ANNUAL REPORT

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VERNON FOREST INSECT LABORATORY

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THE ANNUAL REPORT OF THE VERNON FOREST INSECT LABORATORY.

CALENDAR YEAR 1942

INTRODUCTION

The principal work of the Vernon Forest Insect Laboratory during 1942 has been the Forest Insect Survey, the bark beetle control project at Banff, bark beetle studies in the Kootenay Park infestation, and studies connected with the larch sawfly.

The Forest Insect Survey was conducted about the same as in 1941, with a slight decrease in the number of collections received.

In the bark beetle control at Banff, treatment of the entire main area in the Bow Valley was completed. This entailed the cutting and burning of 9, 192 trees over 5,374 acres. Over the area treated the infestation was reduced 98 per cent. At the time of closing down the work in April there remained only outlying areas west of Johnson Canyon, on Brewster and Healy Creeks and on the Spray River to treat during the 1942-43 control season.

Recent data on the larch sawfly indicates that it has now reached the western limit of *Larix occidentalis* but control factors seem to be holding it in check sufficiently to prevent lasting damage to larch stands.

In addition to the bark beetle and the sawfly there have been rather serious infestations of the spruce budworm and the lodgepole pine needle miner. These occurred in Banff and Kootenay National Parks. This report covers the detailed studies of these various projects.

PERSONNEL OF THE VERNON FOREST INSECT LABORATORY.

Geo. R. Hopping	--Entomologist in Charge
W.G. Mathers	--Assistant Entomologist
H.B. Leech	--Agricultural Assistant (XI)
C.V.G. Morgan	--Agricultural Assistant (IV)
Miss Rita Beckingham	--Stenographer.

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ATTENDANCE OF OFFICERS AT CONFERENCES, ADDRESSES AND LECTURES.

Geo. R. Hopping addressed the Vernon Rotary Club on January 12. His subject was "The Work of the Vernon Forest Insect Laboratory." A resumè was given of the work during the past twenty years.

Between March 3 and 15 conferences were held at Banff with Superintendent P.J. Jennings and the acting chief warden Bruce Mitchell. Bark beetle control projects were reviewed and plans for future work discussed.

Between April 18 and 24, Geo. R. Hopping lectured at the annual wardens' schools, held at Jasper and Banff. The main topic discussed was bark beetle control. Wardens from all of the National Parks in British Columbia and Alberta attended these meetings. Only Jasper Park wardens were present at the Jasper meeting while at the Banff meeting all of the wardens from Banff, Kootenay, Yoho, Glacier and Revelstoke Parks attended.

RECONNAISSANCE AND FIELD WORK.

During the following periods G.R. Hopping was absent from the laboratory supervising bark beetle control work at Banff:- March 3-15; June 14-15; November 18-December 2.

G.R. Hopping and W.G. Mathers spent June 1 to 16 in Kootenay and Banff Parks making growth studies and tree analyses in connection with bark beetle infestations. G.R. Hopping spent the entire month of July and up to August 10 on similar work.

G.R. Hopping and C.V.G. Morgan spent September 28 to October 9 making a survey of larch sawfly areas between Vernon and Columbia Lake and taking data on bark beetle sample plots in Kootenay Park.

COOPERATION WITH OTHER ORGANIZATIONS.

Fullest cooperation has necessarily been maintained between the Vernon Laboratory and the National Parks Branch in conducting the bark beetle control work in Banff Park and the salvage work in Kootenay Park. The effective work of Superintendent P.J. Jennings and Acting Chief Warden Bruce Mitchell of Banff Park has been particularly valuable in making the control work a success.

The interest in the forest insect survey has been maintained on the part of the British Columbia Forest Service and the National Parks wardens. The interest of the Alberta Forest Service however, seems to have waned considerably and some work may have to be done to revive it.

Several problems in connection with insects injurious to structural timbers have been submitted to the Vernon Laboratory by the Forest Products Laboratory at Vancouver. For the most part these have been referred to Dr. M.L. Prebble of the Victoria Laboratory except in cases where previous experience of Vernon officers could be of assistance.

Inquiries regarding shade tree insects have been referred to this laboratory by the Dominion Experimental Farm at Summerland and by officers of the Provincial Horticultural Branch. All possible cooperation has been given in handling these inquiries.

GENERAL INSECT CONDITIONS.

Forest and Shade Trees - 1942.

Mountain pine beetle - Dendroctonus monticolae Hopk.

Control measures have reduced the infestation in the Bow Valley near Banff by 98 per cent. The infestation is still active on outlying areas, on Brewster and Healy Creeks and on Spray River. These areas will be cleaned during the winter of 1942-43. The Kootenay Park infestation has shown increased activity around Nixon and Dollyvarden Creeks but the extremely wet weather during June and July delayed the emergence to such an extent that the new generation went into the winter as eggs or young larvae. High mortality should result if winter temperatures become severe and a sudden drop in the bark beetle population may be expected in 1943.

Western balsam bark beetle - Dryocoetes confusus Sw.

This bark beetle was active in 1942 in many of the higher balsam stands of Banff Park and was particularly noticeable in the vicinity of Hector Lake on the Banff-Jasper highway. Since many of the balsam stands have a considerable percentage of spruce intermixed, the loss from a scenic standpoint will not be noticeable in a few years.

Lodgepole pine needle miner - Recurvaria milleri Busck.

An intense outbreak of this needle miner became apparent in Banff Park for the first time in June of this year. The area was mainly in the Bow Valley between Castle Mountain and Brewster Creek, but extended through Vermilion Pass into Kootenay Park for a short distance. It was also noted in Kootenay Park at the headwaters of Kicking Horse River. It was more prevalent on reproduction on old fire scars but on such areas as Brewster Creek attacked old trees as well.

European larch sawfly,-Pristiphora erichsonii Hartig

This larch defoliator now occurs throughout the larch stands of British Columbia, having been recovered this year for the first time on the western slope of the Monashee Range. It was discovered near Vernon which is approximately the western limit of Larix occidentalis. This year, defoliation was generally light from Creston eastward. Between Creston and Vernon, heavy defoliation occurred near Gray Creek on Kootenay Lake, along the Kootenay River west of Nelson, in the Slocan Valley and along Arrow Lakes between Nakusp and Needles.

Spruce budworm - Cacoecia fumiferana Clem.

The spruce budwomr caused severe defoliation to balsam reproduction beneath mature spruce and balsam stands on many of the higher areas in the national parks. It was particularly severe between Vermilion Crossing and Vermilion Summit in Kootenay Park and on Mt. St. Piran near Lake Louise and around Boom Lake in Banff Park. A heavy infestation was also reported at an elevation between 5,000 and 5,500 feet 14 miles north-west of Edgewood, B.C.

Tent caterpillar, - Malacosoma disstria Hbn.

This was reported to be heavier than last year in the Cariboo district of British Columbia but details of the extent of the infestation were not accurately determined. The same species was also abundant on poplar south and east of Edmonton.

Poplar sawfly - Pontania pepii Ross (probably)

A widespread infestation of this sawfly occurred in the Eagle River and Shuswap Valleys, B.C. extending from ten miles west of Revelstoke to Grindrod. The poplars (Populus trichocarpa) are scattered over the valleys in groups and along the rivers and lake shores. Many of these groups were completely stripped in late June and early July. The defoliation was heavier in the vicinity of Taft, B.C. The trees were able to put out new leaves before the end of summer, so that the earlier defoliation could scarcely be detected.

Juniper webworm - Dichomeris marginella Fab.

This was reported to be heavily infesting junipers near Kelowna, B.C. This is the first record we have had of this species in the Okanagan Valley since 1934 when it was taken on junipers at Summerland, B.C.

California tortoise-shell butterfly - Nymphalis californica Bdv.

The larvae of this species heavily defoliated considerable areas of Ceanothus sanguineus near Castlegar, B.C. This is about 3 to 4 miles north of a similar infestation reported in 1941.

Pine weevil - Hypomolyx piceus DeG. (presumably)

This weevil is quite common in the interior of British Columbia and occurs in the lodgepole pine stands of Kootenay Parks as well. It probably occurs in all the western lodgepole pine stands of Canada. This year it was reported to be working at the roots of lodgepole pine over an area of about 2 acres near Rocky Mountain House, Alberta.

Black willow beetle - Galerucella carbo Lec.

In the vicinity of Prince George B.C., this leaf-eating beetle defoliated willows over a large area.

Box -elder bug - Leptocoris trivitatus Say.

This bug was numerous again in the Okanagan Valley and inquiries were received from householders in Kelowna and Penticton. They have been successfully reduced to a point where they are no longer a nuisance, by several residents of Vernon simply by destroying the masses of bugs when they gather before and after hibernation.

Lilac leaf miner - Gracilaria syringella

This miner caused much less severe damage than last year to lilacs in the Vernon district. This may have been due to the exceptionally wet June and July or it may be that natural control factors are becoming more effective than when the insect first appeared here less than ten years ago.

DETAILED REPORT OF PROJECTS

E.30.01 - The Forest Insect Survey.

Compared to the peak year of 1941 there was a decrease in the number of collections made. This, however, was expected in view of reduced personnel in the various forestry services and the extremely rainy season. Collections were made by the British Columbia Forest Service, Alberta Forest Service, Dominion Forest Service, and the National Parks Branch.

In the following table data for each year covering collections and returns are summarized from the inception of the survey in 1937 to date.

