A N N U A L R E P O R T

- 1944 -

VERNON FOREST INSECT LABORATORY.

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A N N U A L R E P O R T

of the

VERNON FOREST INSECT LABORATORY

Calendar Year 1944

I n t r o d u c t i o n

The work carried on by this laboratory in 1944 has been the continuation of the forest insect survey; control of the mountain pine beetle (Dendroctonus monticolae Hopk.) in Banff National Park; collection of spruce budworm parasites (in cooperation with the Belleville Parasite Laboratory); reconnaissance and parasite studies in connection with the spruce budworm and lodgepole pine needle miner (Recurvaria milleri Busck); reconnaissance and parasite studies on the larch sawfly (Pristiphora erichsonii Htg.); studies of the correlation of growth and precipitation in connection with the huge bark beetle outbreaks which occurred in the B.C. Interior between 1913 and 1934; as well as biological studies of certain forest and shade tree insects of minor economic importance.

As far as volume of collections was concerned the 1944 insect survey was larger than in 1943 and about the same as in 1942. The material, however, had more immature forms for rearing.

In the bark beetle control work at Banff it was necessary to reclean only one small area. On all other areas the situation was entirely satisfactory and, unless an increase in the bark beetle population is apparent in the summer attack of 1945, no immediate further work will be necessary.

The main collection of spruce budworm parasite material was made in the vicinity of Lillooet using High School and Japanese labour.

Large quantities of several parasite species, both Hymenoptera and Diptera, were recovered and shipped to the Belleville Laboratory for propagation studies and in some cases for direct release.

The tree growth and precipitation studies in connection with bark beetle outbreaks were undertaken in order to establish some index of tree vitality at the start and during the series of large infestations which occurred, commencing with the one at Princeton 1911-1920 and culminating with the one in the Aspen Grove region 1920-1934. This might establish a basis for predicting when such another drouth period will occur and the yellow pine stands again become highly susceptible to bark beetle outbreaks. These stands should undoubtedly be managed under the Keen selection principle and and a knowledge of the approximate time of the next outbreaks will tell us how soon the desired results must be accomplished and how much direct control may be necessary.

The larch sawfly population was at a low ebb in 1944 and work consisted in checking sample plots for defoliation and in taking random cocoon samples wherever possible. Because cocoons were very scarce these samples were necessarily small. In most cases high parasitism by Mesoleius tenthredinis was indicated.

PERSONNEL OF THE
VERNON FOREST INSECT LABORATORY.

Geo. R. Hopping	-- Entomologist in Charge
W. G. Mathers	-- Assistant Entomologist
H. B. Leech	-- Agricultural Scientist (I)
C.V.G. Morgan	-- Agricultural Assistant (X)
Miss R. Beckingham	-- Stenographer (2)

ATTENDANCE OF OFFICERS AT CONFERENCES; ADDRESSES AND LECTURES.

G. R. Hopping was in Victoria February 21 to 24 incl. where he conferred with Chief Forester, D. D. Orchard, Assistant Chief Forest George Melrose, and Dr. M. L. Prebble of the Victoria forest insect laboratory, concerning certain post-war forestry plans and the presentation of a brief on forest entomology before the Royal Commission investigating all phases of forestry in British Columbia.

G. R. Hopping and H. B. Leech attended the 43rd Annual Meeting of the Entomological Society of British Columbia held in Vancouver on February 26.

W. G. Mathers attended the rangers' meeting of the Prince George Forest District on March 24 when he addressed the meeting on forest insect problems of the region.

On March 29, G. R. Hopping and H. B. Leech addressed the rangers of the Kamloops Forest District, Bark beetle problems were stressed and H. B. Leech discussed the forest insect survey and made suggestions for its improvement.

G. R. Hopping attended the annual rangers' meeting of the Nelson Forest District on April 5, discussing forest insect problems of the region.

W. G. Mathers conferred with officers of the Kamloops Forest District on April 12, making arrangements for labour in connection with spruce budworm parasite collecting.

G. R. Hopping and M. L. Prebble gave evidence and presented a brief on British Columbia forest insect conditions before the Royal Commission on forestry at the Court House, Victoria, May 11 and 12.

G. R. Hopping addressed the Rotary Club of Kamloops on May 29. The topic was "The Control of Injurious Forest Insects."

Assistant Forester McKee of the Kamloops office called at the laboratory on May 18 to discuss, with W. G. Mathers, labour arrangements in connection with spruce budworm parasite collecting. F. McBride,

forester of the Kamloops district, conferred with officers of the Vernon Laboratory on two occasions during the month of May to make arrangements for investigation of insect attack in relation to cutting procedure in spruce balsam stands.

A. Wilkes and H. Coppel of the Belleville Parasite Laboratory arrived in Vernon on June 13 to make final plans for the collection of spruce budworm material in the Lillooet district.

Dr. Edmund Schulman of the Tree Ring Laboratory, University of Arizona, Tucson, called at the laboratory on September 8. He wanted some increment cores from Douglas fir and ponderosa pine on dry sites. Officers of the laboratory were able to show him the most promising sites.

Dr. L. G. Saunders, Professor of Entomology at the University of Saskatchewan visited the laboratory on September 29.

The Royal Commission on forestry, headed by Chief Justice Sloan, held sessions in the Court House at Vernon, October 19 and 20. Officers of the Vernon Laboratory attended. G. R. Hopping conferred with Mr. Davey, counsel for the Commission, and Chief Forester Orchard on October 20 concerning matters of future cooperation between the Provincial Forest Branch and the Forest Insects Unit. On the same day a brief discussion of forest insect problems was held with Commissioner Sloan.

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RECONNAISSANCE AND FIELD WORK.

W. G. Mathers examined the bark beetle control work in Banff Park, January 11 to 15. He made a thorough check of the efficiency of spotting and treating work of the control crews.

On April 20 G. R. Hopping and C.V.G. Morgan investigated the poplar sawfly (Nematus nigriventris Curran) areas in the Eagle River Valley near Taft, B.C. A considerable number of cocoons were collected.

G. R. Hopping made an examination of a spruce budworm outbreak between Allison Pass and Hope, June 7 and 8.

G. R. Hopping inspected bark beetle control areas at Banff, June 23 to July 4 incl. Returning via Nelson, examination was made, at the request of the B. C. Forest Service, of dying white pine on logged areas near Kaslo, B.C.

At the request of the B.C. Forest Service, G. R. Hopping made an examination of the timber limits of the Vernon Box and Pine Lumber Co. at Bolean Lake, near Falkland, B.C., July 10. He was accompanied by C. F. McBride and W. R. Eccles of the Kamloops Forestry office. The bark beetle status and the spruce budworm outbreak on the area were studied.

G. R. Hopping spent July 11 to 15 inspecting the spruce budworm parasite collection work at Lillooet. The main object of this was to become familiar with methods used by officers of the Belleville Laboratory in handling spruce budworm material in large volume.

G. R. Hopping and H. B. Leech visited the timber limits of the Vernon Box and Pine Lumber Co. at Bolean Lake, July 18. A more thorough inspection of the limits was made and spruce budworm material obtained for parasite studies.

G. R. Hopping and H. B. Leech were on the Monashee summit between Vernon and Edgewood on July 25 collecting spruce budworm material for parasite recoveries.

G. R. Hopping, W. G. Mathers, and H. Coppel examined the spruce budworm infestation at Bolean Lake on August 5 and the Monashee infestation on August 7.

G. R. Hopping and W. G. Mathers spent September 8 to 17 incl. on a survey of the bark beetle areas in Banff Park, a check of the sample plots in Kootenay Park and the larch sawfly plots between Fernie and Edgewood. The lodgepole pine needle miner areas in Banff, Kootenay, and Yoho Parks were also examined.

G. R. Hopping and W. G. Mathers were absent from Vernon, October 2 to 5 incl. examining old bark beetle outbreak areas at Aspen Grove, in Kane and Voght Valleys, Midday Valley, and on Spius Creek. About 50 increment cores were taken from near Penticton, Princeton, Merritt, and Kamloops, for correlation with weather records at these stations.

COOPERATION WITH OTHER AGENCIES.

Excellent cooperation between the National Parks Branch and the Vernon Laboratory has been continued in the control and study of the mountain pine beetle within the parks.

Close cooperation has been maintained with the B. C. Forest Service in the matter of the forest insect survey in which nearly all of the collectors of samples have been Forest Service officers. The Provincial service also cooperated in the securing of labour for parasite collections and in providing certain equipment for this job, such as a truck and blankets. In return, officers of the Vernon Laboratory have undertaken to make studies of spruce budworm in connection with cutting programs and in making examination and recommendations with regard to insect injury in various forest areas.

DETAILED REPORT OF PROJECTS.

E. 30.01 - Forest Insect Survey - Leech, Morgan.

Summary Report of the Forest Insect Survey British Columbia & Rocky Mountain National Parks.

I. Introduction

In 1944 the Pacific Coast section of the Canadian Forest Insect Survey was made possible through the cooperation of the personnel of the British Columbia Forest Service, the National Parks Branch, in British Columbia and western Alberta, and a few private individuals. Officers of the Division of Entomology have made special collections, visited the more serious outbreaks, and have assisted in the preparation of this report.

Due to a reorganization of territories, members of the Alberta Forest Service and the Dominion Forest Service in western Alberta sent their collections to Winnipeg this year, instead of to Vernon.

Objects of the Survey.

1) To learn what kinds of insects are present in our forests. There are thousands of kinds, some destructive, some harmless, some beneficial. Species unknown to us have been sent in each year, and several proved to be new to science.

2) To observe the habits of the various species, and learn what their effects may be on the growth of trees and other forest life.

3) To accumulate over long periods information on distribution, fluctuations, in numbers and factors which control them, including parasites, predators, weather and different kinds of forest management. Such data are necessary in preventing loss by insect damage.

4) To obtain an annual check on the numbers of potentially destructive insects so that all will be forewarned of serious outbreaks. Advance warning gives a chance to reduce loss; parasites may be introduced, or cutting and management programs may help to restore balance. If control of the pest is not feasible, planned salvage cuttings will help to reduce loss in commercial stands.

5) To assist those working in the woods, as well as the owners of woodlots and forests, in becoming familiar with the signs of insect activity in the forest. Many causes of poor growth and unthrifty conditions go unnoticed, or are not noticed until it is too late to correct them.

These objectives cannot be accomplished by a small staff, so the project has become a co-operative one and depends for its efficiency on maximum assistance from those who can cooperate.

II. Methods.

Cooperators have been asked to make two collections a month, June to September inclusive, one from the dominant evergreen in the district, the other from a tree species of their own choice. Additional samples are sent in by men interested in the work. Outbreaks should be reported as soon as noticed, accompanied by the insects and damage if possible. Notes on the extent and severity of infestations are particularly valuable. Forms are available for special reports.

It is important that collectors include insects from only one kind of tree in one box. They should state clearly what kind of tree has been sampled, and enclose foliage.

When a box reaches this laboratory its contents are given a serial number, examined, and identified if possible. Adult insects are killed and kept for study; the more interesting kinds are placed in the Canadian National Collection at Ottawa.

Immature stages (caterpillars, maggots, pupae, etc.) are taken to the Trinity Valley Field Station near Lumby, where some are killed and preserved for reference and study; the remainder are placed in small cages and reared to maturity if possible. Notes are kept on the life-histories and habits of the various species and the parasites which may serve to keep them under control. When the adults have been obtained and identified, all available information is summarized and placed on permanent record.

Every collection is acknowledged by letter. Each kind of insect in a shipment is listed by its scientific name, and a short description is added so that the collector may recognize the different forms. Data on life-history and habits are added for the more interesting or important species, or upon request.

III. Results in 1944.

Cooperators are to be congratulated on the care taken in making and shipping collections this year. The mailing boxes were usually well sealed. The greater number of short reports on the extent of infestation and damage by the more serious pests have been valuable and indicate that the collectors can recognise the important forest insects.

The insect material reached us in better condition than that of any previous season, and contained a greater proportion of immature stages suitable for rearing. This shows in the following table of negative reports, collections, and total specimens received, 1941-44. Over 8,500 of the nearly 12,000 specimens for 1944 were larvae; it should be noted that the total has been swelled by several special collections of spruce budworm larvae made by officers of the Division of Entomology.

Received at Vernon	1941	1942	1943	1944
Negative Report Forms	137	87	74	70
Survey Collections	945	773	657	771
Total Insects and other Arthropods in Collections	8,114	8,325	6,638	11,939

In the Interior of British Columbia the spruce budworm (Cacoecia fumiferana) was the outstanding trouble maker, while the European larch sawfly (Pristiphora erichsonii) caused much less defoliation than in 1943. On the coast the black-headed budworm (Peronea variana; the name has recently been changed to Acleris variana) caused the greatest defoliation, though the hemlock looper (Lambdina fiscellaria lugubrosa), the pine butterfly (Neophasia menapia) and the lodgepole pine sawfly (Neodiprion sp.) are on the upswing. In Banff National

Park, a bark beetle (Dendroctonus monticolae), the spruce budworm, and the lodgepole pine needle miner (Recurvaria milleri) have been important; the latter is also present in Jasper Park. In Waterton Lakes Park, tent caterpillars (Malacosoma spp.) and a leaf-roller caterpillar on aspen poplar were the chief pests.

IV. Status of Major Forest and Shade Tree Insect Pests during 1944.

A. Species causing serious damage at the present time on spruce, balsam and Douglas fir.

The Spruce Budworm (Cacoecia fumiferana Clemens). This has been the most serious defoliator in the southern interior of British Columbia and adjacent Alberta. It occurs usually on Douglas fir at lower elevations, and on both spruce and balsam higher up. Seventy-two samples were received, from points as widely separated as Terrace, Vedder Crossing, Southbank, Sinclair Mills, Jasper, and Morrissey.

The most extensive outbreaks have been in spruce-balsam stands. Serious damage has been reported from the 4,000 ft. level on the main Tonequo range near Sinclair Mills, where most trees showed at least 50% defoliation (T. Ridler). There is a heavy infestation chiefly on balsam, at Sock Lake on the lower Clearwater River (F. Johnson). Another on the plateau (5,000 ft.) in the Bolean and Arthur Lakes district near Falkland was reported by C. McBride. Special collections were made there on July 18 by G. R. Hopping and H. B. Leech of Vernon; larvae were numerous and outnumbered pupae five to one; 3% of the larvae were parasitized. Defoliation was evident on spruce and balsam on the summit of the Monashee Mountains where they are crossed by the Vernon-Edgewood road (G.R.Hopping); Hopping and Leech collected there on July 25 and found that a few moths had already emerged and laid eggs; pupae outnumbered larvae by twenty to one, and 40% were parasitized. This infestation did not extend to the adjacent (lower elevation) Douglas fir. In an extensive outbreak around Skaist Creek, near Allison Pass on the Hope-Princeton road, spruce, balsam and Douglas fir were all attacked (G.R.Hopping). A general infestation in the vicinity of Lake Louise on spruce, and to a lesser extent on balsam was reported in early July (P. G. Woodworth). The Vermillion Summit and Marble Canyon infestations in Kootenay Park, B.C. were much larger this year, extending westward to Wardle Creek; the intensity was about the same as before (G.R. Hopping).

The main outbreak on Douglas fir was again in the Pemberton district, extending from the western end of Anderson Lake through the Gates and Birkenhead Valleys to Pemberton and north from Pemberton up the Lillooet Valley for 20 miles. This outbreak was less severe than in 1943 but the intensity of the infestations on Mission Ridge and Mt. McLean at Lillooet had increased (W.G.Mathers). Collecting crews, one of 31 teen-age boys at Lillooet, another of 30 Japanese at Shalalth, and a third of 8 Japanese at McGilligray, were employed for about six weeks in the Lillooet district forcollecting spruce budworm. The object was to obtain parasites for eventual release in the budworm areas of Eastern Canada. Under the direction of Dr. Wilkes and Mr. Coppel of the parasite laboratory at Belleville, Ont., and Mr. Mathers of Vernon, an estimated total of 380,000 budworm larvae and 180,000 pupae were gathered.

An infestation on Douglas fir near the mouth of the Adams River was reported as heavy on the lower parts of young trees (H. J. Connett).

There must be an extensive outbreak of budworm within ten or fifteen miles of Nakusp, as on August 12 thousands upon thousands of the moths were found on the streets after a rain storm (L.S. Ott).

On pine.

The Lodgepole Pine Needle Miner (Recurvaria milleri Busck). This species was treated fully in our 1943 Report. In 1944 Mr. G. R. Hopping of Vernon made extensive collections of infested foliage, to obtain data on parasites. He reported the outbreak as generally more extensive but less severe, except at the following points where it was heavier: Brewster Creek, Lake Louise, and Vermillion Summit in Banff Park, and Wapta Lake in Yoho Park. A small light infestation occurred at Marble Canyon and Hawk Creek in Kootenay Park (G. Nasadyk). W. E. Jamieson also reported needle miner as bad all over the Hector Division of Yoho Park.

The Mountain Pine Bark Beetle (Dendroctonus monticolae Hopkins). This species was treated fully in our 1943 Report. This year there is definite evidence that the infestation in Kootenay Park is rapidly subsiding, though still active at the north end. In Banff Park, control work has reduced the infestation to such an extent that no further work appears necessary on any of the areas

except Brewster Creek. There the outbreak is complicated by a weakening of mature trees due to needle miner attack (see above).

The Lodgepole Pine Sawfly (Neodiprion sp.) An outbreak of a species still unidentified has been found on Porcher Island, Prince Rupert district. As yet it is restricted fairly closely to the shoreline around much of the north arm of Kitkatlah Inlet, the southeast corner of the island, and spots along Ogden Channel. Defoliation is evident for about a quarter of a mile inland in places, and to a maximum elevation of about 500 feet (I. Martin). The pine in this muskeg area is non-merchantable, but a similar sawfly has been known to cause serious defoliation elsewhere, in the past.

On hemlock.

The Black-headed Budworm (Acleris (=Peronea) variana Fernald). This species occurs throughout at least the southern half of British Columbia and adjacent Alberta, butall 1944 reports of damage have come from west of the Coast Mountains, and refer to western hemlock.

In the Queen Charlotte Islands, infestation has been quite heavy over the Massett Inlet area (Awun River, Shannon Bay, etc.). Last year the defoliation was chiefly on mature and overmature trees, but this season the hemlock reproduction has been quite hard hit (L. C. Chamberlin). At Jeune Landing the slopes along the sound and for some miles inland were heavily infested, as was the Port Alice district in general (C.E. Southworth; R. W. Aylett). At Hardy Bay the discoloration of foliage caused by larval feeding was very apparent and covered a wide area (R. W. Aylett). On the west end of Midsummer Island and on the Hanson Island there was a slight attack with the usual foliage browning, on hemlock reproduction; at Telegraph Cove near Englewood there was a moderately heavy infestation in reproduction; and a lesser one on the east side of Tribune Channel between Thompson and Bond Sounds (J. W. Ker). On Sonora Island about 100 acres showed damage, especially where exposed to sunlight (C. S. Frampton). Slight defoliation occurred at Quinsam in the Comox district (A. Layton), and at Fifteen Mile Point on Harrison Lake (S. Korsch). On Vancouver Island, the infestation south and east of Great Central Lake has subsided; from Nootka Sound north, and particularly in the Quatsino district, it is more active than formerly, especially in young stands. The Charlottes show scattered areas of conspicuous defoliation on nearly all islands, and on the eastern side of Moresby Island to the

extreme southern part (letter from M. L. Prebble).

On poplar, willow and shrubs.

Tent Caterpillars (Malacosoma spp.). These well known caterpillars rarely if ever feed on conifers, but often strip poplars, willows and shrubs over large areas. The caterpillars are fully grown by or before early July, and by then their yellowish cocoons are found on trees, fences and buildings; during July the chunky brown moths are often attracted to lights at night. Caterpillars of the fall webworm (Hyphantria textor) also make tent-like webs, but are still tiny yellowish larvae at the time the Malacosoma are fully-grown.

An outbreak of tent caterpillars was reported from the Pouce Coupe district; poplars were stripped for miles along the Cutbank and Peace Rivers, and roads were covered with the larvae in early June (S. H. Tuck). Caterpillars were very numerous at Arrowhead (J. Reggin), and further down the lake at Nakusp (H. R. Wood). There was heavy defoliation of poplars between Taft and Revelstoke, but none west of Taft (G. R. Hopping). A few miles north of Rossland there was a severe defoliation of willows (H. C. Nichols; C. D. Grove-White). In Waterton Lakes Park, Alta., larvae of two species of Malacosoma were numerous on poplars and various shrubs both at Waterton townsite (A. H. Harwood), and in the Belly River district (R. M. Christiansen).

The Satin Moth (Stilpnotia salicis Linnaeus). This species was accidentally introduced from Europe many years ago. Except for an area around Lytton, and near Lillooet, it is confined to the coast of British Columbia. The caterpillars are blackish with conspicuous white splotches on the sides, and when mature are a little bigger than tent caterpillars. They feed chiefly on willows and poplars. The only report this year is from Botanie Valley, about 6 miles from Lytton, where the cottonwoods were badly affected (A.G. Kent).

B. Species not causing injury at the present time but known to be capable of doing so.

On Douglas fir.

The Douglas Fir Tussock Moth (Hemerocampa pseudotsugata McDunnough). This species was discussed at length in our 1943 Report. A single specimen was sent in this year from Vernon (S. Farris). The Vernon district has had severe outbreaks at intervals in the past.

On pine.

The Pine Butterfly (Neophasia menapia F. & F.). The butterflies are with with black markings and resemble the ordinary cabbage butterfly somewhat; they fly in August and early September.

The fully grown caterpillars (late July) are about an inch long, dark green, not shiny and have two white stripes down each side. They usually feed on pine, and in some past outbreaks have killed up to 90% of the trees. They have been reported to feed on Douglas fir and hemlock on the coast of British Columbia.

No reports of defoliation have been received, but the butterflies occurred in millions at Buttle Lake-Price Creek-Cruikshank River and north at least as far as Rock Bay (A. Smith for A. C. C. Langstroth); from the Puntledge River to Buttle Lake, and at S. T. L. 3664^{D}, Sayward District (A. Layton). They were reported near Bowser and near Bradley Lake (L. E. Van Tine), and passing over Qualicum in great numbers(R. H. Morrison). A specimen was taken at Thurston Bay, Sonora Island (W. E. Elliot).

On hemlock.

The Hemlock Looper (Lambdina (=Ellopia) fiscellaria lugubrosa Hulst.) This species has caused much damage in the past, and as it re-appears at intervals a sharp watch should be kept for unusual numbers of the caterpillars or moths.

At the coast adults were fairly common at Thurston Bay, Sonora Island (C. S. Frampton). Moths were numerous in the Quatsino region and in the main valley of the Gordon River, where the caterpillars had been present in outbreak proportions (letter from M. L. Prebble).

It is surprising that no larvae were submitted by cooperators. In the Interior of British Columbia the only report is from the Big Bend where between Revelstoke and Downie Creek, moths were common enough along the road to suggest the early stages of an outbreak (G.R.Hopping).

The Hemlock Sawfly (Neodiprion tsugae Middleton). The larvae of this sawfly caused severe defoliation in the Queen Charlotte Islands 14 years ago. The species may be on the upswing again, in conjunction with the black-headed budworm; three samples were submitted from Massett Inlet, where the combined infestation was heavy and on younger trees than last year (L. C. Chamberlin).

On larch.

The European larch Sawfly (Pristiphora (= Lygaeonematus) erichsonii Hartig). No extensions of range have been reported, and no serious defoliation by the caterpillars. From observations made by officers of the Dominion Division of Entomology it appears that the low sawfly population level is due in large part to parasites.

Near East Robson there was a general but light infestation(J.F. Killough). In 1943 there was a heavy infestation near Goatfell, but this year there was none (N. R. Biccum). There was very little trace of the sawfly at Thompson Mountain, Goat River above Kitchener, Englishman Creek at Yahk, or in the Kingsgate area, places where the larvae were plentiful last season (A. I. Ross). None could be found 2 miles SW of Kitchener (A.I. Ross).

V. Status of Minor Forest and Shade Tree Insect Pests during 1944.

On spruce, balsam and/or Douglas fir.

Shoot Moth (Griselda sp., probably radicana Wlshm.♀. The small brownish larvae of this budworm have been received one or two at a time in past years. This season it was reported as causing

medium to heavy defoliation of new growth of small to large Douglas fir, and to a lesser extent of hemlock and amabilis fir, at the 2,200 ft. elevation on Cottonwood Creek, Cowichan Lake, B.C. (M. L. Prebble and K. Graham).

The Yellow-headed Spruce Sawfly (Pikonema alaskensis Rohwer). No outbreaks have been reported this year, through the species was present in 24 collections.

The Green-headed Spruce Sawfly (Pikonema dimmocki Cresson). Larvae were present in 28 collections in 1944.

The Green Spruce Looper (Semiothisa granitata Gn.). The caterpillars were common from July through September, and were present in 86 collections this year.

The Gall Aphids (Adelges and Pineus spp.). The cone-like gall formations caused by these insects are common on spruce. The commonest species, Adelges cooleyi Gillett, has Douglas fir as its secondary host; a heavy infestation was reported on ornamental Douglas fir at Alert Bay (J. W. Ker). Galled twigs were numerous on some trees near Kelowna (M. A. Johnson) and near Smithers (C.L. Gibson), and common around Lake Louise (P. G. Woodworth).

The Spruce Needle Miner (Taniva albolineana Kearf.). No specimens were sent in this year. Examinations made of several infested ornamental spruce in Vernon, showed a natural parasitism of up to 60% caused by a small black wasp, Ascogaster sp.

On pine.

The Green Needle-Tier (Tortricidae?). About 30% of the lodgepole pine in the Finlay Creek area 12 miles west of Canal Flats, B.C. are reported to be infested with small green budworms, at present unidentified (W. Dodds).

The Clear-wing Pitch Moth (Aegeriidae). Many lodgepole pine trees at Malakwa, B.C. are reported to be infested with pitch moth caterpillars and some trees are dying (J.A. Sim). The species may be Vespamima sequoiae Hy. Edw., recorded as injurious in British Columbia.

The Red Turpentine Beetle (Dendroctonus valens LeConte). Many larvae of this large reddish bark beetle were found attacking the roots of white pine at Ganges, on Saltspring Island, B.C. (W. E. Jansen).

On larch.

The Native Larch Sawfly (Anoplonyx spp.). The small green larvae of these native sawflies are common, and were in 30 of the collections received this year. They have not been reported as causing defoliation though they occur in areas not yet reached by the European larch sawfly.

On poplar, willow and shrubs.

The Poplar Sawfly (Nematus nigriventris Curran). This species was provisionally called Pontania pepii in our 1943 Report; adults have now been reared, and identified as above by Dr. Peck of Ottawa. Although the larvae seriously to completely defoliated Black cottonwood in those parts of the Shuswap and Eagle River Valleys between Grindrod and Three Valley Lakes in 1942 and 1943, there has been little or no defoliation by the species this year. However, the trees between Taft and Three Valley Lakes were heavily attacked by tent caterpillars in 1944 (G. R. Hopping).

The Aspen Leaf Roller (Cacoecia sp.). The blackish larvae of a species as yet unidentified, were very numerous in Waterton Lakes Park, Alta. By early June there was a heavy infestation along Chief Mtn. Highway, with many trees defoliated; many larvae dropped down on threads, and covered the underbrush with webbing. About 80% of all aspen on 6 or 7 square miles were completely defoliated; the infestation is spreading northeast, with the pre-

vailing wind. An attack outside the Park, to the north,west of the highway to Pincher Creek, was observed(H.A. de Veber). The whole watershed into the Waterton River north of Pass Creek, comprising several hundred acres, and a considerable acreage in other areas, both in and out of the Park, was infested (J. M. Giddie). The large samples sent in showed a heavy parasitism of the caterpillars.

