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

- 1943 -

VERNON FOREST INSECT LABORATORY

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ANNUAL REPORT

of the

VERNON FOREST INSECT LABORATORY

Calendar Year 1943

Introduction

The principal work carried on by the Vernon Forest Insect Laboratory during 1943 has been the control of the mountain pine beetle (Dendroctonus monticolae Hopkins) in the lodgepole pine stands of Banff National Park; studies in connection with the bark beetle outbreaks in Kootenay and Banff Parks; examination of spruce budworm outbreaks and collection of budworm parasites for the Belleville Parasite Laboratory; continuation of the forest insect survey; and studies in connection with the larch sawfly and its parasites, including collection of 50,000 cocoons for parasite recovery at Belleville Laboratory.

During the winter of 1942-43, nearly all bark beetle control areas were recleaned, and those areas which were not worked the first season were covered. Low temperatures in January, 1943 greatly aided the control work by killing a high percentage of the broods above snow line. This, together with control work, reduced the infestation to such an extent that it was necessary to cover only one area in the 1943-44 season.

The principal development in connection with the spruce budworm was the securing of several hundred larvae of the parasite Phytodietus fumiferanae in the Lillooett district by W. G. Mathers of the Vernon Laboratory, and A. Wilkes of the Belleville Laboratory. These are to be used for breeding up at Belleville and eventual liberation in the eastern spruce budworm infestations.

On most of the larch sawfly areas, parasitism was high by both Tritneptis klugii and Mesoleius tenthredinis. In the lot of 50,000 cocoons collected at Needles for the Belleville Laboratory, parasitism by Mesoleius was about 50 per cent. This shipment should yield 12 to 15 thousand Mesoleius for liberation in areas of eastern Canada where they are required.

Returns from the Forest Insect Survey were somewhat below those of 1942, which is not surprising in view of the reduced personnel. of forest agencies due to the war and the reduction in personal contacts on the part of the Vernon staff and forest officers due to reduced travel.

All projects in progress in 1943 will be continued in 1944. An increase in spruce budworm work will be necessary in view of the increase in the number of infestations. This will necessitate increased travel during 1944.

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 (I a)

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ATTENDANCE OF OFFICERS AT CONFERENCES; ADDRESSES

and

LECTURES

On April 3 and 4, Geo. R. Hopping, conferred with the late Dominion Entomologist, Dr. L. S. McLaine and Major P. J. Jennings, Superintendent of Banff National Park, concerning the bark beetle control work at Banff.

Dr. McLaine conferred with officers of the Vernon Laboratory on April 15 after which the staff attended a meeting of the Okanagan Agricultural Club where Dr. McLaine gave an address on "Entomology in War Time."

On July 22, Geo. R. Hopping conferred with G. F. Horsey, Superintendent of Glacier, Yoho, and Kootenay National Parks, on salvage operations in connection with the Kootenay Park bark beetle outbreak.

H. J. Hodgins, Forester, Economics Division, B. C. Forest Service and C. F. McBride, Assistant District Forester at Kamloops, conferred with officers of the Vernon Laboratory in October in connection with selective cutting in relation to insect damage.

The staff of the Vernon Laboratory attended the Annual Meeting of the Entomological Society held at Kamloops on February 27. Papers were presented by Geo. R. Hopping and H. B. Leech. G. R. Hopping was re-elected to the office of Honorary Secretary-Treasurer and H. B. Leech was appointed to the Editorial Board.

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RECONNAISSANCE AND FIELD WORK

W. G. Mathers was absent from the Vernon Laboratory February 4 to 15, checking over the bark beetle control operations at Banff. While there, examination was made of previously worked areas to determine the advisability of recleaning.

Geo. R. Hopping, was absent from the laboratory April 1 to 9 on bark beetle control work at Banff.

Geo. R. Hopping and W. G. Mathers were absent from the laboratory June 10 to 22, making growth studies and determining winter kill in connection with bark beetle control in Banff, Kootenay, and Yoho National Parks.

W. G. Mathers spent June 25 to July 9 in company with Dr. A. Wilkes, of the Belleville Parasite Laboratory, searching for the spruce budworm parasite, *Phytodietus fumiferanae* in the Lillooet district.

Geo. R. Hopping spent July 22 to 26 making a survey of bark beetle conditions in Yoho National Park between Field and Leanchoil.

W. G. Mathers was absent from the laboratory August 20 to 27 making an examination of the spruce budworm infestations in the Birken, Pemberton, and Pemberton Meadows districts.

Geo. R. Hopping and W. G. Mathers spent September 1 to 17 inclusive on growth studies in Banff and bark beetle studies in Kootenay National Park. They returned via the Kootenay region and made a survey of larch sawfly conditions, taking many samples for parasite recovery.

Geo. R. Hopping and H. B. Leech were at Needles, B.C. September 27 to October 1 collecting and supervising the collection of larch sawfly cocoons for the Belleville Laboratory.

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COOPERATION WITH OTHER ORGANIZATIONS

There has been a continuation of the whole-hearted cooperation between the Vernon Laboratory and the National Parks Branch in the carrying out of bark beetle work inBanff and Kootenay National Parks.

The British Columbia Forest Service and the National Parks wardens still maintain an active interest in the forest insect survey, but diminishing returns suggest that more personal contacts with forest officers are urgently needed. This applies especially to the Alberta Forest Service, from which returns have never been satisfactory.

The Vernon Laboratory has been of assistance to several lumber companies during the year by providing them with reports of insect damage on their timber holdings and recommendations regarding these.

A number of inquiries on shade-tree insects have been referred to this laboratory by the Dominion Experimental Farm director at Summerland and recommendations for control have been supplied in the majority of cases.

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GENERAL INSECT CONDITIONS IN FOREST AND SHADE TREES in 1943

The mountain pine beetle (Dendroctonus monticolae Hopk.)— Very low temperatures in January, 1943 killed a high percentage of the bark beetle broods above snow line in both the Banff and Kootenay infestations. This greatly aided the control work in Banff so that most areas only developed one freshly infested tree in every fifteen acres with the exception of the Sulphur Mountain area, which was considerably heavier, apparently due to attraction by an abnormal number of windfalls.

The Lodgepole Pine Needle Miner (Recurvaria milleri Busck.)—It continued to be active over approximately 50 square miles in the Bow Valley between Castle Mountain and Banff, Alberta. As in 1942, the infestation was heaviest in younger stands between 5500 and 6500 feet elevation. This is the first year of the two-year life cycle, so that 1944 will be a moth-flight year. This year, the current year's needles were only about half mined. It is most surprising how the larvae could survive the severe temperatures in January, 1943, but examination in the summer indicated little mortality due to winter kill.

The European larch sawfly (Pristiphora erichsonii Hartig.)— Again active throughout most of the larch stands in southern British Columbia. Heaviest defoliation was along the Arrow Lakes between Nakusp and Edgewood. Light to medium defoliation with patches of heavier infestation extended as far east as Moyie Lake, while east of there, defoliation was light except for two small areas, one just east of Elko and the other in the vicinity of Morrissey. Cocoon samples collected this year showed parasitism by Mesoleius and Tritneptis to be remarkably high throughout the greater part of the infested areas.

The Spruce budworm (Cacoecia fumiferana Clem.)—Sharp increase in numbers on several areas in British Columbia this year. A severe outbreak occurred in the Pemberton district where Douglas fir at 1500 to 3500 feet elevation suffered heavy defoliation. The infestation extended along both sides of the valleys from Anderson Lake down the Birkenhead Valley to Pemberton and north from Pemberton up the Lillooet Valley for about 20 miles, a total distance of nearly 50 miles. Moderately heavy infestations were found on the south side of Mission Ridge above Shalalth, B.C., and on the slopes of Mt. McLean at Lillooet B.C., Light infestations occurred near the road crossing on Bridge River and in Botanie Valley. A heavy infestation also occurred along the Hope-Princeton road, west of Allison Pass. Infestations have also been in progress in the spruce-balsam stands near Barkerville and in the National Parks but at these higher elevations, the budworm requires two years to complete its life cycle.

The Forest tent caterpillar (Malacosoma disstria var. erosa Stretch)— Continued to be active in the Cariboo District, B.C., It was particularly heavy south of Lac La Hache, where, on July 7, the caterpillars were so numerous on the railway tracks between Lone Butte and Horse Lake, that a train was delayed two hours.

The Poplar sawfly (Pontania pepii Ross -provisional determination)— For the second year this insect has caused severe defoliation of black cottonwood (Populus trichocarpa) in the Eagle River and Shuswap River valleys from Three Valley Lakes west and south to Grindrod. Generally speaking, defoliation was a little less severe than in 1942.

The Willow leaf beetle (Lina aeneicollis Schffr.)— Numerous on all willow plants examined in June at Vermilion Summit between Banff and Kootenay National Parks. These beetles were not noted in any numbers at this locality in 1942.

The Fall Webworm (Hyphantria cunea Drury)— Prevalent as usual in the Okanagan district.

The Box elder bug (Leptocoris trivittatus Say)— Reported to be abundant near Manitoba maples at Lillooet and Lytton, B.C. This is our first report of the species at Lillooet although it has been present at Lytton for at least three years. Few complaints have been received this year of its occurrence in the Okanagan Valley, where the species evidently suffered a heavy mortality from the low temperatures in January 1943.

Shade tree pests were extremely scarce in the interior of British Columbia in 1943 and this also may be the result of low temperatures during the previous winter.

The needle fungus (Hypodermella laricis Tub)—Caused severe and widespread injury to larch this year in the Vernon-Lumby district. The area covered is not definitely known but the injury was apparently confined to the western side of Monashee Pass. The mortality, if any, cannot be determined until the summer of 1944.

The Douglas fir bark beetle (Dendroctonus pseudotsugae Hopk.)— This insect is causing substantial loss to the Columbia River Timber Company on their limits near Blackwater Lakes in the Big Bend of the Columbia River. At the request of this company an examination was made of their timber berth on September 2. A severe hemlock looper outbreak occurred here in 1937-38 which resulted in a tree mortality of 85 to 90 per cent over limited areas and a loss of 5 to 10 per cent over the entire affected area. The Douglas fir bark beetle and the balsam bark beetle (Dryocoetes confusus) followed the looper epidemic and at the time of examination, 60 per cent of the remaining Douglas fir and 50 per cent of the remaining balsam had been destroyed by these two species of bark beetle respectively.

The Lilac leaf miner (Gracilaria syringella)—Lilacs in the Vernon area not as severely injured as in 1942.

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DETAILED REPORT OF PROJECTS.

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

In 1943, 657 samples and 74 negative reports were received at the Vernon Laboratory. In 1942, 773 samples were received and in 1941, 945.

The collections contained ~~over~~ almost 7,000 insects (all stages) representing about 600 different species. Seven or eight of these species are now causing appreciable or serious damage, others have been destructive in the past and may cause further damage at any time, while still others are often collected but are not known to have caused serious injury. The accompanying table gives the number of insects received in the different orders for the three years 1941 to 1943 inclusive.

The following host association summary has been prepared from the survey records dealing only with the most important insects.

Aspen - see poplar
Balsam- " fir
Ceanothus - buck brush
- *Nymphalis californica*

Douglas Fir -
- *Adelgids*
- *Cacoecia fumiferana*
- *Hemerocampa pseudotsugata*
- *Neophasia menapia*
- *Peronea variana*
- *Phenacaspis* (= *Chionaspis*) *pinifoliae*
- *Semiothisa granitata*

Fir - true firs (*Abies*), balsam
- *Cacoecia fumiferana*
- *Hemerocampa pseudotsugata*
- *Phenacaspis* (=*Chionaspis*) *pinifoliae*
- *Semiothisa granitata*

Hemlock -
- *Adelgids*
- *Lambdina* (=*Ellopia*) *fiscellaria lugubrosa*
- *Neodiprion tsugae*
- *Neophasia menapia*
- *Peronea variana*
- *Phenacaspis pinifoliae*

Juniper -
- *Dichomeris marginella*

Larch-

Adelgids
Anoplonyx sp.
Pristiphora (*Lygaeonematus*) *erichsonii*
Pristiphora sp.
Semiothisa sexmaculata

Maple - Manitoba maple or box elder. (*Acer negundo*)

Leptocoris trivittatus

Pine -

Adelgids
Aphrophora permutata
Dendroctonus monticolae
Hypomolyx piceus
Neodiprion spp.
Neophasia menapia
Phenocaspis (=*Chionaspis*) *pinifoliae*
Recurvaria milleri
Urocerus flavicornis

Poplar -

Chrysomela sp.
Malacosoma disstria erosa
Phytodecta americana
Pontania pepii

Spruce-

Adelgids
Autographa spp.
Cacoecia fumiferana
Cephalica sp.
Hypomolyx piceus
Phenacaspis (=*Chionaspis*) *pinifoliae*
Pikonema alaskensis
Pikonema dimmocki
Pissodes spp.
Semiothisa granitata
Taniva albolineana

Willow:

Chrysomela aeneicollis
Galerucella carbo

On any trees infested with Aphids etc.

Chrysopidae *Hemerobiidae*
Coccinellidae *Syrphidae*

INSECTA :

		Specimens Rec'd 1941	1942	1943	Totals 1941	1942	1943
Coleoptera	eggs	40 +	-	-			
	larvae	146	82	69			
	pupae	13	28	23			
	adults	1057	1228	732	1256	1338	824
Collembola					7	4	2
Dermaptera					11	6	14
Diptera	larvae	154	93	343			
	puparia	47	34	50			
	adults	117	124	53	318	251	446
Ephemeroptera					10	6	4
Hemiptera	eggs	53	14	53			
	immatures	184	188	108			
	adults	432	257	274	669	459	435
Homoptera					691+	518+	895+
Hymenoptera:							
Symphyta	larvae	1164	2624	2084			
	cocoons	330	469	212			
	adults	21	14	21	1515	3107	2317
Apocrita	larvae	2	6	2			
	cocoons	23	50	29			
	adults	108	93	60	133	149	91
Isoptera					1	3	3
Lepidoptera	eggs	17	1	466			
	larvae	2230	1354 +	2013			
	cocoons or pupae	179	592 +	317			
	adults	84	51	89	2510	1998+	2968
Neuroptera	eggs	63	-	-			
	larvae	63	23	48			
	cocoons	21	17	19			
	adults	45	19	33	192	59	100

	Specimens Rec'd 1941	Specimens Rec'd 1942	Specimens Rec'd 1943	Totals 1941	Totals 1942	Totals 1943
Orthoptera				25	17	15
Plecoptera				16	31	6
Psocoptera				428	314	232
Thysanoptera				-	-	3
Thysanura				27	15	15
Trichoptera				12	19	16
Miscellaneous				-	37	15
TOTALS				7,821	7,898	6,502
ARTHROPODA, other than INSECTA						
Acarina				9	100's	34
Araneida				219	303	93
Chilopoda				2	2	2
Diplopoda				46	12	3
Isopoda				12	8	3
Oligochaeta				1	-	-
Phalangida				3	1	1
Pseudoscorpionidae				1	-	-
Snail shell				-	1	-
GRAND TOTALS				8,114	8,325 +	6,638

EMERGENCE OF OVERWINTERED 1942 MATERIAL from CONSTANT TEMPERATURE CABINET

The emergence of overwintered 1942 Forest Insect Survey material from the constant temperature cabinet at Vernon is summarized in the accompanying tables.

Until November 9, 1942 all material was kept in the insectary at the Field Station where a minimum of 21.0°F. occurred in the morning of that date. On November 9, lepidopterous pupae, dipterous puparia and the majority of sawfly occoons were transferred to the overwintering chamber, the temperature of which ranged from a maximum of 37.0°F. to a minimum of 15.5°F. Lepidopterous larvae, the majority of hymenopterous cocoons and some of the sawfly cocoons were left in the insectary which was closed with shutters for the winter months, and in which the temperature varied until March 17, 1943 from a maximum of 36.5°F. to a minimum of -8.5°F. The lepidopterous larvae were left in the insectary to develop normally in the spring and summer of 1943.

On January 11, 1943 all but the majority of sawfly material was taken from the overwintering chamber and insectary and held in a room at Vernon until January 13, 1943 when it was transferred to the constant temperature cabinet. During the intervening period of approximately 48 hours the temperature of the room was gradually raised to 70.0°F,

The sawfly material was transferred from the Field Station to a room in Vernon on February 3, 1943. Over a period of approximately 48 hours the temperature of the room was gradually raised to 70.0°F. whereupon the material was placed in the constant temperature cabinet on February 5, 1943. The cabinet was operated at 74.0°F. and 90-95 % relative humidity.

TABLE I. - Summary of Emergence from Lepidopterous pupae

Insect	No. Pupae	Moths etc. No. emerged	Moths etc. Incubation per.	Parasites No. emerged	Parasites Incubation per.	No. of pupae died	% Emergence
Acronicta	1					1	
Anacamptodes	2	2	2-25 days				100.0
Caripeta	6	5	14-65 "			1	83.3
Eupithecia	37	28	3-94 "			9	75.7
Feralia	21					21	
Halisidota	7	5	13-35 "			2	71.4
Hyphantria	2	1	50 "			1	50.0
Incisalia	1			1(61)	14-15 ds.		100.0
Melanolophia	31	22	6-28 "			9	71.0
Misc. Arctiidae	2	1	42 "			1	50.0
Misc. Geometridae	21	14	4-54 "			7	66.7
Misc. Lepidoptera	8	2	10-13 "	1	15 "	5	37.5
Misc. Phalaenidae	11	4	12-23 "			7	36.4
Misc. Tortricidae	14	11	7-9 "	2	14-34 "	1	92.9
Panthea	3	2	12-14 "			1	66.7
Peronea	1					1	
Polia	2	2	15-33 "				100.0
Saturniidae	1	1	19 "				100.0
Semiothisa	81	63	8-71 "			17 *	77.8
Sphingidae	1	1	19 "				100.0
Zale	4	2	3-10 "			1 **	50.0
T O T A L	257	166	2-94 "	4	14-34"	85	
%		64.6		1.5		33.1	66.1

* plus 1 live pupa used in experiment

** plus 1 pupa alive after 110 days, transferred to insectary.

TABLE II - Summary of Emergence from Sawfly Cocoons (in vials)

Insect	No. Cocoons	Sawfly adults		Parasites		No. cocoons died	% Emergence
		No. emerged	Incubation per.	No. emerged	Inc. per.		
Anoplonyx laricis	1					1	
Anoplonyx occidens	18	5	10-19 days		days	12 ***	27.8
Anoplonyx sp.	95	53	6-41 "	2	18-19 "	40	57.9
Cimbex sp	1					1	
Misc. Sawflies	11	1	17 "	1	23 "	9	18.2
Nematine sp	2	1	17 "			1	50.0
Neodiprion spp.	46	12	12-15 "	12	14-29 "	22	52.2
Pamphiliidae	10					8 ⊖	
Pikonema alaskensis	35	12	17-38 "	5	17-41 "	13 *	48.6
Pikonema dimmocki	31	11	11-25 "	4	15-31 "	16	48.4
Pikonema spp.	3					3	
Pristiphora erichsonii	67	16	21-26 "			49 **	23.9
Pristiphora n. sp.	3	1	13 "			2	33.3
Pristiphora sp.	12	3	12-20 "			9	25.0
TOTAL	335	115	6-41 "	24	14-41 "	186	
%		34.3		7.2		55.5	41.5

* plus 5 cocoons with live larvae, April 3/43
** plus 2 cocoons with live larvae, "
*** plus 1 cocoon with live larvae, March 22-43
⊖ plus 2 larvae alive, April 3/43

TABLE II a - Summary of Emergence from Larch Sawfly Cocoons (in jars)

Survey Record No.	No. Cocoons	Sawfly adults: No. emerged	Sawfly adults: Incubation period	Parasites: No. emerged	Parasites: Incubation per.	No. cocoons died	% Emergence
3165	135	78	20-27 days			57	57.8
3166	42	25	21-27 "			17	59.5
3175	11	1	25 "			1 *	9.1
3177	9					9	0.0
3243	20	1	24 "			19	5.0
3280 D	14	4	25-32 "			6 **	28.6
3377	77	33	21-27 "			42 ***	42.9
3391	30	17	21-25 "			11 θ	56.7
3399	19	5	23-27 "			14	26.3
3403	34	22	23-28 "			12	64.7
3443	14	4	23-25 "			10	28.6
3473	29	5	23 "	1	45 days	23	20.7
3475	17	2	25 "	1	40 "	14	17.6
3488	9	8	23-25 "			1	88.9
3530	31	23	21-26 "			7 θθ	74.2
3543	39	2	24 "	1	37 "	36	7.7
3586	22	3	23-24 "	2	41-53 "	17	22.7
3636	89	21	23-66 "	13 θθθ(161)	12-53 "	55	38.2
3655	29	13	19-64 "			16	44.8
T O T A L	670	267	19-66 "	18	12-53 "	367	
%		39.8		2.69		54.8	42.5

* plus 9 cocoons with live larvae, April 13/43
** " 4 " " " " , " "
*** " 2 " " " " , " "
θ " 2 " " " " , " "
θθ " 1 " " " " , " "
θθθ 160 Tritneptis klugii from 12 cocoons--more than one generation.