Year	Boxes sent	Boxes returned	% Boxes ret'd	Negative reports	Totals
1937	401	189	47	138	327
1938	831	470	56	177	647
1939	1877	933	50	120	1053
1940	1746	601	34	62	663
1941	1928	945	49	137	1082
1942	2048	773	32 37	87	860

Emergence from 1941 Material -- Constant Temperature Cabinet

W.G. MATHERS

The emergences of the over-wintered 1941 Forest Insect Survey material, in the constant temperature cabinet at Vernon are summarized in the accompanying tables. The cabinet was operated at 74°F and 90-95% relative humidity. The material had been kept until November 3 in the insectary at the Field Station where a minimum of 24°F was recorded on October 29. On November 3 the material was transferred to the over-wintering chamber, the temperature of which ranged from a maximum of 40° to a low of 25°, but averaging close to 32°.

All but the sawfly material was taken on January 30, 1942 from the overwintering chamber at 32° and held for 24 hours at 56° in a room at Vernon. It was then placed in the constant temperature cabinet at 65° and over a period of 48 hours raised to 74°.

The sawfly material was transferred on February 17, 1942, from the over-wintering chamber at 31° to a room at Vernon at 45°. The temperature of the room was gradually raised over a period of 24 hours to 70°, after which the material was placed in the constant temperature cabinet at 74°.

SURVEY -- 1 9 4 1

Table I -- Summary of Emergence from Lepidopterous Pupae

Species	No. of pupae	No. of moths	Incubation Period	No. of para-sites	Inc. Period	No. of dead pupae	% Emergence
Semiothisa	11	8	8-14 days	-	-	3	72.7
Eupithecia	18	16	5-34 "	-	-	2	88.9
Caripeta	4	3	26-55 "	-	-	1	75.0
Melanolophia	16	15	7-17 "	-	-	1	93.7
Hydriomena	1	1	10 "	-	-	-	100.0
Misc. Geometridae	28	19	5-42 "	-	-	8 *	67.8
Feralia jocosa	5	1	7 "	-	-	4	20.0
Palthis angulalis	1	1	15 "	-	-	-	100.0
Acronicta	3	3	21-35 "	-	-	-	100.0
Misc. Phalaenidae	15	13	2-14 "	-	-	1 *	86.7
Hyphantria textor	8	-	----	1 Hymen)	13 d.	7	12.5
Misc. Arctiidae	1	-	----	-	-	1	Nil
Griselda	1	1	7 "	-	-	-	100.0
Misc. Tortricidae	7	6	7-9 "	-	-	1	85.7
Bucculatrix	1	-	----	1 Hymen)	18 "	-	100.0
Sphingidae	1	1	20 "	-	-	-	100.0
Lycaenidae	30	19	4-23 "	(2 Dipt.) (7 Hymen) (56)Chal.)	13-16 " 25-28 21 "	1	96.7
Misc. Lepidoptera	9	4	3-17 "	-	-	5	44.4
TOTALS	160	111	2-55 days	12	13-28	35	76.9

* 1 pupa alive after 60 days, transferred to Insectary.

SURVEY -- 1 9 4 1

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

Species	No. of cocoons	Sawfly Adults	Incubation Period	No. of parasites	Incub. period	No. of dead cocoons	% Emergence
Pikonema dimmocki	69	11	18-35 days	3 Hymen.	13-26 ds.	55	20.2
P. alaskensis	49	9	13-31 "	4 Hymen.	12-20 "	35 *	26.5
P. spp.	7	2	17-22 "	--	----	5	28.6
Pristiphora erichsonii	22	2	19-20 "	--	-----	19 *	9.1
Neodiprion spp.	52	8	13-16 "	(5 Dipt. (10 Hym. (2(78) (Chals.	16-19" 10-38" 7-22"	25 **	48.1
Anoplonyx laricis	3	-	---	-	----	3	Nil
Nematine	41	10	10-29 "	-	----	31	24.4
Cimbex spp.	4	3	11-12 "	-	----	1	75.0
Misc. Sawflies	12	2	8 "	3 Hymen.	17-21 "	7	41.7
TOTALS	259	47	8-35 days	27 cocoons	7-38 ds.	181	28.6

* 1 cocoon with live larva, pickled

** 2 cocoons with live larvae, pickled.

SURVEY -- 1 9 4 1

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

Survey No.	No. of Cocoons	Sawfly Adults	Incubation period	Diptera Parasite	Inc. period	Tritneptis adults ✱	Inc. period	No. of dead Cocoons
2322	37	4	24-29 d.	1	17 d.	273 (12)	29-47 d.	20
2325	15	-	--	-	--	95(7)	30-37 "	8
2446	22	-	--	-	--	77 (3)	12-37 "	19
2447	9	1	22 "	-	--	89 (7)	20-40 "	1
2448	36	-	--	-	--	295 (19)	11-33 "	17
2452	72	15	22-27 "	-	--	200 (14)	33-54 "	43
2546	21	-	--	-	--	284 (13)	30-47 "	8
2580	7	3	18-28 "	-	--	----	----	4
2582	1[illegible]	-	--	-	--	227 (15)	29-37 "	3
Totals	237	23	22-29 d.	1	17 d.	(90 c)	11-47 d.	123

✱ More than one generation

Total Percentage emergence: 48.1
Percentage emergence of Sawflies : 9.7

Table III -- Summary of Emergence from Miscellaneous Parasite Material

	Host	No. of adults	Incubation period	No. Dead	% Emergence.
Diptera					
3 puparia	Lycaenid larvae	2	13-16 days	1	66.7
4 "	Semiothisa "	2	14-41 "	2	50.0
2 "	Stilpnotia "	-	--	2	Nil
3 "	Hyphantria "	-	--	3	Nil
1 puparium	Geometrid larva	-	--	1	Nil
1 "	Tortricid "	1	11 "	-	100.0
3 puparia	- unknown -	1	27 "	2	33.3
Hymenoptera					
1 cocoon	Cacoecia larva	1	19 "	-	100.0
2 cocoons	Peronea larvae	1	16 "	1	50.0
1 cocoon	Tortricid larva	-	--	1	Nil
2 cocoons	Semothisa larvae	1	37 "	1	50.0
2 "	Geometrid "	-	--	2	Nil
1 cocoon	Phalaenid larva	-	--	1	Nil
4 cocoons	- unknown -	1	35 "	3	25.0
Totals:					
Diptera: 17 p.	-	6	11-41 days	11	35.3
Hymen. : 13 c.	-	4	16-37 "	9	30.8

Table IV -- Summary of Emergence from Miscellaneous Material

	No. of Pupae	No. of Adults	Incubation period	No. of Para-sites	Inc. period	No. of dead Pupae.
Syrphidae	6	5	8-10 days	--	--	1
Dermestidae	1	1	20 "	--	--	-
Parasit. Aphids	2	-	--	1 Hymen.	45 d.	-
Cone moths (Picea)	-	1	18 "	--	--	-
" " (Abies)	-	3	10-27 "	--	--	-
Pissodes in pine shoots	-	-	--	2 Hymen.	12 d.	-
" in spruce shoots	-	-	--	12 "	12-27 d.	-

Summary of Material Received (last 3 seasons) ~~Exclusive of Over-Wintered Material~~.