The Aspen Leaf Beetle (Phytodecta americana Schaeffer). The black larvae of this spotted leaf beetle stripped hundreds of trees of all foliage, in the Belly River area of Waterton Lakes Park, Alta. (R.M. Christiansen).

The Cottonwood Leaf Beetle (Chrysomela scripta Fabricius). The black-marked yellowish beetles were present on all large cottonwoods at Albas, B.C. (J. F. Armstrong). This species rarely causes serious defoliation.

The Black Willow Leaf Beetle (Galerucella carbo LeConte). The only report of damage is from Albas, B.C., where the willow leaves turned brown after being skeletonized by the beetles and their little black-marked yellow larvae (J. F. Armstrong).

The Cherry Tortrix (Caccecia cerasivorana Fitch). Several acres of choke cherry were infested in the Belly River area of Waterton Lakes Park, Alta. (R. M. Christiansen). It was also common on choke cherry (Prunus demissa) along the Canadian National Ry. right-of-way at Endako, B. C. (Mrs. H. R. Foote).

On maple.

The Box Elder Bug (Leptocoris trivittatus Say). The black and red bugs feed on Manitoba maple (box elder) and by their habit of congregating in masses on and in buildings adjacent to the trees, are a nuisance each fall and spring. Due chiefly to the cold winter of 1941-42 the bug population has been low, but has built up rapidly in 1944. The only collection submitted was from Savona (A.M. Gilmour).

On cascara.

A plantation of cascara (Rhamnus purshiana) at Salmon Arm, B.C. was infested with small moth caterpillars which formed a central longitudinal fold in the leaves (C. R. Barlow). Natural parasites were present. The species may be the Cascara Pouch Moth (Cystiocecetes nimbosus).

Insects not Reported.

No reports of unusual abundance of any of the following were received in 1944.

Dichomeris marginella Fab.	Juniper Webworm
Nymphalis californica Boisd.	California Tortoiseshell Butterfly.
Pissodes engelmanni Hopk.	Spruce Weevil.
Chrysomela tremulae Auct.	Aspen Leaf Beetle.
Cephalcia spp.	False Webworms
Urocerus spp.	Horntail Sawflies.
Phenacaspis (=Chionaspis) pinifoliae Fitch.	Pine Leaf Scale.

VI. Beneficial Insects.

A survey collection from Banff National Park (S.W.1/4 S. 17, Tp. 26, R.11. (J.E. Stenton)), contained an unusual abundance of Syrphidae larvae and hemerobiid or brown lacewing adults. Trees in the vicinity were probably heavily infested with aphids or scale insects.

VII. Miscellaneous.

Strawberry Root Weevil (Brachyrhinus ovatus Linnaeus). These little black weevils are a pest of cultivated strawberry and are also common in pastures, brushlands and open hardwood forests. The beetles are flightless. They cause annoyance by entering houses in spring and fall. The species was reported a nuisance in houses at Pouce Coupe, B.C. (J. R. Murrell), and near Falkland (Mrs. R. L. Sweet).

Killing of aspen. Aspens on Wallace Mountain, Beaverdell, B.C. are reported to be hard hit by insects, and dying (J. Haywood). The collection submitted contained a beetle Peeciloneota californica Chamberlin, whose horseshoe-nail shaped white larvae tunnel in aspen.

Infestations on spruce and balsam. The following reports are thought to refer to the spruce budworm (Cacoecia fumiferana), though no samples were obtained.

1) Infestation is evident on spruce and balsam between Grave Creek and Colin Creek, near the headwaters of the White River, a tributary of Kootenay River (Game Warden Tyler, per J. H. Applewhaite).

2) An area of considerable extent, chiefly spruce, was infested in the Similkameen Valley north of the Hope-Princeton road. This is on the Upper Similkameen where it comes from the north and crosses the road about 4 miles above Cambie Bridge, and is about 50 miles west of Princeton (G. P. Melrose).

Fungus diseases. A number of samples of rust fungi have been submitted in connection with the Forest Insect Survey, and the more interesting are here recorded:

On pine.

Hypodermella montivaga (Petrak) Dearn. Found at Wapta Lake, east of Field, B.C. fairly localized on the slopes above the lake (G. R. Hopping). This fungus attacks the needles; Dr. Conners, Associate Plant Pathologist at Ottawa, said it had not been recorded in Canada previously.

On juniper.

Gymnosporangium spp. A stage of one or more species of juniper rusts causes odd growths on hawthorn and saskatoon fruits; samples were taken near the Forest Service cabin on Bush River, northwest of Donald, B. C. (H. J. Coles).

On Douglas fir.

Rhabdocline pseudotsugae Syd. This rust kills the needles and is most common in wet seasons; it rarely kills the trees. Outbreaks have been reported from near Barriere (R. E. Johnson), and Invermere, B. C. (J. L. Johnson).

TREATMENT OF OVERWINTERED 1943 MATERIAL, AND EMERGENCE FROM CONSTANT TEMPERATURE CABINET IN 1944.

All Forest Insect Survey material of 1943 designated for overwintering was kept in the insectary at the Field Station until Nov. 1, 1943, in which a minimum of 23.0° F. occurred on Oct. 31 or Nov. 1. On the morning of Nov. 1, this material which had been sorted previously was either placed in the overwintering chamber or left in the insectary as shown in detail in the following table:

Material	Placed in overwintering chamber		Left in Insectary.		Total	
	Vials	Specimens	Vials	Specimens	Vials	Specimens
Lepidoptera--pupae	180	256	19	79	199	335
Lepidoptera--larvae	3	3	53	61	56	64
Parasites	17	46	55	69	72	115
Sawflies	143	747	23	95	166	842
Miscellaneous	1	1	18	31	19	32
Total	344	1053	168	335	512	1388

Throughout the overwintering period of 1943-1944 the temperature of the insectary which was closed with shutters for the winter months, varied until April 1, 1944 from a maximum of 45.0°F. to a minimum of 8.5°F., while the temperature of the overwintering chamber for the same period ranged from a maximum of 41.5°F. to a minimum of 25.0°F.

The 1943 overwintered material was placed in the constant temperature cabinet in 1944 in three lots to facilitate ease of handling emergence; the first on Jan. 12, the second on Feb. 3, and the third on Feb. 17. In each case the material was transferred from the overwintering environment to a room at Vernon, the temperature of which was gradually raised to about 70° F. in a period of approximately 48 hours. Just prior to incubation

the material of each lot was examined and dead specimens discarded. The cabinet was operated at 74°F. and 90-95% relative humdity. A small portion of the material was not incubated; this was left in the insectary for normal emergence in the spring and summer of 1944. The following table summarizes the material lost through overwintering and that transferred to the constant temperature cabinet.

MATERIAL	Specimens placed in Constant Temperature Cabinet.				Specimens Discarded				Specimens left in insectary	Total
	Lot 1	Lot 2	Lot 3	Total (A)	Lot 1	Lot 2	Lot 3	Total (B)	(C)	A,B,
Lepidoptera-pupae	215	42		257	16	10		26	52	335
Lepidoptera-larvae	2			2	1			1	61	64
Parasites	106			106	8		1	9		115
Sawflies		377	353	730		15	26	41	71	842
Miscellaneous		20		20		1		1	11	32
TOTAL	323	439	353	1115	25	26	27	78	195	1388

The emergence of overwintered 1943 Forest Insect Survey material from the constant temperature cabinet at Vernon is summarized in the accompanying tables.

TABLE I. - SUMMARY OF EMERGENCE FROM LEPIDOPTEROUS PUPAE

Insect	No. Pupae	Moths etc. No. Emerged	Moths etc. Incubation period	Parasites No. Emerged	Parasites Incubation period	No. pupae died	% Emergence
Acronicta sp.	1	1	10 days				100.0
Arctiidae	1					1 *	0.0
Caripeta sp.	18	15	27-86 "	1	16 days	1 ⊖⊖	88.9
Celerio gallii intermedia	1			1	25 "		100.0
Eupithecia luteata	1					1	0.0
E. palpata	9	4	13-20 "			5	44.4
E. sp.	31	28	6-41 "			3	90.3
Feralia jocosa	6					6	0.0
Geometridae	13	10	3-40 "	1	13 "	2	84.6
Hydriomena renunciata	3	3	12-14 "				100.0
Lepidoptera	8	5	13-16 "			3	62.5
Malacosoma sp.	1					1	0.0
Melanolophia imitata	20	15	8-37 "			5	75.0
Melanolophia sp.	5	2	14-17 "	2	13-14 "	1	80.0
Nematocampa limbata	2	2	3 "				100.0
Nepytia canosaria	2	2	41-43 "				100.0
Panthea sp.	5	3	13-14 "			1 ⊖⊖	60.0
Papilio sp.	1					1	0.0
Peronea variana	1			1	11 "		100.0
Phalaenidae	6	1	92 "	2	31-41 "	3 * *	50.0
Semiothisa granitata	53	39	8-85 "	1	47 "	11 ⊖⊖⊖	75.5
Semiothisa sp.	53	34	8-32 "	5	12-41 "	12 ⊖⊖⊖	73.6
Sphingidae	2					2 * *	0.0
Tortricidae	11	3	10-28 "	1 ⊖	18 "	6 ⊖⊖	63.4
Zale sp.	3	2	5 -6 "			1	66.7
T o t a l	257	169	3-92 "	15	11-47"	66	
Per cent		65.8		5.8		25.7	71.6

* Parasitized by Hymenoptera which did not emerge

** One pupa parasitized by Diptera which did not emerge

⊖ 75 hymenopterous parasites from one cocoon

⊖⊖ Plus one specimen alive, Apr.27,'44, and transferred to insectary

TABLE II -- SUMMARY OF EMERGENCE FROM SAWFLY COCOONS

Insect	No. Cocoons	Sawfly Adults: No. emerged	Sawfly Adults: Incubation period	Parasites: No. emerged	Parasites: Incubation period	No. cocoons died	% Emergence
Anoplonyx spp.	93	37	9-43 days	10	13-26 days	46	50.5
? Arge sp.	1	1	21 "				100.0
Neodiprion resinosae	3			2	22 days	1	66.7
Neodiprion spp.	44	8	13-18 "	15	14-47 "	21	52.3
Pamphiliidae	22					3*	0.0
Pikonema alaskensis	46	23	17-39 "	5	13-36 "	13 **	60.9
P. dimmocki	40	16	15-29 "	4	20.-30 "	17***	50.0
Pikonema spp.	8	3	21-23 "			4 θ	37.5
Pontania pepii?	10	1	6 "	4	6-13 "	5	50.0
Pristiphora erichsonii	378	134	20-62 "	1	38 "	192 θθ	35.7
Pristiphora n. sp.	80	18	10-31 "	9	13-39 "	52θθθ	33.8
Sawfly	2					2	0.0
Tenthredinidae	2			1	36 "	1	50.0
Zarea sp.	1	1	11 "				100.0
T o t a l	730	242	6-62 "	51	6-47 "	357	
Per cent		33.1		7.0		48.9	40.1

* Plus 19 larvae alive, April 27/44, and transferred to insectary. One dead specimen parasitized by Hymenoptera which did not emerge

** Plus 5 cocoons with live larvae, April 3/44

*** Plus 3 " " " " "

θ Plus 1 cocoon " " " "

θθ Plus 51 cocoons with live stages: one sawfly stage on Mar. 27)44; one sawfly stage and 4 Mesoleius pupae on Apr. 3/44; 2 sawfly stages on Apr.14/44, and 43 cocoons on Apr.27/44 which were transferred to insectary. Two of the dead sawfly cocoons contained dead Mesoleius pupae Apr. 3/44.

θθθ Plus 1 cocoon with live larva, April 3/44
One dead cocoon contained dead hymenopterous parasite.

TABLE III -- SUMMARY OF EMERGENCE FROM DIPTEROUS PUPARIA

Host	No. Puparia	Diptera: No. Emerged	Diptera: Incubation Period	No. puparia died	% Emergence
Epicnaptera americana	16			16	0.0
Lepidoptera	1	1	15 days		100.0
Malacosoma sp.	2			2	0.0
Panthea sp.	10	5	19-23 "	5	50.0
Peronea variana	2			2	0.0
Pristiphora erichsonii	1			1	0.0
Semiothisa granitata	1	1	53 "		100.0
Semiothisa sp.	1	1		*	0.0
Syrphidae	1			1	0.0
Unknown	5	1 *	31 "	4	20.0
T o t a l	40	9	15-53 "	31	
Per Cent		22.5		77.5	22.5

* Hymenopterous parasite

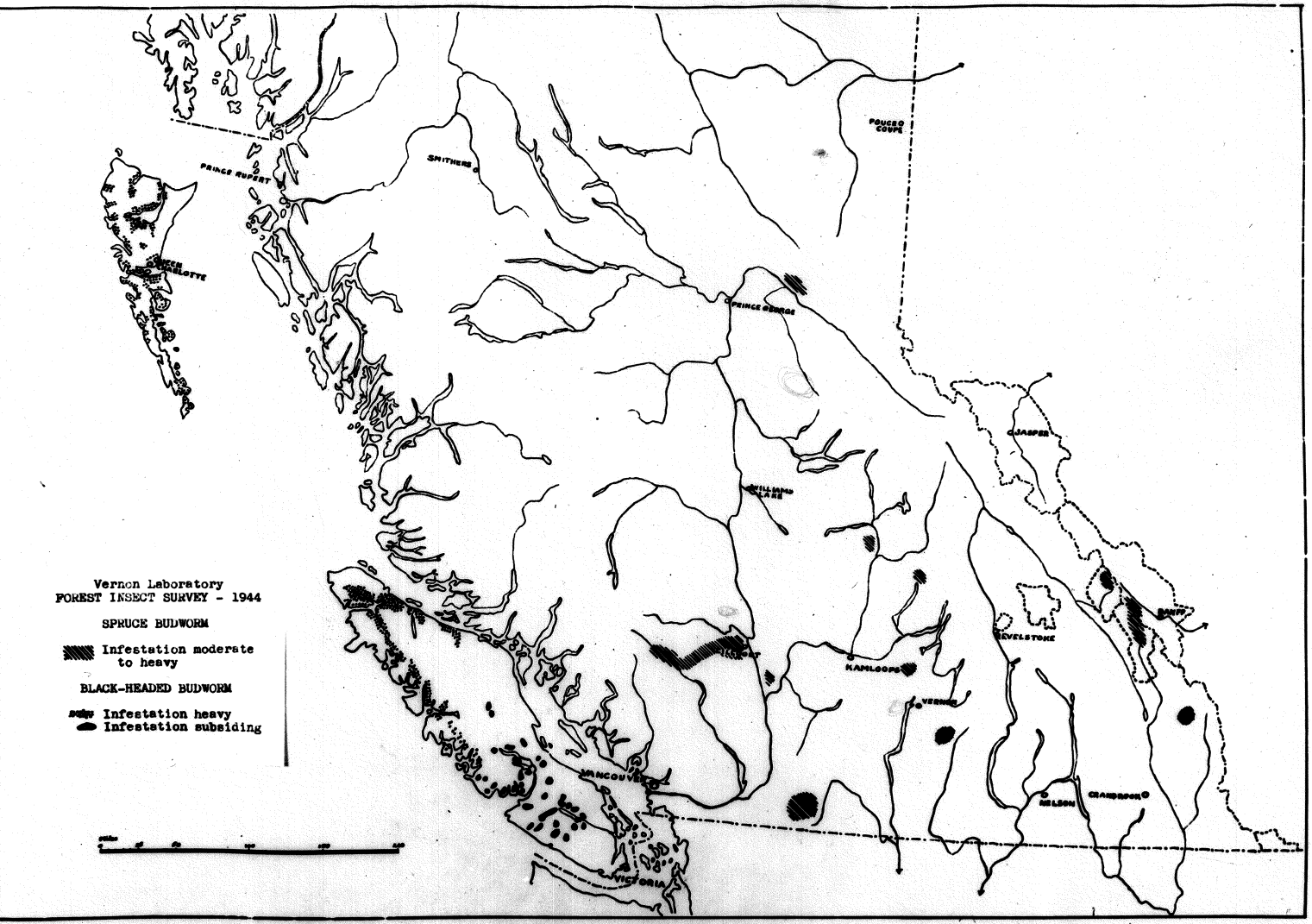
TABLE IV -- SUMMARY OF EMERGENCE FROM HYMENOPTEROUS COCOONS

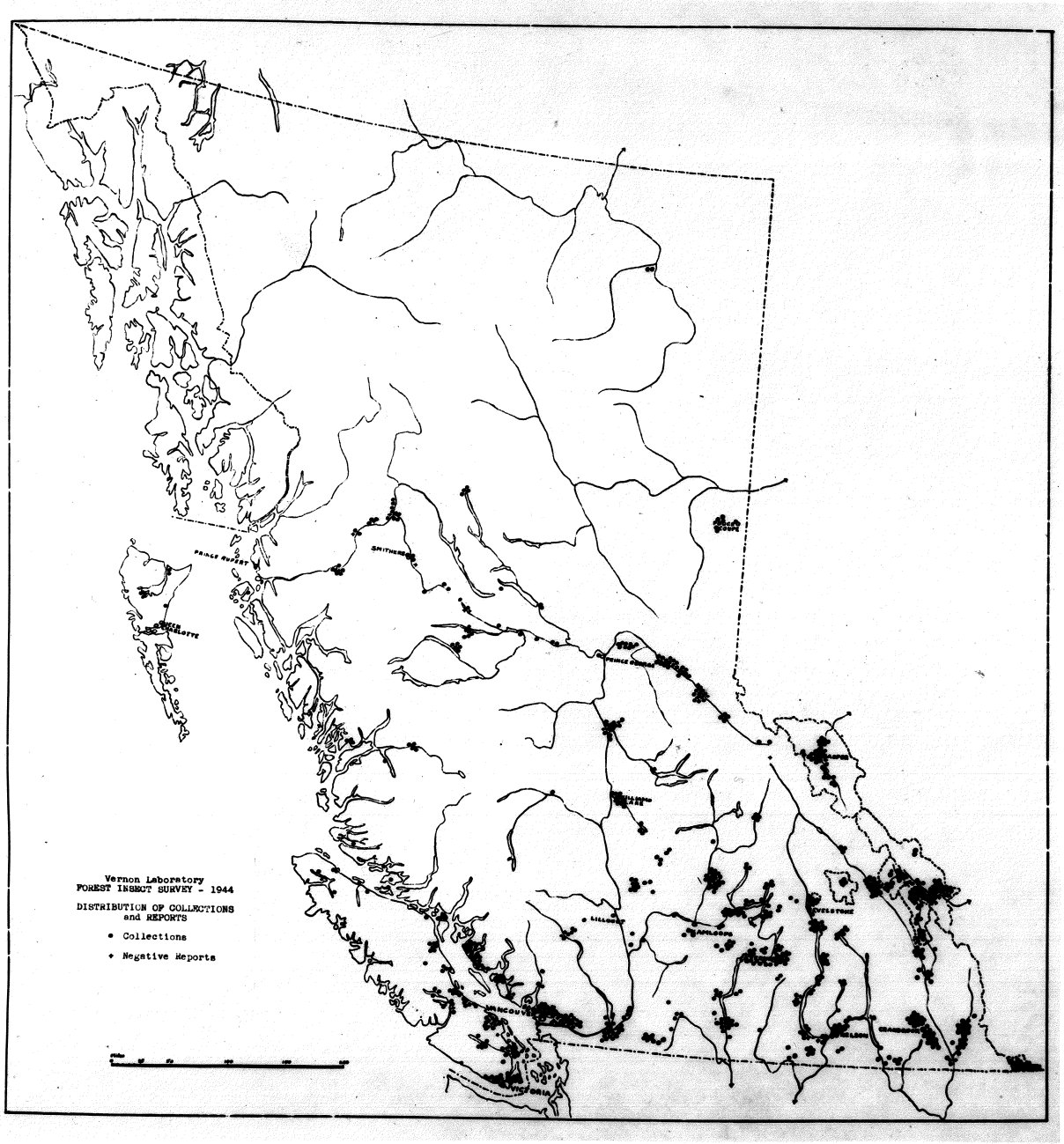
Host	No. cocoons	Hymenoptera		No. cocoons died	% Emergence
		No. adults emerged	Incubation period		
Autographa sp.	1	1	10 days		100.0
Caccecia fumiferana	1	1	33 "		100.0
Caripeta sp.	2			2	0.0
Eupithecia luteata	2	2	27-38 "		100.0
E. palpata	1	1	17 "		100.0
Eupithecia sp.	4	3	9-27 "	1	75.0
Geometridae	5	4	10-38 "	1	80.0
Host ?	6	2	18-43 "	4	33.3
Hydriomena renunciata	8	8	7 "		100.0
Lepidoptera	1	1	25 "		100.0
Melanolophia imitata	2	1	24 "	1	50.0
Nepyta canosaria	1	1	17 "		100.0
Peronea variana	1	1	10 "		100.0
Phalaenidae	2	1	13 "	1	50.0
Pikonema sp.	2	1	8 "	1	50.0
Semiothisa granitata	16	15	9-42 "	1	93.7
Semiothisa sp.	9	9	10-23 "		100.0
Tortricidae	2	2	6-17 "		100.0
T o t a l	66	54		12	
Per Cent.		81.8		18.2	81.8

TABLE V. --SUMMERY OF EMERGENCE FROM MISCELLANEOUS

Insect	No. Specimens	Adults		Parasites		No. died	% Emergence
		No. Emerged	Incubation period	No. Emerged	Incubation period		
Aphids *	7			3	9-16 days	4	42.9
Geometridae larva *	1					1	0.0
Insect cocoon	1					1	0.0
Lexis bicolor larva *	1					1	0.0
Neuroptera	10	2	20-23 days			8	20.0
Syrphidae	1					1	0.0
Tipulidae larva	1					1	0.0
T o t a l	22	2	20-23 days	3	9-16 days	17	
Per cent		9.1		13.6		77.3	22.7

* Parasitized


Vernon Laboratory
FOREST INSECT SURVEY - 1944
SPRUCE BUDWORM
Infestation moderate to heavy
BLACK-HEADED BUDWORM
Infestation heavy
Infestation subsiding
PRINCE RUPERT
SMITHERS
POUCE COUPE
PRINCE GEORGE
JASPER
KAMLOOPS
REVELSTOKE
VERNON
NELSON
CRANBROOK
VANCOUVER
VICTORIA


Vernon Laboratory
FOREST INSECT SURVEY - 1944
DISTRIBUTION OF COLLECTIONS
and REPORTS
• Collections
◆ Negative Reports
PRINCE RUPERT
SMITHERS
QUESNEL
PRINCE GEORGE
KAMLOOPS
REVELSTOKE
CRANBROOK
VANCOUVER

FOREST INSECT SURVEY 1944

- ○ *Peronea variana* (85)
- ⊕ *Pikonema alaskensis* (24)
- \# *Pikonema dimmocki* (28)
- ■ *Cacoecia fumiferana* (72)
- ▲ *Pristiphora erichsonii* (22)
- ● *Lambdina fiscellaria lugubrosa* (16)
- ◪ *Malacosoma spp.* (32)
- ✱ *Semiothisa granitata* (84)

Miles 0 25 50 100 150 200

PRINCE RUPERT
SMITHERS
POUCE COUPE
QUEEN CHARLOTTE
PRINCE GEORGE
JASPER
WILLIAMS LAKE
LILLOOET
KAMLOOPS
REVELSTOKE
BANFF
VERNON
VANCOUVER
NELSON
CRANBROOK
VICTORIA

Lodgepole Pine Needle Miner (Recurvaria milleri Busck). (Hopping & Morgan)

The area heavily attacked by the lodgepole pine needle miner (Recurvaria milleri Busck) was extended five to seven miles southward into Kootenay Park from Vermilion Pass and westward into Yoho Park, for several miles west of Wapta Lake (see 1942 annual report). On areas previously infested, the browning of trees was not quite as severe as in 1942. Very severe attacks occurred between Lake Louise Junction and Lake Louise, on slopes north of Wapta Lake, and on Brewster Creek. Near Lake Louise and on Brewster Creek mature trees are involved which may complicate bark beetle control to some extent. Mature trees weakened by miner attack seem to attract bark beetles from considerable distances.

Practically all larvae had pupated in the field by the end of June and about 20 survey boxes of branch terminals were shipped to Trinity Station for parasite and moth emergence studies. Unfortunately, pressure of other work prevented taking data on emergence of moths in the summer and examination of the material in the jars could not be made until March and April of the following year. Data secured in this way, however, was almost as good as if done at the time of emergence since pupal cases, parasite cocoons, parasitized larvae from which parasites had emerged, dead larvae and pupae remained in the mined needles.

It was usually possible to determine what had happened to the miner within the needle and gave an accurate figure for parasitism. The moth emergence taken in connection with the number of needle bundles and individual needles affected will form a basis for comparison of populations of both host and parasites in 1946, the next moth flight year. The accompanying table shows data in connection with the examination of needles from 148 terminals of lodgepole pine from 5 localities distributed over the infested area. The number of needles examined was 13,921 of which 6,855 were infested. A few samples consisted of infested needles only, removed from the terminals. These are included in the parasitism figures but could not be used in the determination of percentage of needles infested.

The average percentage of bundles infested per terminal was 65 while the average percentage of needles was 45. No locality showed

LODGEPOLE PINE NEEDLE MINER

Locality	No. of terminals	No. of needle bundles	No. of bundles infested	%	No. with both needles mined	Total needles mined	%	Moths emerged.	Larvae dead	Pupae dead	Larvae or pupae parasitized	%	Total mortality %
Between Castle &Vermilion Summit	54	2751	2097	76	800	2897	53	1880	36	98	215	10	16
Vermilion Summit Camp	12	778	263	34	29	292	19	165	4	5	34	16	21
3 Mi. W. Vermilion Summit Camp	8	396	74	19	6	80	10	70	0	1	0	0	1
Brewster Creek	34	2255	1553	69	472	2025	45	747	136	22	133	13	28
T O T A L S	108	6180	3987	65	1307	5294	43	2862	176	126	382	11	19
Wapta Camp Infested needles only	14	?	395	?	72	467	?	417	7	17	15	3	9
Between Castle & Vermilion Summit Infested needles only	26	?	831	?	263	1094	?	895	9	63	117	11	17
T O T A L S	40	?	1226	?	335	1561	?	1312	16	80	132	9	15

an average percentage of parasitism greater than 16. Nearly all of this parasitism was caused by a small species of Chalcid. From 5 to 13 parasites were found in a single host larva. The following tabulation shows the count of parasite cells within some of the host larvae.

4	host	larvae	contained	5	parasite	cells	each.
15	"	"	"	6	"	"	"
16	"	"	"	7	"	"	"
38	"	"	"	8	"	"	"
30	"	"	"	9	"	"	"
26	"	"	"	10	"	"	"
7	"	"	"	11	"	"	"
2	"	"	"	12	"	"	"
1	"	"	"	13	"	"	"

From the above it is clear that 139 host larvae contained 1,170 parasites or an average of 8.4 parasites per host. A few larger species of parasites were taken and about six species in all. As yet, none of these have been determined.

The total larval and pupal mortality from all causes was not greater than 28 per cent on any area and averaged 19 per cent. On most of the area over 80 per cent of later stage larvae reached the adult state. This means that the infestation will continue to be severe through 1946 unless some unforseen factor intervenes to reduce the population of the miner.