TABLE II b - Summary of Emergence from all Sawfly Cocoons

	No. Cocoons	Sawfly Adults No. Emerged	Sawfly Adults Incubation period	Parasites No. Emerged	Parasites Incubation period	No. Cocoons died	% Emergence
TOTAL	1005	382	6-66 days	42	12-53 days	553	
%		38.0		4.2			42.2

TABLE III - Summary of Emergence of Dipterous Parasites

Host	No. Puparia	Diptera No. Emerged	Diptera Incubation Period	No. Puparia dead	% Emergence
Malacosoma disstria	4	1	11 days	3	25.0
Nepytia canosaria	2	2	12-15 "		100.0
Panthea sp.	5	3	20-37 "	2	60.0
Peronea variana	16	4 *	17-63 "	12	25.0
Phalaenidae	2			2	
? Polygonia sp.	1			1	
Pristiphora erichsonii	1			1	
? Schizura sp.	4	3	70-76 "	1	75.0
Semiothisa granitata	3	2	41-50 days	1	66.7
Tortricidae	1			1	
TOTAL	39	15	11-76 "	24	
%		38.5		61.5	38.5

* 3 of these puparia produced hymenopterous parasites; incubation period 54-63 days.

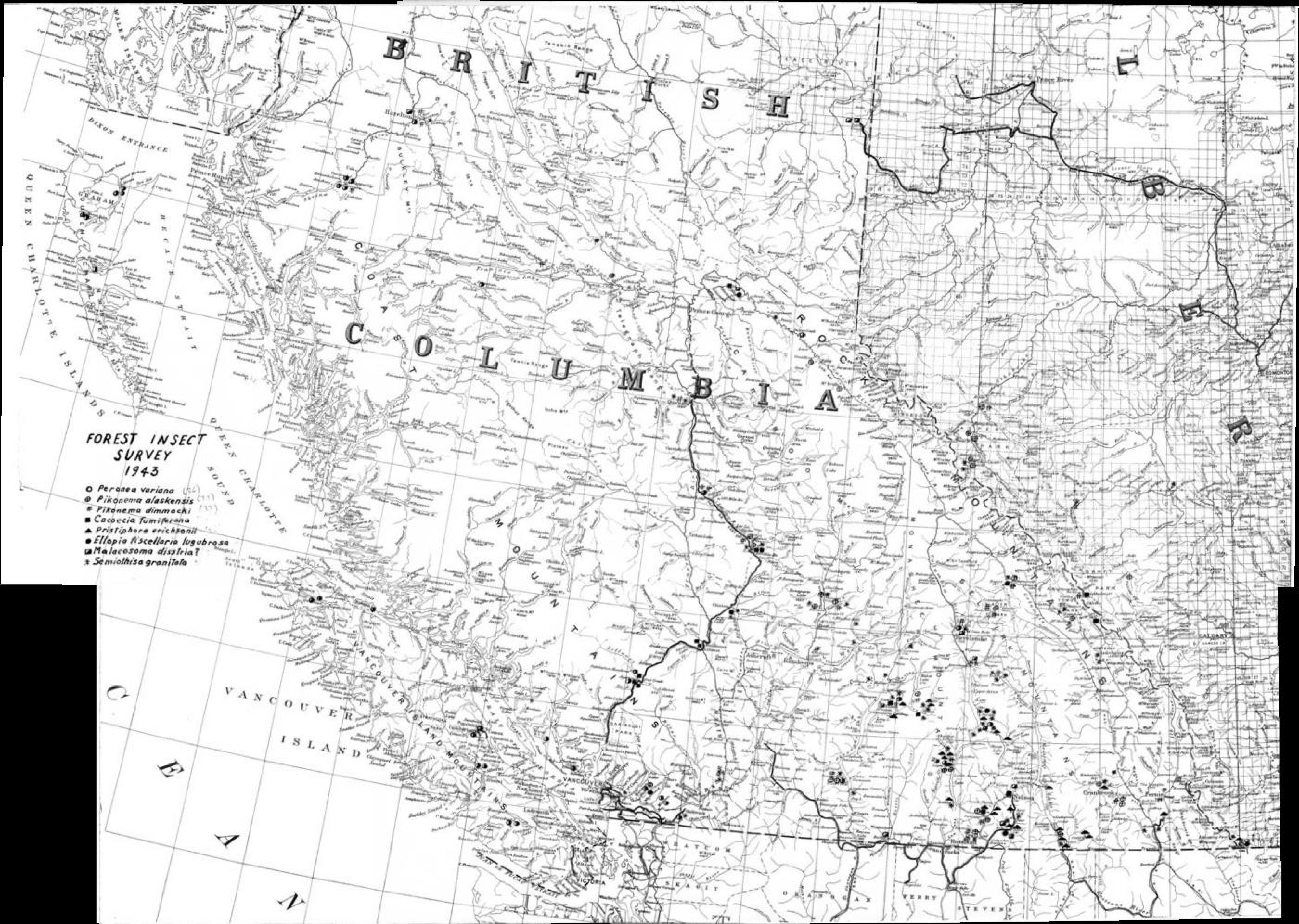
TABLE IV - Summary of Emergence of Hymenopterous Parasites

Host	No. cocoons	Hymenoptera: No. Emerged	Hymenoptera: Incubation period	No. cocoons died	% Emergence
Cacoecia fumiferana	3	2	17-47 days	1	66.7
Eupithecia spp.	5	4	16-62 "	1	80.0
Geometridae	5	2	14-16 "	3	40.0
Hyphantria textor	14	12 **	13-43 "	2	85.7
Lepidoptera	3	3	21-43 "		100.0
Lepidoptera ***	1	1	46 "		100.0
Malacosoma sp***	1			1	
Melanolophia sp.	3	3	18-27 "		100.0
Peronea variana	1	1	17 "		100.0
Semiothisa granitata	10	7	10-63 "	3	70.0
Semiothisa sexmaculata	4	4	22-35 "		100.0
Semiothisa sp.	6	5	11-25 "	1	83.3
Tortricidae	13 *	12	7-23 "	1	92.3
Unknown	8	5	17-30 "	3	62.5
TOTAL	77	61	7-63 "	16	
%		79.2		20.8	79.2

* 5 cocoons, 8 pupae

** 14 hyperparasites emerged from 12 cocoons

*** Parasitized larvae


FOREST INSECT SURVEY 1943
Peronea variana
Pikonema alaskensis
Pikonema dimmocki
Cacoecia fumiferana
Pristiphora erichsonii
Ellopia fiscellaria lugubrosa
Malacosoma disstria?
Semiothisa granitata
BRITISH COLUMBIA
ALBERTA
QUEEN CHARLOTTE ISLANDS
DIXON ENTRANCE
HECATE STRAIT
QUEEN CHARLOTTE SOUND
COAST MOUNTAINS
ROCKY MOUNTAINS
VANCOUVER ISLAND
VANCOUVER ISLAND MOUNTAINS
OCEAN
VANCOUVER
VICTORIA

NOTES ON OLENE GRISEFACTA DYAR. (Lepidoptera, Liparidae)

(C.V.G.Morgan)

Moths of *Olene grisefacta* Dyar emerge during July and the first half of August. In 1943 the first moth, a male, was obtained on June 29 from a cocoon collected immediately N.E. of Lumby, B.C. Thereafter larval specimens collected in various parts of British Columbia produced moths, all females, on July 24, July 31 and August 6 and 18. In 1942 moths were obtained between July 20 and August 12. The earliest emergence was recorded in 1938 on June 27.

As far as is known this species has been recorded as feeding only on *Picea engelmanni* Engelm. and *P. sitchensis* (Bong.) Carr. In British Columbia adults have been recovered from larvae reared on *Picea* spp., *Larix occidentalis* Nutt., *Pseudotsuga taxifolia* (Lamb.) Brit., and *Pinus monticolae* Dougl. Larvae collected on larch or reared for a short time on this host and transferred to either *Pseudotsuga taxifolia* or *Pinus monticola* have completed their development on the latter hosts.

Under artificial conditions adults have remained in copulation for a period of 15 hours or more. A male may fertilize the eggs of two or more females. The moths are mostly nocturnal in habit and it is during this nocturnal period that eggs are deposited on the hosts. These are usually laid in single-layered masses either on the under surface of several needles or on the bark of twigs and limbs. In egg-laying on the foliage the female grasps several needles close to their extremities and hanging upside down with the wings spread at about a 50° angle to the horizontal, deposits the first eggs as far as she can reach down the needles. The others are deposited in front of these and in order to lay the last of the mass the body is progressively arched down and forward without changing her position. In some cases she may turn around to complete the egg-laying of one mass. The eggs of any one mass are laid very quickly--each egg requiring from 5 to 10 seconds--one after the other in rows which are almost perfectly straight, but only diagonally across the mass. Masses of eggs deposited on the bark are laid in the same manner. A mass may consist of 25 eggs; and a female may lay up to 125 eggs or more.

The eggs, which are glued to the surface of the needles or bark, are smooth and round except for the top or micropylar end. The top end is slightly flattened, and often has a shallow concavity in this area. Fine microscopic ridges can be observed on the surface especially at the micropylar end. In size the eggs vary in length from 1.04 to 1.12 mm., and from 1.20 to 1.60 mm. in width. The egg is a greenish-white in color with a dull bloom over the surface. The micropylar end has a greenish spot, 0.01 mm. in diameter, in its centre. Outside of this spot there is a whitish-green area, 0.32 mm. in diameter, which gradually fuses in color with the rest of the egg. The bottom of the egg is a little greener than the remainder.

Unfertilized eggs begin to collapse about seven days after being laid. Those which eventually produce larvae begin to discolor about two days before hatching occurs. This discoloration consists of only a slight greying throughout the egg, accompanied by a loss of the apparent bloom. Eggs laid in the latter part of July hatch within 22 to 24 days when exposed to insectary air conditions. The first sign of hatching is the protrusion of the mandibles through the chorion producing a hole the size of a pin head. This hole is enlarged until the young larva is able to crawl outside. The egg shell removed is ingested. Hatching requires from one to two hours. After emerging from the eggs, the larvae continue to feed on the empty egg shells sometimes entirely devouring them. They then migrate to the needles for further feeding leaving behind them a fine webbing wherever they wander. This feeding commences approximately 24 hours or more after hatching, but some larvae may not begin to feed on the foliage for several days. First instar larval feeding is confined to the stomatal areas of the needle. On western white pine this injury causes the edges of the needle to fold together and eventually the entire needle becomes twisted as a result of the mesophyll tissue being removed from small areas on either one of the two stomatal surfaces.

In 1943 the first moult occurred around September 10. All larval feeding had ceased by October 1, and the larvae overwintered in the second instar. However, from information at hand, it is believed that this defoliator may overwinter in other instars besides the second. On white pine, the larvae spin sparce shelters amongst the needles, particularly at their base, in which to hibernate.

On emerging from the eggs, the larvae are quite wet and as a result the hairs lightly cling to each other in loose "pencils".The hatching fluid quickly dries and the hairs separate and assume their normal position.

The thoracic and abdominal hairs can be divided into two groups. Those of the first group are relatively short and of the same color as the integument and cover most of the body on the dorsal and pleural surfaces. Those of the second group are about twice as long as the first and are a yellowish-brown in color; these are particularly prominent on the ear-like lobes of the prothoracic segment and on the posterior segments. The color of the head and prothoracic shield of the newly hatched larva is black. The integument of the thorax and abdomen is a light yellow. Inside of several hours after emergence from the egg, the color of the thorax and abdomen turns almost black.

In size the first instar larva is about 3.0mm. in length. The width of the head varies from 0.64 to 0.70 mm. The prothoracic segment including the lobes is from 1.02 to 1.20 mm. wide. From this segment the body tapers posteriorly to the anal segment which is approximately 0.42 mm. wide at its anterior margin. The prothoracic shield varies from 0.64 to 0.65 mm. in length and from 0.22 to 0.24 mm. in width.

Each segment of the thorax and abdomen has a number of characteristic lobes or plates on the dorsal and pleural areas; these bear the hairs of the larva. It is these structures which harden and darken just after emergence. The most prominent of these are the prothoracic lobes borne on the dorso-lateral margins of the first thoracic segment. This segment also has three other pairs which in decreasing size are as follows: the first pair lies in the prothoracic shield on its anterior margin--one on each side of the mid-dorsal line; the second pair is situated in the pleura well below the prothoracic lobes and just above the legs; the third pair is placed at the posterior-lateral angles of the prothoracic shield--these are quite small. Both the meta- and mesothoracic segments have three dorsal pairs of more or less round plates arranged in a transverse row above the spiracular line and one prominent pair below. The three pairs of dorsal plates are on the abdominal segments but in the first four of these segments the two mesal pairs are much larger and form a rectangular plate in which the two are separated by a membranous fold of the integument running posteriorly from the anterior to the lateral mesal margins.

OVIPOSITION HABITS AND EGGS OF XYLOPHAGUS FASCIATUS (Diptera, Coenomyiidae)

(C.V.G. Morgan)

Xylophagus fasciatus Walker (det. A.R. Brooks) is predacious on other insects but so far as is known little of its biology has been recorded. During 1943 some observations of its habits were made at Trinity Valley, B.C. All observations were made on Western white pine (Pinus monticola Dougl.) logs felled on July 29, 1942. Subsequently these logs were heavily attacked by Coleoptera, especially Monochamus spp. (Cerambycidae) upon the immature stages of which the larvae of Xylophagus fed.

The adults of Xylophagus emerge in the spring and were first observed in the field on May 12. Logs caged in the summer of 1942 produced the first adults on May 20. The two sexes were found together on the logs, but were not seen to mate. Females were far more numerous than males. Both sexes were very easily disturbed within a distance of two feet or less, the males in particular being difficult to approach.

The presence of bark, and its deterioration to a certain degree are apparently needed to stimulate oviposition. These two factors provide the correct environmental conditions required by the larvae. In all cases noted, egg laying took place on bark: it never was attempted on barked surfaces which were available. Eggs were laid through cracks, crevices, fissures ,mechanical scars, and insect egg slits (particularly of Monochamus spp.) made in the bark the previous season. Under the observed conditions, oviposition took place on logs felled approximately ten months previously. In this time the bark had gradually separated from the sapwood and had become comparatively soft and pulpy. As a result of this deterioration, especially throughout the winter months, the openings in the bark had enlarged and were then easily penetrated by the long and needle-like , but soft ovipositor. Such conditions require no actual boring which, because of the structure of the ovipositor cannot be affected by this insect.

The female prefers to deposit her eggs in a shaded environment. In most instances the majority of eggs were laid on the north side of logs lying in an east and west direction. Within this exposure most eggs were placed on the lower half or undersurface of the log. Especially during hot weather the female seeks the shaded surfaces of the log in which to oviposit.

The eggs are deposited in the region of the inner layer of the bark, either almost on the surface of the wood or in the bark close to the cambium layer. Only one egg is laid at each oviposition. However, other adults may use the same area, and thus two or more eggs may be found together.

No distinctive feature characterizes the act of oviposition. The female holds her wings horizontally and closed on the dorsal surface of the body as do both sexes when at rest. All legs rest firmly on the bark surface. Except for the slight apparently rotary movement of the ovipositor, the body and appendages remain still from the time the ovipositor is first inserted into the bark until it is withdrawn. The entire act is completed in from 20 to 60 seconds.

An egg is approximately 1.52 mm. long and from 0.28 mm. to 0.30 mm. wide; the length is almost constant. In shape it is sausage-like, elongate, oval, and curved slightly throughout its length; in some cases one side is almost straight. The egg tapers to both ends; one end is blunt and nearly flat; the other more pointed. Eggs in their natural environment are light brown--the ends being slightly darker than the midsection--a color which is almost identical with that of the bark. This and their small size make them difficult to find, even with a microscope. This is even more difficult when they have been deposited in Monochamus egg slits. Here the small boring chips of the young Monochamus larvae closely resemble the xylophagid egg in size and appearance. In the ovaries the eggs are pearly white in color, but when artificially exposed to the air they turn a rich dark brown within about five minutes, and eventually blacken.

Although the egg is comparatively smooth and shiny it is ornamented with small but conspicuous hexagonal areas. The outlines of these areas formed by the impressions of the follicular cells, are prominent, and, for the most part, are almost perfectly geometrical throughout the surface of the egg. The ornamentations appear to be placed in exact rows, horizontally, vertically, and diagonally. Median impressions measure about 0.02 mm. in width.

MISCELLANEOUS INSECTS

1. Lodgepole pine needle miner (*Recurvaria milleri* Busck): The infestation of this needle miner in the Bow Valley near Banff occupied about the same area as in 1942, extending from Vermilion summit eastward to Brewster Creek on the south side of the valley and from Castle mountain to Johnston Creek on the north side. It may have been the cause of concentrating bark beetles on the Brewster Creek area in the summer of 1943 after the control work of the previous winter. The trees on this area had noticeably thin foliage due to the activities of the miner and this weakening of the trees may have served to attract the bark beetles to the area. A group of about 22 freshly infested trees was found there in September of 1943 in the vicinity of peeled stumps from a much larger group of trees which had been treated.

On June 15 samples of needles containing larvae were sent to Vernon for examination. At that time larvae were 2 to 3 mm. long. Of 100 needles examined, only 6 contained dead larvae; 38 were empty, the larvae apparently having migrated, and 56 contained live larvae. This indicates that the population at the middle of June was still very high and an extensive flight of moths can be expected in the summer of 1944.

On July 22, examination of the infested areas revealed that the larvae were still in the 1942 needles. Examination of 75 needles from material brought back to the Vernon laboratory showed 50 larvae alive. These averaged 4.5 mm. in length. The larval development closely followed that found by Patterson in Yosemite National Park, California.

2. The Northern Smoky Moth, *Lexis bicolor* Grt. Investigations in previous years have shown that fructicose lichens growing on conifers might serve as a host for larvae of *Lexis bicolor* Grt. This fact has already been alluded to in literature. No adults have been successfully reared from immature larvae on lichens or any coniferous hosts. Adults have been obtained only from forest insect survey larvae received several days previous to pupation, and which did not appear to require further feeding.

Rearing immature larvae on lichens alone proved unsuccessful. After a short period of apparently normal growth, feeding stopped entirely, and the larvae died. This may have been due partly to the fact that the host material dried up too quickly for successful rearing, even when new material was supplied quite frequently.

In 1942, preliminary investigations revealed that substitute hosts more suitable for artifical rearing could be found in other low forms of plants. One of these, a liverwort, probably of the genus <u>Marchantia</u> (Bryophyta, Hepaticae, Marchantiaceae) growing on the surface of soil in a damp environment showed promise of fulfilling the requirement.

Of 25 or more larvae acquired in the survey in 1943, the majority of those (7) received prior to July 18, were larvae which had overwintered. Five of these died; one received on July 16, pupated on the 26th and emerged as an adult 16 days later. Another, received on July 17, pupated July19, and emerged 11 days later. These larvae did not feed before pupating. Of 18 or more received after July 18, all but 7 died during the summer. The 7 remaining alive are now overwintering.

Beginning in August 1943, the larvae were provided with both the liverwort and the coniferous host from which they were collected. Of all specimens treated in this manner only 2 died. These succumbed to a wilt disease encountered for the first time in this insect.

The technique followed was to place the larvae in 1 X 5¼ inch glass vials corked with a bacteriological-rolled cotton plug. The coniferous host from which the larvae was taken in the field was provided along with the liverwort. The latter was lifted from its habitat and placed directly into the vial after any loose dirt had been shaken from the rhyzoids. At least a lobe of the thallus and all its attachments were used in each case; this prevented the plant from drying out too fast. The tightly rolled plug also reduced evaporation.