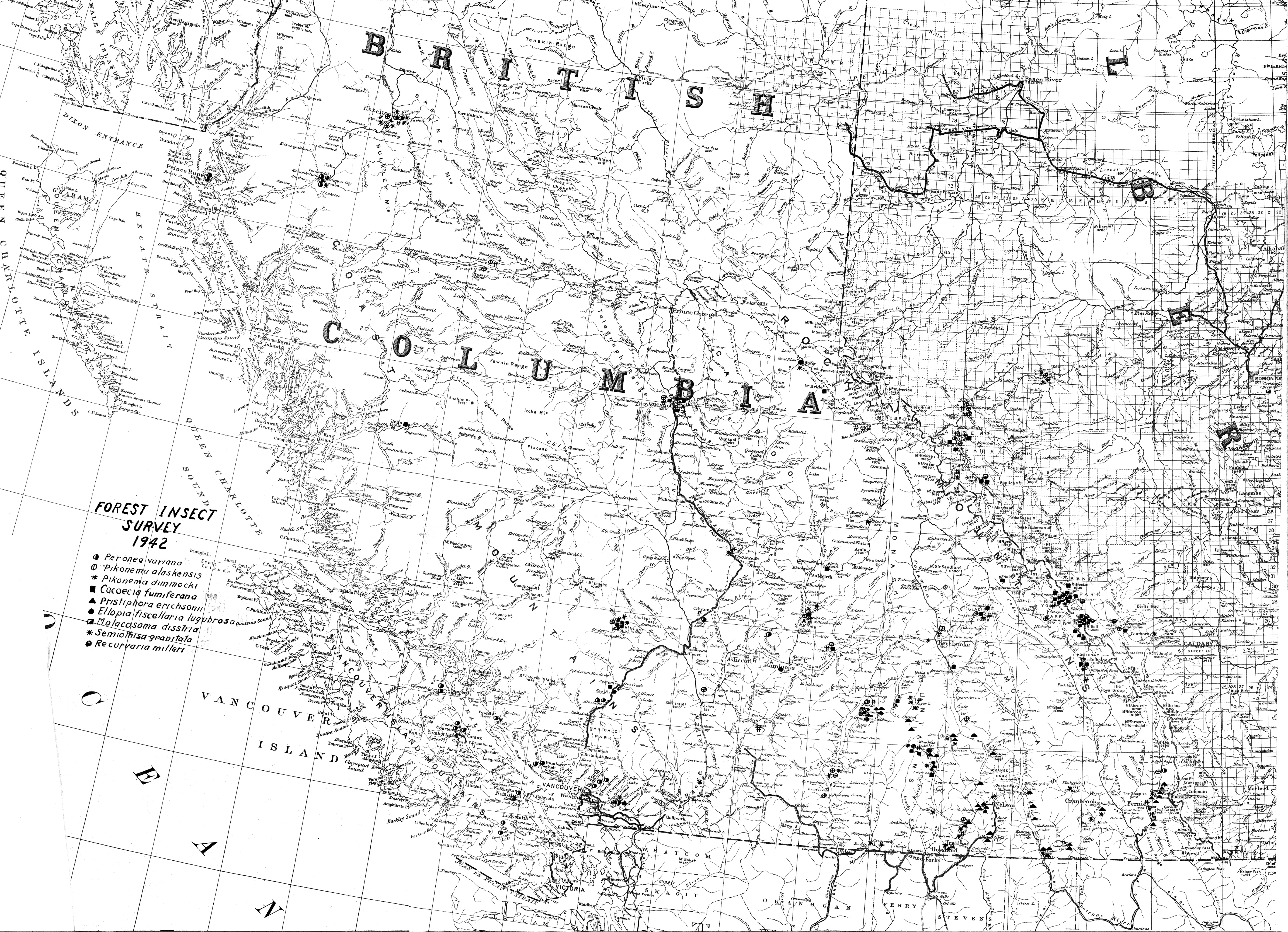
	H.B. LEECH Specimens Rec'd 1940	1941	1942	Totals. 1940	1941	1942
Insecta:						
Coleoptera....eggs	--	40+	--			
....larvae	140+	146	82			
....pupae	9	13	28			
....adults	959	1,057	1228	1,108	1,256	1,338
Collembola..................				7	7	4
Dermaptera..................				1	11	6
Diptera ......larvae	67	154	93			
......puparia	24	47	34			
......adults	130	117	124	221	318	251
Ephemeroptera..................				9	10	6
Hemiptera						
Heteroptera..eggs	32	53	14			
immatures)	491	184	188			
adults)		432	257	523	669	459
Homoptera..................				562+	691+	518+
Hymenoptera						
Symphyta...larvae	620	1,164	2,624			
..cocoons	105	330	469			
...adults	15	21	14	840	1,515	3,107
Apocrita..larvae	3	2	6			
....cocoons	33	23	50	147	133	149
...adults	111	108	93			

Summary of material Received (Cont'd)

		Specimens Rec'd			Totals		
		1940	1941	1942	1940	1941	1942
Isoptera					26	1	3
Lepidoptera	eggs	334	17	1			
	larvae	877	2,230	1,354 +			
	cocoons or pupae	350	179	592 +			
	adults	127	84	51	1,688	2,510	1,998
Neuroptera	eggs	---	63	---			
	larvae	42	63	23			
	cocoons	19	21	17			
	adults	37	45	19	98	192	59
Orthoptera					14	25	17
Plecoptera					19	16	31
Psocoptera					412	428	314
Thysanura					22	27	15
Trichoptera					20	12	19
Miscellaneous							37
TOTALS					5,617	7,821	7,898

Arthropoda, other than insecta.

	1940	1941	1942
Acarina	14	9	100's
Araneida	196 +	219	303
Chilopoda	--	2	2
Diplopoda	4	46	12
Isopoda	2	12	8
Oligochaeta	--	1	--
Phalangida	--	3	1
Pseudoscorpionida	--	1	--
Snail shell	--	--	1
GRAND TOTALS	5,833	8,114	8,325 +


FOREST INSECT SURVEY 1942
Peronea variana
Pikonema alaskensis
Pikonema dimmocki
Cacoecia fumiferana
Pristiphora erichsonii
Ellopia fiscellaria lugubrosa
Malacosoma disstria
Semiothisa granitata
Recurvaria milleri
BRITISH COLUMBIA
VANCOUVER ISLAND
QUEEN CHARLOTTE ISLANDS
DIXON ENTRANCE
HECATE STRAIT
QUEEN CHARLOTTE SOUND
COAST MOUNTAINS
SELKIRK MOUNTAINS
PRINCE GEORGE
VANCOUVER
VICTORIA
KAMLOOPS
EDMONTON
CALGARY

E. 30.03 - 2 -- Rearing and Identification of Miscellaneous Forest Insects.

G.R. HOPPING & C. V. G. MORGAN.

Lodgepole pine needle miner (Recurvaria milleri Busck.)

A severe epidemic of this needle miner developed in Banff and Kootenay Parks in 1942. The discolouration of the trees was first noted in early June around Vermilion Pass. The injury extended from Castle Mountain on the north side of the Bow Valley eastward to Johnsons Canyon and on the south side from Vermilion Pass eastward to Brewster Creek. It was also noticeable around Lake Louise and the headwaters of Kicking Horse River. It extended through Vermilion summit into Kootenay Park where it was also reported from Hawk Creek, a tributary of Vermilion River. The approximate area covered by the outbreak was 50 square miles.

The main discolouration and subsequent dropping of mined needles was confined to a belt between the 5,000 and 6,500 foot contours. Below 5,000 feet the mined needles were much less numerous and on the floor of the Bow Valley the injury practically disappeared. The infestation occurred mainly in reproduction six to twenty feet high which has become established on old burns. However, mature trees were heavily infested in Vermilion Pass and on Brewster and Healy Creeks.

The peak of moth emergence was between July 19 and 24. By July 26 over 60 per cent of the pupae had produced adults. Young trees on the Banff side of Vermilion Pass were examined on July 22 when jarring of the trees produced clouds of adults. Emergence of moths from material sent to Vernon occurred between July 6 and 27. Several species of parasites have been recovered but the parasitism did not exceed 1 per cent. Thus far the seasonal development seems to be following that indicated by Patterson * for the same species in Yosemite Park, California. This life cycle is as follows:-

Moths are in flight every second summer. Eggs are deposited on and under the needle sheaths at the base of the needles during July and August. The eggs hatch from the early part of August to about September 10, and the young larvae commence to mine needles of the current year's growth shortly after emergence. About one third of each needle attacked is mined the first year, before activity ceases for the winter. Activity is resumed in early spring of the following year. By mid-summer about 2/3 of each needle has been mined and larvae are about half grown. When the new needles are nearly fully developed the larvae transfer to them during August. By the end of this second year 1/2 of the new needle has been mined. The brood overwinters in these needles and resumes activity again the following spring completing the mining of the needles entered the previous year.

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* Patterson, J. E. Life History of Recurvaria milleri, the lodgepole pine needle-miner, in Yosemite National Park, California --Journ. Agr. Res. XXI (3):127-142 plus 1 unnumbered page, 1921.

These are then abandoned and the larvae transfer to green needles of the same year's growth. Pupation occurs in these needles which drop after the moth emergence. Thus the discolouration of trees is more pronounced every second year because then the larvae mine twice as many needles of the same year's growth as in the previous season. 15

In the Bow Valley practically all signs of discolouration had disappeared by the end of summer and the trees were again green because of the development of current year's needles. Close inspections of the crowns however, showed a decided thinning of the foliage with apparently about 50 per cent of the needles cast. This was particularly marked on mature trees on Brewster Creek.

Monochamus notatus var. Drury

C.V.G. MORGAN

The life history of Monochamus notatus Drury on western white pine, Pinus monticola Dougl., requires two years for its completion at Trinity Valley, B.C. There are four stages in the life of this timber sawyer represented by the adult, the egg, the larva, and the pupa.

Adult.

The adult is a square-shouldered, elongate beetle. The male varies in length from 17.5 mm. to 32.0 mm. and from 4.5 mm. to 9.5 mm. in width. The length of the female varies from 18.0 mm. to 29.0 mm., and the width from 5.5 mm. to 9.0 mm.

The general colour of this insect is ashen grey, mottled with darker spots which on the elytra are elongate and velvety black. Areas of a whitish colour are evident on the head, thorax, and abdomen. The colours are chiefly due to a pubsecence of very fine, short hairs, which when rubbed off leave the body a reddish-brown colour. This explains, in part, the confusion resulting from some keys in which the colour is described as a greyish-brown.

Examinations, begun in 1941, of over 200 galleries in logs felled in 1940 revealed that the first adults were formed in the tunnels between July 2 and 9, 1942. On the latter date only two emergence holes were evident on the surface of all logs. The last adults emerged about August 10, 1942, and these were from portions of logs which were heavily shaded. The emergence period extends, therefore, over a period of approximately one month.

The adult emerges from the log by extending the pupal chamber to the surface of the wood and through the bark. A perfectly round exit hole is bored, usually at right angles to the surface of the wood especially when the larval gallery occurs on the upper areas of the log. If the gallery is situated on the side of the log, the exit hole may be made on a slight upward slope, but in all cases, it is straight throughout its linear length. The walls of the hole are comparatively smooth and the line of demarcation between it and the pupal chamber is easily distinguished. The size of the exit hole varies depending upon the size of the adult. The majority measure about 7 mm. in diameter. None have been found smaller than 5 mm. while the largest noted measured 11 mmm.