Sample plots will be established in 1945 in order to establish a more exact method of sampling and population determination as well as to determine, more accurately, the effect on the timber stands.

The Poplar Sawfly, Nematus (Pteronidea) nigriventris. (Hymenoptera; Tenthredinidae)

- Morgan -

Nematus nigriventris (Curran) was described in 1926 as a new species of Pteronidea (Canadian Entomologist 58(9):233-234). The description was made from specimens supplied by R. Glendenning who had obtained them from or reared them at, Agassiz, B. C. on March 27, 1926. In his article Curran stated that "During the spring of 1926 specimens of a sawfly which had caused serious damage to cottonwoods in the neighborhood of Agassiz, B. C. were forwarded to the Dominion Entomologist for determination." Previous to April, 1944, the Vernon Laboratory had given this sawfly the provisional determination of Pontania pepii Ross. Adult specimens from the Eagle River Valley near Taft, B. C. sent to Ottawa on April 25, 1944, were identified by C. Peck as Nematus (Pteronidea) nigriventris Curran. The sawfly is known definitely only from British Columbia, and its only known host is the black cottonwood, Populus trichocarpa T. & G./Keen (U.S.D.A. Misc. Publ. 273: 92 (1938), describes a cottonwood sawfly (Pteronidea sp.) from Idaho and says "the larvae construct small, parchment-like cocoons that are attached to the leaves." The cocoons of Nematus nigriventris are constructed in the soil. Until 1942 this sawfly had not been noted causing serious damage since the time of Curran's description, and the writer is not aware of any other mention of this insect in the literature.

History of Outbreak

The infestation which has recently occurred in the interior of British Columbia was first observed on June 1, 1942 by G. R. Hopping and W. G. Mathers who collected 39 larvae on black cottonwood "east of north fork of Eagle River, on road to Revelstoke, B.C." (Forest Insect Survey, B.C. Record No. 2974). The infestation was reported as widespread in the Eagle River and Shuswap Valleys, extending for a distance of 45 miles and a width of one-half to two miles between Revelstoke and Grindrod. It was particularly heavy in the vicinity of Taft where both young and mature trees were completely defoliated in late June and early July. No adult material was reared from this collection.

In 1943, Hopping and Mathers, passing through the area on June 10, found severe defoliation in approximately the same locality as in 1942.

Generally speaking, defoliation was a little less severe in 1943 than in 1942. A small collection (Forest Insect Survey, B.C. Record No. 3744) of larvae and cocoons was made on June 10 at Taft, B.C. At that time larvae had finished feeding and 27 specimens were taken from the soil. The collectors reported that cocoons were hard to find and most of the collection consisted of larvae. When the material reached the Trinity Valley field station on June 12, all larvae had spun cocoons. Adults were not obtained until 1944. Ten cocoons of the collection were left in their natural soil in a vial and wintered in an overwintering chamber until Feb. 17, 1944, when they were placed in a constant temperature cabinet operated at 74°F. and 90 to 95% relative humidity. A male sawfly was obtained after six days of incubation, and four hymenopterous parasites were recovered between Feb. 23 and March 1, incl. The remaining 17 cocoons were overwintered in soil under field conditions. Two sawfly adults (1 female and 1 male) emerged on May 5, and one female on May 6. One hymenopterous parasite emerged on May 12 and another on May 15. Unemerged cocoons were later examined. It was estimated that parasites--all Hymenoptera-- had killed 37% of the nigriventris larvae and pupae.

On April 20, 1944, G. R. Hopping and C.V.G. Morgan collected 165 cocoons just east of Taft, B.C., from soil beneath black cottonwood trees 8 to 15 inches d.b.h. and 75 feet or so high. Small patches of snow were still present on shaded areas of north slopes; none was present on the level collecting site. Here the soil was still very damp but quite warm where exposed to the sun. In this area the soil consisted of a top layer of loose, black, loamy-like duff about six inches deep composed of leaves, twigs and a profusion of intertwined roots in various degrees of decay. Near the surface of this layer the frass of the 1942 and 1943 infestations showed as a preponderance of black, oblong, pellet-like objects about one millimeter in length. Immediately below the duff was a layer of sandy soil. The majority of cocoons were taken in the duff about three to five inches below the surface, though some were found just below the first inch of duff or almost on the surface of the sandy layer. It was difficult to find cocoons because of their very dark brown color which closely resembled that of the duff. In a few instances the population of both old and new cocoons was as high as 20 per square foot of soil. In the process of searching for cocoons many live adults (sexes about equal) were uncovered; they had just emerged and were working their way to the surface. At about 2:00 p. m. of April 20, numerous adults, mostly males, were observed swarming about the trunks and lower branches of the poplar trees particularly in areas where there was bright sunshine.

The leaf buds had not yet opened and no leaves could be observed--only two bud scales were found on the ground. It is very unlikely therefore, that egg-laying had commenced. The catkins on mature trees were only about one inch long. Because of the number of adults in flight it was predicted that a heavy defoliation might occur in 1944.

In May, 1944, a request was made of Assistant Ranger P. J. Westman to collect larvae of this sawfly when in the vicinity of Taft. Westman reported that he could find no sawfly larvae at "three or four places" on May 29. His collection received at Vernon contained no sawfly larvae.

G. R. Hopping examined the areas in the Eagle and Shuswap Valleys on June 23 and reported that defoliation was scarcely noticeable, indicating a great reduction in the population of the sawfly. At that time approximately 50 per cent of the cocoons collected on April 20 had produced parasites and it was concluded that such a parasitism would account for a substantial portion of the decrease in defoliation as compared with that of previous years.

The collection of 165 cocoons made on April 20, 1944, consisted of 92 apparently sound cocoons, 49 from which sawflies had emerged, 11 which had been opened by rodents, 6 from which large hymenopterous parasites had emerged, and 7 from which small hymenopterous parasites had emerged. On the morning of April 21, five adult sawflies (3 males and 2 females) had emerged from the collection which was kept overnight in a container of damp soil in the insectary at Vernon. The cocoons were placed in the overwintering chamber at the Trinity Valley Field Station on that day. In the afternoon of May 2, they were removed to the field station insectary and placed in vials without soil. Five female sawflies had emerged in the overwintering chamber--none were obtained thereafter. Parasites began to emerge on May 5 and continued to do so until June 19 as shown in the following table.

	May											June				
	5	12	15	16	18	25	26	27	28	29	30	31	1	5	9	19	Total
No. hymenopterous parasites emerged	1	1	6	2	2	2	1	(25	)	7	2	1	1	1	1	1	53

G. W. Walley of the Division of Systematics at Ottawa examined all the parasites and found five species of Ichneumonidae as follows:

Perilissus pleuralis (Cress.)	-- 1 female	
Smicroplectrus apicatus (Prov.)	- 1 "	, 1 male
Erromenus sp.	-- 1 "	
Diaborus mediatus (Cress)	-- 3 "	, 6 males
Endasys pubescens (Prov.)	-- 21 "	, 19 "

Unemerged cocoons were examined on Sept. 15 with the following results:-

18	cocoons	contained	live, sawfly larvae
1	"	"	dead, soft, sawfly larva
5	"	"	dead, dry, sawfly larvae
1	"	"	dead, moldy, sawfly larva
1	"	"	dead, dry, sawfly pupa
2	"	"	dead, dry, hymenopterous pupae
1	"	"	dead, dry, hymenopterous larva
29			

From the above data it can be calculated that 60.9% of the 92 apparently sound cocoons contained parasites. It should not be concluded, however, that this percentage of cocoons in the field was parasitized for on the day of collection many adult sawflies had already emerged and were in flight. Therefore at least some of the 49 cocoons designated as empty and from which it is believed adult sawflies emerged, undoubtedly belong to the 1943-44 generation. Probably not more than 50 per cent of the cocoons of this generation were parasitized. This figure is considerably higher than the 37 per cent parasitism calculated for the same generation from the collection of 27 larvae and cocoons made on June 10, 1943.

Life History and Habits.

Adults of N. nigriventris recovered from the collections made on June 10, 1943 and April 20, 1944 were used to investigate the biology of this insect. These studies were conducted in the insectary at the Trinity Valley field station; the small number of adult sawflies prevented the carrying out of field experiments. Eggs were obtained by allowing females to oviposit on leaves of cottonwood branches kept in vials of water in large cages. The branches were then removed from the cages and the eggs and larvae allowed to develop under normal insectary air conditions. The young larvae are difficult to rear under artifical conditions as they often become drowned in the sticky substance of the foliage which is particularly heavy on the young leaves.

There is only one generation a year. Although adult emergence, and egg and larval stages are completed in little over one month, there is no evidence that two generations a year occur in British Columbia. Adults emerge in early spring before cottonwood leaves are out of the buds. Mating was never observed and consequently the preoviposition

period is not known. Females can reproduce parthenogenetically. Eggs are laid on the uncurling leaves just as soon as a sufficient surface is available In 1944, egg-laying occurred about the last week of April. The eggs hatch within 13 to 15 days. Larval feeding is completed by the end of May or the first week of June when the larvae enter the duff and form cocoons. The summer and following winter is passed in the cocoon. Normally the life cycle is completed the following spring but there is evidence at hand which indicates that a small proportion of the prepupae in cocoons remains in diapause through a second winter.

Adult Stage

How long the adults live is not definitely known. In rearing experiments they remained alive for seven to ten days without food. The males died several days before the females. In a dry laboratory room they lived one or two days. Observations made in the field and in experiments revealed that the adult feeds on exudations from the tree. While watching the swarming adults on April 20, 1944 it was noticed that now and then individuals would alight on branches, and some appeared to feed on the oily exudations of the new buds. In laboratory investigations it was found that beside the buds they frequently visited the catkins in which they also appeared to feed. They will survive for one week on a diet of tap water.

Oviposition

The female commences to lay eggs when the leaves are one or two inches out of the bud. Very few eggs were recovered from one-inch leaves which were only just beginning to uncurl. Better results were obtained on one and a half-inch leaves which were partially uncurled. In these investigations not more than seven eggs were laid on any one leaf and that number occurred only once. About 34 per cent of the leaves deposited in contained only one egg, 22 per cent contained two eggs, 19 per cent contained three eggs, and 16 per cent contained four eggs.

The eggs are deposited in the undersurfaces of the leaves completely beneath the under epidermis. They are laid indiscriminately over the leaf surface except that none at all are deposited close to the tip or near the base of the leaf. About 80 per cent of all eggs were laid with the opening of the egg slip pointing towards the tip of the leaf, the other 20 per cent with it pointing towards the base. In only two instances were eggs deposited immediately over lateral or main veins. In egg-laying the light, yellowish-white ovipositor is

extruded for three to four millimeters. The ovipositor is curved forward and laterally so that the opening of the egg slit sawn in the leaf points laterally and in the opposite direction of the adult. The whole operation of egg-laying is completed in about one minute. The maximum number of eggs laid by a fertilized female was 33. Unfertilized females produced an average of 19.

Egg Stage

The mouth of the egg slit is a curved, concave opening, 0.60 mm. long and 0.04 mm. wide. Generally it is constant in shape and regular in outline. The leaf area covering the egg and composing the egg slit does not appear to be injured physiologically except for a small region behind and adjoining the slit opening. This area of the lower epidermis is a little darker in color than the rest of the leaf surface and is definitely raised above the mesophyll. When first laid the position of the egg shows on the lower leaf surface only as a slight bump which is hardly noticeable. As development of the egg progresses the leaf is distorted in its horizontal plane by the formation of a pit in which the egg is situated. On the upper leaf surface these pits, represented by pimple-like swellings, become very conspicuous in eight or nine days.

As the egg is slightly translucent the development of some organs can be easily observed microscopically. Five or six days after being laid a noticeable swelling of the egg is apparent. The first structure which can be seen with a microscope is the eye-spot which shows in six or seven days as a small, round, light brown area at the anterior end of the egg. Also at this time, the original color of the egg has faded and is only evident in a localized area of the posterior dorsal portion. In a nine-day old egg the eye spot is a dark brown in color and the outline of the larva can be seen through the transparent chorion. The mandibles and thoracic claws become evident in eleven or twelve days; both structure are a light brown. A grey stippling at this time outlines the shape of the head and the ventre of the thorax.

Larval Stage

At the field station eggs laid on May 3, 1944 , began to hatch 13 days later on May 16 and continued until May 18. At Vernon, in a laboratory room of approximately 70°F. and 10 to 20% relative humidity, eggs hatched in less than six days. Upon emerging from the egg the yound larva generally crawls away from the hatching site for one or two centimeters and begins to feed on the under epidermis where it eats a round hole 0.5 mm. in diameter through to at least the upper epidermis

or cuticle. This feeding lasts for about three hours. Sometimes these initial feeding holes are enlarged but usually the young larva migrates up the stem to new environs where fresh holes are completed. Circular holes are eaten through any part of the mid-section of the leaf. These are enlarged and the lateral veins may be eaten before the first molt occurs. The larvae hang on to the edges of these holes in feeding and particularly in the early instars the molted skins may be found attached to the leaf at this edge. After each molt the larvae migrate upwards to recommence their feeding on other leaves Feeding after the first molt is initiated on each leaf at the edge and may progress to and include the main vein. This type of feeding continues until larval development is completed. In two to three weeks the larva is full grown and enters the duff to form a cocoon.

Cocoon Stage

The majority of cocoons are formed in the duff three to five inches below the surface. The sawfly remains in this stage for approximately ten to eleven months, that is, from about the first or second week of June to the third or fourth week of April the following year. Some specimens, however, do not emerge in the spring but extend their hibernation for a period which is at present not definitely known. Evidence of a larval diapause was obtained from the cocoons collected on April 20, 1944 near Taft, B.C. Parasite emergence from this collection ceased on June 19. On September 15, the remaining 29 cocoons which had not produced adult material were examined. Eighteen of these contained live sawfly larvae or approximately 19.6 per cent of the 92 apparently sound cocoons collected.

Morphological Features.

Egg.

In situ the eggs appear green but this color is mainly due to the transmission of green light from the leaf. When the lower epidermis is removed the egg isyellowish-green in color. If the egg is removed from the egg slit, its natural color is seen to be a light orange-yellow. The egg is smooth and shiny, and somewhat translucent. In size it measures from 1.04 to 1.16 mm. long and from 0.40 to 0.44 mm. wide. An average egg is about 1.12 mm. long and 0.43 mm. wide, and consequently long and narrow in shape, and widest towards the posterior end. They are distinctly flattened on the sides adjoining the epidermis and mesophyll. The dorsal surface is convex in shape and the ventral surface slightly concave or almost straight. Both ends are rounded but the anterior end is more pointed. When almost mature the eggs are ellipsoidal and are about 1.44 mm.long and 0.76 mm. wide.

Larva

As only a few larvae were available, it was impossible to determine accurately the number of instars. It is believed, however, that there are five feeding instars having the following theoretical head widths: 0.50, 0.64, 0.83, 1.08, and 1.40 mm. respectively. Larvae removed from cocoons one week after they had entered the duff had the same head measurements as those of the last feeding instar.

First Instars: Width of head 0.49 to 0.53 mm. Body 2.19 to 2.83 mm. in length and 0.45 to 0.50 mm. in width, slightly tapered posteriorly from thorax; light yellowish-white in color on hatching, but becoming light green when food is ingested; without stripes. Thoracic pleura tinged with grey. Thoracic legs light brown. Head light brown, smooth, shining. Setae short, fine, light brown. Mouth parts light brown. Eyes black, 0.75 mm. in diameter.

Fourth Instar: Width of head 1.038 mm. Body 7.0 mm. in length, light green in color, marked only by a subspiracular greyish-green line. Thoracic legs green; claws brown. Head light greenish-brown, smooth, shining; coronal suture dark brown; dark brown lateral line between eye and coronal suture. Head and body clothed with short, fine greenish-white setae.

Fifth Instar: Width of head 1. 27 mm. Body 12 mm. in length and 1.6 mm. in width, slightly tapered posteriorly from thorax; bright leaf-green in color, shining; subspiracular line greyish-green, more prominent than in the fourth instar. Narrow whitish-green spiracular line formed by spiracles and tracheae. Fine middorsal line dark green. Thoracic legs light green, somewhat translucent; claws brown. Head light brownish-green. Eyes black, 0.142 mm. in diameter. Mandibles dark brown. Head markings as in fourth instar but not so prominent.

Frass dark greenish-black, about 0.9 mm. long and 0.5 mm. wide.

Cocoon

The cocoons are dark brown, tough, papery-like cells, rough on the outside but smooth and shiny on the inside. They vary in size from nine to five millimeters long and from four to two millimeters wide. Eighty-nine cocoons were measured with the following results:

No. of cocoons	Length in mm.	Width in mm.
15	5-5.5	2-2.5
25	6-6.5	2.5-3
19	7-7.5	3-3.5
30	8-9	3.5-4

Adult

The adult has been described by Curran in the above-mentioned reference.

Both sexes are shining black, with yellowish-white or white parts on the head, thorax and abdomen. The males are rather darker.

Notes on the Spruce Needle Miner (Taniva albolineana Kft.) (Lepidoptera, Olethreutidae)

- Morgan -

Introduction

In the past several years a number of complaints from residents of the city of Vernon have been received at this laboratory concerning the webbing spruce needle miner, Taniva albolineana Kft. on a variety of blue spruce, Picea parryana (Andre) Parry grown by the residents as an ornamental tree.

The first report at hand (Forest Insect Survey, B.C. Record No. 3739) was made by H. B. Leech on May 28,1943; the report consisted of a collection of 72 cocoons from one small tree at 117 S. Mara Ave. Leech noted that adults were in flight on that date. The moths were reared at the Trinity Valley field station as follows: May 29- 1 male, June 5 - 6 males, 11 females and June 7 - 2 females. Forty-nine pupae died; three others were pickled. No parasites were recovered from this collection.

On April 25, 1944, G. R. Hopping and C. V. G. Morgan at the request of a resident at 157 N. Mara Ave. examined two blue spruce trees 6-8' high which were heavily infested with this needle miner. A cursory examination about the same time showed that all blue spruce trees in the city were harboring the insect. Forty-nine per cent of a sample of 100 larvae taken from trees at the above residence on the same date and examined on April 26 contained living hymnopterous larvae. Hopping and Leech observed moths in flight around other blue spruce trees in Vernon on May 26. Later, on May 30, Hopping saw both moths and parasites in flight around the same trees. These trees were examined again by Hopping and Morgan on May 31 just after a shower of rain. The moths and parasites were resting on the foliage and large numbers of both were easily put to flight by disturbing the branches.

Type of Damage

Trees attacked by T. albolineana at Vernon show no conspicuous damage from a distance. At a close view however, the interior of a heavily infested tree shows numerous dirty, brownish webs composed of frass and dead and dying needles which have been webbed together by the larvae. The webbed mats are particularly conspicuous at the base of twigs and around whorls on branches or on the trunk. As a result

the inside of a tree appears heavily laden with dead needles. In the early spring these mats can be easily removed by the handful which affords an easy method of control on small trees. If this is done in the spring, practically all larvae or pupae can be taken off in these mats.

Each web consists of a number of larvae which confine their feeding to one or more year-old needles. Consequently the current year's growth is not touched and the surface of the tree looks green and healthy. Undoubtedly feeding on the older needles reduces the vigour of the tree. Also, it has been observed that the webs are a very suitable habitat for the development of mites which at times become exceedingly numerous.

Biological Investigations

At Vernon there appears to be only one generation a year. The moths emerge in the latter half of May and the first two weeks of June, and lay their eggs on old needles. The green larvae feed as needle miners throughout the summer and overwinter in this stage. A small amount of feeding occurs the following spring whereupon they leave the needles and pupate in cocoons made in the frass etc. of the web. Cocoons are first formed about the beginning of May and the first pupae are evident about a week later.

Egg.

In 1943, eggs were obtained at the Trinity Valley field station from moths caged on branches of spruce (*Picea engelmanni* Engelm.) containing both old and new foliage. In all cases however, the eggs were laid on the old needles. They are deposited in a scale-like manner generally on the undersurface of the needle, and usually in single rows containing up to a dozen or more eggs. Sometimes they are laid in small masses covering two surfaces of a needle.

The eggs are uniform in shape and size and measure about 0.80 mm. long, 0.48 to 0.60 mm. wide, and 0.32 to 0.36 mm. thick. The surface is smooth and shiny and apparently is without follicular impressions. It is lightly marked however, with a few longitudinal ridges which may or may not be parallel with each other. The number of these

ridges is not constant. Each egg overlaps anteriorly the one following it towards the tip of the needle, by 0.16 to 0.24 mm. The eggs are soft and fragile and mostly opaque but dentrally there is a somewhat translucent area in the midsection. When first laid they are a light yellowish-green, that is, lighter than the old needles to which they are glued. As development progresses the color changes to a dark orange in about 15 days and then to a brick red in 18 days or so.

Eggs laid at the field station on June 7 began to hatch around the first of July in 1943.

Larva.

Spring feeding begins in the latter part of April. When an examination of infested trees was made on April 25, 1944, the first greenish-brown frass was then evident at the outer edges of the webs. Less than five per cent of all larvae were in the needles; most were on the twigs at the base of the needles amongst the frass and the webbing.

Measurements of larvae made on the same date showed that the width of the head capsule varied between 0.62 and 0.70 mm. and averaged 0.663 mm. They varied in length from 7.5 to 9.5 mm. and averaged 8.42 mm. The width of larvae ranged from 1.20 to 1.60 mm. and averaged 1.48 mm.

Collections

Collections of webs were made on April 25, May 1, 8, 22 and 29. No data were taken on the contents of the webs collected on April 25 but the larvae were placed on branches of blue spruce in a cage in the Vernon Laboratory from which emergence was recorded. In this environment the temperature averaged about 70°F. and the relative humidity probably varied between 10 and 40 per cent. The other four collections were taken to the field station. Those made on May 1, 8 and 22 were examined in detail on May 4, 9, and 22 respectively. The results of these examinations are shown in Table I. The larvae, pupae and parasites were placed in separate jars in the insectary for emergence. Larvae were placed on branches of Engelmann spruce in the jars. The collection of May 29 was not examined or disturbed but the webs were placed in a cage in the insectary. The emergences from the five

collections are shown in Table II.

The parasites obtained before June 30 were determined by G. S. Walley as Ascogaster sp. near carpocapsae (Vier.). These recovered on July 10 were determined by O. Peck as Dibrachys cavus Walk.: twenty-six of these chalcids emerged from seven Ascogaster cocoons.

TABLE I

Examination of Collections

Collected	May 1		May 8		May 22	
Examined	May 4		May 9		May 22	
Detail	No.	%	No.	%	No.	%
Live larvae partially in needles	8	12.12				
Live larvae out of needles amongst frass etc.	45	68.18	8	6.90		
Dead larvae amongst frass etc.	3	4.55	2	1.72		
Cocoons containing live larvae	10	15.15	22	18.97	2	1.92
Cocoons containing live pupae			6	5.17	4	3.85
Host cocoons containing live parasite larvae external on host larvae			8	6.90		
Host cocoons containing parasite cocoons			70	60.34	98	94.23
T o t a l	66	100.00	116	100.00	104	100.00

TABLE II -- EMERGENCE FROM COLLECTIONS - 1944

Date	April 25			May 1			May 8			May 22			May 29.		
	Moths ♂	Moths ♀	Para-sites	Moths ♂	Moths ♀	Para-sites	Moths ♂	Moths ♀	Para-sites	Moths ♂	Moths ♀	Para-sites	Moths ♂	Moths ♀	Para-sites
May 11	7		2												
12	3		9												
13	5		17												
15	2	1	18												
18	2	3	1												
20		1													
June 1															
2													2		
3															
4															
5										1			1		4
6													1		4
7				1											2
8											1				8
9											1				7
10	Not examined														
11	Note examined														
12				4		2		3			6	3	1		17
13				2				3			7		1		2
14															
15				1				6			22				5
16				6				9			11				1
17	Not examined														
18	Not examined														
19				4	1	1		1	30		15				1
20					3	3	1		8		5				
21					2	1			5		2				
22					1	1									
23					1	3			8						
24	Not examined														
25	Not examined														
26							1		2						1
27					1	1									
28															
29				1											
30															
July 10											*7				
Total	19	5	47	17	11	10	3	2	74	1	0	77	7	2	52

* 26 chalcids emerged from 7 Ascogaster cocoons

E. 30.07-3 -- Spruce Budworm (Cacoecia fumiferana Clem.)

(Mathers)

During 1944 the most important phase of the work on spruce budworm in British Columbia was the joint project with the Dominion Parasite Laboratory for the collection of parasite material in the Lillooet district. A number of special recovery collections, several of which were included in the Forest Insect Survey, were also made during the season for more detailed data on parasitism and, in addition, examinations were made of the more important outbreaks.

As shown in the following table there was a large increase in both the number of collections and number of specimens of spruce budworm received in 1944 in the Forest Insect Survey.

Table I -- Spruce Budworm Collections

- Forest Insect Survey -

Year	Number of Collections				Number of Specimens			
	Sp.-Balsam	D. fir.	Misc.	Totals	Sp. Balsam	D. fir.	Misc.	Totals
1940	-	-	-	29	-	-	-	501
1941	14	4	5	23	39	7	7	53
1942	33	5	8	46	213	6	12	231
1943	6	8	1	15	6	136	2	144
1944	41	19	1	69 (*)	2125	109	172	2928.

* incl. 8 special collections containing 2406 specimens.

A more detailed summary of the spruce budworm returns for 1944 follows:

Table II - Spruce Budworm Collections

- Forest Insect Survey -

Host	No. of collections	Number of specimens Larvae	Sound pupae	Empty pupae	Adults	Totals
Abies lasiocarpa	12(1)	306	44	-	-	350
Picea spp.	22(2)	145	100	2	8	255
Picea & Abies	7(3)	587	1244	3	-	1834
P. taxifolia	19(4)	172	111	7	9	299
Tsuga heterophylla	3	3	-	-	-	3
Pseudotsuga & Abies	1(5)	172	-	-	-	172
Pinus contorta	4	3	3	-	2	8
Pinus monticola	1	1	-	-	-	1
No host recorded	-	-	-	-	6	6
T o t a l s	69	1389	1502	12	25	2928

(1) incl. 3 special collections containing 262 larvae
(2) " 1 " " " 88 "
(3) " 2 " " " 548 " & 1227 pupae
(4) " 1 " " " 109 "
(5) special collection

Of the 8 special collections in the Survey this year, one, containing 525 larvae and 120 pupae was made on July 18 by G. R. Hopping and H. B. Leech from spruce and balsam at Bolean Lake and another, consisting of 23 larvae and 1107 pupae, was made on July 25 by the same officers from spruce and balsam on the Monashee summit. The other 6

special collections, totalling 631 larvae, had been made on June 7 by G. R. Hopping from spruce, balsam and Douglas fir in the vicinity of Skaist Creek near the summit of the Hope-Princeton road.

The rest of the Douglas fir material received in the Survey was from Bella Coola Valley, Pemberton district, Kelly Lake area, Lac La Hache, Barriere district, Kamloops, Adams River, Lumby and Fauquier, B. C. The balance of the material from spruce and balsam was from Penny, Dome Creek and Goat River on the upper Fraser River, Southbank on Francois Lake, Clearwater River and Barriere in the North Thompson Valley, Kelly Lake, Chase, Bolean Lake, Sugar Lake, Monashee Summit, Penticton, Gold Creek and Mt. Revelstoke, Jasper, Yoho, Banff and Kootenay National Parks. Of the three collections of single specimens from hemlock, two were from the Chilliwack area and one from Terrace. The lone specimen from white pine was from the Sugar Lake area and undoubtedly a stray, while the specimens from lodgepole pine were from spruce-balsam infested areas in Jasper, Yoho and Banff National Parks and a single dead specimen of doubtful determination from Morrissey, B. C.