The rearing of the larvae in the above manner proved more successful than any method tried previously. The larvae were observed to feed on nearly all structures of the liverwort, including the antheridiophores, archegoniophores, rhyzoids, and particularly the chlorophyllose, leaf-like thallus. Evergreen feeding was observed in only one instance of all larvae given a choice of both evergreen and liverwort hosts. The coniferous feeding lasted for three days (Sept.13-15 incl.) on <u>Pseudotsuga taxifolia</u> (Lamb.) Brit. after about one month continuous feeding on the bryophyte. Evergreen feeding was confined entirely to the epidermal cells of the under surface of the needle. Feeding then reverted to the liverwort. Fall feeding of all larvae had ceased by November 1, 1943. The majority had stopped within the first two weeks of October.

It may be that larvae require two hosts, the fructicose lichen and the conifer to complete development, but more data are needed in this connection. Whether or not the liverwort is a satisfactory host in lieu of the lichen cannot be stated until a complete life cycle has been observed.

3. The Poplar Sawfly (Pontania pepii? Ross)

This sawfly again appeared in epidemic numbers in the Eagle River and Shuswap Valleys between Grindrod and Three Valley Lakes. Black cottonwood, (Populus trichocarpa) seems to be the only host. Defoliation appeared to be not quite so heavy as in 1942. By June 10, practically all larvae had entered the soil and a large percentage had pupated. Pupae and larvae from the duff were sent to Trinity Field Station for rearing. In spite of the early pupation there has been no indication of more than one generation per year.

E.30.07.8 - Spruce Budworm (<u>Cacoecia fumiferana</u> Clem.)

(W.G.Mathers)

In 1943, work on the spruce budworm included

1) special trip to the Lillooet district with Dr. A. Wilkes of the Dominion Parasite Laboratory, Belleville, Ont. for the purpose of obtaining, if possible, the parasite, <u>Phytodietus fumiferanae</u>, for introduction to eastern Canada.

2) examination of a large infestation reported on Douglas fir in the Pemberton district, and

3) further observations on the biology of the spruce budworm.

In addition to the infestation at Pemberton, an outbreak was also reported on Douglas fir along the new Hope-Princeton road at the headwaters of the Skagit River. An examination of this area is planned for 1944.

Spruce budworm material received during the year at the Vernon Laboratory in connection with the Forest Insect Survey has been summarized as follows:

Host	No. of collections	Number of Specimens				
		larvae	Sound pupae	Empty pupae	Adults	Totals
Abies lasiocarpa	2	-	-	2	-	2
Picea engelmanni	3	2	-	-	1	3
Picea & Abies	1	1	-	-	-	1
Pseudotsuga taxifolia	8	64	64	3	5	136
Thuja plicata	1	-	2	-	-	2
<u>Totals</u>	15	67	66	5	6	144

128 of the Douglas fir specimens were from two special collections made at Lillooet, B.C. The rest of the Douglas fir material was from 103 Mile Lake (Cariboo district), Clinton, Nelson, Cherryville and Pemberton, B.C. The two pupae from western red cedar were also from Pemberton where a heavy infestation occurred on Douglas fir. No feeding on cedar had been observed. The collections from Engelmann spruce were from 103 Mile Lake, Pass Creek (Castelgar) and Lumby, B.C. while the balsam material was from Aleza Lake, B.C. and Kootenay and Banff National Parks. 1943 was the first year on areas where the spruce budworm requires two years to complete its life-cycle. The fact that comparatively little defoliation occurs at such time probably accounts for the limited number of returns from spruce-balsam areas.

Report on Collecting Trip for Phytodietus fumiferanae Rohwer, parasite of the Spruce Budworm.

Between June 25 and July 9 a collecting trip was made from Vernon to the Lillooet district by Dr. A. Wilkes of the Dominion Parasite Laboratory, Belleveille, Ont. and the writer. The object of the trip was to obtain, if possible, the spruce budworm parasite, Phytodietus fumiferanae, for introduction to eastern Canada. This parasite, which has not been recorded outside of British Columbia, was an important factor in controlling a spruce budworm outbreak in Douglas fir in the Lillooet district in 1919-20. Although no spruce budworm had been reported on Douglas fir in this province in recent years, nor this year up to the time of the trip, it was considered possible that the budworm might by now be on the increase on the Lillooet areas.

The main areas visited during the trip are shown on the accompanying map and descriptions together with the findings on each, follow:

1) Bridge River Valley: A trip into Bridge River Valley was made on June 28 and 29. On the first day a visit was made to Walker Creek, Big Gun Lake, with B.C. Forest Service Patrolman Keary and on the following day examinations were made at Tyaughton Lake and down the Bridge River Valley floor as far as the main road extended. Although spruce budworm larvae were to be found on Douglas fir throughout the valley, the larvae were few in number except near the road bridge at the foot of Mission Ridge. Here a light infestation occurred with the budworm in the larval stage; no pupae being present nor were any Phytodietus taken in the valley.

2) Mission Ridge: This ridge separates Seaton Lake from Bridge River Valley and is crossed at over 4,000 feet by the main road into the valley. A moderately heavy spruce budworm infestation was found on the south side of the ridge above Seaton Lake and extending from about 1,500 feet elevation to the summit and with the greatest population around ,2,500 feet. This was the only area on which feeding by the budworm was to be noticed by other than a close examination of the trees. A day and a half of intensive collecting was carried out on this area and although over 1,500 spruce budworm larvae and pupae were taken, only about 5 Phytodietus specimens were recovered. The latter were present on the budworm either as eggs or very small grubs. At the time of collecting, June 29-30, young budworms were present at the summit of the ridge and development increased with lower elevation, with moths emerging at 1,500 feet elevation.

3) Botanie Creek Valley: This area was visited on July 2 with Asst. Ranger Kent of the B.C. Forest Service. The valley lies north east of Lytton and is about 10 miles long. The vegetation ranged from sagebrush at the junction with the Thompson River up through yellow pine, Douglas fir, mixed conifers including white pine, red cedar to spruce and balsam at Botanie Lake situated at only 2,500 feet elevation. A few mature larvae and pupae of the spruce budworm were found on Douglas fir at about 1,200 feet and also occurred in limited numbers on the spruce and balsam at Botanie Lake. However, on the latter area budworm development was so retarded that it indicated a two-year life cycle. This was substantiated by specimens brought back to the Varnon Laboratory for rearing. They failed to show any further development but instead spun hibernacula in which they remained dormant.

4) Fountain Creek Valley: Fountain Creek flows north and joins the Fraser River a few miles east of the mouth of Bridge River. The valley is about 6 miles long and separated from the Rraser by a mountain ridge. It was visited on the morning of July 4 in the company of B.C. Forest Service Patrolman Taylor of Lillooet, B.C. Although evidence of spruce budworm feeding of previous years was found, the present population is very low with corresponding poor collecting.

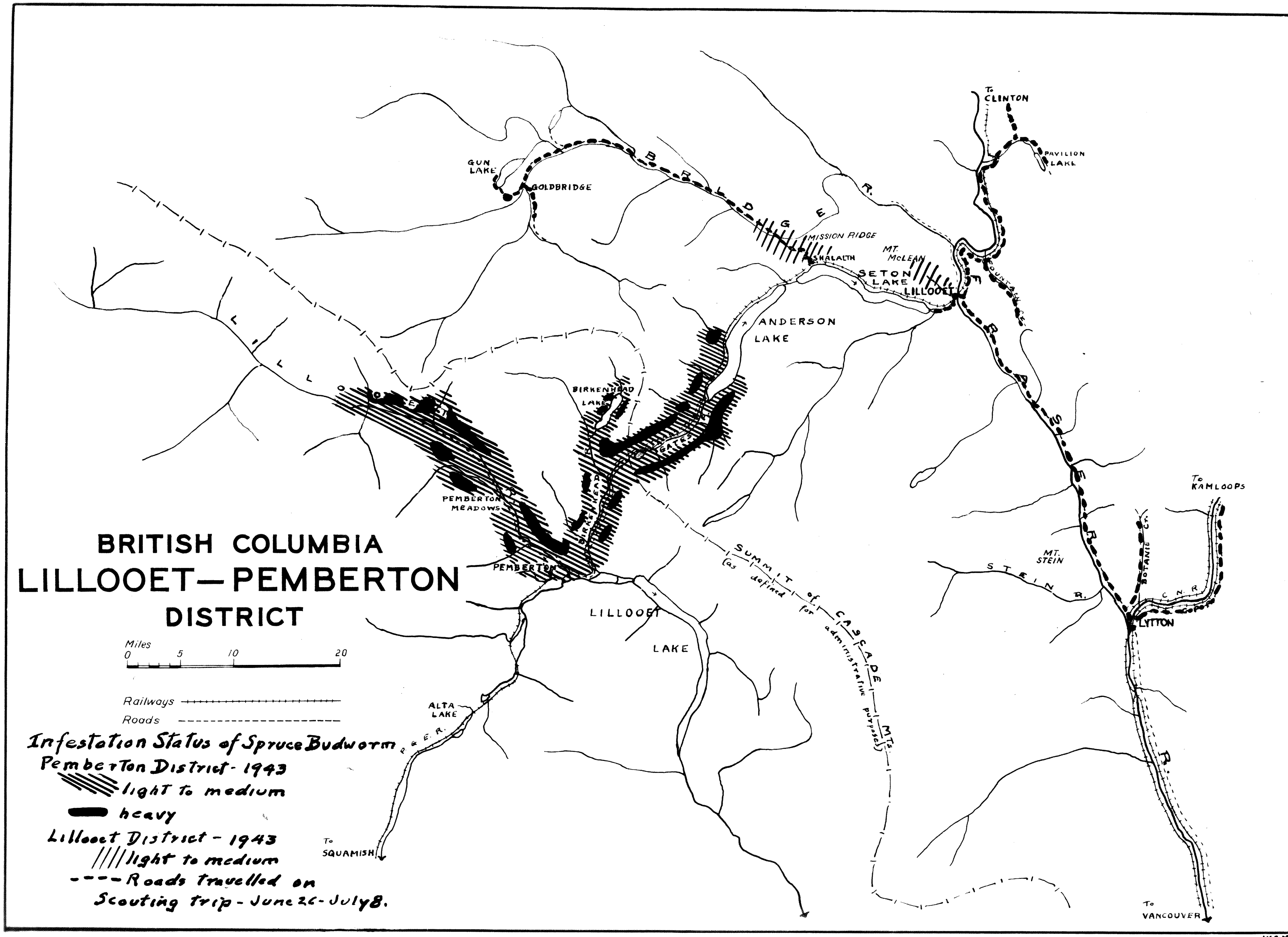
5) Mt. McLean, Lillooet, B.C. Mt. McLean lies north west of Lillooet and a trail leads up a steep valley immediately back of the town to the summit. Town Creek, a small stream about 4 miles longs, flows down the valley. On June 27 and again on July 1, collections were made on the east side of the creek. Here a light infestation of the spruce budworm occurred at

about 2,000 to 3,000 feet elevation. Only about 4 specimens of Phytodietus were taken each day, but in view of the difficulty of finding the parasite on the other areas examined, this area was considered to be the best prospect. As a result, collecting from July 4 to 7 inclusive was confined to this area, particuarly on the west side of the creek where a somewhat greater budworm population, together with a higher parasitism by Phytodietus was found. During this period, and with the help of two local boys, a total of close to 2,900 spruce budworm larvae and pupae and over 300 specimens of Phytodietus were collected; a parasitism by Phytodietus of about ten per cent. The development of the budworm ranged from practically all pupae and with moths emerging at the lower elevation to nearly all larvae at the higher elevation. Similarly, mature Phytodietus grubs and cocoons occurred at the lower part of the slope while atthe upper part of the infestation, eggs and very young grubs were to be found on the budworm larvae. The most satisfactory collecting of the parasite was from suppressed young trees in the midst of stands of pole size to large Douglas firs, the parasitised budworm evidently dropping from the larger trees.

A visit to Mt. Stein, on the west side of the Fraser River, north of Lytton, B.C. was planned. However, as the ferry was not operating due to high water, the trip would have required at least two days, and as much of the previously budworm infested areas had been burnt over in 1926, the visit at this time was considered inadvisable.

In addition, a trip was made on July 9 to McGillivray Creek, a tributary to Louis Creek, north of Kamloops, B.C. In 1940, a spruce budworm outbreak was reported on spruce and balsam at about 4,000 feet elevation in the vicinity of McGillivray Lake. It was suspected that the budworm would have a two -year life cycle on such an area. Time did not permit an examination of the main part of the area, but a point was reached at about 3,000 feet on McGillivray Creek where a light population of spruce budworm was found on Douglas fir and with evidence of one and two-year life cycle budworm overlapping.

The Phytodietus material collected was brought back to the Vern n Laboratory where it was reared through to the cocoon stage before being forwarded to the Parasite Laboratory at Belleville, Ont. By far the greater part of the spruce budworm material collected, however, was forwarded direct to Bellville, only the specimens collected on June 27 on Mt. McLean being sent to Vernon for rearing. Data concerning the material collected is given below under the heading "Parasites".


BRITISH COLUMBIA
LILLOOET—PEMBERTON
DISTRICT
Miles
0 5 10 20
Railways
Roads
Infestation Status of Spruce Budworm
Pemberton District - 1943
light to medium
heavy
Lillooet District - 1943
light to medium
Roads travelled on
Scouting trip - June 26 - July 8.
GUN LAKE
GOLDBRIDGE
BRIDGE R.
MISSION RIDGE
SHALALTH
MT. McLEAN
SETON LAKE
LILLOOET
To CLINTON
PAVILION LAKE
FOUNTAIN CR.
FRASER R.
ANDERSON LAKE
BIRKENHEAD LAKE
GATES
BIRKENHEAD
LILLOOET R.
PEMBERTON MEADOWS
PEMBERTON
LILLOOET LAKE
SUMMIT OF CASCADE MTS.
(as defined for administrative purposes)
MT. STEIN
STEIN R.
BOTANIE CR.
To KAMLOOPS
C.N.R.
LYTTON
ALTA LAKE
P.G.E.R.
To SQUAMISH
To VANCOUVER
W.G.M.

The infestations on Mt. McLean and the south side of Mission Ridge were so light that no discoloration of the trees was evident from the bottom of the slopes on August 21 when the writer passed through the Lillooet district en route to Pemberton.

Pemberton Infestation

On August 13 a report was received from the office of the District Forester, Vancouver, B.C. of heavy defoliation to fir in the Pemberton district. On the same date partly stripped Douglas fir twigs together with specimens of spruce budworm which were responsible for the injury, were received by the Forest Insect Survey from Asst. Ranger Keith at Pemberton, B.C. At the suggestion of the B.C. Forest Service and in view of the apparent serious nature of the infestation, the writer spent from August 21 to 24 on the area in an attempt to determine the status of the outbreak and its value as a source for the budworm parasite, *Phytodietus fumiferanae*, a cocoon of which was included in the Survey collection.

Pemberton, elevation 700 feet, is located on the Pacific Great Eastern Railway, about midway between Squamish and Lillooet and was reached by train from Lillooet. There is no through auto road to the district but a local road extends up the Lillooet valley from Pemberton for about 16 miles and another parallels the railway from Pemberton through the Birkenhead and Gates River valleys to D'Arcy at the west end of Anderson Lake. Trips over both roads were made by car with Ranger Keith in connection with the examination. Both the Birkenhead and Gates Valleys are narrow but the Lillooet Valley for about 15 miles north of Pemberton is from one to one and a half miles wide with meadow land in the bottom. The sides of the valleys rise to over 5,000 feet and are timbered mainly with Douglas fir and cedar but with some hemlock, spruce and white pine.

As shown in the accompanying map, the infestation extended from Pemberton up the Lillooet valley at least for 20 miles, the extreme limit was not determined, and through the Birken-head and Gates valleys to the west end of Anderson Lake, a distance of 30 miles.

Heaviest defoliation was in practically pure stands of Douglas fir, occurring in patches of from a few hundred acres up to several square miles in size and located at from about 1,500 to 3,500 feet elevation along the sides of the valleys. The trees on these areas had green needles entirely stripped fromthe upper half of the crowns and showed the typical red discoloration resulting from spruce budworm feeding.

On the lower parts of the slopes the timber stands varied from large old Douglas firs up through mixtures of fir, balsam, hemlock , cedar and white pine. Some feeding had occurred on hemlock and balsam and also on small white pines under Douglas fir. Trees in the understory showed considerably more defoliation than large dominant trees.

Phytodietus cocoons were not numerous, only 30 being taken in several days of intensive searching, but empty Glypta cocoons were more common and several diptera parasite puparia were also recovered. (Data concerning the parasite material is given below under the heading "Parasites")

The red discoloration of trees was first noticed in the fall of 1942 by Ranger Keith on limited areas at the upper end of the Lillooet Valley area and on both sides of the valley at the west end of Anderson Lake. The injury was not recognized as spruce budworm work and unfortunately a sample of diseased foliage, thought to be typical of the area and which was submitted to the Forest Insect Survey in September, showed only rust infection.

Some mortality will probably occur among suppressed trees and young trees in the understory and undoubtedly the tops of a number of the more severely defoliated trees will be killed back. However, in view of past records of spruce budworm infestations in Douglas fir and the value of the timber infested, no serious loss is expected from this outbreak.

Biological Studies

Rearing experiments started in 1942 with larvae from two-year life cycle material were continued in 1943 at the Trinity Valley Field Station. The larvae were from eggs laid in July 1942, by moths reared from larvae taken on June 14 at Vermilion Summit, Kootenay National Park. The experiments, which were set up as the larvae emerged from the eggs, were as follows:

a) 100 larvae on a caged young engelmann spruce in the field.
b) 15 larvae in individual vials in the insectary; 8 provided with engelmann spruce foliage, 4 with Douglas fir and 3 with alpine balsam.
c) 19 lots of 10 larvae each in separate vials in the insectary. At the start of the experiment 4 lots were given engelmann spruce,

4 Douglas fir, 4 alpine balsam and one hemlock, one lodgepole pine and one larch. The other 4 lots were without foliage until the larvae emerged from their hibernacula in May, 1943 when 2 lots were provided with spruce and one with Douglas fir and one with balsam.

One other experiment (D) consisting of second instar larvae removed from their hibernacula on August 24, 1942 and which respun hibernacula, was carried over into this year.

In addition to the above, two large rearing jars were set up in the insectary in May of this year with extra larvae from stock material. To one jar with Douglas fir foliage were added 66 larvae and to the other jar with engelmann spruce foliage were added 109 larvae as soon as they emerged from their overwintering cocoons. Unfortunately the pressure of other work prevented full attention to the experiments which probably accounted for excessive larval mortality.

<u>Results</u>: The emergence of the second instar larvae from their hibernacula this year extended from May 18 to June 3 with close to 50 per cent emerging between May 24 and 26.

<u>Experiment(a)</u>-- Feeding this year was first observed on the caged tree on May 18 but only one moth, a female, was reared. The pupa was formed on June 21, and the moth emerged July 1.

<u>Experiment (b)</u>: Of the 15 individually reared larvae, 12 formed hibernacula in 1942 and of these only 8 emerged in May of this year to resume activity. One only developed through to the adult stage this year. This specimen was on balsam and the pupa was formed on July 5 while the moth, a male, emerged on July 20. The remaining 7 specimens showed very little development. By June 17 three were dead and by July 2 the other four had respun cocoons in which they remained dormant.

<u>Experiment (c)</u>: 147 of the 190 larvae, reared in lots of 10 in the insectary, survived the winter of 1942-43 and emerged from their hibernacula in May. However, very little feeding took place and by July, 121 specimens had died. Of the remaining 26 larvae, 21 had respun hibernacula in which they were dormant. Further mortality occurred so that by October only 20 larvae were evidently still alive in their overwintering cocoons. None of the larvae survived on hemlock, lodgepole pine or larch. Of the

remaining hosts, spruce, Douglas fir and balsam, no significant difference was noticed in the number of larvae surviving on each, regardless as to whether the host had been available from the time of hatching or only since the larvae emerged in the spring.

Experiment (d): Of the second instar larvae which had respun cocoons after being removed from their original hibernacula in August, 1942 only 3 emerged in May of this year. These, however, developed but very little and all were dead by the end of June.

Development among the material placed in the two rearing jars in May was similarly retarded and mortality was very heavy. No larvae developed to over 3/8 inch in length and less than 20 were still alive on July 2 and these had already respun cocoons in which they were inactive.

A comparison of the number of specimens reaching the adult stage this year, with the number of moths recovered in similar rearings in 1941, follows:

	1941	1943
Rearings in Vials		
No. of larvae emerging from hibernacula	17	155
No. of moths recovered	3	1
Rearings in Jars		
No. of larvae emerging from hibernacula	9	175
No. of moths recovered	1	nil
Rearings on Caged trees		
No. of larvae liberated in cages	158	100
No. of moths recovered	16	1

Moreover, in 1941 only 4 of the larvae reared in the insectary were alive in secondary overwintering cocoons at the end of the season, whereas in 1943, close to 50 larvae were alive in hibernacula in the fall.