A survey of the logs after the emergence period showed that at least 90% of the emergence takes place on that portion of the log receiving direct sun during the summer months. These adults are the first to emerge. Toward the latter part of the emergence period, unemerged adults were found only on areas of the log receiving indirect rays. Generally speaking, it may be said that the time of adult emergence varies indirectly with the sum total of sunlight, and will take place progressively later throughout the surface of the log from the point of direct sunlight, to that of total shade. Adults were obtained from areas of total shade but the percentage was less than one. Total natural shade should be distinguished from artificial shade produced by placing branches etc. over the logs which obstruct oviposition.

The last adults were observed on logs on October 1, 1942, but in the latter half of September their numbers were very few and then they appeared only during the warmest period of sunny days, usually between 2 and 4 o'clock in the afternoon. The majority of these adults were females.

The adult will live, when provided with food, for at least one month. Many will live for 50 days or so. One female kept in a wire cage built around a log, and provided with food, lived for 82 days.

So far as is known the only food taken by the adult during its life is the outer bark and phloem of twigs and branches of western white pine(<u>Pinus monticola</u> Dougl.), Douglas fir (<u>Pseudotsuga taxifolia</u> Raf.), engelman spruce (<u>Picea engelmanni</u> Engelm.), western hemlock (<u>Tsuga heterophylla</u> Sarg.), and cedar (<u>Thuja plicata</u> Donn.). The bark and phloem of white pine is most preferred, cedar is only occasionally eaten. The xylem of the attacked twigs is not ingested but may be severely scored by the mandibles. It is interesting to note that feeding scars are never found on the logs during the active flight period. In the evening after sunset, nearly all adults fly from downed logs to standing trees close at hand, indicating that feeding naturally occurs on living trees during the evening through to the following day. The height of flight may be as much as 40 feet or more. In the latter part of September a small amount of feeding by old and weak adults was noticed on the logs. Under forced conditions adults feed voraciously on the bark of down logs.

Monochamus, being a sun-loving insect, prefers to lay its eggs on areas of logs exposed to sunlight. The presence of bark on the log is a prerequisite to oviposition, and thick bark rather than thin is preferred. The egg scars are made not necessarily in crevices as is often the case with other species of this genus. The type of scar made prior to oviposition is characteristic of both M. notatus and M. oregonensis. It consists of two punctures and a narrow slit, and is made as follows. Selecting a place on the log where the young are likely to develop, the female begins to dig out a slit invariably starting with the left mandible, the right mandible serving as a fulcrum which produces one puncture. Then the mandibles are switched to the left so that the left mandible forms a fulcrum and thus the second puncture while the right mandible completes the slit into which the ovipositor will eventually be placed. The depth of the slit is the full length of the exposed mandibles; the depth of the punctures depends on the softness of the bark and the effort expended in digging out the slit. The slit is about 2 mm. in length, and the thickness of the mandibles in width. The bark dug from the slit is cast aside Having complted the egg scar, the adult turns around, usually clockwise, and with the aid of the tactile hairs on the end of the abdomen finds the scar into which she forces her ovipositor. Sometimes, after much effort, the egg scar is not located and she wanders off in search of other grounds to begin all over again.

The adult in making the egg scar on the side of down logs is generally in such a position that the head is uppermost.

In most cases, but not always, the egg scar is made nearly parallel with the grain of the wood. Seldom is it constructed at right angles to the grain.

During the most active ovipostion period the male is very often found in attendance with the female. Copulation occurs frequently immediately before and after ovipostion but once the female begins to form the egg scar, the male seldom intervenes until oviposition is completed, although he remains mounted on her back throughout the process.

EGG

Only one egg is deposited in each egg scar. It is placed in the soft succulent secondary phloem close to the cambium layer. No matter at what angle to the grain the egg scar is constructed, the egg is always placed with its longitudinal axis parallel with the grain of the wood. The phloem around the slit in which the egg is deposited soon turns brown which enables one to readily pick out the position of eggs when bark, including the phloem, is peeled from the log.

The egg is elongate oval, with a tendency to be somewhat sausage-shaped. The micropyle end is slightly flattened and depressed. Close to this end, the egg has its greatest width, and then tapers slightly towards the opposite end which is more pointed. The outer surface is very lightly but profusely patterned as a result of the impressions of the follicular cells. The length and width of the eggs are fairly constant, averaging 4.46 mm. and 1.22 mm. respectively. Of 26 eggs examined the length ranged from 3.34 mm. to 4.81 mm., and the width from 1.12 mm. to 1.28 mm.

The eggs hatch within 9 to 15 days depending upon weather conditions and position of the egg with respect to amount of direct sunlight.

Emergence of the larva takes place at the micropyle end but somewhat on the side of the egg.

The first observable signs of hatching are the minute swellings on the surface of the egg; these being the outer manifestations of pressure applied by the mandibles of the young larva. Soon the chorion is broken and the larva emerges from a very ragged hole. As much as 5 hours may elapse from the first signs of hatching until the larva is completely free from the egg.

LARVA

The larva is an elongate, footless, white grub. Locomotion is achieved through the use of dorsal and ventral ampullal which when contracted to the anterior end of the body move the larva along the tunnel.

The size of the larva varies considerably according to age, individual, and sex. A larva just emerged from the egg measures 4.24 mm. long, 1.28 mm. wide at the prothorax, and 1.20 mm. thick. Larvae taken from galleries on December 15, 1942, approximately four months after hatching, varied from 11.5 mm. to 22 mm. in length and from 4.03 mm. to 5.72 mm. in width. At maturity some measure as much as 60 mm. or more.

Immediately on hatching, the larva begins to feed, It soon makes its way to the cambium region where it spends much time mining, between the bark and the sapwood considerably scoring the latter. The chips and excrement are packed between the bark and the wood so that eventually the bark becomes somewhat separated from the wood.

About two months after the first eggs are laid, the first extrusion holes are formed from which the chips are emitted. These oblong holes are approximately 4 mm. long and 2 mm. wide and occur in the majority of cases, on the lower surfaces of a down log.

At about the time the extrusion holes are formed, the larvae begin to excavate a hole in the wood. The progeny of two females examined on Sept. 25, 1942, revealed that only eight of 23 living larvae had begun to make galleries into the sapwood. During the first fall, the holes are extended into the wood, to a maximum of about two inches. As in the case of the extrusion holes, the mouths of the wood galleries are found generally on the sides and lower surfaces of down logs. These holes extend upwards from the surface of the log.

Feeding continues throughout the following year and by the spring of the second year a U-shaped tunnel is formed. The larvae are now practically full grown.

The galleries never extend beyond the centre of the log even though the diameter of the log may only be 4 inches.

PUPA

The pupa which possesses characteristics of both the larva and the adult is formed in a pupal chamber at the end of the larval gallery. This chamber is oblong in cross section and varies from 1/4 " to 1/2 " in thickness and from 7/16 " to 1 " in width. It may be 2 " or more in length. The pupal chamber usually extends to within about 1/4" from the surface of the wood; some however, extend to within only 1" while others have been found as close as 1/16 " or less. Generally the chamber is constucted on a slope so that the pupa rests comfortably on one side.

The first signs of pupal transformation were observed in 1942 on June 5 when only one pupa could be found in many galleries examined. The duration of the pupal stage is approximately one month.

The prepupal stage must be exceedingly short for of all galleries examined in June and July of 1942, only one specimen was taken. Minor changes occurred in this specimen from the time it was removed from the gallery until it was preserved, the time being about 20 minutes.

As the pupa matures the first signs of true adult characters become evident in the eyes. These structures change colour from a yellowish-white to a bright pink and soon after assume the black pigment of the adult. Subsequently, blackening of the cuticular surfaces becomes evident first at the extremities of the appendages such as the claws, the distal ends of the mandibles, the edges of the wings, and also around the joints of the legs. This blackening, whichmmay be deposition of melanin, continues progressively backwards, especially on the mandibles, as the pupa matures.

PARASITES.

Only one parasite (Ichneumoid) of *Monochamus notatus* is definitely known. This has been tentatively identified as belonging to the genus *Ichneumon*. Another Icheumonoid belonging to the genus *Doryctes* has been found in the galleries of *Monochamus* but its relationship with the host is not definite. Both are larval parasites.

In 1941 a dipterous maggot was taken from a gallery in which the sawyer larva was partially destroyed. An attempt to rear this specimen was unsuccessful. Parasitism by Diptera has not been observed since.

DISEASE

Apparently *Monochamus* is quite free from disease. Of all galleries examined over a two-year period only two specimens have been taken which showed definite effects of pathogens. These specimens were fully formed but unemerged adults. They are the only adults which have been found dead in galleries. At the time of examination (July 29, 1942) the specimens were entirely black and reaked of a strongand sickly odour. The entire body was soft and mushy, of the consistency of newly made cheese.

MISCELLANEOUS.

Males of *M. oregonenis* Lec. have been observed in copulation and in attendance with females of *M. notatus* Drury while the latter have been depositing eggs. The development of these eggs is being followed.

Various statements have been made as to what time must elapseafter trees are cut before the logs become receptive to adults of *Monochamus*. At Trinity Valley, B.C. adults of *M. notatus* are attracted to and will oviposit in white pine exactly two days after healthy trees have been felled and cut into logs. This observation was made at the height of the flight period.