The spruce budworm was the most serious defoliator this year in the territory under the jurisdiction of the Vernon Laboratory. The most extensive infestations occur in spruce-balsam stands at the higher elevations which are usually two-year life cycle areas. This being the moth flight year, defoliation was heavier than in 1943 on such areas. The Vermilion Summit and Marble Canyon infestation in Kootenay National Park is much larger than in 1943, extending southward to Wardle Creek, but the intensity was about the same as in 1942. The outbreak on Mt. St. Pèran above Lake Louise, in Banff National Park, is not so severe as in 1942. New infestations occur in spruce-balsam stands on the Monashee summit between Vernon and Edgewood, B. C. and on the plateau (5,000 ft.) on the Bolean-Arthur Lakes area near Falkland, B. C. Heavy infestations were reported on spruce and balsam at the 4,000 foot level on the main Tonequo range about six miles north of Sinclair Mills, B. C., and at Sock Lake on lower Clearwater River, B. C. What are presumed to be spruce budworm oubtreaks were also reported on spruce and balsam between Grave and Colin Creeks, tributaries to White River in the east Kootenay district and in the upper Similkameen Valley, 50 miles southwest of Princeton, B. C. This latter outbreak is probably an extension of the infestation reported in 1943 on the headwaters of the Skagit River west of Allison Pass and which this year appeared to have increased in intensity. The Skagit infestation occurs in spruce, balsam and Douglas fir and in June extended in the Cedar Creek Valley from a point about 5 miles west of Allison Pass westward to the slopes bordering Skaist Creek.

A noticeable reduction in the intensity of the infestation on Douglas fir in the Pemberton district was evident this year. Light to medium feeding occurred throughout the 1943 areas but heavy patches of defoliation were noticed only on the slope above Owl Creek and Poole Creek on the west side of Birkenhead Valley and on both sides of Gates Valley about midway between Birken and D'Arcy. The intensity of the infestations on Mission Ridge and Mt. McLean has increased. The spruce and balsam above the limits of Douglas fir on Mt. McLean showed no defoliation. The infestation on the Botanie Lake area continues to be light to moderate. In the immediate vicinity of the lake the north slopes are covered with spruce and balsam and in 1943 what were presumed to be two-year life cycle larvae were obtained from these stands. This year very few budworm were found on the spruce and balsam but were fairly numerous on Douglas fir growing in more open stands with southern exposure. A heavy infestation on young Douglas fir coming in on an old burn was also reported at the head of Adams Lake, B. C.

An extraordinary flight of spruce budworm moths occurred at Vernon, B. C. on the night of August 16. The moths were attracted to the light of a street carnival and were so numerous at 11 p.m. that it became necessary to close up some of the games. The source of the moths is not known. The lateness of the season indicates that they must have originated at a very high altitude. The nearest known infestations are at Belean Lake, 20 air-line miles northwest of Vernon and on Monashee Summit 35 air-line miles east of Vernon. What was evidently a similar flight occurred at Nakusp, B. C. The forest ranger submitted specimens under date of August 12 with the comment that 'thousands and thousands found on street after rain storm'. In 1940, a similar flight of spruce budworm moths was reported to have occurred at Kamloops, B. C. on the evening of August 5.

Mass Collecting of Spruce Budworm Parasites in the Lillooet District

As a result of the scouting trip made in 1943 by Dr. A. Wilkes of the Dominion Parasite Laboratory at Belleville, Ont. and W. G. Mathers of the Dominion Forest Insect Laboratory, Vernon, B. C., for parasites of the spruce budworm, three species, the Ichneumonid, Phytodietus fumiferanae and the Tachinids, Cerocerasia auricaudata and Phorocera incrassata, which have not been recorded from eastern Canada, were found in the Lillooet district. Because of these recoveries and the relative abundance of the parasites, a program for the mass

collecting of parasites in 1944 in the Lillooet district was drawn up by the Dominion Parasite Laboratory. The project was to be carried out in cooperation with the Vernon Forest Insect Laboratory.

A review of the labour situation indicated that the only help that might be available for collecting would be boys of school age and possibly members of the Japanese self-supporting communities which had been established in the Lillooet district as a war measure. Initial contacts with the British Columbia Forest Service and the British Columbia Security Commission were made by the Parasite Laboratory following which preliminary arrangements were completed by Mr. Mathers of the Vernon Laboratory. This work entailed a conference with District Officers of the B. C. Forest Service at Kamloops on April 12 and a trip to the Lillooet district in the latter part of April. On this trip, through the Security Commission's supervisor at Shalalth, B. C. a conference was held with the head of the Japanese colony at Bridge River Station in connection with the employment of members of the colony. Moreover, the hotel at Lillooet was approached on the matter of providing accommodation for out-of-town school boys who would be employed, visits were made to schools at Lillooet, Lytton and Ashcroft and plans made with the Asst. District Forester at Kamloops for the canvassing of high-school students in Kamloops and other centres. An application form was then drawn up at Vernon and distributed to the different schools. A further discussion of details took place in Vernon on May 18 with the Asst. District Forester and G. R. Hopping, in charge of the Vernon Forest Insect Laboratory.

Dr. A. Wilkes and Mr. H. Coppel of the Dominion Parasite Laboratory arrived in Vernon on June 13 and, after completing final plans, proceeded on June 15 with Mr. Mathers to Lillooet. En route to Lillooet arrangements were made for the transportation of the out-of-town school boys. On arrival at Lillooet, spruce budworm development was found to be so far advanced, particularly at the lower elevations, that collecting crews were immediately organized and actual collecting began on June 19. By the end of the first week all crews were up to full strength.

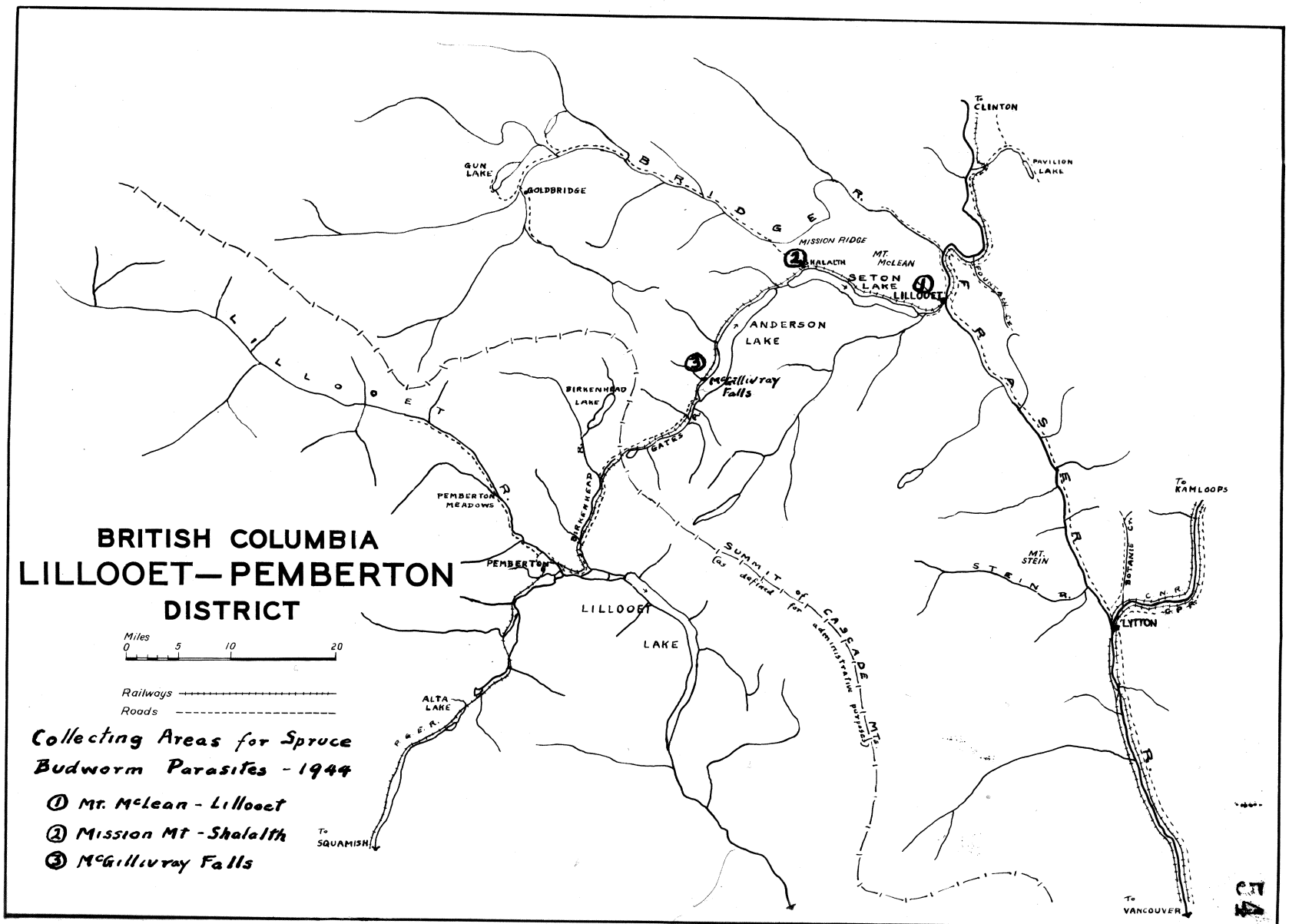
The collecting period extended from June 19 to July 18 and the organization was as follows: At Lillooet an average of 30 school boys, 18 of whom were brought in from Vernon, Salmon Arm, Kamloops and Ashcroft, collected on Mt. McLean or assisted with the rearing work. In addition, 6 local boys were employed for an extra week to assist in the finishing up of the work at the field laboratory. Fortunately, the principal of the local school and two high-school teachers from Vernon were available for the role of 'foremen', each being put in direct charge of a group of boys. Thirty-two Japanese, including

boys and girls, men and women, from the community at Bridge River Station, near Shalalth, collected on Mission Ridge above the settlement and 8 Japanese from a similar but smaller colony at McGillivray Falls collected on the mountain back of that settlement. The location of these areas is shown on the accompanying map.

The slopes of the mountains were ideal collecting areas for our purpose for as the elevation increased budworm pupation was progressively later. Collecting began at an elevation of from 1,500 to 2,000 feet and, as the season advanced gradually extended up the slopes until, by the end of the collecting period, the crews were working at close to 4,000 feet elevation. As an excellent road crosses over Mission Ridge from Shalalth, daily transportation to and from the collecting area was provided the workers from the Bridge River community. During the latter part of the season the collectors at Lillooet, were also given transportation each morning as far as the road was passable, a distance of about 2 miles. There being no road at McGillivray Falls the workers there had to travel on foot to and from the collecting area and towards the end of the collecting period nearly one hour was required to reach the area.

A temporary field laboratory was established near Lillooet and all material collected was handled at the laboratory. Each collector was provided with three containers, one for budworm larvae bearing Phytodictum, one for all other budworm larvae and the third for budworm pupae. The three containers were tied together or held in a canvas bag and carried in front of the collector. The collections from Mission Ridge were consolidated into the three classes at the end of each day and shipped daily by train to Lillooet. From McGillivray Fall, however, the material could only be shipped three times a week.

All budworm larvae were reared at Lillooet until feeding was completed; those parasitized by Phytodictus being placed individually in shell vials and the balance handled in wooden trays. The trays were 3 feet square and 4 inches deep with cloth bottoms held in position by paste and with removable cloth tops. Approximately 6,000 larvae were placed in each tray together with fresh Douglas fir foliage. The trays were examined at least every second day, when the foliage was changed and all dipterous puparia removed. As budworm pupae and dipterous puparia were recovered, either directly from the field or from the trays, they were held in a refrigerator for shipment in iced containers to the Parasite Laboratory at Belleville, Ont. The refrigeration available, however, proved inadequate in that


BRITISH COLUMBIA
LILLOOET—PEMBERTON
DISTRICT
Miles
0 5 10 20
Railways
Roads
Collecting Areas for Spruce Budworm Parasites - 1944
① Mt. McLean - Lillooet
② Mission Mt - Shalalth
③ McGillivray Falls
To CLINTON
PAVILION LAKE
GUN LAKE
GOLDBRIDGE
B R I D G E R.
MISSION RIDGE
MT. McLEAN
SHALALTH
SETON LAKE
LILLOOET
FOUNTAIN
ANDERSON LAKE
McGillivray Falls
BIRKENHEAD LAKE
L I L L O O E T
GATES
PEMBERTON MEADOWS
PEMBERTON
BIRKENHEAD R.
SUMMIT of CASCADE (as defined for administration purposes)
LILLOOET LAKE
ALTA LAKE
P.G.E.R.
To SQUAMISH
To KAMLOOPS
MT. STEIN
STEIN R.
BOTANIE
C.N.R.
C.P.R.
LYTTON
To VANCOUVER
W.G.M.

dipterous maggots present in the pupae caused a considerable amount of breakdown. In order to avoid the loss of the parasites it was advisable to remove the material from storage, take off the first flush of emergence and separate the newly formed puparia before shipping.

Although a definite record was not kept of the number of spruce budworm larvae and pupae, it was estimated that close to 380,000 larvae and 180,000 pupae were collected. From this material 7,500 Phytodietus cocoons and over 50,000 dipterous puparia were recovered. From samples made at Belleville, the puparia are expected to yield approximately 10,000 Cercetrasia auricaudata and 2,000 Phorocera incrassata for release in eastern Canada next spring.

The cooperation of the British Columbia Forest Service and the British Columbia Security Commission in this project was greatly appreciated. We are particularly indebted to the District Forestry Office at Kamloops for its assistance in lining up out-of-town school boys and for the loan of a truck for one week at the beginning of the work for transporting the boys to Lillooet and organizing the work there, and again at the end of the season for returning the boys to their homes.

Parasites

Data on parasites of the spruce budworm were obtained this year from: - (1) special recovery collections made in cooperation with the Dominion Parasite Laboratory, (2) special collections made by members of the Vernon Laboratory staff in connection with the Forest Insect Survey, and (3) regular Forest Insect Survey collections.

(1) Special Recovery Collections

The following special recovery collection were made in co-operation with the Dominion Parasite Laboratory and were designated according to the system of experiment numbering used by the Parasite Laboratory:

a) collections made on July 5 by Dr. A. Wilkes and W. G. Mathers from Douglas fir at an elevation of 2,500 to 3,000 feet on Mt. McLean, Lillooet, B. C. (Exp. No. 18086C44-239 a & b).

B) collections made on July 7 by Dr. A. Wilkes and W. G. Mathers from Douglas fir about 6½ miles from Lytton, B. C. on the Botanie Creek road; elevation about 1500 feet (Exp. No. 18086C44-504 a & b).

c) collections made on July 7 by Dr. A. Wilkes and W. G. Mathers, mainly from open growing Douglas fir but a few from spruce and balsam at Botanie Lake, 12 miles from Lytton, B.C.; elevation 2500 feet (Exp. No. 18086C44-504 c & d)

d) collections made on July 11 by Dr.A. Wilkes and H. Coppel from Douglas fir at an elevation of 3500 to 4000 feet on the south side of Mission Ridge, above Shalalth, B. C. (Exp. No. 18086C44-503 a & b.)

e) collections made on August 5 by G. R. Hopping, W. G. Mathers and H. Coppel from Engelmann spruce and alpine fir at Bolean Lake, B. C.; elevation about 4900 feet (Exp. No. 18086C44-152 a & b).

All the specimens in these collections were placed individually in shell vials. The material from the first four sets of collections was handled at Lillooet until the end of July when it was transferred to the insectary at Vernon. The rearing of the Bolean Lake material was done entirely at Vernon. Records were kept on rearing cards of all emergences and all parasite adults were pinned and labelled and , after tentative identifications had been made of the Hymenoptera, forwarded to Belleville for final determinations. In November all dead budworm pupae were dissected and the balance of the unemerged material over-wintered in the insectary. In January all the dipterous puparia were transferred to the incubator in the laboratory and early in February all puparia from which emergence had not taken place were sent to Belleville for identification. The balance of the overwintering material, except 20 Phytodietus cocoons from the Mt. McLean collection, was transferred in February to the incubator.

The results obtained from the collections are shown in Tables 3 to 8 incl. Several of the collections were too small to have much significance. This applies especially to the Botanie Creek road collections and to the larval collection from Bolean Lake and pupal collection from Botanie Lake.

TABLE III

Parasite Recoveries from Spruce Budworm Collections on Mt. McLean, Lillooet, B.C. -1944-

Date Collected	July 5 Larvae (239a)				July 5 Pupae (239b)		
Stage Collected	males	females	Totals	%	Males	females	Totals
No. Collected			376				536
No. host emerged	35	93	128	34.04	56	43	99
No. host larvae dead (not para.)			87)	29.79			
No. host pupae dead (not para.)			25)				242
Primary Parasites							
Hymenoptera							
Glypta fumiferanae	13	22	35)				
" " cocoons dead			21)	17.55			
" " para. by hyperparasites			10)				
Apechthis ontario	1		1	0.26	15	45	60
Itoplectis obesus						3	3
Phaeogenes hariolus	1		1	0.26	9	6	15
Apanteles fumiferanae		1	1)				
" sp.	1		1)				
" cocoons dead			2)	1.33			
" para. by hyperparasites			1)				
Phytodietus fumiferanae cocoons -unemerged			21)				
- dead			5)	7.71			
" para. by hyperparasites			3)				
Host pupae para. by Hymen. unemerged							
-dead							14
Total Hymenoptera			102	27.13			92
Diptera							
Phorocera incrassata					6	8	14
Phorocera erecta			1	0.26		(3)	5
Ceromasia auricaudata			1	0.26	(1)	(2)	5
Madremyia saundersii		1	1	0.26	1		1
Phryxe pecosensis	1	2	3	0.80	(3)		5
Zenillia caesar						1	1
Winthemia fumiferanae	(2)		14	3.72			3
Dipterous puparia-unemerged (dead)			5)				11)
Dipterous maggots dead			8)	3.72			34)
Host pupae para. by Diptera-unemerged, dead			1)				24)
Total Diptera			34	9.04			103
Total Primary Parasitism			136	36.17			195
Hyperparasites							
				Σ*	Σ*		
Itoplectis obesus ex Glypta cocoons	5	2	7	10.61)			
Scambus sp. " " "		3	3	4.54)	15.15		
Gelis prob. tenellus ex. Phytodietus cocoons	1		1	3.45)			
Amblymerus verditer " " "			1	3.45)	10.35		
Habrocytus phycidis " " "	1		1	3.45)			
Gelis sp. ex. Apanteles cocoon	1		1	20.00	20.00		

* Percentages of Primary parasites parasitized by hyperparasites.

TABLE IV

Parasite Recoveries from Spruce Budworm Collections on Botanie Creek Road, Lytton, B. C. - 1944

Date Collected	July 7,1944				July 7,1944			
Stage Collected	Larvae (504a)				Pupae (504b)			
	males	females	totals	%	males	females	totals	%
No. Collected			14				56	
No. host emerged		2	2	14.29	17	14	31	55.36
No. host larvae dead (not parasitized)			3	21.43				
No. host pupae dead (not parasitized)							9	16.07
Primary Parasites								
Hymenoptera								
Glypta fumiferanae		4	4)					
" " cocoons-dead			1)	42.85				
" para. by hyper-parasites			1)					
Apechthis ontario					1		1	1.79
Itoplectis obesus					2	4	6	10.71
Phytodietus fumiferanae	1	2	3	21.43				
Host pupae para. by Hymen. unemerged-dead							2	3.57
Total Hymenoptera			9	64.28			9	16.07
Diptera								
Phorocera incrassata					1		1	1.79
Phorocera erecta						1	1	1.79
Ceromasia auricaudata					(1)		4	7.13
Dipterous maggots-dead							1	1.79
Total Diptera			nil				7	12.50
Total Primary Parasitism			9	64.28			16	28.57
Hyperparasites								
Itoplectic obesus ex Glypta cocoon	1		1	16.67				

TABLE V

Parasite Recoveries from Spruce Budworm Collections at Botanie Lake, Lytton, B.C. - 1944

Date Collected	July 7, 1944				July 7, 1944			
Stage Collected	Larvae (504c)				Pupae (504d)			
	males	females	totals	%	males	females	totals	%
No. Collected			336				10	
No. host emerged	109	114	223	66.37	6	1	7	70.00
No. host larvae dead (not parasitized)			71)					
No. host pupae dead (not parasitized)			11)	24.40			3	30.00
Primary Parasites								
Hymenoptera								
Glypta fumiferanae	2	2	4)	1.48				
" cocoons dead			1)					
Phytodietus fumiferanae	2	8	10)	4.76				
" cocoons-unemerged			6)					
Angitia sp.	2	2	4	1.19				
Total Hymenoptera			25	7.43			nil	
Diptera								
Pherocera erecta	1		1	0.30				
Ceromasia auricaudata	2	1	3	0.90				
Phryxe pecosensis	1		1	0.30				
Dipterous puparia-unemerged-dead			1	0.30				
Total Diptera			6	1.80			nil	
Total Primary Parasitism			31	9.23			nil.	

TABLE VI

Parasite Recoveries from Spruce Budworm Collections on Mission Mt., Shalalth, B.C. 1944

Date Collected	July 11,1944 Larvae (503a)				July 11,1944 Pupae (503b)			
Stage Collected	males	females	Totals	%	males	females	Totals	%
No. Collected			692				129	
No. host emerged	54	61	115	16.62	15	5	20	15.50
No. host larvae dead (not parasitized)			169)	53.03				
No. host pupae dead (not parasitized)			198)				71	55.04
Primary Parasites								
Hymenoptera								
Glypta fumiferanae	10	29	39)	9.39				
" cocoons-dead			26)					
Apechthis ontario		1	1	0.14	8	4	12	9.30
P. hariolus	1		1	0.14				
Apanteles sp.	1	2	3 (1))	0.43				
" cocoons-dead			3 (2))					
Phytodietus fumiferanae	2	4	6)	2.17				
" cocoons-dead			9)					
Host pupae para. by Hymen. unemerged, dead			1	0.14			1	0.77
Total Hymenoptera			86	12.42			13	10.07
Diptera								
Phorocera incrassata	3	3	6	0.87				
Ceromasia auricaudata	(22)	(19)	64	9.25	(3)	(4)	13	10.08
Madremyia saundersii							2	1.55
Phryxe pecosensis	(1)		2	0.29				
Zenillia caesar		(2)	3	0.43				
Winthemia fumifemanae	(2)	(1)	40	5.78			2	1.55
Diptera lost (undet.)							1)	
Dipterous puparia-unemerged, dead			3)				2)	
Dipterous maggots-dead			2)	1.30			2)	6.20
Host pupae para. by Diptera-unemerged, dead			1)				3)	
Total Diptera			124	17.92			25	19.38
Total Primary Parasitism			210	30.34			38	29.45

TABLE VII

Parasite Recoveries from Spruce Budworm Collections at Bolean Lake, Vernon, B.C. - 1944

Date Collected	August 5 ,1944				August 5,1944			
Stage Collected	Larvae(152a)				Pupae (152b)			
	males	females	totals	%	males	females	Totals	%
No. Collected			29				204	
No.host emerged		1	1	3.45	13	15	28	13.73
No.host larvae dead (not parasitized)			11)	44.83				
No.host pupae dead (nott parasitized)			2)				102	50.00
Primary Parasites								
Hymenoptera								
Glypta fumiferanae	1	3	4)					
" cocoons(dead)			5)	48.27				
" para. by hyper-parasites			5)					
Apechthis ontario					10	28	38	18.63
Itoplectis obesus					1	12	13	6.37
Hymenoptera lost (undetermined)							2)	9.31
Host pupae para. by Hymen.-unemerged dead							17)	
Total Hymenoptera			14	48.27			70	34.31
Diptera								
Madremyia saundersii	1		1	3.45				
Host pupae para.by Diptera-unemerged-dead							4	1.96
Total Diptera			1.	3.45			4	1.96
Total Primary Parasitism			15	51.72			74	36.27
Hyperparasites								
Itoplectis obesus ex. Glypta cocoons	1	1	2	14.29)				
Scambus hispae " "		1	1	7.14)				
Scambus? sp. " "		1	1	7.14)	35.71			
Habrocytus phycidis" Glypta cocoons		1	1	7.14)				

TABLE VIII

Summary of Primary Parasite Recoveries from Special Recovery Collections in British Columbia - 1944

Locality	Mt. McLean			Mission Mt.			Botanie Cr. Road			Botanie Lake			Bolean Lake		
Stage Collected	Larvae	Pupae	Totals	Larvae	Pupae	Totals	Larvae	Pupae	Totals	Larvae	Pupae	Totals	Larvae	Pupae	Totals
No. Collected	376	536	912	692	129	821	14	56	70	336	10	346	29	204	233
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Hymenoptera															
Glypta fumiferanae	17.55	-	7.23	9.39	-	7.92	42.85	-	8.57	1.48	-	1.44	48.27	-	6.01
Apechthis ontario	0.26	11.19	6.69	0.14	9.30	1.58	-	1.79	1.43	-	-	-	-	18.63	16.31
Itoplectis obesus	-	0.56	0.33	-	-	-	-	10.71	8.57	-	-	-	-	6.37	5.58
Phaeogenes hariolus	0.26	2.80	1.75	0.14	-	0.12	-	-	-	-	-	-	-	-	-
Apanteles spp.	1.33	-	0.55	0.43	-	0.36	-	-	-	-	-	-	-	-	-
Phytodietus fumiferanae	7.71	-	3.18	2.17	-	1.83	21.43	-	4.29	4.76	-	4.62	-	-	-
Angitia sp.	-	-	-	-	-	-	-	-	-	1.19	-	1.15	-	-	-
Miscel. unemerged-dead	-	2.61	1.54	0.14	0.77	0.24	-	3.57	2.86	-	-	-	-	9.31	8.15
Diptera															
Phorocera incrassata	-	2.61	1.54	0.87	-	0.73	-	1.79	1.43	-	-	-	-	-	-
Phorocera erecta	0.26	0.93	0.66	-	-	-	-	1.79	1.43	0.30	-	0.29	-	-	-
Ceromasia auricaudata	0.26	0.93	0.66	9.25	10.08	9.38	-	7.13	5.71	0.90	-	0.87	-	-	-
Madremyia saundersii	0.26	0.18	0.22	-	1.55	0.24	-	-	-	-	-	-	3.45	-	0.43
Phryxe pecosensis	0.80	0.93	0.88	0.29	-	0.24	-	-	-	0.30	-	0.29	-	-	-
Zenillia caesar	-	0.18	0.11	0.43	-	0.37	-	-	-	-	-	-	-	-	-
Winthemia fumiferanae	3.72	0.56	1.86	5.78	1.55	5.12	-	-	-	-	-	-	-	-	-
Miscel. unemerged-dead	3.72	12.87	9.10	1.30	6.20	2.07	-	1.79	1.43	0.30	-	0.29	-	1.96	1.72
Total Hymenoptera	27.13	17.16	21.27	12.42	10.07	12.05	64.28	16.07	25.72	7.43	nil	7.22	48.27	34.31	36.05
Total Diptera	9.04	19.21	15.02	17.92	19.38	18.15	-	12.50	10.00	1.80	nil	1.73	3.45	1.96	2.14
Total Primary Parasitism	36.17	36.37	36.29	30.34	29.45	30.20	64.28	28.57	35.72	9.23	nil	8.95	51.72	36.27	38.19

(2) Special Forest Insect Survey Collections

Three special collections of spruce budworm were made in 1944 by officers of the Vernon Staff in connection with the Forest Insect Survey. One of the collections was made on June 7 by G.R. Hopping while examining the infestation at the head Skagit River. The collection was made up of a series of lots (B.C.44-57 to B. C. 44-62 incl.) gathered from Douglas fir, Engelmann spruce and alpine fir along Cedar and Skaist Creeks and at an elevation of about 3,000 feet. At the time of collecting the host buds were just opening. The larvae were in the second and third instars and the majority were mining the buds. The material was reared in glass jars at the Trinity Valley Field Station. As the differences in the parasitism of the material from the different hosts was not significant, the results obtained have been consolidated and are shown in Table IX.