An explanation for the more retarded development this year in comparison with 1941 may be found in the average daily mean temperatures as given inthe following table:

	Ave. Daily Mean Temp. °F. 1941	1943
May 17-31	53.1	52.7
June 1-15	58.0	54.7
June 16-30	59.3	56.8
June 1 -30	58.7	55.7

The average daily mean temperature for June 1943 was 3° lower than for June 1941 which would be sufficient to have a noticeable effect on the rate of development of the budworm. Furthermore, it is now suspected that the Trinity Valley area, elevation 2,100 feet, may be a transition zone for one and two-year life cycle spruce budworm. Not only did the reduced activity of the budworm during the past season indicate such a possibility, but what was thought to be two-year life cycle spruce budworm was observed in August on larch in the field at the Station by Mr. Morgan. What might be called a transition zone was found in July at McGillivray Creek, north east of Kamloops, B.C., where at an elevation of about 3,000 feet both one and two-year life cycle spruce budworm were found on the same area. Moreover, two-year life cycle material was found in July at only 2,500 feet at Botanie Lake, north east of Lytton, B.C.

Parasites

Lillooet Material

Two lots of spruce budworm larvae and pupae collected June 27 by Dr. Wilkes and the writer, from Douglas fir at Lillooet were included in the Forest Insect Survey. One lot (B.C.3794) was taken at about 2,000 feet elevation and the other (B.C. 3795) at about 3,000 feet. On being opened at Vernon on June 30, the collections contained the following:

	Lot 1	Lot 2
Spruce budworm larvae living	11	11
" " " dead	11	28
" " pupae living	47	18
" " " dead	2	0
Total living	58	29
" dead	13	28

A summary of the emergence from the live material follows:

Spruce budworm moths ♂♂	15	11
" " " ♀♀	29	13

Parasites	Lot 1	Lot 2
Ephialtes probably obesus	1	-
Apechthis " ontario	1	-
Budworm larvae dead (dried up)	1	4
" pupae " " "	11	1
Totals	58	29

Both parasites emerged from budworm pupal cases; the Ephialtes on July 7 and the Apechthis on July 10.

A summary of the spruce budworm material forwarded to Belleveille has not been received to date.

Pemberton Material

Phytodietus cocoons collected on August 22 and 25 at from 1,500 to 2,500 feet elevation (Lot X 30342) on the mountain slope immediately east of Pemberton consisted of the following:

Cocoons apparently sound	-	21
" with small (Chalcid) exit holes ...	-	2
" with large exit holes	-	3
" malformed containing dead Phytodietus larva		1
		27

Three Phytodietus cocoons were also collected on August 24 at 1400 feet elevation near Birken but emergence had already occurred from each ; 2 cocoons showed Chalcid exit holes while the emergence hole in the third cocoon was larger.

The hyperparasites, Epiurus sp. (det. Walley)emerged from two of the sound cocoons, from one on August 26 and from the other on September 18 while between August 28 and September 4 a total of 16 chalcids, (Amblymerus verditer (det. Peck) emerged from 4 other cocoons. Moreover, an undetermined hymenoptera emerged on September 8 from what appeared to be an undersize Phytodietus cocoon.

Of 4 apparently sound spruce budworm pupae also collected on August 25, a series of 5 A. verditer emerged on August 28 from one pupa and the parasite Itoplectis obesus (det. Walley) emerged from another. On dissection, the contents of the other two pupal cases were found to have dried up completely.

A total of 5 diptera puparia were also collected on Lot X 30342 from spruce budworm-injured trees but no emergence has occurred to date.

Miscellaneous

Parasites recovered from spruce budworm collections, other than the two Lillooet lots, in connection with the Forest Insect Survey were as follows:

1/ An undetermined Diptera from a spruce budworm pupa. The budworm was taken as a larva on June 25 from Engelmann spruce near Lumby, B.C. and pupation occurred on June 30. A dipterous maggot emerged through the abdominal intersegmental membrane of the pupa and formed its puparium on July 13, from which the adult fly emerged on July 25 (B.C.3779).

2/ A series of 15 Amblymerus verditer adults emerged on September 9 and 10 from a Phytodietus cocoon received on August 13 from Pemberton B.C. (B.C. 4050).

3/ On July 5 a dying spruce budworm larva with what appeared to be a Phytodietus larva attached, was received from Pemberton. By July 22 the host was dead and the parasite had spun a light brown cocoon about 8 mm. in length. An undetermined hymenoptera female adult emerged in the incubator on February 14, 1944, after an incubation period of 33 days (B.C. 3867).

E.30.09-3 - THE LARCH SAWFLY (Pristiphora erichsonii Hartig)

No radical spread of the sawfly was noted in 1943. The only portions of the larch distribution where the sawfly is not known to have reached are a few areas near Shuswap Lake and a small portion east of Penticton. Defoliation in 1943 throughout the larch areas was as follows:

Fernie district: There was no noticeable defoliation of larch except on very limited areas on Lizard Creek and near Morrissey. Otherwise infestation was light with larch trees looking thrifty. Trees on the Hartley Wilson estate in Fernie where the sawfly was first discovered in 1934 are still thrifty with no noticeable defoliation.

Elko to Moyie Lake: There was a medium to heavy limited area of infestation about one mile east of Elko. Between Elko and Moyie Lake, the infestation was generally light.

Moyie to Yahk: The infestation was medium to heavy in this section.

Yahk to Kitchener: In this section the infestation was light to medium, generally lighter toward Kitchener.

Kitchener-Creston: Infestation was generally light throughout this area.

Creston to Grey Creek: Larch is very scattered west of Creston until within a few miles of Grey Creek. Around this latter point infestation was light to medium with occasional heavily defoliated trees.

Kootenay Lake and Nelson: It was medium to heavy between these areas

Slocan Lake: It was light throughout the New Denver district and between there and Creston.

Arrow Lakes: It was light to medium on areas along these lakes with scattered small heavily defoliated areas. It was light to medium in Fire Valley with some heavily defoliated, small trees between there and the Kettle River Crossing.

Monashee district: Infestation was generally light with a few medium areas west of the Monashee summit. From there westward to the Okanagan infestation was generally light. Defoliation on the sample plots from the time of establishment in 1939 is shown in Table XIII

TABLE XIII - DEFOLIATION ON SAWFLY PLOTS

Plot No.	Degree of Attack	1939	1940	1941	1942	1943
		Number of Trees				
1 Grey Creek	none	0	36	10	0	0
	light	43	64	81	41	83
	medium	46	0	7	54	15
	heavy	11	0	2	5	2
		100	100	100	100	100
2 6 mi. E. Creston	none	0	58	41	63	0
	light	67	11	28	6	68
	medium	2	0	0	0	1
	heavy	1	0	0	0	0
	dead	0	1	1	1	1
		70	70	70	70	70
3 30.8 mi. E. Cranbrook	none	0	121	7	no	0
	light	57	23	132		143
	medium	31	0	4	check	0
	heavy	57	0	0		0
	dead	0	1	2		2
		145	145	145		145
4 4.0 mi. W. Cranbrook	none	0	99	84	0	0
	light	139	50	65	149	149
	medium	10	0	0	0	0
	heavy	0	0	0	0	0
		149	149	149	149	149
5 E. end Moyie Lake	none	0	154	58	0	0
	light	184	31	127	178	185
	medium	1	0	0	7	0
	heavy	0	0	0	0	0
		185	185	185	185	185

Table I continued)

Plot No.	Degree of Attack	Number of Trees 1939	1940	1941	1942	1943
6	none	0	44	0	0	A few
22.4 mi. W.	light	109	78	96	66	medium,
Cranbrook	medium	13	1	17	31	nearly
	heavy	2	0	6	22	all
	dead	0	1	1 + 4*	1 + 4*	light.
		124	124	124	124	
7	none	0	20	0	0	0
11.9 mi. W.	light	19	39	51	34	17
Moyie	medium	13	7	14	20	29
	heavy	34	0	1	12	20
	dead	1	1	1	1	1
		67	67	67	67	67
8 5.5 mi. W. Yahk	Logged in 1941					
9	none	0	10	0	0	0
Slocan Lake	light	62	1	6	2	36
Golf Course	medium	0	51	16	34	0
(edge)	heavy	0	0	14	0	0
				+ 26*	+ 26*	+ 26*
		62	62	62	62	62

* Felled in clearing for roadway in 1941

In all of the areas invaded by the sawfly the most severe defoliation has occurred during the first few years after the sawfly has become established. After that the severity of infestation has declined and any severe defoliation thereafter has been spotty and as a rule has not involved large areas. This is thought to be due largely to parasitism by <u>Mesoleius tenthredinis</u> Morley, <u>Tritneptis klugii</u> Ratzburg, <u>Isaria farinosa</u> and to predators such as mice and voles. Apparently heavy rainstorms sometimes destroy small larvae and in one instance early low temperatures in October when snow was absent, killed a high percentage of larvae in the cocoons.

The cocoon parasitism in 1943 was very high. In three localities it was 90 per cent or over. Table II gives data on sixteen samples collected at intervals between Fernie and Vernon. These are listed consecutively from east to west. It should be noted that the lowest sawfly survival is in the older part of the infestation and this survival roughly increases progressively from east to west, corresponding approximately to the recency of the invasion by the sawfly. The sawfly survival is highest on the most recently invaded areas near the Okanagan Valley.

Further Data on 1942 Material

Material remaining after examination of cocoon samples immediately after collecting in the fall of 1942 was placed (without soil or duff) in jelly jars covered with cheese cloth. These were kept in the insectary at the field station until November 9 when they were placed in the overwintering vault. On April 30, 1943 the material was removed from the vault and transferred to the insectary to await emergence. After all emergence of sawflies and *Mesoleius* had ceased and after the emergence of the first generation of adult *Tritneptis*, remaining cocoons were opened and examined under a binocular microscope. Table III gives emergence data for this overwintered material. Table IV gives the results of examination of the remaining cocoons after all emergence. Table V gives the total survival and mortality of *Mesoleius* from samples overwintered in the soil 1942-43.

Cold Resistance of Tritneptis

The remarkable resistance to cold by *Tritneptis* was exhibited during the winter of 1942-43 when 114 cocoons were placed in a jelly jar without soil or duff and overwintered in an outside insectary at Vernon. During the period January 17 to 25 incl. the average maximum temperature was -1.8° F., the average minimum -15.4° F. The extreme low was -25° F. on January 21.

On May 3, 1943, these cocoons were moved to the Trinity Valley Field Station. Table VI gives the emergence of *Tritneptis* from this material. From this table it is seen that 132 *Tritneptis* survived the extreme temperatures mentioned above. Examination of the entire lot of cocoons after all emergence by *Tritneptis* showed that all of the latter emerged from 7 cocoons. Results of the examination are as follows:

75 coconns contained dead sawfly larvae
17 " " " " " plus dead *Tritneptis* larvae
8 " " " " " with white fungus
10 empty (Produced *Tritneptis* adults)
1 cocoon contained Bessa selecta puparium
__________, 1 cocoon produced a male *Mesoleius* adult, 2 cocoons contained dead *Mesoleius* larvae

TABLE ~~XIV~~ II - LARCH SAWFLY PARASITISM - 1943

Coll. point	Date. coll.	Date. exam.	A No. coll.	B No exam.	C No. 1942 cocoons	D (B-C)	E cause death unknown	F (D-E)	G Trit.	H %	I Mes-ol.	J %	K Trit. on Mes.	L %	M Saw-flies alive	N %
Lizard Creek (Fernie dist)	Sep.11	Oct.16	72	72	20	52	2	50			39	78.0	1	2.6	11	22.0
1 mi.E. Elko	Sep.11	Oct.16	115	51	11	40		40	1	2.5	35	87.5	1	2.8	4	10.0
5 mi.W. Yahk	Sep.13	Oct.19	125	125	95	30		30	19	63.3	9	30.0	3	33.3	2	6.7
Plot 7	Sep.12	Oct.18	68	68	24	44		44	25	56.8	18	40.9	8	44.4	1	2.3
Plot 6	Sep.12	Oct.19	41	41	30	30		11	3	27.3	5	45.4			3	27.3
Just off Plot 2	Sep.13	Oct.18	22	22	4	18	6	12	8	66.6	2	16.7			2	16.7
Plot 1	Sep.16	Oct.15	117	50	8	42		42	8	19.0	23	54.8	3	13.0	11	26.2
5 mi.N.Burton	Sep.17	Oct.15 -16	31	31	10	21		21	8	38.1					13	61.9
6 mi.N.Needles	" 17	Oct.15	116	50	2	48		48			28	58.3			20	41.7
Whatshan cut-off E. end.	Sep.17	22 Sep.22	-709	50	4	46		46	4	8.7	26	56.5	1	3.8	16	34.8
"	"	Oct.19	709	59	6	53	1	52	4	7.7	30	57.7	1	3.3	18	34.6
"	Sep.27 Oct.2	Oct.14	1330	150	22	128		128	20	15.6	70	54.7	6	8.6	38	29.7
Lower Inonoaklin crossing	Sep.17	Oct.12	83	83	4	79		79	5	6.3	47	59.5	4	8.5	27	34.2
2 mi.S.of Bevans Ranch, Monashee Rd.	Sep.17	Oct.15	93	93	5	88		88	2	2.3	19	21.6			67	76.1
Trinity Sta.	Aug.26	Oct.26	22	22		22		22			3	13.6			19	86.4
"	Oct.1	Oct.19	21	21		21		21			1	4.8			20	95.2

TABLE ~~XV~~ III - EMERGENCE IN 1943 FROM 1942 SAMPLES

	Plot 5	Plot 7	4.0 mi. S.Grey Creek	8.9 mi. W.Nelson	26.8 mi. W.Nelson	10.9 mi. S.Nakusp	1 mi. S.Burton	8 mi. W. Lower Inonoaklin Crg.
No.cocoons	148	138	87	59	72	194 *	132	98
Pristiphora erichsonii	37	12	12	5	33	122	54	44
Tritneptis klugii	325 19 cocoons	829 28 cocoons	9 1 cocoon	1,582 50 cocoons	381 16 cocoons	0 0	396 18 cocoons	286 8 cocoons
Mesoleius tenthredinis	25	38	33	0	0	19	13	3

* 15 cocoons containing live sawfly larvae removed for other experiments

TABLE ~~XVI~~ IV - EXAMINATION OF REMAINING COCOONS

	Plot 5	Plot 7	4.0 mi. S.Grey Creek	8.9 mi. W.Nelson	26.8 mi. W.Nelson	10.9 mi. S.Nakusp	1 mi. S.Burton	8 mi. W. Lower Inonoaklin Crg.
No. cocoons	67	60	41	9	23	53	47	43
Dead sawfly stages	47	16	20	3	11	53	25	18
Living sawfly stages			3	5	1		5	4
Fungus	8	30	3		11		10	9
Mesoleius dead	6	5	2					
Mes. alive	1	3	13					
Tritneptis alive	5	4		1			7	12
Trit.alive on Mesol.	1							
Trit. dead		2						

TABLE ~~XVI~~ V - SURVIVAL OF OVERWINTERING MESOLEIUS

Place of Collection	No. cocoons	Total Mesol. No.	Total Mesol. %	Living Mesol. em. & unem. No.	Living Mesol. em. & unem. %	Mortality No.	Mortality %
Plot 5	148	32	21.62	27	84.38	5	15.62
Plot 7	138	46	33.33	43	93.48	3	6.52
4.0 mi. S. Grey Creek	87	48	55.17	46	95.83	2	4.17
10.9 mi. S. Nakusp	194	19	9.79	19	100.00	0	0.00
1.0 mi. S. Burton	132	13	9.85	13	100.00	0	0.00
4.0 mi. W. Lower Inonoaklin Crossing	98	3	3.06	3	100.00	0	0.00

TABLE ~~XVII~~ VI - RESISTANCE OF TRITNEPTIS TO LOW TEMPERATURES

Date	Tritneptis emerged	Date	Tritneptis emerged	Date	Tritneptis emerged
May 26	7	June 1	15	June 7	11
" 27	28	" 2	11	" 8	6
" 28	26	" 3	7	" 9	-
" 29	1	" 4	12	" 10	-
" 30	-	" 5	-	" 11	"
" 31	6	" 6	-	" 12	2
TOTALS	68		45		19

It will be seen that Tritneptis survived in 37 per cent of the cocoons containing that parasite, while none of the sawfly larvae survived. This would be of considerable importance in the field when there was scant snow on the ground. In some cases, it would mean a greatly increased ratio of parasites to hosts the year following.

Evidence of Modes or Rhythms in Sawfly and Parasite Emergence

On several occasions, the presence of two modes or rhythms has been noted in the emergence of the larch sawfly and the parasite Mesoleius tenthredinis. As early as 1936, H. B. Leech noted this at Fernie, B.C. In that year, the first emergence period of the sawfly was between May 8 and June 10 and the second between June 23 and July 2. The two periods of Mesoleius emergence occurred for the males June 3 to June 21 and then June 30 to July 22; for the females June 14 to June 27, and July 1 to July 22. This same phenomenon was noted by C. V. G. Morgan at Trinity Field Station in 1943. The emergence periods for the sawfly were May 25 to July 10, and July 16 to July 22. Mesoleius also exhibited two modes the first June 14 to July 8, and the second July 19 to July 24.

The same type of occurrence was noted at the Belleville Laboratory in 1943 in connection with Exenterus abruptorius. Two distinct modes were observed separated by seven or eight days.

The explanation for this behavior has not been found. Apparently it is not caused by weather conditions at the time of emergence. It may have something to do with diapause. This is further suggested by the smaller emergence during the second period and the fact that it does not occur every year.

Number of Generations of *Tritneptis klugii* (Ratzeburg) in a season.

(C.V.G. Morgan)

Studies of the number of generations of *Tritneptis klugii* (Ratzeburg) occurring in a season on cocoons of *Pristiphora erichsonii* (Hartig), begun in 1941, were continued in 1943.

Series V, which was begun on August 10, 1942 did not produce adults in that year to complete the generation. The parasitized larch sawfly cocoons were placed in duff in a jelly jar on Nov. 9, 1942 and left in the insectary for the winter of 1942-43. The minimum temperature obtained in the insectary during this time was -8.5°F. On May 5, 1943, the duff was removed from the jelly jar and the parasites allowed to develop under air temperature and humidity.

Adult parasites from Series V. began to emerge on June 21, 1943 and continued for eight days until June 28 as shown below. One hundred and ten parasites were obtained from five cocoons. The length of this overwintering generation is 315 to 322 days as compared to the similar generation of 1941-42 of 324 to 330 days. In the latter case, however, the parasitized cocoons were wintered in an overwintering chamber from November 7, 1941 until June 3, 1942, and in which a minimum temperature of only 25.0°F. was recorded.

Emergence of Parasites from Series V

Date of Emergence								Total	Cocoons producing parasites	Ave. per cocoon	% Sex	
June 21	June 22	June 23	June 24	June 25	June 26	June 27	June 28				♂	♀
9	17	6	41	30	Not examined	Not examined	7	110	5	22.0	17.65	82.35

After emergence was completed the cocoons were examined. All cocoons were parasitized and produced adult parasites. Four of the cocoons contained no dead or live parasite material; the fifth contained seven dead parasite larvae.

Series VI was established on June 22, 1943--the same technique was followed as already outlined in previous reports On July 8 all adults except one were dead. This specimen died by July 10. Parasite emergence of this first summer generation began on July 25 and continued for five days until July 29.

Emergence of Parasites from Series VI

Date of Emergence July 25	July 26	July 27	July 28	July 29	July 30	Total	Cocoons producing parasites	Ave. per cocoon	% Sex ♂	♀
14	99	77	61	11	0	262	5	52.4	19.86	80.14

An examination of cocoons after emergence showed that all cocoons were parasitized. Only one cocoon contained any parasite material--two dead parasite pupae were found in this specimen.

Series VII was begun on July 26, 1943, in a similar manner to the preceding experiments. Five of the parasite adults used in this series were still alive on August 7; these were dead on August 9. Emergence of parasites from this second summer generation began on September 6 as follows:

Emergence of Parasites from Series VII

Date of Emergence Sept. 6	Sept. 7	Total	Cocoons producing parasites	Ave. per cocoon	% Sex ♂	♀
36	6	42	1	42.0	23.81	76.19

The cocoons were examined on September 10, and it was found that all parasites had emerged from only one cocoon. This cocoon contained eight dead parasites, all of which were larvae. The other four cocoons contained dead sawfly larvae but these were not parasitized. It is considered that these sawfly larvae were dead when the experiment was begun on July 26.