Tritneptis klugii (Ratzbury) versus Microplectron fuscipennis Zett. On the Hemlock Sawfly Neodiprion tsugae Midd.

C.V.G. MORGAN

On August 5, 1941, 400,000 Microplectron fuscipennis Zett. from the parasite laboratory at Belleville, Ontario were liberated in the Vernon-Sugar Lake region of British Columbia. The object was to establish this parasite as a factor in the control of the hemlock sawfly Neodiprion tsugae Midd.

The degree of competition between M. fuscipennis and the parasite Tritneptis klugii (Ratzburg) and the comparative effectiveness of each with N. tusgae as a host were not known. An experiment was conducted at the Trinity Valley Field Station to determine some of the factors bearing on the problem. Details of the experiment follow:

Fifteen females and 10 males of each parasite were confined with 25 sound hemlock sawfly cocoons in the field insectary on August 15, 1941. These parasites were not more than 24 hours old. By August 29/41, all the parasites were dead and were removed from the containers. The cocoons were not covered with duff until November 7, 1941, when they were placed in the overwintering chamber at the field station. On May 23, 1942 the cocoons were removed from the chamber to the insectary. One cocoon was then placed in each of 25 vials. Parasites began to emerge on June 16, 1942 for a period of 8 days. On July 2, 1942 another emergence took place which continued for a total of 5 days. The following table gives emergence data.

Emergence of Parasites.

Date of Emergence	JUNE															JULY						
Vial No.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7.
1																	19	1				
2		17	1					1														
3					Cocoons not examined	Cocoons not examined											16	1				
4																	11					
5																	24	3				
6				21					No Emergence													
7	11	22	1				1															
8																		3				
9										"	"	"	"	"	"	"	18					
10																	30	3				
11										"	"	"	"	"	"	"		16				
12				10			4															
13																						
14																	6					
15							4	1														

Vial No.	JUNE 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	JULY 1	2	3	4	5	6	7
16																		14			1	
17																	23					
18				19			13															
19																		17				
20																	7					
21																	12		1			
22																		11				
23																	13	1	1			
24																						
25																						

Parasites from each cocoon were preserved in separate vials. Examination later showed that the parasites obtained during the first emergence period consisted entirely of M. fuscipennis and those of the second were entirely T. klugii. This information together with the numbers of each sex in both parasites is summarized below:

Summary of Examinations.

Vial No.	M. fuscipennis Total Number	M. fuscipennis Sex.		T. klugii Total Number	T. klugii Sex	
1				20	3	17
2	19	10	9			
3				17	4	13
4				11	1	10
5				27	4	23
6	21	14	7			
7	35	15	20			
8				3	1	2
9				18	3	15
10				33	6	27
11				16	1	15
12	14	11	3			
13						
14				6	1	5
15	5	2	3			
16				15	4	11
17				23	5	18
18	32	19	13			
19				17	3	14
20				7	2	5
21				13	3	10
22				11	1	10
23				15	2	13
24						
25						
	126	71	55	252	44	208

From the previous experiment the following conclusions have been drawn:

1. In all cases only one species of parasite emerged from any cocoon.

2. M. fuscipennis emerged during June 16-23, 1942 inclusive. The number of adults per parasitized cocoon averaged 21, of which 56.35% were males and 43.65% females.

3. The first adults of T. klugii were obtained 16 days after the first and 9 days after the last emergence of M. fuscipennis. The average number of adults per parasitized cocoon was 15.75, of which 17.46% were males and 82.54% were females.

4. The total number of Tritneptis adults recovered as compared to Microplectron was in the ratio of 2 to 1.

5. Sixty-four per cent (16) of the sawfly cocoons were parasitized by T. klugii and 24% (6) by M. fuscipennis. Two cocoons (8%) were attacked by one of the two parasites but these did not develop beyond the young larval stage. One cocoon (4%) was apparently not parasitized.

It was not ascertained if adults of the two parasites had originally deposited eggs in the same cocoon, The degree of competition is, therefore, difficult to estimate accurately.

As to potential control, the data indicate that the parasite T. klugii. is more effective than is M. fuscipennis with respect to the hemlock sawfly. This is shown by the greater percentage of coooons parasitized, the greater number of females produced, and the fact that they are parthenogenetic.

Laboratory findings were not verified in the field chiefly because T. klugii, so far as is known, is not yet present in these localized areas where M. fuscipennis was liberated. Under natural conditions T. klugii would probably show even greater potential control for in the experiment equal numbers of females of each parasite were used whereas in the field the ratio of females to males in this parasite is much higher than in M. fuscipennis.

In conjunction with the above work two other experiments were conducted, one on the hemlock sawfly and one on the lodgepole pine sawfly Neodiprion burkei ? Midd., using only the parasite Microplectron fuscipennis. The details of these experiments were reported on in 1941. They were overwintered in the same manner as outlined for the experiment with M. fuscipennis and T. klugii on the hemlock sawfly.

M. *fuscipennis* emerged from the hemlock sawfly cocoons as follows:

DATE	NUMBER
June 11/42	30
" 12	71
" 13	79
" 14	46
" 15	1
" 16	1
TOTAL	228

After the emergence of parasites had ceased, the cocoons were examined. The results of this examination are incorporated in the conclusions tabulated below:

1. Ten cocoons were apparently not parasitised. A male sawfly emerged from one of these in the summer of 1941. The sawfly larvae in 3 others were dead on September 9, 1941. The examination of the cocoons the following spring showed that 6 sawfly larvae had died and molded.

2. Fifteen of the 25 hemlock sawfly cocoons were parasitized. Of the 15 cocoons, 5 were exained on September 9, 1941, and in another cocoon all the parasite larvae and pupad had died and molded the following spring. Parasites emerged, therefore, from only 9 cocoons.

3. The number of adult parasites per cocoon averaged 25.33 as compared to 21 in the first experiment.

4. The percentage of males was 55.26. This compares very favourably with the percentage of 56.35 obtained in the initial experiment.

5. The cocoons which produced adult parasites contained a total of only 2 dead parasite larvae in one cocoon and 2 dead parasite pupae in another.

Adults of M. *fuscipennis* emerged from lodgepole pine sawfly cocoons as follows:

DATE	NUMBER
June 12/42	92
" 13	232
" 14	51
" 15	57
TOTAL	432

Cocoons in this experiment were also examined after parasite emergence was completed. The conclusions reached were as follows:

1. Seven cocoons were apparently not parasitized. Of these 5 cocoons produeed adult sawflies in the summer of 1941, and by the time of examination of the cocoons in 1942, the sawfly larvae in the other 2 cocoons had died and molded.

2. Eighteen of the 25 lodgepole pine sawfly cocoons were parasitized. Of these, 5 were examined on September 9, 1941. Parasites emerged, therefore, from only 13 cocoons.

3. The number of adult parasites per cocoon averaged 33.26.

4. The percentage of males was 38.66.

5. Eleven of the cocoons from which adult parasites emerged, contained a total of 78 dead parasite pupae and 1 dead adult parasite (male).

The conclusions of the two latter experiments show two significant differences.

1. The average number of parasites per cocoon is 25.33 on the hemlock sawfly and 33.23 on the lodgepole pine sawfly.

2. The percentage of male parasites on the hemlock sawfly is 55.26 and 38.66 on the lodgepole pine sawfly.

In the initial experiment, _M. fuscipennis_ began to emerge on June 16, 1942 whereas in the latter two experiments they commenced on June 11 and 12, 1942 respectively. This difference can be explained at the present time only by the fact that cocoons of the first experiment were exposed to parasites on August 15, 1941, while those of the other two experiments were exposed to parasites on August 10, 1941.

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

W.G. MATHERS

Observations have been continued at the Trinity Valley Field Station on the biology of the spruce budworm, particularly with regard to the behavious of material originating from two-year life cycle areas.

1942 was a flight year on areas where the two-year cycle occurs and heavy feeding was reported in spruce-balsam stands from Vermilion Crossing to Vermilion Summit in Kootenay National Park and in the vicinities of Boom Lake and Mt. St. Piran in Banff National Park. Heavy defoliation also occurred in Yoho Valley, north-east of Field, B.C., and a severe infestation was also reported on spruce and balsam at 5,000 to 5,500 feet elevation 14 miles north-west of Edgewood, B.C. No report was received this year on the status of the budworm infestation in the Barkerville district.

Spruce buddworm material received in 1942 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	4	66	-	-	1	67
Picea engelmanni	10	72	4	-	2	78
Picea spp.	15	10	5	2	16	33
Picea & Abies	4	6	21	-	8	35
Pseudotsuga taxifolia	5	4	1	-	1	6
Pinus contorta	5	6	2	-	1	9
Tsuga heterophylla	1	-	-	-	1	1
Larix occidentalis	2	-	-	-	2	2
TOTALS	46	164	33	2	32	231

The collections from lodgepole pine were from Vermilion Summit, Field, B.C. and Jasper National Park areas where heavy infestations on spruce and balsam occurred. The Douglas fir material was received from Quesnel, B.C., Goldbridge, B.C., Pemberton, B.C., Barriere, B.C. and Arrowhead, B.C.; while the two collections from western larch were from

Edgewood, B.C. and near Mabel Lake, B.C.; the one from western hemlock also from near Edgewood. The material from spruce and balsam was collected at or near McBride, B.C., Quesnel, B.C., Goldbridge, B.C., Birch Island, B.C., Chase, B.C., Vernon, B.C., Edgewood, B.C., Blackwater Lake, B.C., and in Jasper, Glacier, Yoho, Banff and Kootenay National Parks.