The other special collections were made by G. R. Hopping and H. B. Leech at Bolean Lake on July 18 and on the Monashee Summit on July 25. The Bolean Lake collection (B.C.44-413) consisted of larvae and pupae and was from Engelmann spruce and alpine fir at an elevation of 4,900 feet and on the same area as the special recovery collection (18086-C-44-152). The Monashee collection (B. C. 44-423) was from the same two hosts at an elevation of about 4,800 feet and consisted almost entirely of pupae. The results obtained from the two collections are also given in Table IX. As the larvae and pupae from Bolean Lake were reared together, the parasitism of each stage was not obtained. However, since what few larvae present in the Monashee collection died within a few days, they are not included in the results.

For the purpose of comparison, the results obtained from the two collections made at Bolean Lake are given together in Table X.

TABLE IX

Parasite Recoveries from Special Forest Insect Survey Collections in British Columbia - 1944 -

Locality & Date Collected	Skagit River - June7-44				Bolean Lake - July 18-44				Monashee Summit - July 25-44			
Stage Collected & F.I.S.No.	Larvae(B.C.44-57--62 incl.)				Larvae &Pupae(B.C.44-413)				Pupae(B.C.-44-423)			
	males	females	totals	%	males	females	totals	%	males	females	totals	%
No. collected			631				652*				1115	
No. host emerged	113	123	236	37.40	179	255	434	66.56	159	104	263	23.59
No. host pupe dead			71)	51.82			60)	29.14			402	36.05
No. host larvae dead			256)				130)					
Primary Parasites												
Hymenoptera												
Glypta fumiferanae	14	22	36)	7.92	7	10	17)	3.06				
" cocoons-dead			14)				3)					
Apechthis ontario					1		1	0.15	10	91	101	9.06
Itoplectis obesus					1	1	2	0.31	2	30	32	2.87
Phaeogenes hariolus									48	94	142	12.73
Apanteles sp.			11)									
" cocoons-dead			6)	2.85								
" para. by hyperparasites			1)									
Undetermined Hymenoptera										1	1)	
Host pupae para. by Hymen. unemerged							1	0.15			48)	4.39
Total Hymenoptera			68	10.78			24	3.68			324	29.06
Diptera												
Undetermined Diptera							4	0.61				
Dipterous puparia-unemerged											1)	
Host pupae para.by Diptera-unemerged-dead											77)	11.30
											48)	
Total Diptera			nil				4	0.61			126	11.30
Total Primary Parasitism			68	10.78			28	4.89			450	40.36

* Incl. 532 larvae, 120 pupae

TABLE X

Parasite Recoveries from Special Collections made at Bolean Lake, B.C. -1944

Collection No.	B.C. 44-413	18086-C-44-152
Date Collected	July 18	August 5
Total Archips collected	652 (1)	233 (2)
	%	%
Archips emerged	66.56	12.45
" unemerged-dead	29.14	49.35
Primary Parasites		
Hymenoptera		
Glypta fumiferanae	3.06	6.01
Apechthis ontario	0.15	16.31
Itoplectis obesus	0.31	5.58
Misc. immature Hymen. -dead	0.15	8.15
Total Hymenoptera	3.68	36.05
Diptera		
Dipterous adults	0.61	0.43
Misc. immature Diptera-dead	-	1.72
Total Diptera	0.61	2.15
Total Primary Parasites	4.29	38.19

(1) incl. 532 larvae, 120 pupae
(2) incl. 29 larvae , 204 pupae.

The wide difference in the percentage of parasitism in the two collections id due almost entirely to the difference in the time of collecting. On August 5 budworm development was so far advanced that very few larvae were present and the majority of these were sickly. Moreover, moths were already emerging and no data on the proportion which had emerged were obtained, thus increasing the relative percentage of parasitism in the material collected.

(3) Regular Forest Insect Survey Collections

The parasite material recovered from the balance of the Forest Insect Survey collections received in 1944 is shown in Table XI and the localities and hosts from which all the species of spruce budworm parasites were recovered in 1944 are shown in Table XII.

TABLE XI

Spruce Budworm Parasitic Material obtained from Forest Insect Survey Collections (other than collections given in Tables IX and X) in 1944

F.I. Survey No.	Locality & host tree	Material Rec'd	Parasitic Material Recovered
B.C.44-37 V-28	Gordon Cr., Barriere Dist. B.C. Douglas fir	3 Archips larvae	1 Dipterous puparium (unemerged)
B.C.44-94 VI-15	Owl Cr., Pemberton Dist., B.C. Douglas fir	17 Archips larvae 38 " pupae 6 Glypta cocoons	1 Apechthis ontario 6 Glypta fumiferanae 1 Diptera (undetermined) 1 Dipterous puparium (dead)
B.C.44-141 VI-19	Fauquier, B.C. Douglas fir	2 Archips larvae 10 Hymen. larvae attached to Archips larval skin	1 Phytodietus fumiferanae, female 4 Hymenoptera (undetermined) 2 cocoons (dead)
B.C.44-233 VI-27	Owl Cr., Pemberton Dist., B.C. Douglas fir	4 Archips larvae 72 " pupae 6 Dipterous puparia 1 Hymen. cocoon	8 Apechthis ontario 5 Phaeogenes hariolus 10 Dipterous puparia (unemerged) 2 Diptera (undetermined) 1 Hymenoptera (undetermined)
B.C.44-255 VI-28	Vermilion Crossing, Kootenay National Park. Balsam	27 Archips pupae 2 Dipterous puparia 3 Hymen. cocoons	1 Phaeogenes hariolus 2 Diptera (undetermined) 2 Hymenoptera (undetermined)
B.C.44-286 VII-4	Monashee Summit Spruce and Balsam	6 Archips larvae 12 " pupae	1 Dipterous puparium (unemerged)
B.C.44-313 VII-7	12 mi.W. of Clinton, B.C. Douglas fir	24 Archips larvae 5 " pupae	1 Glypta fumiferanae 1 " cocoon (dead) 1 Diptera (undetermined)
B.C.44-322 VII-9	12 mi.W. of Kamloops, B.C. Douglas fir	1 Archips larva	1 Phytodietus fumiferanae, female
B.C.44-344 VII-11	East of Sardis, B.C. Western hemlock	1 Archips larva	1 Phytodietus fumiferanae, female
B.C.44-371 VII-17	Hawk Cr., Koot. Nat. Park Engelmann spruce	21 Archips larvae 54 " pupae	2 Itoplectis obesus 1 Phaeogenes hariolus
B.C.44-769	Birken, B.C. Douglas fir	5 Phytodietus cocoons 1 Apanteles cocoon 16 Hymen. cocoons in mass, budworm head capsule att.	1 Hymenoptera (undeter.) ex. Phyto. cocoon 12 Chalcids ex. 2 Phytodietus cocoons
B.C.44-770	Owl Cr., Pemberton Dist. Douglas fir	2 Phytodietus cocoons	1 Hymenoptera (undetermined)
B.C.44-423C	Monashee Summit Spruce & balsam	83 Glypta cocoons	16 Glypta fumiferanae 23 Hymenoptera (undetermined) 4 Chalcids

TABLE XII

Species of Parasites of the Spruce Budworm Recovered in British Columbia in 1 9 4 4

x - Douglas fir
O - Spruce & balsam
● - Western hemlock

	Mt. McLean, Lillooet, B.C.	Mission Mt., Shalalth, B.C.	Botanie Creek, Lytton, B. C.	Botanie Lake, Lytton, B. C.	Owl Creek, Pemberton, B.C.	Birken, B. C.	Kelly Lake, Clinton, B.C.	Lac La Jeune Rd., Kamloops, B.C.	Gordon Creek, Barriere, B.C.	Pauquier, B.C	Chilliwack district, B.C.	Skaist Creek, Skagit River, B.C.	Bolean Lake, (Vernon, B.C.)	Monashee Mt., (Vernon, B.C.)	Vermilion Crossing, Koot. Nat. Park.	Hawk Creek, Koot. Nat. Park
Ichneumonidae																
Phytodietus fumiferanae	x	x	x	x	x	x		x		x	●					
Glypta fumiferanae	x	x	x	x	x		x					x ●	O	O		
Apechthis ontario	x	x	x		x								O	O		
Itoplectis obesus	x		x										O	O		O
Phaeogenes hariolus	x	x			x									O	O	O
Angitia sp.				x												
Scambus hispae													●			
Scambus sp.	x												O			
Gelis spp.	x															
Braconidae																
Apanteles fumiferanae	x	x				x						x ●				
Apanteles sp.	x															
Chalcidae																
Amblymerus verditer	x															
Habrocytus phycidis	x												O			
Tachinidae																
Pherocera incrassata	x	x	x													
Pherocera erecta	x		x	x												
Ceromasia auricaudata	x	x	x	x												
Madremyia saundersii	x	x														
Phryxe pecosensis	x	x		x									O			
Zenillia caesar	x	x														
Winthemia fumiferanae	x	x														
Hymenoptera - undetermined					x	x				x		x ●	O	O	O	1
Diptera - undetermined					x		x		x				O	O	O	

Phytodietus fumiferanae: The recovery of this Ichneumonid was the primary object of the scouting trip made in 1943 and the mass collecting in 1944 in the Lillooet district. This species has not been recovered to date from spruce-balsam stands where the spruce budworm requires two years to complete its life cycle.

The incubation periods of Phytodietus cocoons recovered in 1944, exposed to outside temperatures until February and incubated at 74°F. and 90-95% R.H. in the constant temperature cabinet at the Vernon Laboratory are shown in the following table:

Source of Coccoons	Date transf. to incubator	No. of adults males	females	Incubation Periods* males	females
Fauquier, B.C.	Feb. 3	-	1	-	21
Kamloops dist.	"6	-	1	-	22
Sardis dist.	"	-	1	-	23
MissionMt.	Feb. 6	2	3	18	20-25
Botanie Lake	"	1	2	17	23-24
Botanie Lake	Feb. 23	2	8	13-15	15-19

*in days.

The difference in the incubation period of the two lots from Botanie Lake is significant. Both lots had received the same treatment up to the time they were transferred to the incubator yet the incubation periods of the second lot were several days shorter than those of the first lot. These results would indicate a prolonged diapause, a factor which needs to be considered in order to obtain the most efficient results in the incubation of insect specimens.

The hyperparasites of Phytodietus fumiferanae, recorded in Table 3 were recovered from field-collected cocoons. Emergence of all three species occurred between July 28 and August 4.

Glypta fumiferanae: This Hymenoptera is probably the commonest and one of the most effective parasite of the spruce budworm in British Columbia. As shown in Tables VIII and IX it was recovered from all the special larval collections. Thousands of the cocoons of this species were recovered in the mass collecting at Lillooet, the species being particularly abundant on the McGillivray Falls area, but because of the early dates of emergence, no attempt was made to keep a record of the number of specimens collected. The adults were liberated in the field as they emerged. Other localities from which the species was recovered in 1944 are shown in Table XII.

This species evidently parasitizes the first instar larvae of the host and it and Apanteles fumiferanae were the only two species of parasites recovered from the special collection of young budworm larvae made on June 7, in the Cedar and Skaist Creek area at the head of Skagit River (see Table IX). Dates of emergence of reared specimens are given in the following table.

Collection Data			Glypta Emergence Data	
Locality	Date	Stage	No. Adults	Dates
Skagit River	June 7	Parasitized larvae	36	July 18-31
Owl Creek	" 15	Glypta cocoons	6	July 10-13
Mt. McLean	July 5	Para. larvae & cocoons	35	July 12-24
Botanie Cr.	" 7	" " "	4	July 18-22
Botanie Lake	" 7	" "	4	July 22-28
Kelly Lake	" 7	" "	1	August 2
Mission Mt.	" 11	" " " "	39	July 19-28
Bolean Lake	" 18	" " " "	17	Aug. 1-16
Monashee Mt.	" 25	cocoons	16	July 25-Aug. 15
Bolean Lake	Aug. 5	"	4	August 15.

Emergence occurred from 9 to 11 days after the cocoons were formed. Identified hyperparasites of Glypta recovered in 1944 are given in Tables III, IV and VII. Of those emerging from the Mt. McLean material, the Itoplectis emerged between July 18 and 24 and the Scambus specimens between July 18 and 20. The Itoplectus from the Botanie Creek road material emerged on July 20 and the two Itoplectis from the Bolean Lake material emerged on August 19. The Scambus hispae and Mebrocytus phycidis both emerged from the later material on August 23 while an adult, believed to be a species of Scambus emerged in the incubator on February 21 from a Glypta cocoon also collected at Bolean Lake. All of the above hyperparasites apparently were recovered from field-collected cocoons.

A considerable number of hyperparasites have been recovered from Glypta cocoons collected on July 25 on the Monashee Summit (see Table II) but the specimens have not yet been identified.

Apechthis ontario: This species is one of the commoner and most effective parasites of spruce budworm in British Columbia. The adults emerged from the host pupae and were recovered from material collected as larvae as well as from field-collected pupae. The dates of emergence of reared specimens are given in the following table.

Collection Data			Emergence Data.	
Locality	Date	Stage of host	No. of Adults	Dates
Owl Creek	June 15	Larval & pupal	1	July 10
Owl Creek	June 27	Pupal	8	July 11-21
Mt. McLean	July 5	Larval	1	July 20
Botanie Cr.	July 7	Pupal	60	July 12-28
		Pupal	1	July 20
Mission Mt.	July 11	Larval	1	July 24
		Pupal	12	July 19-28
Bolean Lake	July 18	Larval & pupal	1	Aug. 7
Monashee Mt.	July 25	Pupal	100	Aug. 2-28
Bolean Lake	Aug. 5	Pupal	38	Aug. 11-31

Itoplectis obesus: This Ichneumonid is also an important parasite of the spruce budworm in British Columbia. It has wide distribution but was only recovered from field-collected budworm pupae which would indicate that it is probably a true pupal parasite. As shown in Tables III, IV and VII Itoplectis obesus was also recovered as a hyperparasite of Glypta fumiferanae; oviposition in such cases evidently occurring through the cocoon. The dates of emergence of the reared specimens of Itoplectis obesus are given in the following table.

Collection Data			Emergence Data	
Locality	Date	Host & Stage	No. of adults	Dates
Mt. McLean	July 5	Archips pupae	3	July 18-24
		Glypta cocoons	7	July 18-24
Botanie Cr.	July 7	Archips pupae	6	July 18-20
		Glypta cocoon	1	July 20
Hawk Creek	July 17	Archips larvae & pupae	2	July 28-Aug. 1
Bolean Lake	July 18	Archips larvae & pupae	2	Aug. 7-9
Monashee Mt.	July 25	Archips pupae	31	Aug. 7-25
Bolean Lake	Aug. 5	Archips pupae	14	Aug.15-31
		Glypta cocoons	2	Aug. 19

Phaeogenes hariolus: Like the preceding hymenopterous parasites, this spedes also plays an important role in the control of the spruce budworm in British Columbia. As shown in Table IX it was particularly effective this year in the Monashee infestation but was not recovered from the Bolean Lake area. It was reared from both larval and pupal collections as shown in the following table.

Collection Data			Emergence Data	
Locality	Date	Stage of host	No. of Adults	Dates
Owl Creek	June 27	Pupal	5	July 20-25
Vermilion Crossing	June 28	Pupal	1	July 24
Mt. McLean	July 5	Larval	1	July 22
		Pupal	15	July 17-25
Mission Mt.	July 11	Larval	1	July 28
Hawk Creek	" 17	Pupal	1	Aug. 7
Monashee Mt.	" 25	Pupal	142	Aug. 7-31

Apanteles fumiferanae: This Braconid is evidently a more effective parasite of the spruce budworm than the data obtained in 1944 would indicate. In connection with the special recovery collections only 4 Apanteles cocoons were collected on Mt. McLean and one on Mission Mt. One other cocoon was obtained from Birken, B.C. However, Apanteles were recovered from 17 of the larvae in the special collection made on June 7 on Skagit River. The cocoons of which were

formed between June 21 and 30 and the adults recovered between June 29 and July 24. One Apanteles cocoonwas obtained on July 12 from the Mt. McLean larval collection and 5 cocoons on July 19 from two budworm larvae in the Mission Mt. larval collection. The two adults from the Mt. McLean material emerged on July 20. The hyperparasite Gelis sp. from the Mt. McLean collection emerged on July 22 from a field-collected cocoon.

Apanteles has a wide distribution but its scarcity or absence in the collections is due to the fact that the majority of the collections were made after the species had destroyed the host larvae.

Dipterous Parasites

Only the Diptera obtained from the special recovery collections have been identified to date. Notes on the species follows

Ceromasia auricaudata: This and the following Tachinid species are the two dipterous parasites which have not been recorded in eastern Canada and which were recovered in quantity in the Lillooet district. C. auricaudata was particularly abundant on Mission Ridge. The host larvae are parasitized by this species but the majority reach the pupal stage before the maggots emerge. The puparia are usually formed outside the host and about 8 to 11 days are spent in this stage. Dates of emergence of reared adults are given in the following table.

Collection Data			Emergence Data	
Locality	Date	Stage of Host	No. of Adults	Dates
Mt. McLean	July 5	Pupal	3	July 17
Botanie Cr.	July 7	Pupal	1	July 22
Botanie Lake	July 7	Larval	1	July 18
Mission Mt.	July 11	Larval	41	July 24-Aug. 10
		Pupal	7	July 24-28

Phorocera incrassata: The host larvae are parasitized by this species but are not killed until they have reached the pupal stage. The puparia are formed invariably within the pupal case. The dates of emergence of reared flies are given in the following table

Collection Data			Emergence Data	
Locality	Date	Stage of Host	No. of adults	Dates
Mt. McLean	July 5	Pupal	14	July 17-28.
Botanie Cr.	" 7	Pupal	1	July 20
Mission Mt.	" 11	Larval	6	Aug. 4

Proscera erecta: This species also parasitize the host larvae but the latter are usually not killed until after they have reached the pupal stage. The maggots then emerge and form puparia from which the flies emerge 8 to 14 days later. The dates of emergence of reared specimens are given in the following table.

Collection Data			Emergence Data	
Locality	Date	Stage of Host	No. of adults	Dates
Mt. McLean	July 5	Pupal	3	July 17-22
Botanie Cr.	" 7	Pupal	1	July 20
Botanie Lake	" 7	Larval	1	July 18

Madremyia saundersii: Only a few specimens of this parasite were recovered. The species parasitizes the larvae and the puparia are formed outside the host; in one instance the maggot emerged from the larva and in another case, from the host pupal case. Adults were recovered on July 17 and 22 from material collected on Mt. McLean and about 10 days after the puparia had been formed.

Phryxe pecosensis: This Diptera apparently has a similar life history as the preceding species, it parasitizes the larvae and the puparia are formed outside the host, the maggot emerging from either the larva or pupal case. From 10 to 14 days is spent in the puparia. The dates of emergence of reared adults are given in the following table.

Collection Data			Emergence Data	
Locality	Date	Stage of Host	No. of adults	Dates
		Pupal	3	July 17-22
Mt. McLean	July 5	Larval	3	July 18-22
Botanie Lake	July 7	Larval	1	July 18
Mission Mt.	July 11	Larval	1	July 24

Zenillia caesar: Only a few specimens of this parasite were recovered. One adult emerged on July 17 about 9 days after the puparium had been formed outside the host in the Mt. McLean pupal collection. Two other adults were recovered on July 28 from the Mission Mt. larval collection.

Winthemia fumiferanae: This parasite was particularly abundant on Mission Ridge but was not recovered from spruce-balsam stands. Its life history differs from the preceding dipterous parasites in that the eggs are laid externally on the host larvae and the adults do not emerge until the following year. The puparia are formed outside the host. In many instances the host was destroyed in the larval stage while in others, the maggots emerged from pupal cases, usually before the end of July . A number of puparia was transferred on January 17 to the incubator in the Vernon Laboratory and emergence of 3 males occurred in 12 to 16 days and of one female in 19 days at a temperature of 74°F. and a relative humidity of about 90%.

Biological Notes

Biological studies of the spruce budworm in 1944 were limited to the carrying through of the following rearing experiments of two-year life cycle material started in 1942 at the Trinity Valley Field Station.

Experiment (b) larva reared in individual vials in the insectary.
(c) lots of 10 larvae each reared in large vials in the insectary.
(e) 2 lots of larvae reared in jars in the insectary.

The larvae used in these experiments were the progeny of moths reared from larvae collected on June 14,1942 from spruce and balsam at Vermilion Summit, Kootenay National Park.

Results

Experiment (b): Originally consisted of 15 larvae but only 8 survived the winter of 1942-43. One on balsam completed its development in 1943, the moth, a male, emerging on July 20. The other 7 larvae showed very little development in 1943, 3 were dead by June 17 and by July 2 the remaining 4 had respun hibernacula. Of these four, three survived the winter of 1943-44 and commenced feeding about the middle of May. One was dead by the end of May but the other two, one on Douglas fir and the other on spruce, continued to develop normally and reached the adult stage on July 6 and 10. Both moths were females. Thus from the progeny of two-year life cycle material, one specimen required one year to complete its life cycle while two specimens required two years under the conditions in the insectary at the Trinity Valley Field Station.

Experiment (c): Of the 190 larvae used at the beginning of this experiment not one completed its development in 1943 and only 20 were alive at the end of that season. Nineteen survived the winter of 1943-44 and all but 9 died during or before reaching the adult stage in 1944. Data on the nine moths recovered follows:

Host	Spruce		Balsam		Douglas fir.	
Sex	♂	♀	♂	♀	♂	♀
July 5	-	2	1	-	1	-
" 10	-	-	1	1	-	2
" 12	-	-	-	1	-	-
" 17	-	-	-	1	-	-
Totals	-	2	2	3	1	2

Experiment (d): As mentioned in the report for 1943, mortality was also extremely high in this experiment. Of the 175 larvae used, only 20 were alive at the end of the 1943 season. In May of this year, 1944, six larvae on Douglas fir and five on Engelmann spruce were still alive. Two of the Douglas fir specimens were dead by June 1 while the other four produced moths, 2 males and 2 females, between July 3 and 10. Two of the larvae on spruce were also dead by the end of May. The other 3 spruce specimens reached the pupal stage and 2 male moths emerged, one on July 10 and the other on July 15. The third specimen failed to emerge.

The results of the above experiments are in line with those obtained in previous years. No significant difference was noticed in the development of the larvae on the three hosts, Douglas fir, Engelmann spruce and alpine fir, and the progeny of material from spruce and balsam apparently develops readily on Douglas fir. The life cycle of material originating from two -year life cycle areas may be reduced to one year under favourable conditions. However, as was suggested in the report for 1943, the Trinity Valley area is evidently a transition zone with regards to the development of the spruce budworm; a factor which undoubtedly influences the results obtained in the above rearings. Various spruce budworm larvae have been reared in one year at the Field Station but one specimen taken on June 4, 1943 on Abies lasiocarpa did not reach the adult stage until July 13 of this year. The specimen which was transferred to the insectary did not develop further in 1943 but instead spun a hibernaculum from which it did not emerge until May 1944. This year it developed normally and pupated on June 26.

Observations on Seasonal Development of Spruce Budworm.

In British Columbia the seasonal development of the spruce budworm varies greatly between different localities and even in the same localities. The differences are due to climatic conditions, including such factors as latitude, topography, elevation, exposure and weather. Examples of extreme differences in development occur on the one and two year life cycle areas. Variations in the same locality are to be found on the slopes of mountains such as on Mt. McLean at Lillooet and Mission Mt. at Shalalth where the mass collecting for parasites was done in 1944. On such slopes, the higher the elevation the later the seasonal development of the budworm. The comparative development of the spruce budworm at the time the special parasite collections were made on the different areas in the Lillooet district was indicated by the proportion of larvae and pupae obtained. The figures are given in the following table:

Locality	Elevations	Date of collection	Specimens Collected			
			larvae		pupae	
			No.	%	No.	%
Botanie Creek Road	1500'	July 7	14	20.0	56	80.0
Mt. McLean	2500-3000'	" 5	376	41.2	536	58.8
Mission Mt.	3500-4000'	" 11	692	84.3	129	15.7
Botanie Lake	2500'	" 7	336	97.1	10	.29

Development was particularly retarded at ~~McLean~~ Botanie Lake in comparison with that at the same or higher elevations on Mt. McLean and Mission Mt. The difference was largely due to topography. Whereas the Mt. McLean and Mission Mt. Specimens were from south slopes rising more or less uniformly from an elevation of 800 feet. Botanie Lake lies in a basin surrounded almost entirely by high ridges.

In view of the foregoing observations, a study of the spruce budworm material received at Vernon through the Forest Insect Survey has been made in an attempt to determine the comparative seasonal development of the budworm for the different areas from which the material was received. If it proved possible the information would be useful should we wish to make special collections on any of the areas. Factors considered in the study were the number and stage of development of the specimens received and also the dates of moth emergence of the immature specimens transferred to the Trinity Valley Field Station. Early and late areas could be recognized but in the majority of the collections the number of specimens and the locality data were insufficient for more definite conclusions. An interesting point observed, however, was that the moth emergence period for material from a known two-year life cycle area in Kootenay National Park coincided closely with that of material from some of the known one-year cycle areas.

E.30.09-3 - Larch Sawfly (Pristiphora erichsonii Htg.)

(Hopping, Mathers, Morgan)

Examination of larch stands in September, between Hosmer, east of Fernie, westward to the Okanagan Valley, indicated a very drastic reduction in the sawfly population. All larch stands appeared to be in excellent condition except in the Elko district where the effects of a drouth were evident. Here the foliage started to turn colour unusually early.

In all stands examined between Hosmer and Nelson, curled shoots were difficult to detect and fresh cocoons were extremely hard to find. Curled shoots became more evident in the Slocan Lake region but no noticeable defoliation occurred. The only apparent defoliation was found in the Arrow Lakes Valley where a few trees might have been termed 'medium'. Even here the majority of the trees had the full complement of foliage. It was possible to get cocoon samples only in this region and at Trinity Valley, that is of sufficient size to give any indication of the amount of parasitism.