Series VIII was not set up in the fall of 1943. This series would have undoubtedly overwintered as larvae to complete the generation late in the spring of 1944. Three generations of Tritneptis klugii were obtained in 1943. This information is summarized in the following table and compared to results of 1941 and 1942.

Year	Generation	Period of Emergence	Length of Generation	Ave. no. of parasites per cocoon	% Sex ♂	% Sex ♀
1941	Overwintering generation	June 5-July 8	Parasitized cocoons taken from field	35.0	13.9	86.1
	1st summer generation (Series I)	July 12-25	31-34 days	65.9	14.7	85.3
	2nd Summer generation (Series II)	August 11-19	29 -31 days	49.0	15.7	84.3
1942	Overwintering generation (Series III)	July 2-8	(artificially overwintered) 324-326 days	55.5	17.7	82.3
	Summer generation (Series IV)	Aug.8-16	33 days	38.0	12.1	87.9
1943	Overwintering generation (Series V)	June 21-28	315 days (cocoons overwintered in duff in insectary)	22.0	17.7	82.3
	1st Summer generation (Series VI)	July 25-29	33 days	52.4	19.9	80.1
	2nd Summer generation (Series VII)	Sept.6-7	42 days	42.0	23.8	76.2

In conjunction with the above, supplementary experiments were performed in an overwintering chamber at Trinity Valley, B.C. and in an insectary at Vernon, B.C. The method of experimentation followed in both environments was the same as that already outlined for the generation studies.

The experiment in the overwintering chamber was commenced on June 23, 1943. From this date onward the temperature of the chamber was maintained at a fairly uniform level by opening and closing the doors and vents. The maximum and minimum temperatures recorded for a period of 55 days after June 23, were 61.5°F. and 48.0°F. respectively. The former was obtained on only one day and the latter on three days. The range of temperature on each of 47 days was 5.0° F. or less. A maximum range of 11.5F.° was noted for one day only. A maximum daily mean temperature of 59.2°F. was recorded for the period while the minimum daily mean temperature was 50.0°F. Relative humidity throughout the period averaged 79.5%

Adult parasites used to start the experiment emerged on June 23, the day the experiment was begun. One parasite was still alive on July 22, but by July 24, this adult had died.

On August 9, two of the five larch sawfly cocoons were transferred to the field insectary. One of these cocoons was opened and adult parasites were found crawling about inside. The cocoon was then closed and sealed. Parasite emergence from this same cocoon began on August 10 and ended on August 11. Adult parasites could be seen in the second cocoon, without opening it, on August 10 but these did not emerge until August 16; emergence ceased on August 17. Cocoons left in the overwintering chamber produced parasites on August 11 and continued to do so until August 17. The above data are summarized in the following table:

Aug. 9 1943	Date of Emergence Aug. 10	Aug. 11	Aug. 12	Aug. 13	Aug. 14	Aug. 15	Aug. 16	Aug. 17	Total	Cocoons producing parasites	Ave. per cocoon	% Sex ♂	♀
2 cocoons transferred to insectary	52	2					71	3	128	5	60.2	7.6	92.4
3 cocoons left in overwintering chamber		58	97	10	3	2	2	1	173				

No dead parasite larvae or pupae were found in the cocoons upon examination after emergence. One cocoon from the overwintering chamber contained a dead parasite adult (♀).

In summary, it is to be noted that the developmental time for the generation in the overwintering chamber under the abovementioned conditions of temperature and relative humidity was 49 days. During this time the number of day-degrees amounted to 2,694.2. The daily mean temperature for the period averaged 54.98°F.

A second experiment was begun in the overwintering chamber on August 13. Four of the adults used lived for one month; one was still alive on September 17, but died September 19. This series did not produce adults in the fall of 1943. For 49 days after the start of the experiment the daily mean temperature averaged 51.31°F. Although the number of day-degrees had amounted to only 2,514.2 Fifty-five days after August 13, the respective figures were 51.15 and 2,813.2

The apparent conclusion from the above two experiments is that the development of a generation from the egg to the adult ceases somewhere between the average daily mean temperatures of 51.3°F. and 54.9°F, and at approximately 80% relative humidity.

The experiments in the insectary at Vernon were not begun until June 28, 1943. These were conducted in the same manner as those of the generation studies and permitted to develop under air temperature and humidity. Daily maximum and minimum temperature records were taken from thermometers placed close to the containers in a shaded environment. Under this environment the adults were short-lived, four were still alive on July 2 but all had died by July 7.

Parasite emergence began on July 21 just 23 days after the cocoons were subjected to the parent parasites. During this period, the average daily mean temperature was 69.49°F. and the number of day-degrees amounted to 1,598.3. Emergence took place as follows:

Date of Emergence					Total	Cocoons producing parasites	Ave. per coconn	% Sex	
July 21	July 22	July 23	July 24	July 25				♂	♀
105	74	63	1	21	264	5	52.8	10.2	89.8

A second experiment was commenced at Vernon in the insectary on July 26, 1943. This was an exact duplication of the first. Here, however, hygrothermograph records were taken in addition to the maximum and minimum temperatures from thermometers. Daily mean temperatures and relative humidities were calculated according to Gedde's formula. Emergence first occurred on August 24. In this period of 29 days the average daily mean temperature and relative humidity were 67.87°F. and 56.90%, respectively. Day-degrees for this time numbered 1,968.4. Two of the parent parasites used on July 26 lived until August 3; these died on August 4. Emergence occurred as follows:

Date of Emergence during August				Total	Cocoons producing parasites	Ave. per cocoon	% Sex.	
24	27	28	31				♂	♀
5	6	7	2	20	5	4	35.0	65.0

A third experiment started in the same environment on August 24 did not produce adults in the fall of 1943.

It is stated elsewhere in this report that in 1943 the first emergence of parasites from cocoons overwintered at Vernon occurred in the latter part of May. This is approximately one month earlier than that taking place at Trinity Valley. After considering this fact, and making a comparison of the length of only two generations in both environments, it is believed that at least four, and possibly five generations of <u>Tritneptis klugii</u> might occur in Vernon as compared to a maximum of three at Trinity Valley.

Although we have to date definite knowledge on the development of <u>Tritneptis klugii</u> from only one environment and partial information from another it is seen from the above experiments that on sawfly areas of British Columbia topographical and climatic differences may be great enough between environments to produce large differences in the number of generations a year and the developmental time of each of these generations. The information at hand on two environments--Trinity Valley and Vernon-- which are approximately 15 miles apart shows that differences in developmental time for a generation at the same period of the year may be as much as 13 days in August and 10 days in July. The differences in the number of generations will vary accordingly and consequently the amount of larch sawfly control produced by this parasite . It is known that in some larch sawfly areas this control is almost negligible while in others it is quite considerable reaching 60% or more for one generation only on some areas in 1943. Since reasons for the above differences are not specifically known, it was thought an explanation could be found in experiments already performed. An attempt was therefore made to account for differences in length of generations between environments and of different generations in the same environment. The only two natural factors which could influence the development of the parasite under the conditions of the experiment were temperature and humidity. Accordingly, the mean daily temperature and relative humidity were calculated for three generations using Gedde's formula were possible.

The influence of temperature as affecting parasite development was then considered as a separate factor. Experiments begun in Vernon and Trinity Valley on July 26 were compared. Here there was a difference in length of generation of 13 days. But differences in mean temperatures would only account for 4.98 of these days. Relative humidity was then treated as a separate factor. It could account for only 6.85 days. The sum of these two factors totals only 11.83 days. Temperature and relative humidity were then combined and correlated with length of generation as a single factor. In this manner the two factors accounted for 13.01 days as compared to 13 days obtained in the experiment. Adults were recovered 42 days after July 26 at Trinity Valley. Theoretically they would have been obtained in 42.01 days.

The experiments of Vernon, July 26 and the overwintering chamber, June 23 were compared in a similar manner. Theoretically adults would have emerged in the latter environment in 50.01 days; the actual time required was 49 days. Based on the experiment of July 26 in the insectary at Trinity Valley, the generation in the overwintering chamber would have completed itself in 50 days. No corrections were made for low temperatures in the overwintering chamber which are considered to be below the medial range of development.

The above facts are summarized in the following table:

Environment	Date of inception	Length of generation	Ave.mean daily temperature	Ave.mean daily hum.	Theoretical length of generation based on Vernon
Vernon Insectary	July 26	29	67.9	56.9	
Trinity V. Insectary	July 26	42	57.9	70.3	42.01
Overwintering Chamber	June 23	49	54.9	79.5	50.01

Under natural conditions weather factors, especially soil temperature and humidity, would detérmine if the parasite could develop in an area, the length of the generation, and the number of generations in a year. It is of practical interest to know what these requirements are for then the amount of larch sawfly control by Tritneptis can be comparatively estimated. From the above preliminary investigations, it is apparent that such estimations can possibly be made if detail weather records are available for any area in question.

E.30.19 - 3 -BARK BEETLE CONTROL AND SAMPLE PLOT STUDIES

Geo. R. Hopping &W.G. Mathers

Bark beetle control work was continued on the Banff areas during the winter of 1942-43, and one crew is working in the present winter 1943-44. At the end of the first winter's work (1941-42) approximately 5,423 acres had been covered from which 9,192 trees had been treated. After the attack in the summer of 1942 a survey of the areas indicated that there had been considerable infiltration of bark beetles into areas already worked from portions which could not be worked the first season. During the 1942-43 winter it was possible to reclean most of the areas worked the first year and to extend the work to include practically all of the infestation. The total number of trees treated during the second winter was 17,911.

Table I. gives the results of the 1941-42 and 1942-43 control work. The latter includes both reworked and extended areas. Table II gives a comparison of the two winters' work on the same acreage basis. It will be noted that all but two areas showed declines while the increases on the two were 5.76 and 44.44 per cent respectively. At the same time, small outlying areas which had never been worked showed increases of 150 per cent.

Table I. Bark Beetle Control

	1941-42		1942 - 43		Infested trees per acre	
Area	No. acres	Inf.trees (green)	No. acres	Inf.trees (green)	First Year	Second Year
Hillsdale	2558.9	1984	4041.7	2897	0.8	0.7
Sulphur Mt.	575.0	529	921.4	551	0.9	0.6
Spray River	413.5	219	1971.8	1657	0.5	0.8
Tunnel Mt.	75.0	27	135.5	104	0.4	0.8
Squaw Mt. (1)	38.3	93	65.2	102	2.4	1.6
Squaw Mt. (2)			174.2	201		1.2
Healy Cr.	1539.6	2030	1036.5	3716	1.3	3.6
Healy Gate			136.4	228		1.7
Brewster Cr.			321.8	1089		3.4

8804.5

As pointed out in Table I, the number of trees per acre the second year is not directly comparable to the number the first year because the former figures include additional acreage worked for the first time in 1942 - 43. For a direct comparison based only on the acreage covered twice see Table II.

Table II. - Bark Beetle Control

Area	1 9 41- 1942 No. acres	Inf. trees (green)	1942 - 43 No. acres	Inf. trees (green)	% Change Incr.	Decr.
Hillsdale	2467.4	1595	2467.4	1687	5.8	
Sulphur Mt.	575.0	529	575.0	472		10.8
Spray River	413.5	219	413.5	203		7.3
Tunnel Mt.	75.0	27	75.0	39	44.4	
Squaw Mt.	38.3	93	38.3	9		90.3
Healy Cr.	323.2	668	323.2	564		15.6
South Bow	91.9	122	91.9	115		5.8

These figures in Table II indicate that in spite of the first year's control, there was an increase on two of the areas before the start of the second year's work and only a small decrease on four other areas. The large decrease on Squaw Mt. is probably due to the fact that this area is somewhat isolated from the main areas, and there was no large unworked contiguous area from which bark beetles might infiltrate.

Table III gives a summary of control work for the first two winters (1941-42 and 1942-43.)

Table III. Summary-Bark Beetle Control

Season	Acres	Red tops Total No.	Ave.per acre	Green inf. trees Total No.	Ave. per acre	Total trees Total No.	Ave. per acre
1941-42	5374.5	3609	.672	5083	.946	8692	1.617
1942-43 new areas	4826.1	.3609	1.423	7355	1.524	14223	2.947
Recleaned	3984.3	599	.150	3089	.775	3688	.925
Totals	8810.4	.847	.847	10444	1.185	17911	2.033

The number of red-tops listed includes dead trees and some sickly or stag-topped trees which it was advisable to remove. These figures for green-infested trees show the effect of the control work on the portions worked the first season compared to areas still unworked. Trees on the former averaged .775 per acre while on the latter the average was 1.524.

Twelve days of sub-zero weather in the middle of January 1943, greatly aided the control work by practically exterminating the bark beetle broods above snow line. The average minimum temperature for this period was -29°F., the average maximum -4.3°F. The extreme minimum was -47.2°F. While this heavy mortality has aided in the control it will not end the outbreak unless the balance is restored by other factors such as increase in tree vigour as the result of substantially increased precipitation. This same situation arose in the Kootenay Park outbreak in the winter of 1934-35, when practically all bark beetle stages above snow line were killed by abnormally low temperatures. Although this slowed the infestation down for several years, by 1939 the outbreak had regained its former impetus, and went on to new heights of destruction.

A survey of the Banff areas in September 1943, showed only Sulphur Mt. with any appreciable reinfestation. This amounted to less than one tree to every three acres. An unusual number of windfalls on this area apparently attracted many of the beetles which survived in the tree bases. All other areas showed one tree or less to every fifteen acres. Consequently, only one control crew is employed at present to reclean the Sulphur Mt. area. Control work will be resumed on the other areas if and when the bark beetle shows appreciable increase.

Winter Kill of Bark Beetles

In Kootenay Park, analyses of samples were made to determine the extent of winter kill above snow line and to determine how far up the trunk survival extended. Two samples were taken from each of four trees. One sample on each tree was taken from near ground level and the other was taken well above the snow line of the previous winter. Table IV shows bark beetle survival. The first four samples were taken near Nixon Creek and the second four near Dollyvarden Creek. Each sample was one foot long.

Table IV - Winter Mortality of Dendroctonus Broods

Tree No.	Sample No.	Circum. ave inches	Dist. above ground (inches)	Dendroctonus Stages living eggs	living larvae	living adults	dead eggs	dead larvae	dead adults
1	1	30	12-22	31	15	18		153	75
1	2	26	70-82					170	37
2	1		18-30						14
2	2	28	58-70					1	9
3	1	33	2-14		46			156	52
3	2	19	50-62					144	25
4	1	48	4-16	9	103	10		230	42
4	2	21	52-64					317	34

Many adults found dead would have died in the galleries irrespective of the low temperatures. No pupae were present. In sample 1, tree 1, all living Dendroctonus stages were within 4 inches of the lower end indicating the effect of snow protection. Supplementary evidence was gathered by examination of about 30 trees above and below snow line and no living Dendroctonus stages could be found above a point about two feet from the ground. Examination of about the same number of trees in Banff Park gave the same results.

Contrast this with Table V giving results of sample analyses from two trees in 1942, one near Nixon Creek and one 1 mile north of Nixon Creek. Samples were the same length as those in Table IV.

Table V. - Survival of Dendroctonus Broods - 1 9 4 2

Tree No.	Samples No.	Circum inches (Ave)	Dist. above ground	Dendroctonus Stages living larvae	living pupae	living adults	dead larvae	dead pupae	dead adults
1	1	31	43-55	312			8		51
1	2	24	82-94	28					23
1	3	26	55-67		3	67	32	15	14
2	1	30	54-66			54	5	1	24
3	1	29	12-24			64	10	2	29

Table V continued)

Tree No.	Sample No.	Circum. ave.in.	Dist. above ground	Dendroctonus Stages: Living larvae	Living pupae	Living adults	Dead larvae	Dead pupae	Dead adults
4	1	29	0-12	5	5	53	158	3	35
	2	26	12-24		2	60	40	18	35
	3	24	24-36	4		39	131	12	37
	4	24	36-48	1		40	115	6	36
	5	23	48-60			44	150	9	25
	6	23	60-72	1	1	33	56	5	22
	7	22	120-132		1	9	129	5	13
	8	21	168-180			7	87		14

Examination of samples 1 and 2 of tree 1 in Table V was made in June before larvae had transformed. The remaining examinations were made in July after most of the surviving brood had reached the adult stage. The heavy larval mortality is apparently due to over-crowding and some to high temperatures on the southwest sides of the trees. By comparing Table V with Table IV, it can be seen that the brood survival after the winter of 1941-42 was far greater than after the winter of 1942-43, that is, above snow line.

Tree Selectivity

Evidence gathered to date indicates that there is a definite preference for certain types of trees by the mountain pine beetle. This is more pronounced on areas where an epidemic is just starting or where bark beetles have recently invaded a new area from an intensive outbreak center. It appears to be more marked in younger stands between 40 and 100 years old. Naturally any selective tendency under severe epidemic conditions where 95 per cent of the stand is taken, is largely obscured.

In young stands, and even in some relatively mature stands, a definite preference for dominant, faster-growing trees seems to be evident.

For the study of tree selectivity 12 plots were laid out in Banff Park on bark beetle control survey strips which had been treated for the first time. Growth data for all infested trees on the plots were provided by discs which were taken when the infested trees were cut. As checks, the growth of 10 trees on each plot, selected at random, was measured by means of increment cores. Diameter measurements at stump height, or approximately 18 inches were taken for these and the remaining trees on each plot. Each plot was 100 feet square. The Healy plots (6) were on a survey strip with a slope between 50 and 60 per cent varying in elevation from 5200 to 5600 feet. The exposure was south-east. The Goat River plots were on a slightly steeper slope with southwest exposure but approximately at the same elevation as the Healy plots.

Increments on both sets of plots were taken in September 1943, after current year's growth had been completed. Individual year's growth was measured with a micrometer disc in a X10 eye piece and X40 objective, binocular microscope. Decade growth was made directly with a millimeter rule.

Table VI gives growth data for attacked and unattacked trees on the Healy Creek plots while Table VII gives the diameter classes of all trees on the plots compared to diameter classes of attacked trees. The same data for the Goat River plots are given in Table VIII and IX respectively.

With a few exceptions, the trees on the Healy plots fell in the 150 to 160 year age class. Trees on the Goat River plots were practically all between 200 and 210 years old.

On the Healy plots, attacked trees average faster growth than unattacked trees. On the Goat River plots, trees have been much slower growing than on Healy Creek, probably because of poorer site factors of the former. On Goat River, preference for fast-growing trees was not evident, but attacked trees averaged larger in diameter.

Table X gives growth data for attacked and unattacked trees in Kootenay and Yoho Parks in younger stands 40 to 70 years old.

The Kootenay plot was one fourth acre in extent. Each of the Yoho plots consisted of a group of infested trees surrounded for considerable distances on all sides by green uninfested trees. Growth studies were made on the attacked trees and on all green uninfested trees immediately surrounding the infested group. On all of these plots the larger trees were attacked and these were the dominant faster-growing trees. On one plot at Leanchoil in Yoho Park, although the trees attacked were dominant, as compared to the group immediately surrounding, the growth at the time of attack was somewhat slower in attacked than in unattacked, but the former trees had been faster-growing for the greater part of their development.