Parasites

Identified parasites recovered from the 1942 spruce budworm survey material were: 1 Phaeogenes hariolos from a pupa from Jasper Park and 3 Conoblasta fumifernae from specimens from Kootenay Park. In addition, 2 cocoons which are evidently Phytodietus, were reared, one from a larva collected near Blackwater Lake, about 45 miles north of Golden, B.C., and the other from a larva from near Goldbridge in the Bridge River Valley. This latter area is not far from Lillooet where Phytodietus proved so effective in 1919 and should the infestation inerease, may prove a valuable source for obtaining the parasite in numbers.

Banff and Kootenay National Parks.

The spruce budworm areas of Banff and Kootenay National Parks were examined this year during July and the first part of August by Geo. R. Hopping. The infestation was heavy in Kootenay Park on the Vermilion watershed and particularly heavy around Marble Canyon. It also occurred in the Floe and Boom Creeks' watersheds. It was found particularly severe in the Mt. St. Perin district on the north-west side of Lake Louise. Light populations could be found in practically all the spruce-balsam stands of the western parks.

The principal damage has been to young balsam reproduction coming up under stands of mature spruce and balsam with the spruce predominating. The mature balsam is much less affected than the reproduction and very little mortality of the mature trees will results from budworm attacks alone. The chief loss, if any, will be from the balsam bark beetle, Dryocoetes confusus Sw., which may attack the weakened trees. These will probably not be the cause of any appreciable mortality in the mature spruce as this has been fed upon to a much lesser extent than the balsam. Most of the young balsam reproduction will survive but the tops of many of them may be killed. The main feeding has been concentrated on the tops. This will cause the trees to be bushy and misshapen.

It is not probable that timber losses due to the budworm in the National Parks of western Canada will ever be as severe as those in eastern Canada because of the difference in the life cycle of the western budworm. In these high park areas, the budworm has a two-year life cycle so that most of the mature larvae appear every second year. This means that every alternate year is a year of light feeding since about 80% of the feeding is done in the later larval stages. This also means that the trees have some chance to recover each year of light feeding. Hence the budworm in western Canada has not proved to be nearly as serious a forest pest as it has in eastern Canada.

Biological Studies.

In 1942, studies on the spruce budworm consisted of:

1) the continuation of a rearing experiment started in 1940 with 45 freshly emerged larvae, of which one was still alive in the spring of 1942.

2) observations on the activities of larvae from the time they emerge from the eggs until after they had spun their hibernacula.

3) observations on the activities of larvae which were disturbed after having spun their hibernacula.

4) rearing of larvae originating from two-year life cycle material for data on development under conditions at the Trinity Valley Field Station.

Procedure: The material used this year originated from two lots of over 50 larvae each collected on June 14 from spruce and balsam at Vermilion Summit, Kootenay National Park. (Forest Insect Survey Lots B.C. 3005 and B.C. 3006). The larvae were reared at the Trinity Valley Field Station and eggs were obtained from 9 pairs of the resulting moths placed in separate glass containers. The dates of egg-laying, hatching and incubation period were as follows;

Set No.	Date Paired	Date of 1st eggs	Date of 1st larvae	Length of Incubation Period.
1	July 13	July 17	July 30	13 days
2	" 13	" 17	" 29	12 days
3	" 14	" 20	Aug. 3	14 days
4	" 17	" 21	" 4	14 days
5	" 17	" 24	" 6	13 days
6	" 17	" 20	" 1	12 days
7	" 20	" 24	" 6	13 days
8	" 20	" 24	" 4	11 days
9	" 21	" 24	" 6	13 days

The average length of time between pairing and the laying of the first eggs was 4.3 days and the average length of the incubation period was approximately 12.7 days.

As the larvae emerged from the eggs, 15 were placed immediately in small individual vials with a fresh tip of either Picea engelmanni, Abies lasiocarpa or Pseudotsuga táxifolia, for observation on the larvae prior to spinning their hibernacula. Moreover, 19 lots of 10 larvae each were placed in separate glass cials, 1" X 5½" and corked with rolled absorbent cotton. A small twig of a host tree was also placed in 15 of the vials while the other 4 were left without any foliage. This series, together with one vial containing 35 larvae without foliage, are being carried over for observation on development in 1943. An additional 100 freshly emerged larvae were liberated on a caged young Engelmann spruce in the field for the same purpose.

Results: Of 45 larvae used in the rearing experiment, started in 1940, 12 were still alive in the spring of 1941 and of these 3 reached the adult stage that year and one other died as a prepupa. The remaining 8 larvae fed very little and remained more or less dormant and only one was alive in the spring of 1942. This specimen again commenced to feed in May and by June 22 had reached the pupal stage. The moth, a male, emerged on July 6. Thus of the 4 moths recovered, 3 required only one year from egg to adult whileone took 2 years to reach the adult stage. The high mortality was probably due mainly to the frequent handling necessitated by the renewing of the food supply at intervals throughout the experiment.

The larvae on emerging from the eggs, were found to start immediately in search of a suitable place in which to spin their hibernacula, such as between loose bud scales, the base of needles, or in cavities in the cork stoppers in the vials.

The larvae under observation emerged from the eggs in the late afternoon and within 2 to 4 hours several had commenced their over-wintering cocoons. On the following morning, 18 hours from hatching, over 50% were within hibernacula and by the end of 5 days all but one larva had completed hibernacula. Although some webbing had already been formed, a few larvae left their shelters, due possibly to being disturbed at the time of observation, and after some wandering either formed a new location to hibernate or returned to their original shelter. On August 3, a 4-day old hibernaculum was opened at one end with a pair of tweezers, but the larva soon recealed the opening. A second hole was then made in the cocoon where upon the larva emerged and after crawling about for 3 days,again settled down and commenced a new hibernaculum.

None of the larvae fed prior to entering hibernation with the exception of one specimen. This larva showed very unusual behaviour and observations on its activities were as follows:

Aug. 3	3.30 P.M.	--emerged from egg and placed in vial with small spruce tip.
	4.00 P.M.	--crawling about base of vial.
	5.30 P.M.	--crawling between cork and vial.
	6.00 P.M.	--in groove in cork.
Aug. 4	9.00 A.M.	--" " " ", spun light webbing.
	11.30 A.M.	--crawling between cork and vial.
	1.30 P.M.	-- " " " " "
	7.00 P.M.	--back in original groove in cork.

Aug. 5. - 10.00 A.M. --on side of vial-yellowish-green in colour.
2.00 P.M. -- " " " " -yellowish in colour.
Aug. 6. - 6.00 PM. --no change.
Aug. 7. - 4.00 P.M. --larva on side of vial, near base.
Aug. 8. - 1.00 P.M. --no change.
Aug.11. - 3.30 P.M. --larva at base of stem, no webbing.
Aug.13. - 3.00 P.M. --same location, disturbed, moulted but no hibernaculum.
Aug.18. - 11.00 A.M. --frass at base of stem from old bud scales
Aug.22. - 10.00 A.M. --larva mining second needle from base of stem. Webbing at base of needle.
Aug.24. - 5.00 P.M. --needle completely mined but larva still in needle.
Aug.28. - 5.00 P.M. --larva back in shelter at base of needle.
Aug.31. - 4.00 P.M. --considerable more webbing. Larvae moulted second time
Sept. 2 - 4.30 P.M. --larva on bottom of vial. Foliage renewed.
Sept. 5 - 11.00 A.M. --no change.
Sept. 8 - 4.00 P.M. --no change.
Sept.25 - 2.00 P.M. --larva on bottom of vial with webbing and frass. Needle next base partly mined.

From the above records it is evident that the larva started to form an over-wintering cocoon within 18 hours from the time it emerged from its egg but for some reason left the shelter and failed to settle down before it moulted for the first time. Having moulted, the larva commenced to feed, first on the old bud scales at the base of the stem and then by mining a needle. In this connection, the first feeding by second instar larvae in the spring is frequently through entering unopened buds. However, this is our first record of a spruce budworm mining a needle in western Canada.

As recorded in 1925 (Gibson, Arthur--Trans. Royal. Soc. of Canada, 3rd series, Vol. 19. Sec. 5 p. 201) spruce budworm larvae moult for the first time soon after the hibernacula are completed. This was readily observed this year without opening the cocoons as a considerable number of larvae spun their cocoons between cotton plugs and glass and could be observed through the glass. Moulting occurred from 5 to 8days from the time the larvae emerged from the eggs. The winter is therefore passed in the second stadium.

Larvae on emerging from the eggs are green in colour but gradually become yellowish in 2 to 3 days and invariably after the larvae have spun their over-wintering cocoons.

In view of the feeding by the one larva, recorded in detail above, a series of 10 second instar larvae were removed on August 24 from their over-wintering cocoons and placed in individual vials with available food. However, none of the larvae fed although some of them were transferred to the Vernon Laboratory. Instead, the larvae re-spun light cocoons in which they again became dormant.

Summary:- The incubation period of eggs laid in the insectary at the Trinity Valley Field Station, by moths from larvae collected on a two-year life cycle area, varied from 11 to 14 days in length with an average of 12.7 days.