The following table gives defoliation records on sample plots since their establishment in 1939

Plot No.	Degree of Attack.	Number of Trees. 1939	1940	1941	1942	1943	1944
1. Grey Creek	none	0	36	10	0	0	0
	light	43	64	81	41	83	100
	medium	46	0	7	54	15	0
	heavy	11	0	2	5	2	0
		100	100	100	100	100	100
2. 6.0 mi. E. Creston	none	0	58	41	63	0	68
	light	67	11	28	6	68	1
	medium	2	0	0	0	1	0
	heavy	1	0	0	0	0	0
	dead	0	1	1	1	1	1
		70	70	70	70	70	70
3. 30.8 mi. E. Cranbrook	none	0	121	7	No	0	132
	light	57	23	132	C	143	11
	medium	31	0	4	h	0	0
	heavy	57	0	0	e	0	0
	dead	0	1	2	c	2	2
		145	145	145	k	145	145

Plot No.	Degree of Attack	Number of Trees					
		1939	1940	1941	1942	1943	1944
4. 4.0 mi. W. Crabbrook	none	0	99	84	0	0	149
	light	139	50	65	149	149	0
	medium	10	0	0	0	0	0
	heavy	0	0	0	0	0	0
		149	149	149	149	149	149
5. E. end Moyie Lake	none	0	154	58	0	0	160
	light	184	31	127	178	185	25
	medium	1	0	0	7	0	0
	heavy	0	0	0	0	0	0
		185	185	185	185	185	185
6. 22.4 mi. W. Cranbrook	none	0	44	0	0	A	0
	light	109	78	96	66	few	119
	medium	13	1	17	31	medium	0
	heavy	2	0	6	22	remain-	0
	dead	0	1	1+4 cut	1	der light	1
		124	124	120	120	120	120
7. 11.9 mi. W. Cranbrook	none	0	20	0	0	0	60
	light	19	39	51	34	17	6
	medium	13	7	14	20	29	0
	heavy	34	0	1	12	20	0
	dead	1	1	1	1	1	1
		67	67	67	67	67	67
8. 5.5 mi. W. Yahk	Logged		in		1941		
9. Slocan Lake Golf Course (edge)	none	0	10	0	0	0	0
	light	62	1	6	2	36	36
	medium	0	51	16	34	0	0
	heavy	0	0	14	0	0	0
		62	62	36*	36	36	36

* 26 cut to clear roadway.

The trend toward lighter defoliation is readily seen in this table but as to whether this will be maintained remains to be seen. The following Table gives the data on cocoon samples taken in 1944.

LARCH SAWFLY MORTALITY IN COCOONS.

Collecting place	Date collected in 1944	Date examined in 1944	Total no. cocoons	No. 1944 cocoons examined	Live healthy sawfly larvae		Mouldy cocoons *Isaria* ?		Dead-cause unknown.		Parasites: Mesoleius.		Parasites: Tritneptis		Parasites: Trit. on Mesol		Parasites: Others		Total mortality.	
					No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1 mi. S. Burton	IX-17	IX-19	23	12	5	42	11	48			7	58							7	58
Whatshan cut-off E. end.	IX-17	IX-20	189	50	16	32	39	44			31	62	1	2	3	6			34	68
2 mi. W. Upper Inonoaklin Crossing.	IX-17	IX-19	22	19	3	16	3	14			13	68	4	21	3	16			16	84
Trinity Field Station	X-6	X-13	53	53	34	64					15	28			4	8			19	36
3/4 mi. N. Trinity Field Station.	X-30	X-31 and XI-1	187	48	33	69	2	4	1	2	14	29							15	31
				48	34	71	2	4			11	23			3	6			14	29
				48	34	71	2	4			12	25			1	2	1	2	14	29
				35	24	69	2	5			10	29			1	3			11	31

A comparison of these results with the table in the 1943 Annual report shows that parasitism by *Mesoleius* at the east end of Whatshan cut-off has increased from 56% to 62% while *Tritneptis* remained about the same. At Trinity Field Station *Mesoleius* increased from an average of 9% to about 26%. *Tritneptis* were recovered in this locality for the first time, in about 5% of the 1944 cocoons.

Material remaining after analyses of samples from cocoon lots collected in the fall of 1943 were placed, free and dry in jelly jars covered with cheese cloth. These were kept in the field station insectary through the winter and the following summer until emergence ceased. The following table shows emergence from this material.

EMERGENCE SAWFLIES & PARASITES

1943 Samples

	Plot I	6 mi. N. Needles	1 mi. E. Elko.
No. cocoons	67	66	63
P. erichsonii	1	13	0
Tritneptis	210 7 cocoons	65 2 cocoons	2 1 cocoon
Mesoleius	5	39	19

Examination of remaining cocoons after emergence gave the following data:

Plot I -- Examined July 7, 1944.

16	cocoons	(1943?)	dead	moldy	sawfly larvae
15	"	"	"	dry	" "
1	"		"	soft	" "
1	"	(1942?)	"	moldy	" "
1	"		"	dry	" pupa
1	"		"	"	" adult
1	"		"	Mesoleius	larva
3	"		"	"	pupae
1	"		"	"	adult
7	"		"	"	pupae parasitized by Trit.
5	"		live Tritneptis stages on sawfly larvae		
2	"		dead	"	"
7	"		empty with Tritneptis emergence holes.		

Six miles N. Needles - Examined Oct. 5, 1944.

3	cocoons (1943?)	Dead	dry	sawfly	larvae
1	"	"	soft	"	"
1	"	"	moldy	"	"
1	"	"	dry	pupa	
4	"	"	"	sawfly adults	
2	"	"	Mesoleius pupae (dry)		
2	"	empty with Tritneptis emergence holes			

One Mile E. Elko - Examined October 5,1944.

8	cocoons (1942)	dead	moldy	sawfly	larvae
7	" (1943)	"	"	"	"
16	" (1943?)	"	dry	"	"
2	"	"	"	"	adults
5	"	"	Mesoleius larvae		
3	"	"	" pupae		
2	"	with 2nd generation Tritneptis (alive)			
1	"	"	Tritneptis emergence holes (old)		
1	"	"	"	"	" (1944)

After eliminating moldy cocoons from the three samples, the parasitism by Mesoleius was found to be:

Plot I -- 34 per cent
6 mi. N.-
Needles 63 " "
1 mi. E.
Elko -- 56 " "

This compares with parasitism by Mesoleius of 54, 58 and 85 per cent respectively for samples from the same lots examined the previous fall. In the case of Plot I and the Elko lot this difference is statistically significant but the difference for the Needles plot is not. The significant differences may be due to the fact that dead, dry larvae were included as a basis for figuring parasitism percentages and possibly these should have been eliminated since no examination was made to see if any contained Mesoleius larvae in the dried sawfly larvae. In the Needles plot there were only 3 of these dried larvae whereas in the other two plots they were quite numerous. At the moment, this seems to be the only explanation for the discrepancy.

Emergence Rhythms of the Larch Sawfly and its Parasite Mesoleius tenthredinis Morley.

(Morgan)

Larch sawfly investigations conducted by the Vernon Laboratory have shown for several years the presence of two rhythms of emergence of the parasite Mesoleius tenthredinis Morley from cocoons collected in the fall or spring from widely separated areas of British Columbia. On several occasions the emergence of its sawfly host, Pristiphora erichsonii Htg., has exhibited the same phenomenon though the evidence of such in this case has often been weak and rather indefinite. The occurrence of two emergence flushes of both the parasite and the sawfly was first reported in July,1943. An examination was then made of data presented in previous reports and it was found that flushes had occurred several times prior to that year.

A. Fernie District - 1936.

The first evidence of emergence rhythms was found in tables presented by H. B. Leech for the year 1936. In that year Leech collected 3,441 apparently sound cocoons in the Hosmer area and 3,313 from the Upper Elk River area. Both places are just north of Fernie, B.C. The Hosmer lot was collected on May 2, 7 and 8 (593 cocoons), May 12 (960 cocoons), May 13 (953 cocoons), May 23 (331 cocoons), May 24(569 cocoons), and June 19 (121 cocoons). Eighty-six of these were found to be empty and were discarded. The Upper Elk River lot was collected on May 9 (1,204 cocoons), May 11 (1,478 cocoons), and May 18 (756 cocoons). Of this collection 125 were found to be empty and were discarded. These collections were placed in two cages at the Lizard Creek field station for emergence of sawflies and parasites. Graphs 1, 2, 3 and 4 show the emergences as plotted from the tables presented in the Annual Report for 1936.

The sawfly emergence (graphs 1 and 2) of both areas show two definite flushes. Adults from cocoons collected in the Hosmer areas (graph 1) began to emerge in the first rhythm on May 28 and continued until June 10. Three sub-flushes were obtained in this rhythm; the first reached a peak on May 30 when 27 adults emerged, the second on June 4 and the third on June 9. Between June 11 and June 22 inclusive, only one adult was recovered. The second rhythm commenced on June 23 and lasted until July 1. The peak of this rhythm occurred on June 26 when 26 female sawflies emerged. The two emergence rhythms are also

present in the Upper Elk River lot (graph 2) though they are not so evident. Adult emergence from this material began on May 17. It is considered that the first rhythm continued until June 11. Several flushes are shown in this rhythm with the peak occurring on May 30 when 20 adults emerged. Four small flushes amounting to 11 specimens took place between June 12 and 22 inclusive. A definite second rhythm commenced on June 23 and reached a peak on June 26 and 27 when 50 adults emerged. This rhythm tapered off quickly and ceased on July 1. Six days elapsed without emergence and then another flush of 17 adults was experienced beginning on July 7 and ending on July 9. These examples of larch sawfly emergence rhythms are the most outstanding of any encountered after 1936.

Mesoleius tenthredinis also showed two rhythms of emergence in both males and females and from both localities (graphs 3 and 4). Emergence of male parasites from the Hosmer collection (graph 3) began on June 4 and reached a peak in the first rhythm on June 14. At the most, this rhythm extended to June 21. Except for two adults the second rhythm was separated from the first by nine days. Emergence of the second rhythm commenced on June 30 and did not stop until July 22. Female recoveries from the same area were first obtained on June 14. The extreme limit of the first rhythm is considered to be June 27. The second female rhythm started on July 1 and ended on July 22. Similar rhythms existed in the material from the Upper Elk River area (graph 4) but particularly in the emergence of males, the rhythms were very pronounced. In this case the first male rhythm extended from June 4 to June 21 while the second is believed to have begun on June 23 and ended on July 20. The line of demarcation between the first and second female rhythms is not very evident. The first rhythm originated on June 12 and is considered to have terminated on June 29. On June 30 a second rhythm began which continued until July 22.

B. New Denver District -- 1941.

No mass collections of cocoons were made after 1936 which showed any evidence of emergence rhythms until 1941. In the latter year W. G. Mathers and H. B. Leech, assisted by Forest Ranger Palethorpe and Asst. Ranger Jeffries, made two cocoon collections near New Denver, B.C. One collection of 3,198 apparently sound cocoons was made April 17 at an elevation of 2,600 ft. above sea level on the north bank of Carpenter Creek at Three Forks. The second collection of 2,541 apparently sound cocoons was made April 18 at an elevation of 3,000 ft. above sea level on the south bank of Carpenter Creek above Alamo. The

cocoons were brought to Vernon on April 19 where they were sorted, counted, and placed in jelly jars, 100 to each jar. Between April 22 and May 6, they were kept in an overwintering vault at the Trinity Valley field station after which they were placed in the insectary there.

The emergence data for these collections appear in the 1941 Annual Report. Both collections showed two rhythms in the emergence of the sawfly and the parasite. In each case the majority of adults emerged in the first rhythm.

The first rhythm of female sawfly emergence from the collection made at Three Forks is believed to have ended on June 23. A second flush commenced on June 16 and reached a peak on June 27. The flush ceased on July 8. The Alamo material produced the first adults on May 6. A peak was reached on May 20 when 155 adults emerged. This first rhythm finished on June 5. A second rhythm began on June 12 and extended through to July 4.

Rhythms of Mesoleius emergence were obtained in both sexes. The first male rhythm from the Three Forks collection originated May 27, and lasted until June 21. Three adults were obtained on June 24 and 25. A definite second flush began on June 28 which lasted until July 13. The female rhythms from the same collection are not so definite. It is thought that the first rhythm extended from June 9 to 20 and the second from June 22 to July 13. Comparatively few Mesoleius adults were recovered from the Alamo collection but even here there is evidence that rhythms of emergence existed in males and females.

C. Samples from Larch Sawfly Plots -- 1943.

Emergence rhythms of the sawfly and the parasite were noted again in 1943 from samples collected in the fall of 1942 by G. R. Hopping and C.V.G. Morgan. These samples were taken at widely separated points in the sawfly areas of British Columbia. Although these collections contained a relatively small number of cocoons it was in 1943 that the sawfly and its parasite were first noted to be exhibiting emergence rhythms. As the amount of adult material recovered from the collections was small, the details of emergence rhythms will not be discussed. However, it may be stated that the time of occurence of these flushes varied somewhat between the different collections.

D. Whatshan Cut-off -- 1944.

In 1944 an opportunity presented itself to obtain more detailed information on the occurrence of these rhythms and to determine if the artificial treatment of cocoons was responsible for this occurrence in previous years. On Sept. 17, 1943, G. R. Hopping and W. G. Mathers collected 709 apparently sound cocoons at "The beginning of the Whatshan cut-off, E. end, B.C.". Five hundred cocoons of this sample were divided into five lots of 100 cocoons each and treated at the Trinity Valley field station in the following manner beginning Sept. 24,1943.

Lot.1-- Cocoons placed in a jelly jar without soil etc. and left in insectary for emergence in 1944.

Lot. 2- Cocoons placed in soil in a large jar and left in insectary for emergence in 1944.

Lot.3-- Cocoons placed in a jelly jar without soil etc., left in insectary until Nov. 1,1943, when they were placed in an over-wintering chamber, removed to insectary on May 6,1944 for emergence.

Lot.4-- Cocoons treated as in lot 3 but placed in soil in a large jar.

Lot.5-- Cocoons placed in soil in a wire-screen cage 12" square and 2" deep, which was placed in duff 1" below the surface and 3' away from the trunk of a larch tree on its east side. On June 2, 1944 the top screen and the 1" of duff were removed, and a large cheese-cloth cage placed over the screened cage.

Another collection of 1,330 apparently sound cocoons was made between Sept. 27 and Oct. 2, 1943 by G. R. Hopping and H.B. Leech from the same locality as the above. Beginning November 18, 1943, 658 cocoons of this collection were designated and treated at the Trinity Valley Field Station as follows:

W 1.-- 225 cocoons placed in a jelly jar without soil etc., and left in insectary for emergence in 1944.

W 2.-- 208 cocoons placed in soil in a screened 6" square box and the whole placed in duff between two large larch trees north and south in line. No deciduous trees which would give much shade were near the area in which the box was placed.

W.3 -- 225 cocoons treated as in W 2 but the box of soil containing them was placed on the north side of a larch tree around which deciduous trees were growing and which gave much shade over the area containing the box.

On June 2,1944, the top screen of the boxes of W 2 and W 3 were removed and replaced by small cheese-cloth cages.

Emergences from these eight lots were recorded from day to day. As the cocoons contained a relatively high percentage of Mesoleius tenthredinis, few sawflies were recovered. It was impossible therefore, to draw reliable conclusions as to the existence of emergence rhythms. In several cases comparatively large numbers of Mesoleius were obtained. The results of these daily recoveries of the parasite for the eight lots are presented as graphs in which the cumulative totals are plotted against the date of emergence (graph 5). Besides showing the amount of emergence at any particular date the graphs also give an indication of the influence of different cocoon treatments throughout the winter on the emergence in the following spring and summer. Rhythms of emergence were obtained in all lots, either in male or female, or in both.

Lot 1 showed two rhythms of emergence only in the female and even here the tendency of a second rhythm was not strong. The first rhythm totalling ten adults ceased on June 28. Fourteen days later, an apparent second rhythm began but only two adults were recovered; the first on July 12 and the second on July 22.

In Lot 2 two rhythms of emergence were obtained in the male and female but in both cases the first rhythm was small. The second in the male was separated from the first by 17 days and in the female by 21 days.

Lot 3 showed two strong emergence rhythms in both sexes. In both the male and the female the beginning of the second rhythm was separated from the end of the first by 25 days.

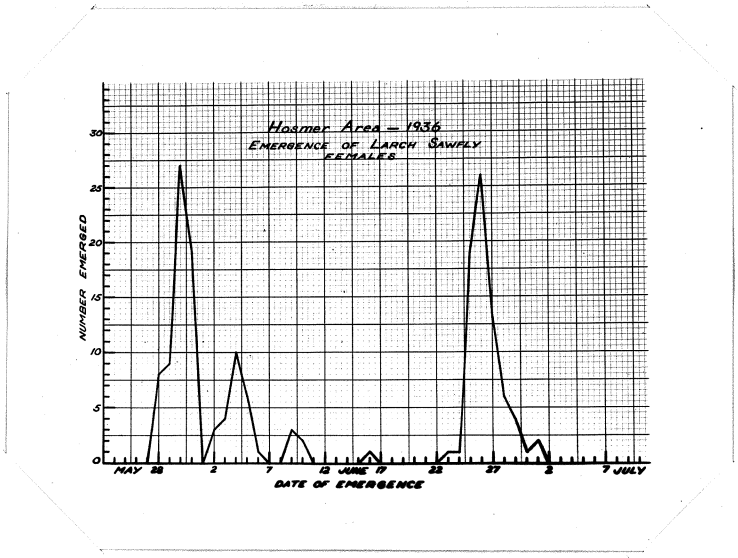
In Lot 4 it is considered that two emergence rhythms were obtained only in the male. A period of 24 days elapsed without emergence between the first and second male rhythms. Two rhythms were obtained only in the female in lot 7; here the evidence of a second rhythm was very weak.

In W1 the first rhythm of the male stopped on June 26 and a second began on July 2. The female second rhythm is considered to have started on July 15, that is, five days after the end of the first rhythm.

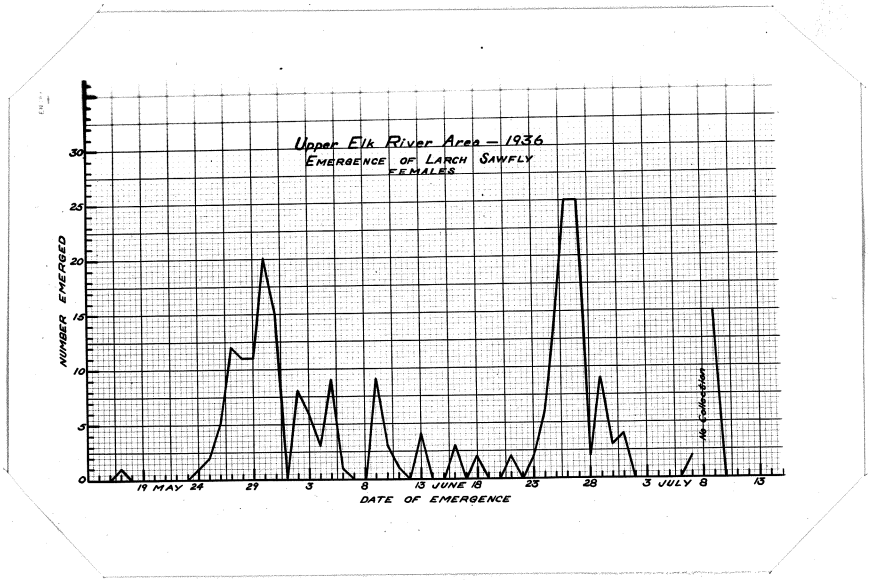
W 2 showed two strong rhythms in both sexes. In both, the first and second rhythms were separated by 15 days.

W 3 also showed two rhythms in both sexes but in the female these were not so definitely separated. In the male the first rhythm ended on July 8 and the second commenced 13 days later, on July 21. In the female the first stopped on July 20 and a second rhythm began on July 26.

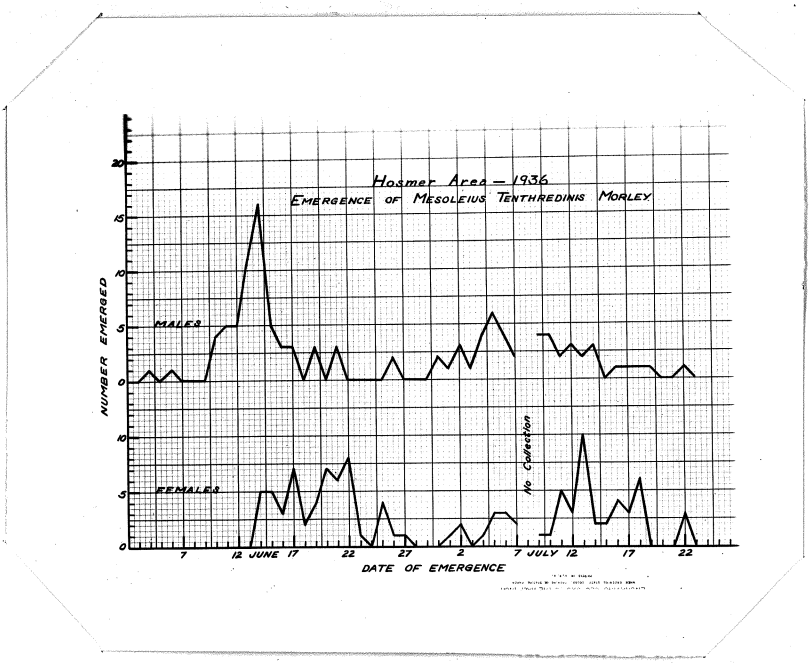
In conclusion it is evident that the various treatments of cocoons throughout the winter did not affect appreciably the existence of parasite emergence rhythms. Apparently such rhythms exist under natural conditions. It is also concluded that these rhythms are not caused by weather fluctuations during the entire emergence period.



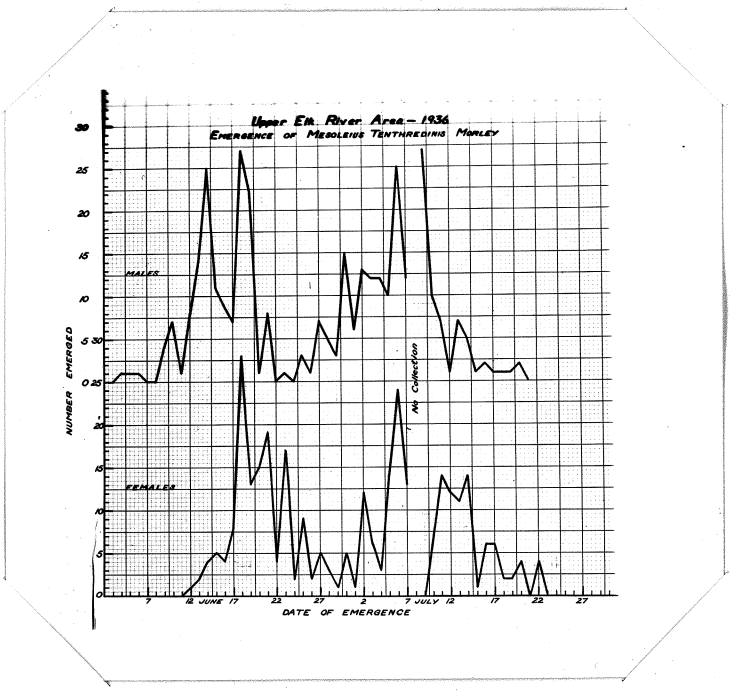
GRAPH I



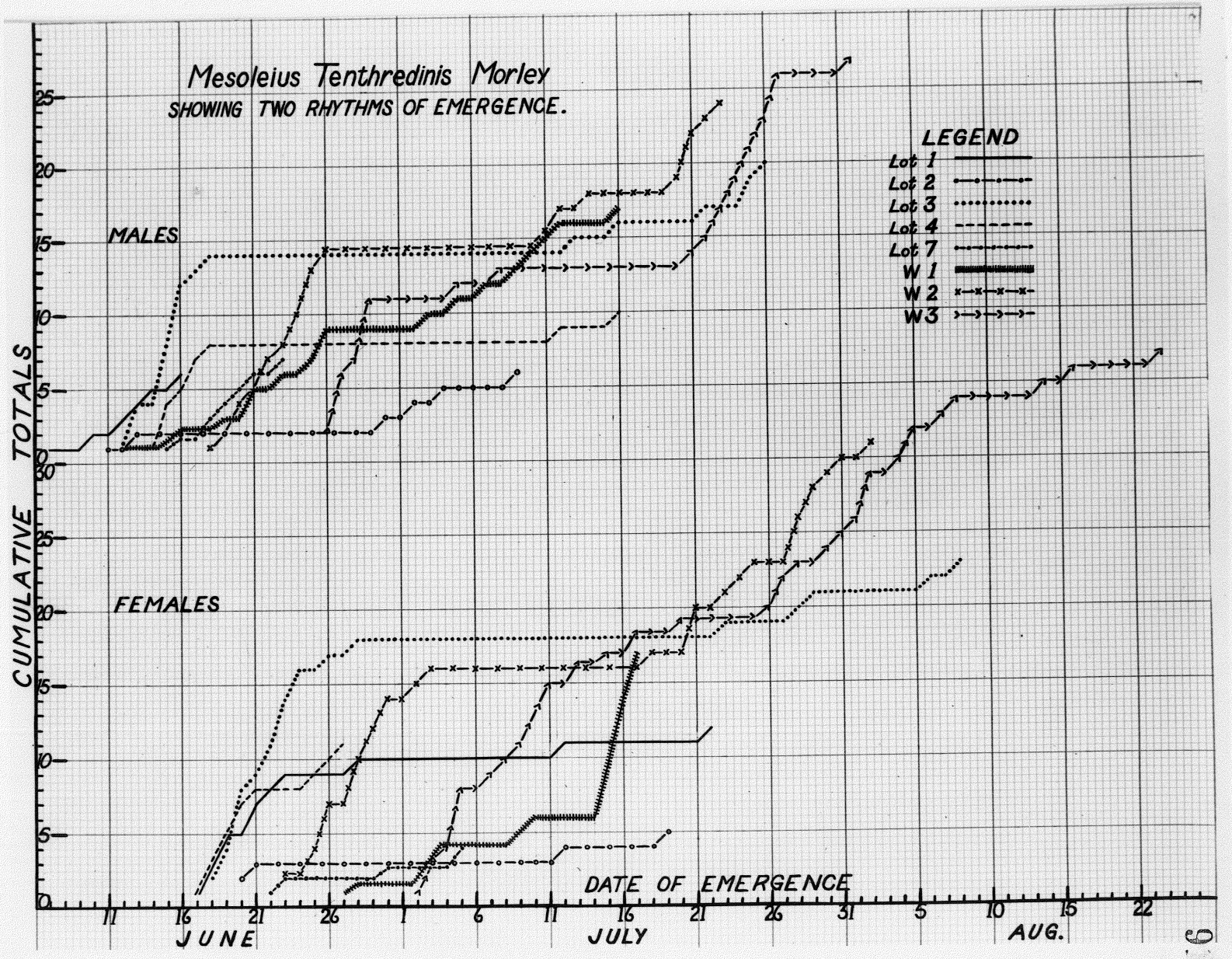
GRAPH 2



GRAPH 3



GRAPH 4


Mesoleius Tenthredinis Morley
SHOWING TWO RHYTHMS OF EMERGENCE.
LEGEND
Lot 1
Lot 2
Lot 3
Lot 4
Lot 7
W 1
W 2
W 3
MALES
FEMALES
CUMULATIVE TOTALS
DATE OF EMERGENCE
JUNE
JULY
AUG.

GRAPH 5

Bark Beetle Control, Banff National Park.

The Banff control areas were examined by G. R. Hopping and W. G. Mathers Sept. 10 to 14, 1944. This was done mainly by re-running some of the strip lines as samples and spotting trees within 100 feet of each line. The following conditions were found:-

Mt. Rundle (Spray River): Only two or three 'red-tops' were found on this entire area. Cruising of strip 25 disclosed six small green infested trees. None of these was more than 8 inches in diameter and it would be impossible to produce large bark beetle broods in trees of this size.