In this connection it is interesting to note that A. C. Thrupp, reporting on an infestation of D. monticolae around Lac le Jeune in 1933 made the following statement:

"This stand is about 133 years old and was attacked in the late summer of 1928 when it was 129 years old. The stands to the south of the lake

TABLE VI - UNATTACKED TREES - HEALY CR.- BANFF PARK

Plot No.	No. of Trees	Ave.in. stump diam.	Age in Years	1891-1900	1901-1910	1911-1920	1921-1930	1931-1940	1931-1935	1936	1937	1938	1939	1940	1941	1942	
1	10	11.5	160-170	4.74	5.76	4.33	2.81	2.06	1.22	.196	.190	.152	.158	.143	.125	.118	
2	10	10.8	140-160	4.61	4.77	4.02	3.74	2.44	1.34	.215	.255	.249	.181	.205	.177	.151	
3	10	12.0	150-160	6.16	5.77	5.09	4.26	3.06	1.69	.251	.272	.296	.283	.274	.238	.241	
4	10	10.0	150-160	3.39	4.18	3.99	3.12	2.02	1.09	.211	.203	.184	.171	.167	.158	.154	
5	10	8.8	150-160	3.50	3.46	2.55	3.42	2.98	1.80	.239	.236	.262	.220	.222	.169	.165	
6	10	11.3	150-160	6.03	6.73	6.06	4.40	3.76	1.96	.310	.319	.384	.361	.424	.363	.317	
							ATTACKED TREES										
1	9	13.0	152	7.00	7.67	5.33	3.60	2.89	1.62	.272	.260	.260	.251	.226	.222	.182	*
2	9	13.4	161	6.30	9.13	6.69	3.89	3.43	1.83	.366	.321	.369	.273	.268	.229	.164	X
3	12	14.3	148	9.38	9.90	6.99	4.98	3.60	2.03	.312	.299	.337	.320	.302	.250	.247	* *
4	19	11.5	159	5.38	6.26	4.87	3.57	3.12	1.65	.283	.275	.308	.316	.286	.232	.220	/
5	13	10.2	158	3.93	4.79	3.57	2.94	2.99	1.59	.299	.327	.301	.295	.243	.221	.163	X
6	12	12.6	159	7.58	8.17	5.37	4.53	3.50	1.87	.325	.323	.355	.310	.318	.298	.204	#

Legend below applies only to the Growth Figures under 1942

* 7 trees only. Other two 1941 att.

* * 8 " " " four " "

X All Trees 1942 att.

/ 10 trees only. Other 9, 1941 att.

\# 11 trees only, one 1941 att.

TABLE VII - GROWTH DATA - HEALY CR. - BANFF PARK

Plot No.	Total Trees	Ave. diam. inches	No. of Trees in Diam. Classes (In.) - All Trees 5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	22
1	63	11.0	1	3	7	4	10	6	6	6	6	2	7	1	2	--	2	--
2	22	12.2	--	--	3	1	--	2	4	1	3	2	3	1	1	--	1	--
3	57	10.4	1	4	7	5	8	9	6	3	1	5	4	2	--	1	--	1
4	99	8.7	7	14	12	19	16	12	8	4	1	2	1	1	1	1	--	--
5	100	8.8	--	7	21	23	15	14	11	5	3	1	--	--	--	--	--	--
6	45	11.6	--	--	2	2	6	7	10	4	5	2	1	4	1	--	--	1
Totals	386	10.0	9	28	52	54	55	50	45	23	19	14	16	9	5	2	3	2
% Total stand			2.3	7.3	13.5	14.	14.2	13.	11.7	6.	4.9	3.6	4.1	2.3	1.3	.52	.78	.52
			No. of Trees attacked in Diam. Classes															
1	9	13.0	--	--	--	--	1	1	3	--	1	--	--	1	1	--	1	--
2	9	13.4	--	--	1	--	--	--	2	--	2	1	--	1	1	--	1	--
3	12	14.4	--	--	--	--	--	1	2	1	--	3	2	2	--	1	--	1
4	19	11.5	--	--	--	2	3	4	3	1	1	2	1	--	1	1	--	--
5	13	10.2	--	--	1	1	--	7	2	1	--	1	--	--	--	--	--	--
6	12	12.6	--	--	--	1	2	1	2	1	1	1	--	2	--	--	--	--
Totals	74	12.5	--	--	2	4	6	14	14	4	5	8	2	6	3	2	2	2
% Total No. in Age.Cl.			--	--	3.8	7.4	10.9	28.	31.1	1.7	26.3	57.1	12.5	66.6	60.	100	66.6	100
% of Total Att. Trees		19.2	--	--	2.7	5.4	8.1	18.9	18.9	5.4	6.8	10.8	3.0	8.1	4.1	3.0	3.0	3.0

TABLE VIII -UNATTACKED TREES-GOAT R.-BANFF PARK

(Growth in mm.)

Plot No.	No.of trees	Ave.stump diam.	Age in years	1891-1900	1901-1910	1911-1920	1921-1930	1931-1940	1931-1935	1936	1937	1938	1939	1940	1941	1942
1	5	8.4	200-230	3.16	3.44	3.14	2.46	2.38	1.15	.167	.171	.296	.247	.349	.304	.323
2	5	10.8	130-170	6.70	5.90	4.80	2.99	1.56	1.56	.281	.308	.281	.293	.266	.235	.269
3	5	11.6	200-220	3.06	3.54	3.00	2.68	2.13	1.10	.159	.232	.247	.190	.205	.213	.224
4	5	11.4	200-210	2.64	2.66	1.79	1.54	1.13	0.60	.084	.099	.137	.106	.099	.121	.118
5	5	11.6	190-200	3.03	3.02	2.39	1.94	1.69	0.85	.148	.167	.201	.159	.169	.159	.194
6	5	8.6	190-200	1.76	1.67	1.31	1.08	0.92	0.48	.068	.076	.087	.099	.110	.099	.125
							ATTACKED TREES									
1	6	10.1	204	3.90	4.11	3.95	3.11	2.10	1.27	.184	.190	.187	.139	.133	.105	... *
2	6	11.8	190	4.35	4.15	3.67	3.17	1.93	1.11	.168	.180	.152	.143	.174	.162	.316 X
3	7	10.7	197	2.90	2.60	2.22	1.95	1.64	0.89	.136	.155	.138	.179	.138	.138	....**
4	11	11.4	204	3.52	4.05	3.30	2.59	1.98	1.02	.180	.211	.225	.173	.169	.168	.183
5	3	11.0	192	3.07	3.07	2.60	2.33	1.41	0.72	.133	.108	.095	.184	.165	.152	.... ≠
6	11	11.3	201	3.18	3.23	2.59	2.22	1.86	0.94	.168	.192	.188	.185	.188	.204	.176 #

Legend below applies only to the Growth
Figures under 1942.

* All trees except 1 -- 1941 attack

** All trees except 2 -- 1941 attack

≠ All but 1 tree 1941 attack

X Only 3 trees --other 3 1941 attack

Three trees 1941 att. Remainder 1942 att.

TABLE IX - GROWTH DATA -GOAT RIVER - BANFF PARK

Plot No.	Total trees	Ave.diam. inches	Number of Trees in Diam. Classes all Trees: 5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	21	9.5	-	-	3	4	4	4	3	2	-	1	-	-	-	-	-	-
2	35	10.5	-	2	2	3	6	4	5	6	3	3	1	-	-	-	-	-
3	34	11.3	-	-	1	1	5	7	3	7	6	2	2	-	-	-	-	-
4	52	9.9	-	3	3	5	6	12	11	6	3	3	-	-	-	-	-	-
5	38	10.7	-	-	1	2	9	8	4	8	2	3	1	-	-	-	-	-
6	55	9.6	-	4	7	6	7	15	8	3	3	1	1	-	-	-	-	-
Totals	235	10.3	-	9	17	21	37	50	34	32	17	13	5	-	-	-	-	-
% of total stand				3.8	7.2	8.9	15.7	21.3	14.5	13.6	7.2	5.5	2.1	-	-	-	-	-
			Number of trees attacked in Diam. Classes															
1	6	10.1	-	-	-	1	1	1	2	1	-	-	-	-	-	-	-	-
2	6	11.8	-	-	-	-	-	1	2	1	1	1	-	-	-	-	-	-
3	7	10.7	-	-	-	1	1	2	1	-	1	1	-	-	-	-	-	-
4	11	11.4	-	-	-	1	-	1	5	1	2	1	-	-	-	-	-	-
5	3	11.0	-	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-
6	11	11.3	-	-	-	1	-	3	2	2	2	1	-	-	-	-	-	-
Totals	44	11.0	-	-	-	4	3	8	12	7	6	4	-	-	-	-	-	-
% Total No. in Age cl.			-	-	-	19.	8.	16.	35.3	2.2	35.3	30.8	-	-	-	-	-	-
% Total Att. Trees			-	-	-	9.	6.8	18.2	27.3	15.9	13.6	9.1	-	-	-	-	-	-

TABLE X - TREE SELECTION BY BARK BEETLES - KOOTENAY PARK

Unattacked Trees

Plot No.	No. of Trees	Ave. stump diam. in.	Age. yrs.	1891-1900	1901-1910	1911-1920	1921-1930	1931-1940	1931-1935	1936	1937	1938	1939	1940
10	20	5.9	60-70	16.2	11.95	7.77	5.11	4.78	2.56	.363	.367	.510	.528	.454
11 *	18	9.2	70-80	17.9	24.4	17.0	13.0	11.32	6.15	1.04	1.00	1.00	1.07	1.06
12 *	8	7.0	40-45	....	32.1	31.7	18.3	11.01	6.43	1.05	0.99	1.03	0.80	0.71

Attacked Trees

Plot No.	No. of Trees	Ave. stump diam. in.	Age. yrs.	1891-1900	1901-1910	1911-1920	1921-1930	1931-1940	1931-1935	1936	1937	1938	1939	1940
10	9	7.2	60-70	21.9	17.9	12.4	7.16	7.48	3.67	.700	.673	.821	.891	.720
11 *	13	13.4	70-80	31.2	27.8	19.9	15.0	13.13	7.17	1.15	1.19	1.20	1.18	1.24
12 *	4	9.2	40-45	....	42.4	41.5	21.0	9.79	5.41	1.09	0.83	0.89	0.83	0.74

Legend

* Leanchoil, B. C. - Yoho Park

are mostly of the same age class.... It was found that about 40 % of the trees were killed. Since these were mostly dominants, it is probable that they make up some 60 per cent of the volume."

The Parks Warden at Leanchoil, Klaus Nickolson, also remarked that the trees which were attacked (1942) were the larger trees in the stand, in other words, dominants. This selectivity for dominant trees has been noted so many times in the case of younger stands 40 to 100 years old, that it could hardly be attributed to chance, and there is undoubtedly a preference by the bark beetle for this type of tree, at least at the start of epidemics. As the epidemic progresses and this type of tree becomes scarce, the beetles are forced to take the less attractive trees, often destroying almost the entire stand.

Tanglefoot Traps

It was suggested by Mr. Harry Holman, Dominion Forest Service, Calgary, that the Banff infestation may have started from beetles being taken into the upper atmosphere by high winds and being carried over the high range of mountains separating the Banff and Kootenay areas. Subsequent studies have indicated that this was not the origin of the Banff outbreak and that it developed independently of any other. At the time, however, the theory was not entirely discounted. In order to test whether beetles of *D. monticolae* flew at any appreciable height after emergence, 2 ft. X 2ft. wooden squares, covered on both sides with tanglefoot were placed as follows:

1. Two squares were mounted vertically, one with faces exposed to north and south and the other facing east and west, on a 70-foot tower. The tower stood on a bare knoll, the top of which was about 80 feet above the surrounding terrain. Thus the top of the tower was fully 60 feet above the surrounding forest canopy. The tower was located about one half mile south of Dollyvarden Creek. The other tanglefoot squares were located about one mile north of Dollyvarden Creek, three facing north and south, and three facing east and west. They were placed in line across the valley at about breast height, one board distant from the next by several hundred yards. The squares were put in position on June 12, 1942. These boards were examined at intervals during the flight period of *Dendroctonus*. Only one *D. monticolae* was caught on the tower boards while several were caught on three of the lower boards. However, it seems probable that if any appreciable numbers of *D. monticolae* had risen in flight to any appreciable height, more would have been caught on the tower boards. The catches on these high squares consisted mainly of *Diptera*. The biggest percentage of insects caught on the low boards was *Coleoptera*, mainly *Elateridae* and *Diptera*. *Hymenoptera* was next in point of numbers.

Bark Beetle Sample Plots

Half of each of the sample plots established in Kootenay Park has been cleared of all dead timber by clearing operations along the highway carried out during the past two years. An exception is Plot VIII north of Vermilion Crossing which has not been touched. The following tables XI (A-J) inclusive gives the number of dead trees and the number down on each plot since their establishmant.

TABLE XI - TREE MORTALITY FROM BARK BEETLES

A - Plot I - 0.2 miles south of Meadow Creek, Kootenay Park.

Year	Dead Trees No.	Dead Trees %	Trees freshly attacked	Total	Not att. or recov.	Total	Trees down	Trees removed
1934	83	43.5	79	162	29	191	0	
1935	147	77.0	10	157	34	191	0	
1936	153	80.1	10	163	28	191	0	
1937	156	81.7	3	159	32	191	4	
1938	159	83.2	0	159	32	191	10	
1939	159	83.2	0	159	32	191	10	94
1940	159	83.2	0	159	32	191	10	
1941	159	83.2	0	159	32	191	11	
1942	160	83.8	3	163	28	191	12	
1943	163	85.3	0	163	28	191	25	

B- Plot 2 - 0.4 miles north of Meadow Creek

Year	Dead Trees No.	Dead Trees %	Trees freshly attacked	Total	Not att. or recov.	Total	Trees down	Trees removed
1934	80	34.8	11	91	139	230	0	
1935	85	26.9	8	93	137	230	0	
1936	91	39.6	12	103	127	230	0	
1937	101	43.9	2	103	127	230	19	
1938	103	44.8	2	105	125	230	25	
1939	105	45.7	2	107	123	230	35	
1940	107	46.5	72	179	51	230	36	
1941	177	76.9	4	181	49	230	52	
1942	184	80.0	8	192	38	230	52	58
1943	195	84.8	1	196	34	230	53	159

C - Plot 3 - 0.9 miles north of Meadow Creek, Kootenay Park

Year	Dead trees No.	Dead trees %	Trees freshly attacked	Total	Not att. or recov.	Total	Trees down	Trees removed
1934	80	23.7	7	87	250	337		
1935	85	25.2	5	90	247	337		
1936	89	26.4	9	98	239	337		
1937	97	28.8	9	106	231	337	4	
1938	100	29.7	19	119	218	337	8	
1939	113	33.6	41	154	183	337	14	
1940	147	43.6	116	263	74	337	18	
1941	263	78.0	28	291	46	337	24	
1942	279	82.8	2	281	56	337	25	87
1943	281	83.4	0	281	56	337	?	206

D - Plot 4 - 4.0 miles north of Meadow Creek

Year	Dead trees No.	Dead trees %	Trees freshly attacked	Total	Not att. or recov.	Total	Trees down	Trees removed
1934	0	0	3	3	176	179		
1935	2	1.1	1	3	176	179		
1936	3	1.7	0	3	176	179		
1937	3	1.7	0	3	176	179		
1938	3	1.7	0	3	176	179		
1939	3	1.7	123	126	53	179		
1940	114	63.7	26	140	39	179		
1941	139	77.7	16	155	24	179		
1942	139	77.7	0	139	40	179		
1943	139	77.7	0	139	40	179	2	81

1

E. Plot 5 - 5.1 miles north of Meadow Creek

Year	Dead trees No.	Dead trees %	Trees freshly attacked	Total	Not att. or recov.	Total	Trees down	Trees removed
1934	0	0	5	5	260	265		
1935	3	1.1	2	5	260	265		
1936	5	1.9	0	5	260	265		
1937	5	1.9	0	5	260	265		
1938	5	1.9	0	5	260	265		
1939	5	1.9	0	5	260	265		
1940	5	1.9	117	122	143	265		
1941	119	44.9	73	192	73	265		
1942	131	49.4	6	137	128	265		
1943	135	50.9	4	139	126	265	2	86

F - Plot 6 - 3.6 miles north of Meadow Creek

year	Dead Trees No.	Dead Trees %	Trees freshly attacked	Total	Not att. or recov.	Total	Trees down	Trees removed
1934			3	3	240	243		
1935	3	1.2	3	6	237	243		
1936	6	2.5	2	8	235	243		
1937	7	2.9	8	15	228	243		
1938	15	6.2	24	39	204	243		
1939	35	14.4	135	170	73	243		
1940	144	59.3	21	165	78	243		
1941	165	67.9	32	197	46	243	1	
1942	190	78.2	13	203	40	243	4	47
1943	199	81.9	5	204	39	243	4	51

G - Plot 7 - 1. 5 miles south of Meadow Creek.

1934			32	32	89	121		
1935	13	10.7	13	26	95	121		
1936	19	15.7	7	26	95	121		
1937	25	20.7	9	34	87	121		
1938	28	23.1	6	34	87	121		
1939	34	28.1	0	34	87	121	2	
1940	35	28.9	2	37	84	121	2	
1941	38	31.4	6	44	77	121	9	
1942	47	38.8	54	101	20	121	9	14
1943	90	74.4	2	92	29	121	9	65

H - Plot 8 - 7 miles north of Vermilion Crossing

1941	1	1.7	20	21	39	60		
1942	11	18.3	5	16	44	60		
1943	13	21.7	8	21	39	60		

I - Plot 9 - 1.1 mi. north of Dollyvarden Creek

1940	11	10.7	6	17	86	103		
1941	16	15.5	11	27	76	103		
1942	18	17.5	31	49	54	103		8
1943	27	26.2	6	33	70	103		18

J - Plot 10 - .6 mi. north of Dollyvarden Creek

1941	0	0	0	0	66	66		
1942	1 *	1.5	17	18	48	66		
1943	6	7.7	1	7	59	66		2

* Porcupine killed

Besides determining the progress of the epidemic, these plots were established to determine the lengthhof time elapsing between time of killing of trees by <u>Dendroctonus</u> and the time they fall. <u>Table XII</u> gives this data. This elapsed time depends on a number of factors such as density of stand, type of soil, exposure to wind, and age of trees. The year of death is considered to be the year the foliage turned colour after attack. It is probable that trees fell on these plots a little earlier than otherwise would have been the case, because nearly all plots were bordering the highway and thus one side of each plot was more or less exposed to wind which might sweep along the cleared lane.

TABLE XII - TIME OF FALLING OF BEETLE-KILLED TREES

Year Killed	No. of trees killed	Number of trees falling in years after 1934 — Years: 1	2	3	4	5	6	7	8	9
Prior to 1934	243			26	11	18	3	17		5
1935	95				1		8	2		
1936	28	1	1			2				
1937	28	2	1							
1938	19									
1939	41									
1940	257			2						
1941	349									
1942	70									
1943	69									
Totals	1199	3	2	28	12	20	11	19		5

Since the infestation started in 1929, (according to the best information available) a total of 128 trees have fallen out of 1199. This was prior to the start of any clearing operations. Thus in about 14 years 10 per cent of the killed trees had fallen.

It is quite probable that the fall of dead trees will accelerate during the next ten years.

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

(C.V.G. Morgan)

Larval rearings of the Douglas fir tussock moth, *Notolophus pseudotsugata* McD. were continued in 1943 with particular reference to the wilt disease of this insect. The original stock for these rearings was acquired as eggs in the fall of 1939 from Otter Bay near Okanagan Lake, where a heavy infestation was completely wiped out in that summer by this disease. Since then, each generation has been inbred from the previous year's stock, and in each year the disease has accounted for large numbers of larvae and pupae.

A total of six egg masses was recovered from the 1942 rearings. These were overwintered in jelly jars in the insectary which was closed with shutters for the winter months. Variations and extremes in temperatures obtained therein were not so great as outside temperatures. For instance, the minimum recorded outside for the winter was -28.0°F. whereas only -8.5°F. was reached in the insectary.

The six egg masses contained 1213 eggs, an average of 202.16 eggs per mass or per female. Of these, 959 hatched or 79.06%. On June 1, 1943 the eggs were divided into three lots. Those in the first lot began to hatch on June 22, and on that date all larvae and the egg masses were placed on a caged Douglas fir tree in the field. The cloth cage was placed over the tree so that the glass front faced south. In the second lot hatching commenced on June 23, and eggs and larvae were treated as in lot 1, but here the cage was turned so that the glass front faced north. In each case, the egg masses were pinned to the tree in a position similar to that found under natural conditions. Eggs of the third lot commenced to hatch on June 24. Immediately on hatching these young larvae were transferred to twigs of fir placed in water and enclosed in two large jars kept in the insectary. In this lot hatching occurred as follows:

Date 1943	No. eggs hatched	Date larvae transferred to foliage	Larvae transferred to:
June 24	40	June 24	Jar No. 1
" 25	149	" 25	Jar No. 1
" 26) " 27) " 28)	337	" 28	Jar No. 2
" 29	1	" 29	Jar No. 2
TOTAL	527		

Larvae hatching on June 26, 27, and 28 and not transferred to foliage until the latter date produced abundant webbing. Migration of the newly hatched larvae from the egg masses did not take place for several days after emergence. In lot 1 for example, except for three specimens, the larvae were still on the egg mass on June 25, but by the 28th they had completely dispersed. Migration in lot 2 began on June 25 at which time many were migrating along the main stem but only four were on needles. On the same date, larvae in lot 3 in the insectary had migrated as in lot 2. Migration occurred toward the crown of the tree. First feeding in lot 2 had progressed so far by June 28 that some shoots had already wilted. Feeding was still confined however, to the under epidermis of the needles. In only a few cases had the upper epidermis been attacked, and in only one or two cases did feeding from the under surface extend through to the upper epidermis. Throughout this time, find sparce webbing was produced by the larvae wherever they crawled.

