postage	107.07			.85								107.92
T. Travel	618.04	204.39	275.18	96.65								1194.26
TOTALS	4048.53	3656.80	3206.75	440.53	2.00	20.70	281.99	508.17	409.42	46.20	142.58	12763.67

Northern 1941 Winnipeg Insect and Disease Species Index