Sulphur Mountain: The entire lower portion of this area between the base line and the Cave and Basin road was carefully examined. Only 5 green infested trees were found, two of these 8 inches in diameter. The other three trees were near a windfall which had evidently attracted the beetles to that spot. The area generally is remarkably free from bark beetle attack.

Tunnel Mountain: This area is small and examination was not made by strips but by a general examination of trees between Tunnel road and Banff townsite. In one section several 'red-tops(were found which had been killed by Pityogenes. No green infested trees were found.

Brewster Creek Fairly heavy infestation in large trees was found on part of this area. On strip 4, about 20 green infested trees were found within the space of 2 chains. On strips 6 to 10 more green infested trees were found indicating that this area should be reworked by the control crews. It is believed that heavy attack on these trees by the needle miner Recurvaria milleri served to attract bark beetles to the weakened trees from considerable distances.

Healy Creek: Beginning at Station 25 N. the trees on both sides of the base line were cruised for about 10 chains. In addition, trees were examined around several small groups of 'red-tops' on this area. Only 2 green infested trees were found and some

of the attacks had been drowned out. There is evidence of a declining bark beetle population on this area.

Hillsdale Area: Several groups of red-tops were examined on this area as well as strips 55 W. and 74 W. Forty-seven 'red-tops' were encountered and 19 green infested trees. This indicates a reduction in population but bark beetles are more active on this area than on any other except Brewster Creek. However, even though seasons might turn dry again it would be at least two years before the infestation could reach the stage it was in when the control work commenced.

Stoney Squaw Mt.: The western half of this area was examined in considerable detail. A severe wind had caused a number of trees on this area to break off and the standing snags were infested by Dendroctonus murrayana which seldom increase to epidemic proportions. Only one heavily infested tree (D. monticolae) was found (Strip 14, Chain 2). The bark beetle population appears to be declining.

To summarize, it may be stated that the bark beetle population appears to be declining on all areas except Brewster Creek. With the exception of this area no control work was called for during the winter 1944-1945.

Cruising of the Brewster Creek area was completed on November 11. On 360 acres, 30 'red-tops', and 151 green infested trees were discovered. The treating work was completed on November 22. In addition 11 red-tops and 11 green infested trees were cleaned up on the Hillsdale area (strips 24 and 25) near the highway.

Bark Beetle Sample Plots, Kootenay National Park.

Most of the trees on some of the sample plots established in the Kootenay Park infestation have been removed by clearing and salvage operations.

Plot I: Only 64 trees remain standing on this plot. Of these 23 are green and the remainder dead. No fresh attack occurred on any of the green trees in 1944.

Plot II: All trees except two (Nos. 407 and 408) have either been removed from this plot or have fallen. The two standing trees are both dead.

Plot III: Only 1 green standing tree remains on this plot. There was no attack on it in 1944.

Plot IV: Only 47 trees remain standing on this plot of which 9 are green. None of these were attacked in 1944.

Plot V: Eighty-six trees have been removed from this plot. Of the remainder 169 are still standing with 120 still green. Two of these were freshly attacked by D. monticolae in 1944.

Plot VI: All trees have been removed from this plot.

Plot VII: Only 47 trees remain standing of which 20 are green. No fresh attack occurred in 1944.

Plot VIII: was not involved in clearing and salvage operations. Full data for this since its establishment is given in following table.

PLOT VIII

Year	Dead		Fresh attack	Totals	Not att. or re-covered	Totals	Trees down	Trees re-moved
	No.	%						
1941	1	1.7	20	21	39	60	0	0
1942	11	18.3	5	16	44	60	0	0
1943	13	21.7	8	21	39	60	0	0
1944	18	30.0	0	18	41	60	0	1

Plot IX: Clearing operations have removed only a few trees from this plot. This is in a younger 60-70 year-old stand. The following table gives the data on these trees.

PLOT IX

Year	Dead No.	Dead %	Fresh attack	Totals	Not att. or recovered	Totals	Trees down	Trees removed
1940	11	10.7	6	17	86	103	0	0
1941	16	15.5	11	27	76	103	0	0
1942	18	17.5	31	49	54	103	0	8
1943	27	26.2	6	33	70	103	0	16
1944	31	30.0	0	30	72	103	0	23

Plot X: This plot is also in a 60 to 70 year-old stand. The following table indicates progress of infestation.

PLOT X

Year	Dead No.	Dead %	Fresh attack	Totals	Not att. or recovered	Totals	Trees down	Trees removed
1941	0	0	0	0	66	66	0	0
1942	1*	1.5	17	18	48	66	0	0
1943	6	9.1	1	7	57	66	0	2**
1944	9	13.6	0	9	55	66	0	2

* Porcupine killed ** green trees.

One of the additional trees dead in 1944 showed no insect attack and appeared to have been killed by shading out.

Tree Growth and Precipitation in Relation to Bark Beetle Outbreaks in the Interior of British Columbia.

It has been noted by various United States workers (Keen and others) that bark beetle epidemics often occur during protracted drouth periods. Most of the observations however were correlated with precipitation records from stations at some distance from the infested areas. In the present study, four stations were selected for a study of precipitation, tree growth and occurrence of outbreaks. These were Penticton, Princeton, Merritt and Kamloops,. Two of these stations, Princeton and Merritt were located within outbreak areas and the other two were 15 to 20 miles from major outbreaks.

First the precipitation records for these stations were tabulated by months. The Merritt records date from 1919 but records taken at Nicola only 7 miles away and 150 feet higher in elevation go back to 1896. For practical purposes these combined records are considered as one station. Continuous records for Princeton commenced in 1901, for Penticton, 1908, and for Kamloops, in 1897.

Description of Sites: In selecting the trees for correlation of growth and precipitation an attempt was made to get trees as near as possible to the weather station and at the same time with reasonably high sensitivity to precipitation changes. Such trees are usually found on the drier southwest exposures.

The first site is situated 8 miles in a direct line south and a little west of Penticton near the point where the Keremeos road leaves the main Oroville highway. The stand is scattered, consisting of ponderosa pines with a few Douglas firs on a fairly steep slope with southern exposure. The soil is thin with numerous rock outcroppings (granitic ?). No logging has occurred here.

The second site is 5 miles in a direct line north and a little west of Princeton on the one-mile road to Merritt. The country here is rolling with little pronounced exposure. The area has been logged from time to time leaving scattered ponderosa pines and a few Douglas firs. The soil seems to be fairly deep with few rock outcroppings.

The third site is 2 miles in a direct line northeast of Merritt on a fairly steep slope above the Merritt-Kamloops highway. The exposure is southeasterly. The soil is thin with numerous granitic outcroppings. No logging has occurred here.

The fourth site is 12 miles in a direct line east and a little south of Kamloops on a gradual slope with southern exposure above the Vernon-Kamloops highway. Little, if any, logging has occurred here.

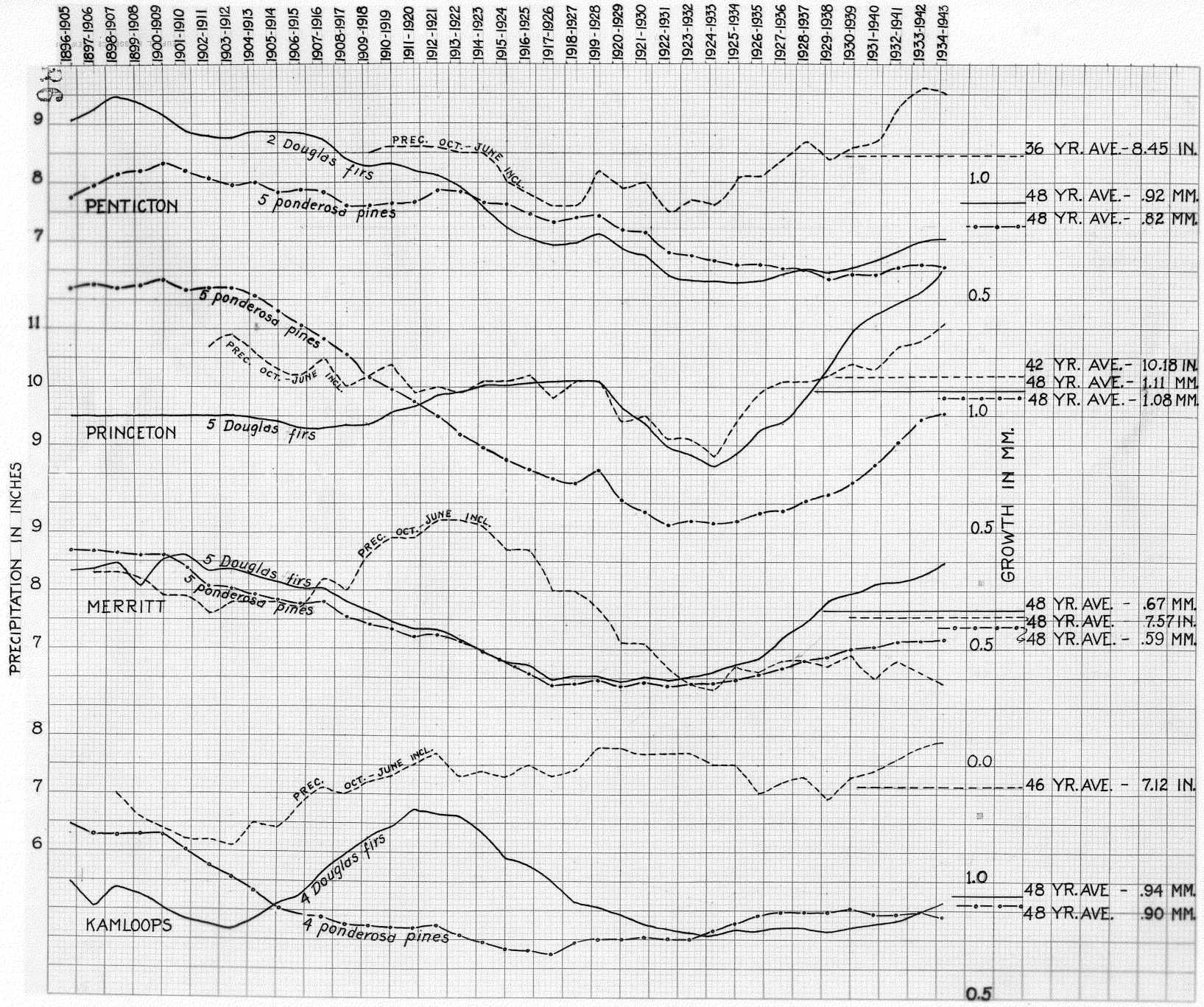
Growth Study Procedure: Increment cores were secured from 5 ponderosa pines and 5 Douglas firs on each site. These were placed immediately into glass tubes plugged with cotton for transperation to the laboratory. There the cores were shaved off with a razor and each ring, including spring and summer growth was measured with a binocular microscope, using a micrometer disc in a 10X ocular and 40 mm. objective. Measurements were recorded to the nearest hundredth of a millimeter and later reduced to the nearest tenth for charting purposes. After recording the ring measurements, the cores were cemented into grooves in birch blocks. Five cores were mounted in each block and polished with the finest grade sand paper. The rings were then measured again, corrections made and the trees of each group cross-dated. Cross-dating was also possible to some extent between the trees of different groups.

In order to determine whether individual trees showed growth correlation with precipitation, the trees of each group were charted separately with precipitation using absolute values for both. In many of the trees a correlation of growth with precipitation for the period October 1 to June 30 of the following year was found. Various other intervals were tested but no other interval showed any appreciable correlation with growth. For example, in the Douglas fir group from Merritt, four of the trees showed a growth trend in the same direction as precipitation for 32 out of 47 years using the period indicated above. Some trees taken individually agreed in trend for 38 out of 47 years.

The age of the trees averaged about 150 years, although the exact age of some could not be determined because the core missed the center or failed to reach center on a few of the larger trees.

In preparing the accompanying chart, the growths of trees in each group were averaged for each year and the points on the growth trend curve determined by advancing ten year averages by one year at a time in the same manner in which the precipitation values were charted. The trends of both tree growth and precipitation are thus readily compared.

It may be noted from the chart that three stations--Penticton, Princeton and Merritt show marked depressions in precipitation for


1896-1905
1897-1906
1898-1907
1899-1908
1900-1909
1901-1910
1902-1911
1903-1912
1904-1913
1905-1914
1906-1915
1907-1916
1908-1917
1909-1918
1910-1919
1911-1920
1912-1921
1913-1922
1914-1923
1915-1924
1916-1925
1917-1926
1918-1927
1919-1928
1920-1929
1921-1930
1922-1931
1923-1932
1924-1933
1925-1934
1926-1935
1927-1936
1928-1937
1929-1938
1930-1939
1931-1940
1932-1941
1933-1942
1934-1943
PRECIPITATION IN INCHES
GROWTH IN MM.
PENTICTON
2 Douglas firs
5 ponderosa pines
PREC. OCT.-JUNE INCL.
36 YR. AVE.- 8.45 IN.
48 YR. AVE.- .92 MM.
48 YR. AVE.- .82 MM.
PRINCETON
5 ponderosa pines
5 Douglas firs
PREC. OCT.-JUNE INCL.
42 YR. AVE.- 10.18 IN.
48 YR. AVE.- 1.11 MM.
48 YR. AVE.- 1.08 MM.
MERRITT
5 Douglas firs
5 ponderosa pines
PREC. OCT.-JUNE INCL.
48 YR. AVE. - .67 MM.
48 YR. AVE. - 7.57 IN.
48 YR. AVE. - .59 MM.
KAMLOOPS
4 Douglas firs
4 ponderosa pines
PREC. OCT.-JUNE INCL.
46 YR. AVE. - 7.12 IN.
48 YR. AVE - .94 MM.
48 YR. AVE. .90 MM.

the period October 1 to June 30 during the 1920's. The lowest point of this drouth period came during the latter part of the decade 1924 to 1933. A corresponding depression in tree growth is indicated for the same period both in ponderosa pine and Douglas fir. It is probably significant that nearly all of the bark beetle outbreaks in the Interior of the Province occurred during this drouth period. The same coincidence of drouth and bark beetle epidemics has been found in the majority of cases in western United States. In fact there is considerable evidence to indicate that the drouth period indicated on the chart extended over the entire western part of North America with the exception of coastal wet belts.

If there is a true correlation between bark beetle outbreaks in the pine stands of the B.C. interior and drouth then it is probable that there will be no major epidemics until another extended drouth period occurs. Although the rings on nearly all trees were measured back to 1835, growth curves have not been prepared further back than weather records (1896 for some stations). Consequently the regularity of drouth and wet periods as reflected in tree growth has not yet been investigated. For this purpose the trees used were hardly old enough to show a sufficient number of fluctuations to indicate regularity or otherwise. It is also probable that trees more sensitive to precipitation fluctuations can be found.

Dr. Edmund Schulmann of the Tree Ring Laboratory, Tucson, Arizona, visited the Vernon Laboratory in the summer of 1944 and he has provided many helpful suggestions with regard to growth studies. On his trip he found some ponderosa pines near Kamloops which are highly sensitive to precipitation fluctuations. It is planned to investigate these trees further, particularly with reference to regularity of drouth periods. If the cycle[15] is somewhat regular and conforms to the 23 year period recognized by meteorologists, it would imply that the weather for the B. C. interior has reverted to the wet cycle and that the peak years of this phase have not yet occurred. This would mean that we probably have 8 or 10 years left before another period of high bark beetle epidemic frequency occurs. During the time previous to this next drouth, much can be done toward placing logging operations in ponderosa pine stands on a practical selection basis to obtain maximum resistance to bark beetle attack for the residual stand. Unlogged mature stands remaining at that time will require applied control measures when epidemics develop. A close check on precipitation trend may indicate when special vigilance is required in the examination of lodgepole and ponderosa pine stands in order to detect these outbreaks at the very beginning.

E.30.40 -- The Douglas Fir Tussock Moth
(Notolophus pseudotsugata McD.)

- Morgan -

In 1943 only two egg masses were obtained from adult material which had been reared by inbreeding from stock taken near Otter Bay, Okanagan Lake, B.C. in the fall of 1939. No larvae hatched from these eggs in the spring of 1944. The death of these eggs, therefore, brings to an end the generation rearings of this defoliator. The cause of death of the eggs has not yet been determined but it is believed that a virus disease may have been responsible. This disease has been present in all generations, particularly in the larval stage, since the original stock was taken in 1939 at Otter Bay. In that year, the infestations existing in the North Okanagan Valley were destroyed by the wilt disease. Since then no infestations of this insect have been known to occur in this territory.

The only knowledge we have of how the Tussock moth has recovered in the field from this natural control factor is that of the Forest Insect Survey. Between 1939 and 1944 only one report was received with respect to this insect in the Okanagan Valley. This report consisted of one larva collected June 20,1940 at Larkin, B.C. Seven days after collection the larva died from wilt. After 1940 no other reports were received from this territory until July 26, 1944, when one mature larva was taken just NW. of W. Hall's place on Pleasant Valley road at Vernon. A female moth was reared from this larva on August 28.

Only three reports of Notolophus pseudotsugata have been received from outside of the Okanagan Valley since 1939. These were all taken in 1941 as larvae; one from Barriere on June 30, one from Penny on July 1, and three from Kettle Valley on July 7. The Barriere larva cocooned on July 22 and a male adult emerged on August 18. The larva from Penny was inflated. Two of the Kettle Valley larvae died in the prepupal stage, apparently from wilt. The third larva from this same locality was parasitized by a dipterous larva which also died.

PHENOLOGICAL OBSERVATIONS

Laboratory: Trinity Valley Field Station (Vernon, B.C.) Year: 1944 Observer: C.V.G.Morgan

Sta.	Species	Observations	Date	Remarks
1.	Picea engelmanni	First bud-scales shed	May 12	Only on very young trees
		" " " "	May 16	On mature trees
		First staminate flowers shedding pollen		Datum not available
		Terminal growth completed	July 28	Fourth week of July
2.	Pinus contorta latifolia	Terminal candles $\frac{1}{2}$" long & lateral " $\frac{1}{4}$" " Terminal " 1" " on young trees	May 4	Only on young trees
			May 12	2" long on trees 50' high
		First bud-scales shed	May 1	
		First staminate flowers shedding pollen	May 27	
		First needles separated in bundles	June 5	
		Terminal growth completed	Aug. 5	First week of August
		Old needles turning color	Aug.20	
		Old needles falling	Sept.4	
3.	Abies lasiocarpa	First bud-scales shed	May 4	
		First staminate flowers shedding pollen		Datum not available
		Needles 1/4" long	May 12	
		Terminal growth completed	July 21	Third week of July
4.	Larix occidentalis	First staminate flowers shedding pollen		Datum not available
		Needles separated in bud	Apr.21	Needles $\frac{1}{8}$" long on young trees
		Needles $\frac{1}{8}$" long on young trees	May 1	$\frac{1}{8}$" long on mature trees
		Needles full grown	May 12	On all trees
		Terminal growth completed	Aug. 1	First week of Aug.
		Needles turned-100%	Oct.23	
		Needles dropped-98%	Nov.13	
5.	Pyrus sitchensis	First bud-scales open	Apr.21	Leaves beginning to uncurl.
		Terminal leaves 2½" long	May 4	Leaves still curled
		Terminal leaves 4½" long	May 12	
		First flower open	May 28	
		100% flowers open	June 2	
		First fruit ripe	Aug.20	
		Tree leafless	Oct.23	

Sta.	Species	Observations	Date	Remarks
9.	Clintonia uniflora	Plants 2-3" high	May 5	
		Plants 3-4" high	May 12	
		First flower open	June 5	
		First fruit ripe	July 25	
10	Cornus canadensis	First green bracts separated	May 17	Not fully expanded
		First floret open	June 3	
		10% florets open	June 6	
		25% florets open	June 10	
		First fruit ripe	July 18	
		10% fruit ripe	July 27	
11	Solidago canadensis	First flower open	Aug. 8	
		Flowers common in region	Aug. 14	75% flowers open
		70% leaves turned	Oct. 23	
		100% leaves turned	Nov. 13	
12	Epilobium angustifolium	First flower open	July 10	
		Flowers common in region	July 28	
	Abies lasiocarpa	Bud-scales split & ends of needles showing	May 8	
	Acer glabrum	First bud-scales split & open	Apr. 22	Leaf bud showing
		20% flowers open	May 1	
		95% flowers open	May 4	First leaves uncurling
		Leaves 1¼" long	May 12	
		First leaf fully expanded	May 16	
		Tree leafless	Oct. 23	
	Achillea lanulosa	First flower open	June 15	
		100% flowers open	July 7	
	Alnus sp.	First bracts split open	Apr. 11	
		Tips of leaves just protruding from buds	May 4	
	Amelanchier alnifolia	Leaf buds expanding	Apr. 21	Leaves not yet uncurled
		Leaves ½"- ¾" long	May 4	
		Leaves fully expanded	May 12	
		First flower open	May 15	
		90% flowers open	May 17	
		100% flowers open	May 19	
		First fruit ripe	July 24	
		100% leaves dropped	Oct. 23	
	Anaphalis margaritacea	First flower open	July 3	
		40% flowers open	July 17	

Sta.	Species	Observations	Date	Remarks
	Aquilegia formosa	First flower open	June 6	
	Aralia nudicaulis	Petiole 5" high	May 4	Leaves not yet uncurled
		Leaves 2" long	May 12	Not fully expanded
		First flower open	May 30	
		95% flowers open	June 9	
		40% fruit ripe	July 21	
	Arctostaphylos uva-ursi	First flower open	May 16	
	Berberis aquifolium	Racemes 2" long	May 4	No flowers open
		First flower open	May 13	
		80% flowers open	May 19	
		First berries ripe	July 21	
	Betula occidentalis	Buds beginning to swell	Apr. 1	
		Bud-scales split & open	Apr.11	
		Tips of leaves just protruding from buds	May 4	
		Leaves 3/4" long	May 10	
		First flowers shedding pollen	May 13	
		85% leaves dropped	Oct.23	
	Calypso bulbosa	First flower open	May 2	
		100% flowers open	May 12	
	Carduus arvensis	First flower open	July 19	
	Ceanothus sanguineus	First flower open	June 4	
		90% flowers open	June 8	
		60% leaves dropped	Oct. 23	
	Chimaphila umbellata	Leaf buds 1/4" long	May 4	
		First flower open	July 1	
		25% flowers open	July 8	
		90% flowers open	July 21	
	Clematis columbiana	100% flowers open	May 19	
	Cornus stolonifera	First flower open	June 6	
	Corylus californica	Staminate flowers shedding pollen	Apr.21	
		Leaf buds 1/2" long	May 4	Leaves just beg. to uncurl.
		Leaves 1" long	May 12	Not fully expanded
		95% leaves dropped	Oct.23	100% leaves turned

Sta.	Species	Observations	Date	Remarks
	Disporum trachycarpum	First flower open 20% flowers open 95% flowers open	May 2 May 4 May 12	
	Fragaria spp.	First flower open 40% flowers open 75% flowers open 100% fruit ripe	May 2 May 12 May 19 July 7	
	Lathyrus ochroleucus	First flower open	June 1	
	Lilium parviflorum	Plants 6-12" high Flower buds 1" long First flower open	May 19 June 8 June 15	
	Linnaea borealis var. americana	First flower open	June 12	
	Lonicera ciliosa	Leaves 1" long Leaves fully expanded First flower open	May 4 May 12 June 13	Not fully expanded
	Lonicera involucratum	First flower open 100% flowers open	May 18 June 5	
	Lonicera utahensis	First flower open 5% flowers open 95% flowers open First fruit ripe 50% fruit ripe	May 1 May 4 May 12 June 13 June 17	Leaves 1" long Leaves fully expanded
	Lupinus sp.	First flower open	June 6	
	Lysichiton kamtschatcense	90% flowers open 100% flowers open	May 5 May 18	
	Pachystima myrsinites	25% flowers open 75% flowers open New growth 3/8" long 100% flowers open	May 1 May 5 May 12 May 19	
	Pinus monticola	Terminal candles ½" long & lateral candles ¼" " Terminal candles 1" long " " 2" long First needles separated in bundles	May 4 May 12 " June 5	Only on young trees On young trees On mature trees
	Populus tremuloides	Leaves 1" long 10% leaves dropped	May 12 Oct. 23	Not fully expanded 100% turned

Sta.	Species	Observations	Date	Remarks
	Populus trichocarpa	Leaf buds 1-2" long	May 4	Leaves just beginning to uncurl
		90% flowers shedding pollen	May 5	
		Leaves fully expanded	May 12	
		80% leaves dropped	Oct.23	
	Pseudotsuga taxifolia	First bud-scales shed	May 12	Only on very young trees
		First bud-scales shed	May 16	On mature trees.
	Pyrola secunda	First flowers open	June 24	
		50% flowers open	July 8	
		100% flowers open	July 21	
	Ranunculus sp.	First flower open	June 14	
	Ribes lacustre	Leaves 2" long	May 4	
		First flower open	May 12	
		50% leaves dropped	Oct.23	99% turned
	Ribes sanguineum	First flowers open	May 14	
	Rosa melina	Bud-scales split & open	Apr.11	
		Leaves 1 " long	May 4	Just beg. to uncurl
		Leaves 2" long	May 12	Not fully expanded
		First flower open	June 6	
		95% leaves dropped	Oct.23	
	Rubus parviflorus	First flower open	June 11	
		100% flowers open	July 5	
		95% leaves dropped	Oct.23	
	Rubus viburnifolia	Leaves 1/2" long	May 4	
		Leaves fully expanded	May 12	
		First flower open	June 15	
	Salix sp.	Bud-scales split & open	Apr.11	
		Leaves 1" long	May 4	
		Leaves fully expanded	May 12	New stems 2½" long
		90% leaves dropped	Oct.23	
	Shepherdia canadensis	80% flowers open	May 1	
		First paired leaves separated	May 3	
		Leaves 1¼" long	May 12	Not fully expanded
		95% fruit ripe	July 6	
		95% leaves dropped	Oct.23	
	Smilacena racemosa	Plants 4" high	May 4	
		Plants 15" high	May 12	
		First flower open	May 18	
		95% flowers open	June 8	

Sta.	Species	Observations	Date.	Remarks
	Spiraea lucida	Leaves 1" long	May 4	Not fully expanded
		Leaves fully expanded	May 12	
		First flower open	Junel9	
		90% flowers open	July 7	
		98% leaves dropped	Oct.23	
	Taraxacum officinale?	First flower open	May 8	
		80% flowers open	May 19	
		First seeds ripe & spreading	May 27	
	Taxus brevifolia	First needles bared	May 15	
	Tragopogon pratensis	First seeds ripe and spreading	July 7	
	Tsuga heterophylla	Bud-scales split open	May 12	
		First needles bared	June 10	
	Vaccinium membranaceum	Leaf buds 1/2" long	May 4	Leaves just beg. to uncurl
		First fruit ripe	July 3	
		50% fruit ripe	July 8	
		100% fruit ripe	July 21	
	Vaccinium ovalifolium	95% flowers open	May 5	
		100% flowers open	May 12	Leaves 1" long but not fully expanded
		98% fruit ripe	July 21	
	Viburnum pauciflorum	100% flowers open	June 8	
	Viola adunca	First flower open	May 2	
		95% flowers open	May 12	
	Viola glabella	First flower open	May 2	
		95% flowers open	May 12	

GENERAL OBSERVATIONS

Disappearance of winter's snow in open April 11
" " " " " forest " 21

Last spring frost May 11
First fall frost Sept.27

First snow to fly in air Nov. 11.
First snow to whiten ground Nov.21

TRINITY VALLEY FIELD STATION

Winter 1943- 1944

Date	Time	Outside Insectary Max.	Outside Insectary Min.	Outside Insectary At time of reading	Inside Insectary Max.	Inside Insectary Min.	Inside Insectary At time of reading	Overwintering chamber Max.	Overwintering chamber Min.	Overwintering chamber At time of reading	Snow on ground
Nov.1/43	11:00 A.M.	44.5	21.5	31.5	45.0	23.0	30.0	41.5	35.0	35.0	
Nov.8	10:30 A.M.	48.0	24.5	36.0	45.0	29.0	35.0	41.0	37.0	38.0	
Nov.16	10:00 A.M.	44.5	22.5	26.0	41.5	26.5	27.0	39.0	35.0	35.0	
Nov.29	10:30 A.M.	42.0	25.5	31.0	38.5	27.0	31.5	38.0	35.0	35.0	0.5"
Dec.8	2:00 P.M.	42.0	20.0	31.5	38.0	26.0	30.0	35.0	34.0	34.0	2.0"
Dec.21	2:30 P.M.	32.0	10.5	20.0	31.0	21.0	22.0	36.0	29.5	29.5	2.0"
Jan.10/44	10:20 A.M.	33.0	-2.5	-1.5	31.5	10.5	10.5	32.0	26.0	26.0	12.5"
Feb.1	10:00 A.M.	36.5	-3.0	19.0	33.0	8.5	19.5	32.0	25.0	26.0	11.5"
Feb.15	10:00 A.M.	41.5	5.0	17.0	35.0	16.5	18.5	31.0	26.0	28.0	17.5"
Mar.7	10:30 A.M.	43.5	-2.0	19.0	32.0	12.0	18.0	31.0	27.0	28.0	21.5"
Apr.1	10:00 A.M.	48.5	1.5	36.5	40.0	14.0	30.0	33.0	28.0	32.0	16.0"
Apr.11	10:00 A.M	60.5	24.5	40.0	60.0	25.0	38.0	41.0	32.0	35.0	disappeared - in open
April 21	10:00 A.M.	63.5	26.5	43.5	63.0	26.5	44.0	37.0	34.0	36.0	- in forest
May 1	11:30 A.M.	73.0	27.0	46.5	72.0	28.5	46.5	42.0	36.0	40.0	

TEMPERATURE RECORDS

for

TRINITY VALLEY FIELD STATION, B. C.