By July 6, larvae in the three lots had begun to eat the sides of the needles but in no case were whole needles yet devoured. A slower rate of larval growth was very noticeable in both outside cages as compared to insectary material. This was thought to be due to lack of new needles in the outside cages, which had already been used up by the larvae. For a period of one week or more prior to July 28, food available consisted mainly of old foliage of which very few whole needles were eaten. This feeding was particularly characterized by partially eaten needles, nibbled here and there from the edges towards the midrib.

Because of the small amount of new growth available in the cages on June 28, larvae in lot 1 were transferred to a cage in the insectary and those in lot 2 to another field cage. After the young larvae were forced to feed on old growth the later stages of the same larvae appeared to have a tendency to feed on old growth. A small number of larvae were preserved from lot 3 during July and August.

Cocooning commenced on August 10, but the first cocoon was not completed until August 12, and the first pupa was not formed until August 14. Twenty-three cocoons were obtained.

Date	No. of cocoons formed Lot 1	Lot 2	Lot 3	Total
August 12			1	1
" 17	1	2	-	3
" 23	-	-	1	1
" 24	5	-	-	5
" 27	-	-	1	1
Sept. 3	7	1	-	8
" 10	3	-	1	4
Total	16	3	4	23

The first adult emerged on September 13. Emergence is shown in the following table:

Emergence of Adults

Date	Male	Female
Sept. 13	1	
" 17	1	
" 27	1	
" 29		1
30 30	1	
Oct. 5		1
" 7	1	
8	1	
12		1
Total	6	3
Per cent	66.7	33.3

Of the cocoons formed 39.1 per cent produced adults; 14 coconns died of which 3 prepupae failed to pupate, 1 pupa molded, 4 adults (3 males and 1 female) emerged from the pupal cases, but failed to emerge from the cocoons. Six pupae apparently died of wilt disease.

Adults were not proveded with any food and the first male died September 22, the last on November 16. Females started dying on October 18, the last died on November 1.

Only 2 egg masses were obtained from the rearings of 1943. The first was begun on October 4 and the second on October 6.

The wilt dimease in the larvae first became evident on July 16. The number of larvae killed by the disease numbered 212, the mortality occurring as shown in the table. In lot 1 wilt was not apparent until August 3. Of a total of 51 larvae which died from this disease between August 3 and September 29, 42 succumbed during the first 15 days. In lot 2, the first search for wilt was not made until July 30. Wilt had already killed 8 larvae. A total of 67 larvae in this lot died between July 30 and September 17; 31 by August 17 and 64 by September 3. In lot 3 wilt was first noted on July 16 at which date 4 larvae had died. 94 died between July 16 and September 15, 66 by August 2 and 82 by Aug. 9. Six pupae or 26.1 per cent of the total cocoons formed were killed by the virus. The total mortality of all stages known to have been caused by this disease amounted to 22.7 per cent .

LARVAL MORTALITY

Date 1943	Larvae definitely known to have died from wilt	Death due to unknown causes	Larvae Pickled
July 6		32	
7		173	5
16	5	184	5
22	4	8	
23	1	11	5
28	38	161	
30	18	131	
Aug. 2	8		2
3	1	1	
4	7	1	
5	1		
6	2		
9	22		2
10	6	1	
11	3		
13	4		
16	13		2
17	30		
19	1		
23	1		
24	2		
27	1		
Sept. 3	34		
10	4		
15	3		
17	2		
29	1		
Total	212	703	21
% total larvae	22.11	73.3	2.19

PHENOLOGICAL OBSERVATIONS

Laboratory: Trinity Valley Field Station (Vernon, B.C.)

Year: 1943
Observer: C.V.G. Morgan

Sta.	Species	Observations	Date	Remarks
1	Picea engelmanni	First bud-scales peeling back over bud	May 13	No bud-scales shed yet.
		First bud-scales shed	May 18	Tips of individual needles showing but scales not fallen
		First staminate flowers shedding pollen		Datum not available
		Terminal leaders 2" long	May 27	On trees 10' high
		Terminal growth completed	July 23	Fourth week of July
2	Pinus contorta latifolia	First bud-scales shed	May 4	
		Terminal candles 4 - 5" long........	May 27	
		First staminate flowers shedding pollen	June 4	
		First needles separated in bundles	" 14	
		Terminal growth completed	Aug. 7	First week of August
		Old needles turning colour	" 24	
		Old needles falling..	" 30	
3	Abies lasiocarpa	First bud-scales shed	May 7	
		First staminate flowers shedding pollen		Datum not available
		Terminal growth completed	July 16	Third week of July

Sta.	Species	Observations	Date	Remarks
4	Larix occidentalis	First staminate flowers shedding pollen...........		Datum not available
		Needles separated in bud	April 21	
		Terminal growth completed....	July 28	Fourth week of July
		Needles turned--first	Oct. 1	On trees up to 30' high
		Needles turned --first	" 9	On mature trees
		Needles turned--100%	" 18	On some mature trees Only 10% on others
		Needles dropped--15%	" 25	Needles 100% turned on all trees
		Needles dropped--20%.........	Nov. 1	
		Needles dropped --100%	" 16	Only on trees up to 30' high. Only 85% turned on mature trees--some went into winter with approx. 10% needles.
5	Pyrus sitchensis	Terminal buds 1¼" long	Apr.22	Leaves separated but still curled
		Leaves 2" long........	May 4	Still curled
		First leaf fully expanded	" 19	
		First flower open	June 7	
		90% flowers open	" 10	
		First fruit ripe	Aug.29	
		Foliage turned--first	Sep. 8	
		" " --100%..	" 24	
		85% leaves dropped.....	Oct. 8	
		95% " "	" 18	
		Tree leafless	Nov. 1	

Sta.	Species	Observations	Date	Remarks
9	Clintonia uniflora	First flower open	June 8	
		40% flowers open	June 14	
		First fruit ripe	Aug. 4	
		100% fruit ripe	Aug. 25	
		100% leaves turned	Oct. 8	
10	Cornus canadensis	First green bracts open	May 26	Not yet whitened
		First green bracts whitening	May 30	
		First floret open	June 3	
		75% florets open	June 14	
		First fruit ripe	July 31	
		100% leaves turned	Oct. 8	
11	Solidago canadensis	First flower open	Aug. 12	
		Flowers common in region	Aug. 19	75%
		90% leaves turned	Oct. 18	
		95% leaves turned	Nov. 1	
		98% leaves turned	Nov. 16	80% of foliage still on stems
12	Epilobium angustifolium	First flower open	July 5	
		Plants 4 - 5 " tall	May 13	
		Flowers common in region 50%	July 26	
	Acer glabrum	First bud scales split and open	Apr. 22	Leaves not yet separated
		First flower open		No flowers produced this year on any trees
		First leaves separated in bud	May 5	Leaves about 1/4" long
		Leaves 3/4" long	May 13	
		First leaf fully expanded	May 22	
		70% leaves dropped	Oct. 8	
		98% leaves dropped	Oct.18	
		Tree leafless	Nov. 1	

Sta.	Species	Observations	Date	Remarks
	Achillêa lanulosa	First flower open	June 15	
	Alnus sp.	First bracts split open	Apr. 12	Leaves not out of bud yet
		First flowers shedding pollen	Apr. 22	Terminal leaf buds about 3/8" long
		80% leaves turned	Oct. 8	70% leaves dropped
		100% leaves turned	Oct. 18	90% " "
		Tree leafless	Nov. 1	
	Amelanchier alnifolia	First flower open	May 22	
		75% flowers open	May 27	
		98% leaves dropped	Oct. 8	
		Tree leafless	Oct. 18	
	Aquilegia formosa	First flower open	June 9	
	Aralia nudicaulis	First flower open	May 28	
		98% flowers open	June 14	
	Arctostaphylos uva-ursi	First flower open	May 17	
	Berberis aquifolium	First flower open	May 21	
	Betula occidentalis	First bracts split open	Apr. 12	Leaves not yet out of bud
		Terminal buds 3/8" long	Apr. 22	As above
		Leaves separating in bud	May 4	
		Leaves 3/4" long	May 6	Not uncurled
		First flowers shedding pollen	May 16	
		75% leaves dropped	Oct. 8	
		100% leaves dropped	Oct. 18	

Sta.	Species	Observations	Date	Remarks
	Calypso bulbosa	First flower open	May 8	
	Carduus arvensis	90% leaves turned	Oct. 18	
	Ceanothus sanguineus	First flower open 95% flowers open	June 6 June 14	
	Chimaphila umbellata	Leaf bud 1/4 " long	Apr. 22	Bud-scales split and open
	Corallorhiza multiflora occidentalis	First flower open 80% flowers open	June 14 June 22	
	Corylus californica	First pistillate flowers open	Apr. 12	Groups of stamens just separating. First bracts split open
		First staminate flowers shedding pollen Leaves 1/2 " long Leaves 3/4"-1½ " long 75% leaves dropped 85% leaves dropped Tree leafless	April22 May 5 May 19 Oct. 8 Oct. 18 Nov. 1	Tips of leaves in leaf bud separated Leaves not unfolded
	Disporum trachycarpum	First flower open	May 5	
	Fragaria spp.	First flower open 50% flowers open 90% flowers open 95% fruit ripe	May 11 May 19 May 27 July 1	
	Fritillaria lanceolata	100% flowers open	June 4	
	Gentiana acuta	First flower open	June 19	

Sta.	Species	Observations	Date	Remarks
	Lathyrus ochroleucus	First flower open	May 31	
		40% flowers open	June14	
	Lilium parviflorum	Plants 6" high	May 13	
		First flower open	June 22	
	Linnaea borealis var. americana	First flower open	June 15	
	Lonicera ciliosa	Terminal leaves 3/4" long	Apr. 22	
		First flower open	June 23	
		85% leaves turned	Oct. 18	20% leaves dropped
	Lonicera involucratum	100% flowers open	July 1	
		100% leaves turned	Oct. 18	Very few dropped
	Lonicera utahensis	Terminal leaves ½ to ¾ " long	Apr. 22	Flower heads about 3/8" long
		First flower open	Apr. 30	
		First leaf fully expanded	May 4	In one plane
		90% flowers open	May 13	
		First fruit ripe	June 25	
		95% fruits ripe	July 1	
	Lupinus sp.	First flower open	June 10	
	Lysichiton kamtschatcense	Plants 8" high	Apr. 22	Spadix showing in 10% of plants
	Moneses uniflora	100% Flowers open	July 1	
	Pachystima myrsinites	25% Flowers open	Apr. 30	
	Pinus monticola	Candles ½ - 1" long	May 4	On terminal leaves
		Candles 3-4" long	May 27	As above
		First needles separated in bundles	June 16	

Sta.	Species	Observations	Date	Remarks
	Populus tremuloides	90% leaves dropped	Oct. 8	
		95% leaves dropped	Oct.18	
		Tree leafless	Nov. 1	
	Populus trichocarpa	80% leaves dropped	Oct. 8	
		90% leaves dropped	Oct.18	
		Tree leafless	Nov. 1	
	Pseudotsuga taxifolia	First bud scales peeling back over bud	May 11	
		Terminal leaders 1" long	May 27	On trees 10' high
	Pyrola bracteata	First flower open	June 26	
	Byrola chlorantha	First flower open	June 21	
		75% flowers open	July 1	
	Ranunculus sp.	First flower open	June 15	
	Ribes lacustre	Leaves 1/2" long	April 22	Leaves still curled
		First flower open	May 20	
		10% leaves turned	Oct. 18	
		95% leaves turned	Nov. 1	70% leaves dropped
	Rosa melina	First leaves separating in bud	Apr. 22	
		First flower open	June 8	
		90% flowers open	July 1	
		5% leaves turned	Oct. 8	5% leaves dropped
		15% leaves turned	Oct. 18	10% leaves dropped
		100% leaves turned	Nov. 1	85% leaves dropped
	Rubus viburnifolia	First flower open	June 16	
		80% leaves turned	Oct. 18	
	Rubus parviflorus	First flower open	June 21	
		100% leaves turned	Oct. 8	25% leaves dropped

Sta.	Species	Observations	Date	Remarks
	Salix sp.	First bud-scales split open	Apr. 22	Leaves not separated
		Leaves 1" long	May 4	
		Leaves 1¼ " long	May 13	New stems 2" long
		100% leaves turned	Oct. 8	45% leaves dropped
		60% leaves dropped	Oct. 18	
		Tree leafless	Nov. 1	
	Shepherdia canadensis	Leaf buds ¼ " long	Apr. 12	Leaves not yet separated
		First flower open & leaf buds ½" long	Apr. 22	As above
		First leaves separated	May 3	
		Leaves 1¼" long	May 13	
		98% leaves dropped	Oct. 8	
		Tree leafless	Oct. 18	
	Smilacina racemosa	First leaves separating from stem	May 4	Plants 4-6" high
		First flower open	May 26	
		75% flowers open	June 10	
	Spiracea lucida	Leaves 1½ 2 long	May 4	Leaves fully separated
		First flower open	June 28	
		95% leaves dropped	Oct. 8	
	Taraxacum officinale ?	First seed spread	May 27	
	Vaccinium sp.	First bud-scales split and open	Apr. 22	Leaves not separated
		First leaves separating	May 4	
		First flower open	May 16	
		98% leaves dropped	Oct. 8	
	Viburnum pauciflorum	60% flowers open	June 17	

Sta.	Species	Observations	Date	Remarks
	Vicia americana	First flower open	June 14	
	Viola glabella	First flower open 25% flowers open	Apr. 30 May 4	

GENERAL OBSERVATIONS

Disappearance of winter's snow in open	April 12
" " " in forest	" 22
Last spring frost	June 1
First fall frost	Sept. 8
First snow to fly in air	Nov. 27
First snow to whiten ground	Nov. 27

MISCELLANEOUS NOTES

Vernon, B.C.

- altitude 1250'

Snow patchy on north slopes and in shaded areas... March 15
Snow disappeared in all areas...................... " 18

Acer sp.- First flower open .... Apr. 20
First flower fully expanded .... " 27

~~Amelanchier alnifolia~~ - 75% flowers open....... May 9

Balsamorhiza sagittata - First flower open on south slope ...... Apr. 18
90% flowers open........ " 29

Berberis aquifolium - First flower open .... May 9

Ranunculus sp. - First flower open on south slope March 15
50% flowers open on south slope Apr. 10

Salix sp. - (Russian willow) First flower open " 21

Ulmus sp. - First leaves (¼" long) separated from bud Apr. 10
First staminate flowers shedding pollen " 16

Viola sp. - (ornamental) First flower open on south slope " 6

MISCELLANEOUS NOTES

B.X. District (Vernon, B.C.) - altitude about 1800'; south-west slope; April 25, 1943.

Amelanchier alnifolia - 5 % flowers open
Claytonia lanceolata - 25% flowers open
Dodecatheon puberulum - 75% flowers open
Hydrophyllum capitatum -50% flowers open
Pinus ponderosa - Candles 2 - 3" long on terminal leaders.
Shepherdia canadensis- 100% flowers open

B.C. District (Vernon, B.C.) - altitude about 2000'; south-west slope; May 19, 1943.

Corallorhiza striata - 100% flowers open
Delphinium bicolor ? - 75% flowers open
Geranium viscosissimun - 25% flowers open
Pentstemon fruticosus - 100% flowers open
Smilacina stellata ? - 100% flowers open

TRINITY VALLEY FIELD STATION

Winter 1942 - 1943

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. 9	--	--	--	--	--	--	--	--	--	---	½"
Nov.16	10:30 A.M.	45.0	19.0	31.0	35.0	26.0	31.0	37.0	33.0	35.0	½"
Nov.23	10:00 A.M.	38.0	11.0	33.0	35.0	22.5	32.5	36.0	32.0	34.0	patchy
Dec.12	10:20 A.M.	39.5	10.0	33.0	36.5	22.0	32.5	35.0	30.0	33.0	7½"
21	10:00 A.M.	36.0	18.0	30.5	34.0	26.0	31.0	33.0	32.0	32.5	6½"
Jan.11/43	"	38.0	-1.0	19.0	33.0	13.0	24.0	32.5	26.0	28.0	12½"
Feb. 3	10:30 A.M.	32.0	-28.0	23.0	32.0	-8.5	25.0	31.0	15.5	27.0	26"
19	8:00 A.M.	33.0	18.0	28.5	33.0	22.0	27.0	31.0	26.5	30.0	24"
22	12:30 P.M.	41.5	15.0	32.0	35.0	24.5	27.0	31.0	30.0	30.0	23"
Mar.17	10:00 A.M.	42.5	-5.0	8.0	35.0	9.0	11.0	31.0	24.0	24.0	24"
Apr. 1	10:00 A.M.	48.0	5.0	37.0	44.0	11.5	34.0	32.0	24.0	32.0	16"
12	"	66.0	22.5	42.0	56.0	27.5	34.0	34.0	32.0	33.0	disappeared -in open
22	2:15 P.M.	72.5	25.5	53.0	60.5	29.5	45.0	41.0	33.0	37.0	-in forest
30	10:00 A.M.	64.5	26.0	44.0	55.5	30.0	38.0	40.0	36.0	39.0	
May 3	12:00 noon	64.5	27.5	56.5	63.0	28.0	56.0	--	--	--	

TEMPERATURE RECORDS

for

TRINITY VALLEY FIELD STATION, B. C.