Budworm material originating from a two-year cycle area and reared at the Field Station yielded 3 moths at the end of one year and one moth at the end of 2 years. These results will be checked by further rearings started in 1942.

Larvae on emerging from eggs immediately commence to search for a suitable location in which to spin their over-wintering cocoons or hibernacula.

Hibernacula may be started within 2 hours from hatching and all are usually completed within 5 days.

A larva, after starting a hibernaculum , may abandon it and after further searching or wandering, find a new location or return to the original to complete its over-wintering cocoon.

The first moult normally occurs after the hibernaculum is completed and from 5 to 8 days from the time the larva emerged from the egg. The larva therefore, over-winters in the second stadium.

One exception was a larva which failed to complete its hibernaculum before moulting. This specimen then commenced to feed as a second instar larva, first on old bud scales and then by mining a needle. This is the first time we have found spruce budworm feeding in the fall and our only record of a needle being mined by the species in western Canada.

Attempts to induce similar feeding by removing second instar larvae from their hibernacula and providing them with food were unsuccessful.

Larvae on emerging from the eggs are green in colour but gradually become yellowish in 2 to 3 days and invariably after the larvae have spun their hibernacula.

E. 30.09-3 A Study of the bionomics and control of the Larch Sawfly in British Columbia.

G.R. HOPPING, W. G. MATHERS, C. V. G. MORGAN.

In 1942, the larch sawfly was discovered in the BX district less than 10 miles from Vernon, B.C. It was also found in Trinity Valley and in Creighton Valley a few miles from Lumby, B.C. Thus, the sawfly has practically reached the western limit of the host tree Larix occidentalis. The accompanying map shows the distribution of western larch in British Columbia and the status of the infestation this year.

It should be noted that the infestation was generally light on areas recently invaded by the sawfly such as those west of Arrow Lakes. This would be expected since the sawfly has not yet had time to build up a sufficiently large population to cause serious defoliation. On the other hand, the infestation was also light from Creston eastward on areas where the sawfly has been established longest. This may signify that parasites, including one introduced, predators and fungi are keeping the sawfly down by arriving at more or less of an equilibrium. This, however, can only be shown over a period of years. The heavy parts of the infestation occurred between Grey Creek and Edgewood where the sawfly has been present a sufficient time to build up a large population, but not long enough for the control factors to catch up. The heavy defoliation therefore occurred near Grey Creek, in the Nelson-Slocan district westward to the shores of Arrow Lakes. The heavy defoliation over this area was not uniform but spotty.

This year the field work consisted in taking cocoon samples in late September and early October throughout the infested areas and in recording the degree of defoliation of trees on the eight sample plots. The following table gives data on cocoon sampling.

Place	No. Cocoons Examined	Destroyed by								Total No. Killed	%
		Mesoleius	%	Tritneptis	%	Isaria	%	Other agents	%		
Plot I Grey Cr.	21	6	28.6	0	0.0	0	0.0	0	0.0	6	28.5
Plot IV nr. Cranbrook	4	1	25.0	0	0.0	0	0.0	0	0.0	1	25.0
Plot V Moyie L.	50	13	26.0	3	6.0	2	4.0	0	0.0	18	36.0
Plot VI W. Moyie L.	150	40	26.7	49	32.7	26	17.3	1	0.7	116	77.3
Plot VII S. Yahk	50	14	28.0	17	34.0	12	24.0	2	4.0	45	90.0

Place	No. cocoons ex.	Destroyed by.								Total No. killed	%
		Mes.	%	Trit.	%	Isaria	%	Other agents	%		
4 mi. S. Grey Cr.	132	59	44.7	7	5.3	7	5.3	3	2.3	76	57.5
8.9 mi. W.Nelson	86	0	0.0	37	43.0	2	2.3	0	0.0	39	45.3
Slocan Valley	50	0	0.0	14	28.0	9	18.0	1	2.0	24	48.0
N. Slocan Lake	43	16	37.2	12	27.9	11	25.6	0	0.0	39	90.7
10.9 mi. S.Nakusp	50	3	6.0	0	0.0	0	0.0	1	2.0	4	8.0
1 m. S. Burton	50	7	14.0	1	2.0	3	6.0	0	0.0	11	22.0
2.5 mi. N.Needles	42	4	9.5	0	0.0	1	2.4	1	2.4	6	14.3
8 mi. W. Edgewood	50	1	2.0	3	5.9	12	23.5	0	0.0	16	32.0
16 mi. W. Edgewood	50	2	4.0	6	12.0	3	6.0	0	0.0	11	22.0
Trinity Station	36	0	0.0	0	0.0	0	0.0	1	2.8	1	2.0

From the table it is evident that the highest mortality has occurred on the older part of the infestation. The Isaria mortality is lower than it probably would have been if the cocoons had been collected the following spring instead of in the fall. Much of the Isaria develops during the first warm days of spring. All spring collections have shown greater mortality from Isaria than fall collections.

Parasite Liberations 1942.

Two shipments of parasites were received from Belleville Parasite Laboratory for liberation on the larch sawfly areas. The first shipment had 302 Mesoleius tenthredinis and 3750 Bessa selecta. The second shipment contained 400 Mesoleius and 2245 Bessa. The first shipment was liberated on July 4, 3.2 miles west of the lower Inonvaklin bridge on the Vernon-Edgewood road. The second shipment was received on July 7 and was liberated 24 miles east of Vernon near the Shuswap River on the Vernon-Edgewood road. The following table gives details of shipments.

Shipment No.	Species.	Number shipped		Number dead		Number liberated.	
		♂	♀	♂	♀	♂	♀
1	M. tenthredinis	151	151	8	4	143	147
	B. selecta	1850	1900	30	4	1820	1896
2	M. tenthredinis	200	200	10	16	190	184
	B. selecta	845	1400	154	107	691	1293

In both cases the temperature was approximately 80° F. in bright light with no wind. The larch sawfly infestation in the vicinity of each liberation point was light but there were enough larvae for parasitization.

The following table indicates the degree of attack on trees on the sawfly sample plots from 1939 to 1942 inclusive.

Degree of Attack -- No. of Trees.

Plot No.	1939				1940				1941				1942			
	N	L	M	H	N	L	M	H	N	L	M	H	N	L	M	H
I	0	43	46	11	36	64	0	0	10	81	7	2	0	41	54	5
II	0	67	2	1	58	11	0	0	41	28	0	0	63	6	0	0
III	0	57	31	57	121	23	0	0	7	132	4	0	Data not taken			
IV	0	139	10	0	99	50	0	0	84	65	0	0	0	149	0	0
V	0	184	1	0	154	31	0	0	58	127	0	0	0	178	7	0
VI	0	109	13	2	44	78	1	0	0	96	17	6	0	66	31	22
VII	0	19	13	34	20	39	7	0	0	51	14	1	0	34	20	12
VIII				L O G G E D												
IX	0	62	0	0	10	1	51	0	0	6	16	14 *	0	2	34	0

N -- none; L-- light; M -- medium; H -- heavy.

* Plus 26 felled in 1941.

Light -- Curls noticeable in new shoots but not numerous. No detectable defoliation.

Medium - Upper third of crown noticeably thin. Curls fairly numerous.

Heavy -- Half or more of crown practically stripped.

These plot observations were supplemented by observations on the amount of defoliation all through the larch stands, in order to make a fairly detailed map.

Number of Generations of Tritneptis klugii (Ratzeburg) a Season.

C.V.G. MORGAN.

The determination of the number of generations of Tritneptis klugii (Ratzeburg) in a season occurring on the host Pristiphora erichsonii (Hartig) was continued in 1942. Practically the same method of experimentation.as that outlined in the Annual Report for 1941 was followed this year.

It was concluded in 1941 that under favourable conditions it was possible for Tritneptis klugii on the larch sawfly to produce three generations a year in British Columbia; that is, onve overwintering generation and two summer generations. The last summer generation in 1941 emerged during the period August 11-19 inclusive. On August 12, 1941 five lots (designated as Series III), each containing 5 sawfly cocoons were exposed to 125 (25 to each lot) newly emerged parasites for a period of two weeks. On August 26, 1941 the adult parasites were removed from each lot; at that time 15, 6, 12, 14, and 12 adult parasites were still alive in the respective five lots. A fourth brood of adults did not emerge in the fall of 1941.

Instead of overwintering the parasitized cocoons under their normal conditions, they were covered with duff and placed in an overwintering chamber from November 7, 1941 until June 3, 1942. At the latter date the duff was removed from the containers and the cocoons placed in the insectary. The minimum and maximum temperatures obtained in the chamber between November 7, 1941 and May 20, 1942 were 25.0°F. and 49.0°F. respectively. Temperatures for May 20 to June 3, 1942 are not available but during this time the doors of the chamber were kept closed. It is considered therefore, that the maximum temperature in the chamber did not rise much beyond 49.0°F. The effect of the above treatment and the prolonged low temperatures on the number of generations obtained will be noted later.

Parasites from Series III began to emerge on July 2, 1942, exactly 29 days after the parasitized cocoons were removed from the overwintering chamber. The emergence of this first generation, which continued for 7 days, is summarized in the following table.