1 9 4 4

(May to October)

Date	Outside Insectary			Inside Insectary		
	Max.	Min.	At time of reading 8:00 A.M.	Max.	Min.	At time of reading 8:00 A.M.
May 1	53.0			53.0		
2	64.5	25.5	29.5	64.5	26.5	28.0
3	73.0	27.0	31.0	73.0	28.5	30.0
4	79.0	31.0	35.5	79.0	32.0	34.5
5	71.5	37.5	41.5	71.5	38.5	40.0
6	70.0	30.0	33.0	70.0	31.0	33.0
7	69.5	29.0	34.5	69.5	30.5	34.0
8	62.5	40.0	42.5	62.0	41.0	42.5
9	53.5	35.0	36.5	53.5	35.5	36.5
10	58.0	31.0	33.0	56.5	31.5	33.0
11	63.5	31.0	37.0	63.5	32.0	37.0
12	68.5	32.5	39.0	68.5	33.5	38.5
13	77.0	34.0	40.0	76.5	35.5	39.5
14	79.5	34.5	40.5	79.0	35.5	39.0
15	69.0	41.5	51.0	69.0	42.5	50.0
16	70.0	36.5	43.0	69.0	37.5	42.0
17	72.5	39.5	47.0	71.5	40.5	46.0
18	74.5	41.0	48.0	73.5	41.5	46.5
19	64.0	43.5	47.5	63.5	43.5	46.5
20	58.5	33.0	40.0	57.5	34.0	39.0
21	50.0	37.5	41.5	50.0	38.0	41.5
22	44.5	37.5	39.0	43.5	38.0	39.0
23	41.5	35.5	36.5	41.5	36.0	37.0
24	53.5	34.5	39.0	53.5	35.0	39.0
25	67.0	35.0	42.5	66.0	36.5	42.0
26	76.0	34.0	44.0	76.0	35.0	42.5
27	83.5	38.0	47.5	83.0	39.5	47.0
28	79.0	47.5	56.0	78.5	48.5	55.0
29	75.0	39.0	47.5	74.5	40.0	46.0
30	70.0	40.5	48.5	69.0	41.5	47.5
31	68.0	49.0	52.5	68.0	49.5	52.0

Date	Outside Insectary			Inside Insectary		
	Max.	Min.	8:00 A. M.	Max.	Min.	8:00 A.M.
June 1	62.5	50.0	53.0	61.5	50.0	53.0
2	61.0	46.0	49.0	59.0	46.5	48.5
3	70.0	35.5	43.5	69.5	36.5	43.0
4	70.0	35.0	43.0	69.5	36.5	42.5
5	79.0	38.0	46.0	78.0	39.0	45.0
6	75.0	41.0	48.0	75.0	43.0	47.0
7	51.0	40.5	47.0	51.0	41.5	46.5
8	73.5	41.0	45.5	73.0	41.0	45.0
9	83.0	39.0	47.0	83.0	40.5	46.5
10	85.0	40.0	48.5	85.0	42.0	48.0
11	79.5	45.0	50.0	79.0	46.5	49.0
12	76.5	36.0	40.5	76.0	37.5	40.0
13	67.5	50.0	52.0	66.5	50.5	52.0
14	63.0	49.0	49.5	62.0	49.5	49.5
15	74.5	41.0	47.0	74.0	42.0	46.0
16	77.5	45.5	53.0	77.0	47.0	52.0
17	71.5	49.0	53.5	71.0	49.5	52.5
18	64.0	51.5	54.5	63.5	52.0	53.5
19	75.0	44.0	48.0	73.5	45.0	47.0
20	72.0	49.0	54.0	71.5	49.5	53.0
21	71.5	51.0	55.0	71.0	51.5	54.0
22	78.5	43.5	49.0	78.0	45.0	48.0
23	81.0	44.5	51.0	81.0	46.0	50.0
24	66.0	51.5	55.5	65.5	53.0	56.0
25	67.5	49.0	51.5	67.0	49.5	51.0
26	69.0	41.0	44.0	69.0	41.5	44.0
27	77.5	38.0	45.5	77.5	39.0	45.0
28	80.0	44.0	51.5	80.0	45.0	50.5
29	86.5	46.0	55.5	86.0	47.5	55.0
30	74.0	54.0	60.5	73.5	55.0	60.0
July 1	66.0	39.0	46.5	65.5	40.0	46.0
2	65.5	42.0	47.0	65.0	43.5	46.5
3	77.0	36.0	39.0	76.0	37.5	39.0
4	83.0	40.5	48.0	82.0	42.0	48.0
5	84.0	45.0	52.0	83.5	47.0	51.5
6	65.5	43.0	49.0	65.0	43.5	49.0
7	69.5	37.0	45.5	69.0	38.0	46.0
8	79.0	34.0	42.5	78.0	35.5	43.0
9	82.0	45.0	52.5	81.0	46.0	52.0
10	81.0	49.0	56.5	80.5	50.0	56.0
11	84.0	45.5	55.5	85.0	47.0	54.5
12	74.5	49.0	53.5	74.5	50.0	53.5

Date	Outside Insectary			Inside Insectary		
	Max.	Min.	8:00 A.M.	Max.	Min.	8:00 A.M.
July 13	78.5	47.5	51.0	78.0	48.0	51.0
14	79.5	39.5	47.0	79.0	41.0	47.0
15	73.0	49.5	55.0	73.0	51.0	55.0
16	78.0	47.0	53.0	78.0	48.0	53.0
17	85.0	43.0	48.0	84.5	44.5	48.0
18	93.0	44.0	51.0	94.0	46.0	51.0
19	96.5	47.0	55.0	97.0	49.0	55.0
20	73.0	58.0	61.0	74.0	59.0	61.0
21	78.0	55.0	57.5	78.0	56.0	58.0
22	84.0	46.0	54.5	84.0	47.5	53.5
23	89.5	45.5	52.5	90.0	47.5	52.0
24	81.5	62.0	63.0	81.0	63.0	63.5
25	84.5	41.5	51.5	84.0	43.5	51.0
26	90.0	44.0	51.5	90.0	45.0	51.0
27	92.5	46.0	53.0	92.5	47.0	52.5
28	92.0	50.0	57.5	92.0	51.0	57.0
29	85.0	50.5	58.0	84.5	52.0	57.5
30	62.0	51.0	54.5	62.0	52.0	54.5
31	71.0	50.0	51.5	70.5	50.0	51.5
Aug. 1	78.0	41.5	47.0	78.0	42.0	47.0
2	79.0	41.0	44.5	78.0	42.0	44.5
3	77.0	45.0	51.5	76.5	46.0	51.0
4	81.5	46.0	50.0	81.5	47.0	50.0
5	85.5	45.0	49.5	85.5	46.0	49.0
6	81.0	45.0	51.5	80.5	46.0	51.0
7	61.0	54.0	54.0	61.0	54.5	54.5
8	75.0	38.0	45.0	74.0	38.5	45.0
9	64.0	40.0	45.5	64.0	41.0	45.0
10	73.0	52.0	56.0	73.0	52.0	56.0
11	82.5	41.0	43.0	83.0	42.0	43.0
12	63.0	53.0	57.0	63.0	53.0	57.0
13	59.0	44.0	53.0	59.0	44.0	53.0
14	69.0	36.0	39.0	69.5	37.0	39.0
15	63.0	50.5	51.0	62.0	51.0	51.5
16	71.5	38.0	41.5	71.5	38.5	42.0
17	74.0	45.0	49.0	74.0	46.0	49.0
18	66.5	43.0	46.0	66.0	44.0	46.0
19	66.5	41.0	44.5	66.0	41.5	44.5
20	74.0	35.0	37.5	74.0	36.0	37.5
21	78.0	41.0	42.5	78.0	42.0	43.0
22	77.5	39.0	45.0	77.5	40.5	45.0
23	79.0	39.0	44.0	79.0	40.0	44.0

(Temperature Records)

Date	Outside Insectary			Inside Insectary		
	Max.	Min.	8:00 A.M.	Max.	Min.	8:00 A.M.
Aug. 24	73.0	43.0	48.0	72.5	44.0	47.5
25	75.0	41.0	45.0	74.0	42.0	45.0
26	74.5	43.0	46.5	74.5	44.0	47.0
27	77.5	43.5	46.0	77.5	44.5	46.0
28	73.0	49.5	51.0	72.0	50.5	51.0
29	77.0	40.0	44.0	76.5	41.0	44.0
30	79.5	40.5	44.0	79.0	42.0	43.5
31	84.0	42.0	46.0	84.0	43.5	46.0
Sept. 1	71.0	58.5	58.5	70.0	59.0	59.0
2	71.0	37.0	41.5	70.5	37.5	42.0
3	78.5	43.0	43.5	78.0	44.0	44.0
4	78.5	42.0	43.0	78.0	43.0	43.5
5	81.0	40.0	41.5	81.0	41.0	42.5
6	87.0	41.5	43.5	87.5	43.0	44.0
7	83.0	44.5	46.5	83.0	46.0	47.0
8	83.5	40.5	43.5	83.0	41.5	43.5
9	82.5	41.0	43.0	82.5	42.0	44.0
10	85.0	41.0	42.0	85.0	42.5	43.0
11	86.0	43.0	43.0	86.0	44.0	44.0
12	85.0	42.5	43.5	85.0	43.5	44.5
13	57.0	45.5	48.0	57.0	46.5	48.0
14	54.5	40.5	42.0	55.0	41.0	42.0
15	51.0	43.5	45.5	51.0	44.0	45.5
16	48.5	42.5	42.5	48.5	42.5	42.5
17	52.5	34.5	37.0	52.5	35.0	37.0
18	52.0	38.0	40.5	52.0	38.5	40.5
19	48.0	41.0	42.5	48.0	41.0	42.5
20	51.0	40.5	43.0	51.0	41.0	43.0
21	56.0	39.5	42.0	56.0	40.0	42.0
22	67.5	41.0	42.5	67.5	41.5	42.5
23	69.5	39.0	41.5	70.0	40.0	42.0
24	69.0	39.5	39.5	69.0	40.0	40.0
25	67.5	42.5	42.5	67.0	43.0	43.0
26	65.0	42.5	42.5	65.0	44.0	44.0
27	64.0	31.0	33.0	64.0	32.0	33.5
28	58.0	34.0	36.0	57.5	35.5	36.0
29	51.0	46.5	48.0	51.0	47.0	48.0
30	55.5	44.0	44.0	55.5	44.0	44.0
Oct. 1	60.0	36.5	37.0	60.5	37.5	37.5
2	56.0	45.5	46.5	56.0	46.5	47.0
3	64.5	46.5	48.5	65.0	47.5	48.5

(Temperature Records)

Date		Outside Insectary Max.	Min.	8:00 A.M.	Inside Insectary Max.	Min.	8:00 A.M.
Oct. 4.		54.0	43.5	43.5	54.0	44.0	44.0
5		52.0	39.5	39.5	52.0	40.0	40.0
6		56.0	29.0	29.5	56.0	30.0	30.0
7		60.0	30.0	30.0	59.5	31.0	31.0
8		59.5	31.0	31.0	59.0	31.5	31.5
9		60.0	32.0	32.0	60.0	33.0	33.0
10			30.5	30.5		31.5	31.5
	Time of reading			At time of reading			At time of reading
16	10:30 A.M.	57.0	30.0	38.0	57.0	30.5	38.0
23	11:00 A.M.	53.0	30.0	51.0	53.0	31.0	50.5
30	10:30 A.M.	57.0	29.5	41.0	56.0	30.5	40.5

RAINFALL RECORDS

for

TRINITY VALLEY FIEDD STATION, B.C.

1944
(April to November)

Date	Time	Rainfall in inches	Remarks
Apr.1	10:00 A.M.		Rain gauge set up
11	"	0.080	Fell since April 1
21	"	1.240	Fell since April 11 (incl.snow of Apr.18)
May 1	11:30 A.M.	0.330	Fell since Apr. 21.No rain fell in A.M. of May 1.
Total for Apr.		1.650	
May 1-2	9 A.M.-		Traces fell between 12:30 P.M. & 6:00
	9 A.M.	0.000	P.M. of May 1.
7-8	"	0.010	Fell in late P.M. of May 7 & early A.M. of May 8
8-9	"	0.165	Traces throughout period. Light shower between 4:00 P.M. & 4:50 P.M. of May 8 accompanied by small amountof hail. Heavy showers in late P.M. of May 8 & early A.M. of May 9.
9-10	"	0.060	Traces fell in P.M. of May 9 until 5:30 Light shower fell between 4:15 P.M. & 5:00 P.M. of May 9.
10-11	"	0.000	Traces fell between 7:00 P.M. & 8:00 P.M. of May 10
11-12	"	0.000	Traces fell in P.M.--after 5:00 P.M.--of May 11.
15-16	"	0.105	Showers fell between 9:30 A.M. & 12:00 noon of May 15 & in early A.M. of May 16.
17-18	"	0.000	Traces fell between 5:40 P.M. & 5:50 P.M. of May 17.
18-19	"	0.035	Light showers fell in early A.M. of May 19.
21-22	"	0.210	Showers fell throughout P.M. of May 21 & A.M. of May 22.
22-23	"	0.505	Almost continuous rain throughout period.
23-24	"	0.730	Showers fell between 9:00 A.M. & 4:15 P.M. of May 23, traces fell between 4:15 P.M. and 6:30 P.M. of May 23 & in AM. of May 24.
24-25	"	0.005	Very light rains & traces fell throughout A.M. of May 24.
30-31	"	0.065	Light showers fell in P.M.(after 2:30 P.M.) of May 30.
31-June 1	"	0.270	Traces fell bet. 11:30 A.M. & noon, & at 2:00 P.M. of May 31. Showers fell throughout P.M. (after 3:00 P.M.) of May 31. & A.M.of June 1.
Total		2.160	

Rainfall Records)

Date 9 A.M. to 9 A.M.	Rainfall in inches	Remarks
June 1 - 2	0.145	Showers fell throughout period. Thunder in P.M. of June 1.
2 - 3	0.065	Showers fell bet. 10:25 A.M. & 10:40 A.M. of June 2 and bet. 2:35 P.M. & 3:50 P.M. of June 2.
4 - 5	0.005	Light shower fell in P.M. of June 4.
6 - 7	0.000	Traces fell bet. 3:00 P.M. & 5:30 P.M. of June 6
7 - 8	0.300	Traces fell bet. 11:45 A.M. & 12.15 P.M. of June 7 Showers fell thereafter until 7:30 P.M. of June 7
13 - 14	0.595	Traces & light showers fell bet. 2:40 P.M. & 10:15 P.M. of June 13. Showers fell thereafter until 9:00 A.M. of June 14.
14 - 15	0.020	Light showers & traces fell bet. 9:00 A.M. & 10:30 A.M.,bet. 4:30 P.M. & 4:45 P.M. & bet. 5:20 PM. and 5:30 P.M. of June 14.
16 - 17	0.030	Heavy showers in short periods fell bet. 7:45 & 8:10 P.M. of June 16.
17 - 19	0.185	Fell throughout A.M. & P.M. of June 18.
19 - 20	0.185	Showers fell bet. 4:45 P.M. & 7:30 P.M. of June 19 accompanied by thunder and lightning.
20 - 21	0.010	Traces fell throughout period. Light rains fell in late P.M. of June 20, accompanied by thunder & lightning.
21 - 22	0.040	Traces fell bet. 9:00 A.M. & 5:00 P.M. of June 21. Showers fell bet. 10:30 P.M. & 11:20 A.M. & bet. 2:25 P.M. & 3:05 P.M. of June 21, accompanied by thunder & lightning.
22 -23	0.000	Traces fell bet. 12:05 & 12:10 P.M. of June 22.
24 - 26	0.095	Fell throughout period
26 - 27	0.110	Showers fell bet. 2:30 & 5:30 P.M. of June 26, accompanied by thunder and lightning.
28 - 29	0.000	Traces fell bet. 2:40 & 2:45 P.M. of June 28.
29 - 30	0.000	Traces fell bet. 4:15 & 4:50 P.M. of June 29.
Total	1.785	
July 1 - 3	0.175	Showers fell throughout July 1 and 2
5 - 6	0.050	Showers fell after 9:05 P.M. of July 5 & in early A.M. of July 6.
6 - 7	0.035	Showers fell bet. 1:23 & 1:45 P.M. & bet. 3:15 and 4:00 P.M. of July 6.
7 - 8	0.000	Traces fell at 10:00 AM. & at 1:45 P.M. of July 7

Date 9 A.M. to 9 A.M.	Rainfall in inches	Remarks
July 8 - 10	0.025	Showers fell mostly in late P.M. of July 8.
10 - 11	0.115	Showers fell bet. 1:20 & 1:40 P.M. & bet. 3:20 and 6:00 P.M. of July 10, accompanied by thunder and lightning.
11 - 12	0.000	Traces fell bet. 2:00 & 5:00P.M. of July 11
13 - 14	0.050	Shower fell bet. 11:30 and 11:50 A.M. of July 13. Traces fell at 2:05 P.M. (and thunder), at 3:30 P.M., at 4:45 P.M. & bet. 7:15 and 7:25 P.M. of July 13. Showers fell bet. 8:00 & 9:45 P.M. of July 13.
15 - 16	0.025	Showers fell bet. 12:00 (noon) & 2:30 P.M. of July 15. Traces fell thereafter until 6:00 P.M. of July 15.
19 - 20	0.030	Traces fell at 8:30 P.M. of July 19. Showers fell bet. 9:10 & 9:15 P.M. of July 19. Traces fell thereafter throughout P.M. of July 19. All accompanied by heavy thunder and lightning.
20 - 21	0.190	Showers fell bet. 11:30 A.M. & 1:45 P.M. of July 20 & bet. 3:45 & 5:30 P.M. of July 20; traces thereafter in P.M. throughout July 20, accompanied by thunder & lighting.
21 - 22	0.010	Light showers fell bet. 12:25 & 12:45 P.M. of July 21.
24 - 25	0.000	Traces fell at 3:55 P.M. of July 24.
29 - 31	0.565	Showers fell in late P.M. of July 29, throughout July 30 and in early A.M. of July 31.
31 - Aug.1	0.000	Traces fell bet. 11:50 and 11:55 A.M. of July 31.
Total	1.270	
Aug. 3 - 4	0.005	Light showers fell bet 4:45 & 5:40 P.M. of Aug. 3
4 - 5	0.000	Traces fell bet. 4:40 & 4:45 P.M. of Aug.4.
6 - 7	0.025	Showers fell bet. 7:45 & 9:00 A.M. of Aug. 7.
7 - 8	0.065	Intermittent showers bet. 9:00 A.M. & 7:15 P.M. of Aug. 7.
8 - 9	0.085	Showers fell bet. 4:35 & 5:25 P.M. of Aug. 8
9 - 10	0.160	Showers fell bet. 1:35 & 2:50 P.M. of Aug. 9. Traces thereafter until 4:30 P.M. of Aug. 9. Showers fell in early A.M. of Aug. 10.
11 - 12	0.290	Showers fell bet. 4:20 P.M. of Aug. 11 and 9:00 A.M. of Aug. 12.
12 - 14	0.465	Showers fell throughout A.M. & P.M. of Aug. 12 and throughout A.M. & P.M. of Aug. 13.

Date	9:00 A.M.- 9:00 A.M.	Inches Rainfall	Remarks
Aug.	14 - 15	0.320	Fell between 11:00 P.M. of Aug. 14 & 9:00 A.M. of Aug. 15.
	15 - 16	0.460	Light showers fell bet. 9:00 & 9:50 A.M. of Aug. 15. Intermittent showers fell bet. 12:20 and 5:45 P.M. of Aug. 15, especially heavy showers bet. 5:10 & 5:25 P.M. accompanied by hail (3/16" diam.) and thunder.
	17 - 18	0.095	Fell in late P.M. of Aug. 17 & early A.M. of Aug. 18.
	18 - 19	0.005	Light showers fell bet. 12:00 (noon) & 3:00 P.M. of Aug. 18.
	19 - 20	0.030	Light showers fell bet. 12:00 (noon) & 12:30 P.M. of Aug. 19 & bet. 3:00 & 3:35 P.M. of Aug. 19.
	23 - 24	0.010	Light showers fell bet. 5:54 & 7:35 P.M. of Aug. 23, accompanied by thunder & lightning.
	24 - 25	0.020	Light showers fell bet. 5:05 & 6:15 P.M. of Aug. 24, accompanied by thunder & lightning.
	26 - 28	0.010	Light rains fell in P.M. of Aug. 26, in P.M. of Aug. 27 and in early A.M. of Aug. 28.
	Total	2.045	
Sept.	1 - 2	0.000	Traces fell bet. 5:58 & 6:05 P.M. of Sept. 1.
	13 - 14	0.290	Showers fell bet. 9:25 A.M. & 10:15 A.M. & bet. 11:00 A.M. & 1:45 P.M. of Sept. 13, & in early A.M. of Sept. 14.
	14 - 15	0.480	Continuous showers fell bet. 12:30 P.M. of Sept. 14 and early A.M. of Sept . 15.
	15 - 16	0.500	Almost continuous rain throughout period.
	16 - 18	0.525	Fell throughout Sept. 16 and 17.
	18 - 19	0.000	Traces fell bet. 2:25 & 3:30 P.M. of Sept. 18
	19 - 20	0.345	Continuous rain fell bet. 9:40 A.M. & 4:30 P.M. of Sept. 19. Traces fell thereafter in P.M. of Sept. 19.
	20 - 21	0.155	Showers fell bet. 11:10 A.M. & 4:40 P.M. of Sept. 20.
	21 - 22	0.045	Showers fell bet. 8:45 P.M. & 11:00 P.M. of Sept. 21.
	22 - 23	0.000	Traces fell at 3:00 P.M. & bet. 4:25 P.M. & 5:30 P.M. of Sept. 22
	28 - 29	1.090	Almost continuous rain fell bet. 2:30 P.M. of Sept. 28 and 9:00 A.M. of Sept. 29.
	29 - 30	0.270	Showers fell bet. 9:00 A.M. & 3:20 P.M. of Sept.29.
	Total	3.700	

(Rainfall Records)

Date 9 A.M. - 9 A.M.		Rainfall in inches	Remarks
Oct. 1 - 2		0.080	Fell in late P.M. of Oct.1& early A.M. of Oct. 2
2 - 3		0.010	Fell in late P.M. of Oct. 2 & early A.M.of Oct.3
3 - 4		0.090	Fell in early A.M. of Oct. 4.
4 - 5		0.325	Traces fell bet. 12:05 & 12:10 P.M. of Oct. 4. Showers fell bet. 5:55 P.M. Oct.4 & 9:00 A.M. of Oct. 5.
5 - 6		0.005	Traces fell bet. 9:00 A.M. & 9:30 A.M. of Oct. 5. Hail fell bet. 3:40 & 3:45 P.M. of Oct. 5. Pieces about 5 mm. in diam. Traces fell thereafter until 5:00 P.M. of Oct. 5.
Oc.t23	A.M. 11:00	0.255	Fell since Oct. 16. No rain fell bet. Oct. 6. & Oct. 16. incl. Not raining at time of recording.
30	10:15	0.075	Fell since Oct. 23. Not raining at time of " .
Total		0.840	
Nov.6	11:00	1.490	Fell since Oct. 30. Not raining at time of recording.
13	10:00	0.510	Fell since Nov. 6--frozen in cup-melted to measure. Not raining at time of reading.
20	10:30	0.000	No rain (or ice) in gauge. No snow on ground.
30	10:45	0.770	Fell since Nov. 20--includes both rain & snow. Not raining or snowing at time of reading. Rain gauge dismantled. 4 inches of snow on ground.
Total		2.770	

SUMMARY - WEATHER RECORDS - 1944

Trinity Valley Field Station.
B.C.

	April	May	June	July	Aug.	Sept.	Oct.	November.
No. of days recorded	--	31	30	31	31	30	9	--
Max. temp. of month	73.0	83.5	86.5	96.5	85.0	87.0	64.5	51.5
Min. temp. of month	24.5	25.5	35.0	34.0	35.0	31.0	29.0	14.0
No. days 32°F.or below	--	8	0	0	0	1	16	--
No. days with snow	--	0	0	0	0	0	--	--
No. days with hail	--	1	0	0	1	0	--	--
No. days with rain	--	16	18	17	19	13	--	--
Total precipitation in inches	1.650*	2.160	1.785	1.270	2.045	3.700	0.840*	2.770*

* For full month

RAINFALL

Trinity Valley Field Station,
B.C.

	1942		1943		1944	
Month	No.days recorded	Total precipitation	No. days recorded	Total precip.	No. days recorded	Total precipitation
April	21	0.915"	30	0.735"	30	1.650"
May	31	5.110	31	1.815	31	2.160
June	30	4.675	30	1.815	30	1.785
July	31	6.625	31	1.035	31	1.270
Aug.	31	0.635	31	1.700	31	2.045
Sept.	30	0.895	30	1.030	30	3.700
Oct.	31	1.535	31	1.910	31	0.840
Totals		20.390"		10.040"		13.450"

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