1 9 4 3
(May to October)

Date		Outside Insectary			Inside Insectary	
	Max.	Min.	At time of reading	Max.	Min.	At time of reading
May 3 - 8 A.M.	67.0	--	--	67.0	--	--
4	53.5	38.5	42.0	52.0	39.0	41.5
5	60.5	29.5	31.5	59.5	31.0	32.0
6	56.0	38.5	39.5	55.0	38.5	39.5
7	58.0	34.0	35.5	57.0	34.0	35.5
8	57.0	29.0	34.5	57.0	29.5	34.0
9	55.5	33.5	40.5	55.0	34.0	40.0
10	52.5	28.0	32.0	51.5	28.5	31.5
11	57.5	32.5	36.0	55.5	33.0	35.0
12	54.0	27.0	34.0	53.5	28.0	33.0
13	60.5	28.0	33.0	59.0	28.5	33.0
14	61.0	29.0	34.0	60.5	30.0	33.5
15	63.0	28.5	35.0	62.0	29.5	34.0
16	64.0	28.0	35.5	63.0	29.0	34.5
17	69.5	28.0	36.0	68.5	29.5	34.5
18	74.5	31.0	38.5	74.0	32.0	36.0
19	77.0	34.0	43.0	76.5	35.5	41.0
20	70.0	45.0	51.5	69.0	46.0	51.0
21	59.5	36.0	47.0	59.5	37.0	44.0
22	56.5	44.5	46.0	56.5	44.5	46.0
23	69.0	36.5	44.5	68.5	37.0	43.5
24	77.0	43.5	48.0	76.0	44.0	47.0
25	72.0	44.0	51.0	71.0	45.0	50.5
26	74.5	42.5	50.0	73.5	43.0	49.0
27	70.0	37.5	50.0	69.0	38.5	48.5
28	69.0	30.0	40.5	68.5	31.0	39.0
29	56.0	38.0	47.5	55.0	40.0	46.5
30	62.5	35.5	41.5	62.0	36.0	41.0
31	59.0	39.0	47.0	58.0	40.0	47.0

Temperature Records)

Date		Outside Insectary			Inside Insectary	
	Max.	Min.	8 A.M.	Max.	Min.	8 A.M.
June 1	58.0	28.0	35.0	57.5	29.0	33.5
2	63.0	33.0	39.5	62.0	34.0	39.0
3	66.0	43.0	48.5	65.0	44.0	47.5
4	71.0	37.0	46.0	69.0	38.0	44.5
5	71.5	36.5	47.5	70.0	37.5	46.5
6	74.5	34.5	47.0	74.0	35.5	45.5
7	77.0	44.0	51.0	76.5	45.0	50.0
8	81.0	39.5	51.5	80.0	41.0	49.5
9	77.0	46.0	54.5	76.5	47.0	53.0
10	58.5	38.5	49.0	58.0	40.0	48.0
11	60.0	36.0	45.0	59.5	37.5	44.0
12	74.0	37.5	47.5	73.0	39.0	46.0
13	71.5	38.5	47.0	70.5	39.5	45.5
14	77.5	46.5	51.5	76.5	47.5	50.5
15	74.0	48.0	51.5	73.5	48.5	50.5
16	71.5	46.5	51.0	70.5	47.5	50.0
17	70.5	48.0	51.0	70.5	48.5	50.5
18	67.0	40.0	46.5	66.0	41.0	46.5
19	58.0	38.5	46.5	57.5	39.0	46.0
20	70.5	43.0	48.5	69.5	44.0	48.0
21	60.5	35.0	44.5	59.5	36.5	43.5
22	62.0	46.5	48.5	60.5	47.0	48.5
23	57.0	38.5	44.5	56.5	40.0	44.0
24	70.5	45.0	47.5	70.0	45.5	47.0
25	72.0	40.5	51.0	71.0	41.0	49.5
26	76.5	40.0	51.0	75.0	41.5	49.5
27	80.5	43.0	50.5	79.0	44.0	49.5
28	85.0	44.0	54.0	84.0	45.0	53.0
29	86.0	44.0	53.5	84.5	46.0	52.0
30	80.0	45.0	52.0	80.0	45.5	51.0
July 1	85.5	43.0	51.5	85.5	44.5	50.5
2	81.0	44.0	50.0	80.0	45.5	49.0
3	70.0	50.0	58.5	69.0	51.0	57.5
4	70.5	41.5	48.0	69.5	42.0	47.0
5	77.5	43.5	49.0	76.5	44.0	47.5
6	85.0	47.5	53.0	85.0	48.5	52.0

Temperature Records

Date		Outside Insectary			Inside Insectary		
		Max.	Min.	8 A.M.	Max.	Min.	8 A.M.
July	7	83.5	46.0	56.5	83.0	48.0	55.0
	8	81.5	49.5	58.0	80.5	51.0	56.5
	9	75.5	49.0	57.5	75.0	50.0	57.0
	10	72.5	41.5	53.0	72.0	42.0	52.0
	11	64.0	40.0	47.0	63.0	40.5	45.5
	12	71.5	43.0	51.5	70.0	44.0	51.0
	13	81.5	45.0	51.0	81.0	47.0	50.0
	14	67.5	45.5	52.5	66.5	47.0	52.0
	15	74.0	41.0	50.5	73.0	42.0	49.5
	16	80.0	41.0	48.5	79.5	43.0	47.5
	17	73.5	50.5	55.5	73.0	51.5	55.0
	18	83.0	42.5	51.5	83.0	44.0	49.0
	19	88.5	47.0	55.0	87.5	48.5	53.5
	20	87.0	47.5	54.0	87.0	49.5	53.0
	21	91.0	49.0	57.0	90.5	51.0	55.5
	22	90.5	52.0	58.5	90.5	53.0	57.5
	23	91.5	46.0	52.5	92.0	47.5	51.0
	24	88.5	44.5	52.5	88.0	46.5	51.5
	25	87.0	45.5	50.5	86.5	46.5	49.5
	26	90.5	45.5	50.0	90.5	47.0	49.0
	27	86.0	50.0	56.0	85.0	52.0	55.5
	28	84.5	45.5	53.0	84.0	47.5	52.0
	29	84.0	46.0	52.5	83.0	47.5	51.0
	30	90.5	45.0	51.0	90.5	47.0	50.5
	31	84.5	42.5	50.0	83.5	44.5	49.0
Aug.	1	80.5	42.0	48.5	80.5	43.5	47.5
	2	84.0	44.0	47.0	83.0	45.0	46.5
	3	78.0	44.0	50.0	77.5	46.0	49.5
	4	79.5	49.5	53.0	78.0	50.5	52.5
	5	68.0	56.0	57.5	67.0	56.5	57.0
	6	75.0	49.0	53.5	74.5	49.5	53.0
	7	57.0	49.0	52.5	56.5	49.0	52.5
	8	71.0	47.0	51.0	70.0	48.0	50.5
	9	75.5	40.0	44.5	75.0	41.5	43.5
	10	77.0	41.5	46.0	76.0	43.0	46.0
	11	75.0	55.0	56.5	74.0	55.5	56.5
	12	75.0	48.0	52.0	75.0	49.0	51.0
	13	86.0	39.5	45.0	86.0	41.0	44.5

Date	Outside Insectary Max.	Outside Insectary Min.	Outside Insectary 8.A.M.	Inside Insectary Max.	Inside Insectary Min.	Inside Insectary 8 A.M.
Aug. 14	77.5	43.0	46.5	76.5	44.5	47.0
15	82.5	37.0	41.5	82.0	38.5	41.0
16	85.0	42.0	45.5	85.0	43.0	45.0
17	83.0	39.0	43.5	83.0	41.0	43.0
18	72.5	37.0	45.0	71.5	38.5	44.5
19	73.0	36.5	40.5	72.0	38.0	40.5
20	73.0	44.5	48.5	72.0	45.5	48.0
21	74.0	47.0	51.5	73.0	48.0	51.0
22	61.0	46.0	48.0	60.0	46.5	48.0
23	66.5	49.0	51.0	65.6	49.5	51.0
24	75.5	37.5	39.5	75.0	39.5	40.0
25	80.0	41.0	43.0	79.0	42.5	43.0
26	82.0	44.0	49.0	81.0	45.5	48.5
27	77.0	41.5	44.0	76.0	43.0	44.0
28	79.5	41.0	46.0	79.0	42.0	46.0
29	69.0	45.5	52.5	68.5	46.5	52.0
30	75.0	39.5	45.0	74.5	41.0	45.0
31	62.0	47.0	53.5	61.0	48.5	53.5
Sept. 1	62.0	41.0	47.0	60.5	41.5	47.0
2	65.5	31.5	38.5	65.0	33.0	38.0
3	75.0	33.0	36.0	75.0	34.5	36.0
4	61.5	47.0	49.5	61.0	48.0	50.0
5	71.0	36.0	40.0	70.0	37.5	39.5
6	74.0	41.0	43.0	73.0	42.0	43.0
7	74.0	34.0	36.5	72.5	36.0	37.0
8	75.5	31.0	34.0	75.0	33.0	35.0
9	79.0	35.0	38.5	78.0	37.0	38.5
10	81.0	38.0	41.5	80.0	40.0	41.5
11	83.0	39.5	43.0	82.5	41.5	43.0
12	81.5	39.0	43.0	81.0	41.0	43.0
13	75.5	38.0	40.5	74.5	40.0	41.0
14	69.5	28.5	30.0	68.5	30.5	31.0
15	71.5	28.0	28.5	70.5	30.0	30.0
16	78.5	30.0	30.5	67.5	32.0	32.0
17	66.5	37.5	40.0	65.5	39.0	40.0
18	61.5	30.5	30.5	61.0	32.0	32.0
19	55.0	30.5	36.0	54.5	32.0	35.0
20	61.5	44.5	46.0	61.0	45.5	46.0
21	63.0	43.0	45.0	62.0	44.0	45.0
22	66.0	31.5	31.5	65.0	33.0	33.0

Date			Outside Insectary			Inside Insectary		
			Max.	Min.	8 A.M.	Max.	Min.	8 A.M.
Sept.	23		69.5	33.5	33.5	69.0	35.0	35.0
	24		73.5	36.0	36.0	73.0	37.5	37.5
	25		69.0	38.0	38.5	68.5	39.5	40.0
	26		69.5	41.0	42.0	69.0	42.5	42.5
	27		66.5	38.5	44.0	65.5	41.0	43.5
	28		68.5	32.5	36.0	68.0	34.5	36.0
	29		67.0	40.0	40.0	66.5	41.5	41.5
	30		68.0	31.0	31.0	67.5	33.0	33.0
Oct.	1		70.0	33.5	33.5	69.5	33.0	33.0
	2		68.0	36.0	39.0	67.0	38.0	39.0
	3		71.0	37.5	42.5	70.0	39.0	42.0
	4		65.5	41.0	46.5	64.5	42.5	45.5
	5		66.0	39.5	41.5	65.0	41.0	42.0
	6		67.0	35.0	35.0	66.5	36.5	36.5
	7		70.0	36.0	36.0	69.0	38.0	38.0
	8		71.0	38.5	38.5	70.5	40.5	40.0
	9		59.0	43.5	48.0	58.0	45.0	47.5
	10		59.5	46.0	46.0	58.0	47.0	47.5
	11		54.5	33.0	41.0	53.5	34.0	41.0
	12		--	27.5	27.5	--	29.0	29.5
					Time of reading			Time of reading
	18	10:00 A.M.	55.0	25.5	40.5	54.0	26.5	41.0
	25	10:40 A.M.	51.0	28.0	40.0	47.0	30.0	40.0

RAINFALL RECORDS

for

TRINITY VALLEY FIELD STATION, B.C.

1 9 4 3

(April to November)

Date	Time	Rainfall in inches	Remarks
Apr. 1	10:00 A.M.		Rain gauge set up. Light rains at 10:00 A.M.
12	10:00 A.M.	0.240	
22	2:15 P.M.	0.220	
30	10:00 A.M.	0.275	
Total for period		0.735	
May 1-3	9 A.M.-9 A.M.	0.025	
3-4	"	0.000	trace fell at 5:00 P.M. of May 3 for 10 minutes.
4-5	"	0.020	light showers between 10:00 A.M. and 5:30 P.M. of May 4.
5-6	"	0.050	fell between 9:00 P.M. of May 5 and 9:00 A.M. of May 6.
6-7	"	0.135	fell throughout period as showers. Hail fell at 2:30 P.M., 4:00 P.M., and 5:00 P.M. of May 6 and whitened ground for ½ hr. after 5:00 P.M. Pieces of hail 1/8" - 1/4" in diameter.
7-8	"	0.030	traces throughout day--light shower at 8:30 P.M. for one hour of May 7.
8-10	"	0.320	fell between 9:00 A.M. of May 8 & 9:00 A.M. of May 10
10-11	"	0.065	light shower between 11:30 A.M. & 12:45 P.M. of May 10; traces in P.M. of May 10. Hail at noon of May 10.
12-13	"	0.000	traces fell after 6:00 P.M. of May 12
15-16	"	0.000	traces fell at 11:45 P.M. & 2:40 P.M. of May 15.
20-21	"	0.000	trace fell at 4:45 P.M. of May 20
21-22	"	0.325	fell as continual light rain between 11:30 A.M. of May 21 & 9:00 A.M. of May 22.

	9 A.M. to 9 A.M.	Rainfall in inches	Remarks
May	22 - 25	0.180	fell mostly throughout A.M. & P.M. of May 22
	25 - 26	0.000	trace fell at 3:20 P.M. of May 25.
	29 - 30	0.425	fell throughout P.M. of May 29 & in early A.M. of May 30.
	30 - 31	0.165	fell throughout P.M. (after 1:40 P.M.) of May 30 as periodic light showers & in A.M. of May 31 Hail for 10 min. at 8:45 A.M. of May 31.
	31-June 1	0.075	fell between 9:00 A.M. & 10:30 A.M. of May 31.
Total for period		1.815	
June	2 - 3	0.000	traces fell throughout P.M. of June 2; light hail fell at 1:09 P.M. of June 2 for 1 min.
	3 - 4	0.015	shower between 1:05 P.M. and 1:10 P.M. of June 3 traces fell thereafter until 2:00 P.M. of June 3
	4 - 5	0.010	light shower after 1:40 P.M. for 10 min. of June 4 with thunder & lightning; traces throughout P.M. of June 4.
	6 - 7	0.005	fell in late P.M. of June 6.
	8 - 9	0.070	heavy showers for short periods between 3:40 P.M. & 7:00 P.M. of June 8, accompanied by thunder & lightning.
	9 - 10	0.010	fell between 10:40 A.M. & 11:30 A.M. of June 9
	10 - 11	0.325	Hail fell between 9:30 A.M. & 10:15 A.M. of June 10 (pieces up to ½" in diam.) whitening ground. Accompanied by heavy rain. Light showers fell until 12:30 P.M. of June 10. Traces thereafter until 6:00 P.M. of June 10.
	14- 15	0.450	traces for ½ hour after 4:15 P.M. of June 14. Showers fell in P.M. of June 14 after 5:25 P.M. accompanied by thunder & lightning.
	15 - 16	0.025	fell in early A.M. of June 16 (around 5:00 A.M.)
	16 - 17	0.230	fell throughout A.M. of June 17.
	17 - 18	0.015	light shower between 9:00 & 10:00 A.M. o f June 17. traces at 11:45 A.M. of June 17. light shower between 8:00 A.M. & 9:00 A.M. of 18th.
	18 - 19	0.105	light showers between 9:00 A.M. & 10:30 A.M. of " shower for 5 min. after 2:55 P.M. of June 18 showers in early A.M. of June 19--before 7:00 A.M.
	19 - 21	0.240	fell mostly in P.M. of June 19

	9 A.M. to 9 A.M.	Rainfall in iinches	Remarks
June	21 - 22	0.165	traces fell throughout June 21; light rains fell throughout June 22, A.M.
	22- 23	0.030	traces and light rains of short durations fell throughout A.M. & P.M. of June 22.
	23 - 24	0.010	traces fell throughout A.M. & P.M. of June 23.
	26 - 28	0.005	fell mostly in P.M. of June 26.
	28 - 29	0.000	trace at 2:30 P.M. of June 28 for 2 " accompanied by thunder.
	29 - 30	0.105	trace at 4:25 P.M. of June 29 for 5" accompanied by thunder; showers fell after 7:15 P.M. of June 29 accompanied by thunder.
Total for period		1.815	
July	3 - 4	0.530	fell throughout A.M. & P.M. Of July 3.
	8 - 10	0.120	fell mostly in A.M. of July 9
	10 - 12	0.090	fell mostly throughout P.M. of July 10.
	13 - 14	0.215	traces between 5:30 P.M. & 7:00 P.M. of July 13; light showers in late P.M. of July 13; heavy showers throughout A.M. of July14.
	15 - 16	0.000	trace at 5:30 P.M. of July 15
	16 - 17	0.005	light rain & traces fell throughout A.M. of July17.
	28 - 29	0.000	traces between 8:15 & 8:17 P.M. of July 28 & beween 8:39 & 8:40 P.M. of July 28.
	31 - Aug.1	0.075	showers between 7:58 P.M. & 8:35 P.M. of July 31 accompanied by thunder, lightning & strong winds.
Total for period		1.035	
Aug.	3 - 4	0.005	traces between 3:00 P.M. & 3:05 P.M. and at 3:40 P.M. of Aug. 3; very light shower between 7:00 P.M. & 7:10 P.M.; traces until 10:00 P.M. of 3rd.
	4 e 5	0.105	light showers fell throughout A.M. of Aug. 5.
	5 - 6	0.380	.150" between 9:00 A.M.& 1:45 P.M. of Aug. 5 as light rain; .210" between 4:10 P.M. & 4:35 P.M. of Aug. 5, accompanied by heavy thunder & lightning; .020" between 5:40 P.M. of Aug. 5 & 9:00 A.M. of Aug. 6 as light rain.

	9 A.M. to 9 A.M.	Rainfall in inches	Remarks
Aug.	6 - 7	0.005	traces fell between 12:45 P.M. & 12:55 P.M., between 6:55 P.M. & 7:20 P.M. & in P.M. after 9:00 of Aug.6 and in A.M. of Aug. 7.
	7 - 9	0.540	fell mostly in A.M. & P.M. of Aug. 7
	11 - 12	0.025	light showers fell in early A.M. of Aug. 12.
	20 - 21	0.025	traces fell betwenn 4:45 P.M. & 5:00 P.M. of Aug.20 light showers fell between 7:00 P.M. & 7:50 P.M. of Aug. 20.
	21 - 22	0.435	traces fell bet. 11:30 & 11:55 A.M., bet. 12:55 & 1:15 P.M. & bet. 3:30 and 5:00 P.M. of Aug. 21. Heavy showers (.315") fell bet. 5:15 & 7:30 P.M. of Aug. 21 accompanied by thunder & lightning. Traces until 9:00 P.M.; light showers thereafter in late P.M. of Aug. 21 & throughout A.M. of Aug. 22.
	22- 23	0.095	light showers fell bet. 9:00 A.M. & 10:45 A.M. of Aug. 22 (.060");traces fell throughout P.M. of Aug. 22; light showers fell between 6:25 P.M. & 7:40 P.M. of Aug. 22, and in late P.M. of Aug.22.
	26 - 27	0.005	traces fell between 5:35 P.M. & 5:40 P.M. of Aug. 26; traces fell at 8:15 P.M. of Aug. 26; light rain in late P.M. of Aug. 26 and light thunder.
	28 - 30	0.075	fell mostly in A.M. of Aug. 29.
	31 -Sept.1	0.005	traces fell between 10:50 and 1055 A.M. of Aug. 31 light rains fell at 2:35 P.M. and at 3:00 P.M. of Aug. 31.
Total for period		1.700	
Sept.	1 - 2	0.060	traces fell at 10:00 A.M., 10:40 A.M. & 1:25 P.M. of Spt.1. Light showers fell between 2:35 P.M. and 3:05 P.M. and between 8:00 P.M. & 11:00 P.M. of Sept. 1.
	3 - 4	0.165	showers fell throughout P.M. (after 7:15 P.M.) of Sept. 3 and in early A.M. of Sept. 4.
	17 - 18	0.190	showers fell between 1:50 P.M. & 4:15 P.M. of Sept. 17 and in late P.M. of Sept. 17, after 8:30 P.M.

9 A.M. to 9 A.M.		Rainfall in inches	Remarks
Sept.	18-20	0.490	fell throughout period. Heavy showers fell in P.M. of Sept. 19 and A.M. of the 20th.
	20-21	0.110	intermittent showers fell throughout P.M. of Sept. 20.
	25-27	0.010	fell mostly in P.M. (Afternoon) of Sept. 26.
	28-29	0.005	light rains fell between 4:45 P.M. & 5:30 P.M. of Sept. 28.
Total for period		1.030	
Oct.	4- 5	0.005	traces fell between 5:45 & 6:15 P.M. of Oct. 4. light rain fell between 10:00 & 10:30 P.M. of "
	8- 9	0.000	traces fell in A.M. of Oct. 9.
	9-12	0.145	fell throughout period
	18-10:00 A.M.	0.340	fell since Oct. 12, still raining at 10:60 A.M. of the 18th.
	25-10:40 A.M.	1.135	fell since Oct. 18. Not raining at 10:40 A.M. but water dripping from foliage.
Nov.	1-11:00 A.M.	0.285	fell since Oct. 25. Not raining at 11:00 A.M. Has not rained the past two days, at least.
Total for period		1.910	
Nov.	8 10:30 A.M.	0.095	fell since Nov. 1
	16 10:00	0.040	fell since Nov. 8
	29 10:30	0.140	fell since Nov. 16. Rain gauge dismantled. 1/2" snow on ground --most of this fell on Nov. 27 and 28. Not raining or snowing at time of recording. Precipitation of 0.140" includes both rain and snow.
Total for period		0.275	

SUMMARY - WEATHER RECORDS

Trinity Valley Field Station, B.C.

- 1943 -

	Month							
	April	May	June	July	Aug.	Sept.	Oct.	Nov.
No. of days recorded	--	28	30	31	31	30	11	--
Max. temp. of month	72.5	77.0	86.0	91.5	86.0	63.0	71.0	48.0
Min. temp. of month	22.5	27.0	[illegible]	40.0	36.5	28.0	--	--
No. days 32°F. or below	--	13	1	0	0	9	--	--
No. of days with snow	--	0	0	0	0	0	0	0
No. of days with hail	--	3	2	0	0	0	0	0
No. of days with rain	--	18	18	9	11	10	--	--
Total Precipitation in inches	0.735"*	1.815"*	1.815"	1.035"	1.700"	1.030"	1.910"*	0.275"**

* For full month
* *v For 29 days.

RAINFALL
Trinity Valley Field Station

	1941		1942		1943	
Month	No. days recorded	Total precip.	No. days recorded	Total precip.	No. days recorded	Total precip.
April	28	0.620"	21	0.915"	30	0.735"
May	31	3.565"	31	5.110"	31	1.815"
June	30	4.070"	30	4.675"	30	1.815"
July	31	0.925"	31	6.625"	31	1.035"
Aug.	31	1.885"	31	0.635"	31	1.700"
Sept.	30	4.790"	30	0.895"	30	1.030"
Oct.	31	1.535"	31	1.535"	31	1.910"
Totals		17.390"		20.390"		10.040"

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