Emergence of Parasites from Series III

Lot No.	Date of Emergence July 2	July 3	July 4	July 5	July 6	July 7	July 8	July 9	July 10	Total	Cocoons producing parasites	Ave. per cocoon
3AIA					154	5				159	3	53
3AIB		49			45	10	2			106	2	53
3AIC	13	81	Not Examined	Not Examined	2					96	2	48
3AID					122	1				123	2	61.5
3AIE	30	23			74					127	2	63.5
TOTAL	43	153			397	16	2			611	11	55.5

An examination of the cocoons of Series III on August 6 revealed that only 18 of the 25 cocoons were parasitized, the remaining 7 died from unknown cuases and molded. Of the 18 parasitized cocoons, 11 produced adultsparasites and 7 cocoons contained dead moldy parasite larvae.

Series IV was established on July 6 but due to lack of material, only one lot was set up. The parasites used to begin this Series were removed on July 27; all were dead. Theemergence of parasites of the second generation commenced on August 8 and continued for 9 days until August 16 as shown below.

Emergence of Parasites from Series IV

Lot No.	Date of Emergence Aug. 8	Aug. 9	Aug. 10	Aug. 11	Aug. 12	Aug. 13	Aug. 14	Aug. 15	Aug. 16	Total	Cocoons producing parasites	Ave. per cocoon
3AIAI	11	37	44	24	6	12	29	18	9	190	5	38.0

All sawfly cocoons of this Series were parasitized and produced adults.

Series V, which also consisted of only one lot of 5 cocons, was begun on August 10. The parasites used in starting this generation were removed on August 25, at which time five Tritneptis adults were still alive. This Series did not produce adults in the fall of 1942. The parasitized sawfly cocoons were covered in duff and left in the insectary for the winter of 1942-43.

The following table is a summary of the work conducted since the experiment was begun in 1941.

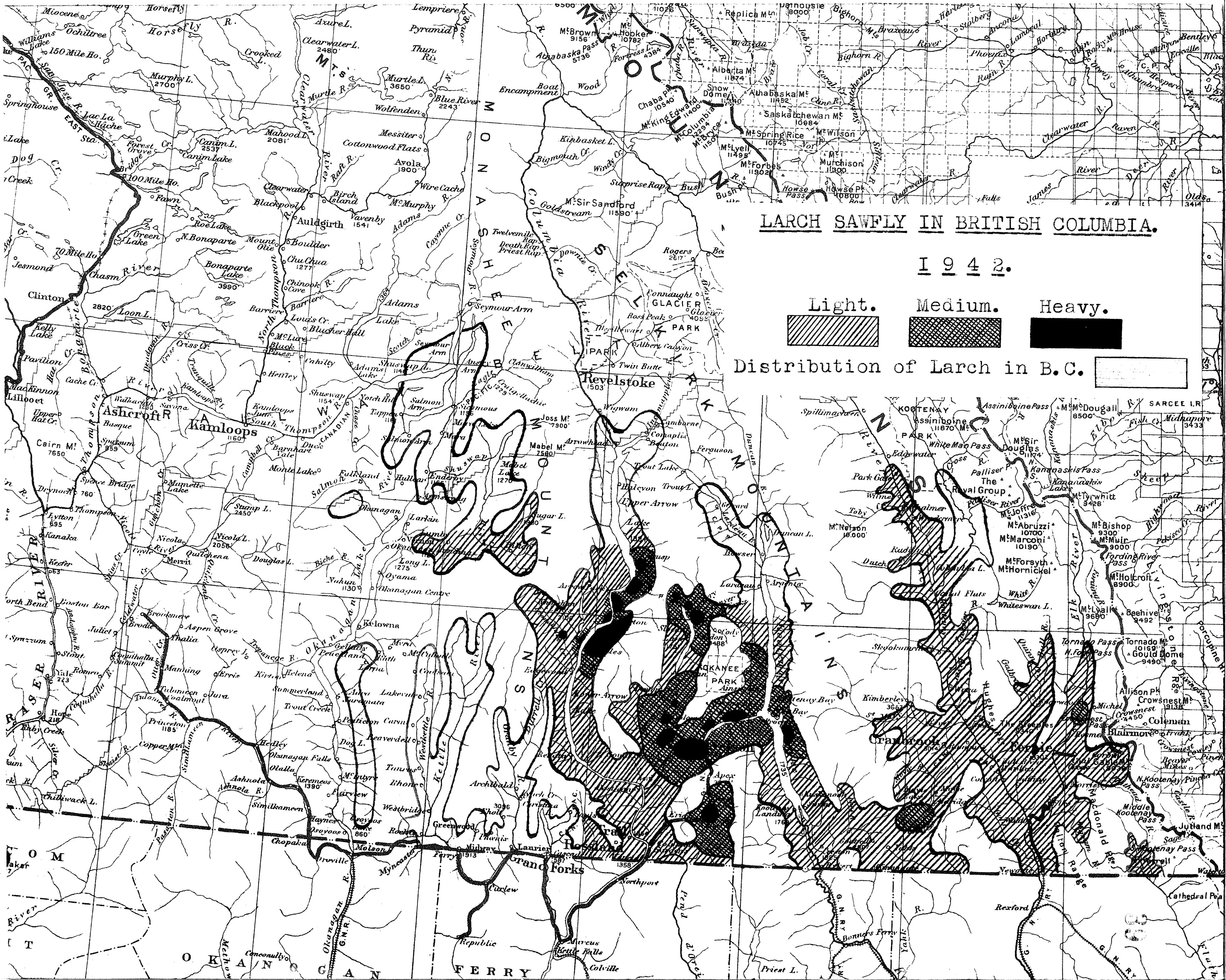
YEAR		1941			1942	
Generation		Overwintering Generation	1st Summer Generation Series I	2nd Summer Generation Series II	Over-wintering G.SeriesIII	Summer Generation Series IV
Period of Emergence		June 5-July 8	July 12-25	Aug.11-19	July 2-8	Aug.8-16
Length of Generation		Parasitized cocoons taken from field.	31-34 days	29-31 dys.	324-326 d. (Artific-ially over wintered.)	33 days
Ave. number of parasites per cocoon		35.0	65.9	49.0	55.5	38.0
% Males		13.88	14.7	15.7	17.68	12.11
% Females		86.12	85.3	84.3	82.32	87.89
Length of ♂ (mm.)	Ave.				1.833	2.07
	Range				1.43-2.14	1.605-2.34
Length of ♀ (mm.)	Ave.				2.02	2.303
	Range				1.69-2.34	1.62-2.66

The above tables show that only two generations of Tritneptis klugii were obtained during the year 1942 as compared to 3 generations in 1941. The reduction in the number of generations in 1942 is probably due to the fact that the overwintering generation of 1941-42 was kept at low temperature without much fluctuation until the first days of June when the first brood of adults would normally have occurred.

The data further show that the development of Tritneptis klugii is considerably dependent on environmental conditions during the season of activity. On the other hand, it begins to enter the dormant stage after the early part of August while there is still plenty of warm weather to produce another generation, thus indicating it is of the heterodgnamic type. Results, of other experiments now being conducted tend to support the latter view.

The emergence of the overwintering generation of 1941 continued for a period of 33 days, while the first summer generation of 1941 emerged during a period of 14 days. All other generations emerged during a period of 7 to 9 days. This difference in the length of emergence periods may be explained in part by the fact that parasites of the overwintering generation of 1941, emerged from cocoons collected in the field. The setting up at different times of each of the 5 lots in Series I explains the emergence period of 14 days in the first summer generation of 1941. These observations indicate that adult parasites are present in the field throughout the summer months of June, July, August, and part of September. The varying times spent by the adults in searching for larch sawfly cocoons would also be a factor responsible for nearly a continuous summer emergence of parasites. The time spent in finding cocoons could be two weeks or more, for it has been found that some females will live two weeks without food. The length of a summer generation, beginning when the parasites were placed with the sawfly cocoons, varies between 29 and 34 days. The parasites used were not more than 24 hours old. Under natural conditions, the first eggs probably would not be laid for several days after emergence, thus extending the time required to produce a generation.

The average number of adult parasites produced per cocoon ranged from 35 to 659. The percentage of males varied from 13.88 in the overwintering generation of 1941 to 17.68 in the overwintering generation of 1942.


LARCH SAWFLY IN BRITISH COLUMBIA.
1942.
Light.
Medium.
Heavy.
Distribution of Larch in B.C.

E. 30.19-3 Bark Beetle Control and Sample Plot Studies.

G.R. HOPPING, W.G. MATHERS, C.V.G. MORGAN.

The control work at Banff, which was originally started in the fall of 1941 was continued through the winter, the work being discontinued in April for the duration of the 1942 fire season. The work accomplished

~~accomplished~~ during this first period of the control work was as follows: The areas referred to are sufficiently indicated on the map accompanying the 1941 Annual report.

Area	Trees Treated		Acreage
	Green inf. trees	Red tops	
I Hillsdale	1984	1515	2558.9
II Castle Mt. (included in Hillsdale)			
III No infestation			
III A. Healy Creek	2030	881	1539.6
IV Sulphur Mt.	529	677	575.0
V Spray River	219	163	413.5
VI Tunnel Mt.	27	10	75.0
VII Stoney Squaw Mt.	93	107	38.0
VIII Race Track and Minnewonka Trail	201	256	174.2
TOTALS	5083	3609	5374.5

This makes a total of 8692 trees treated plus 500 from the Banff townsite or a grand total of 9192 trees cut and burned. As pointed out in the 1941 report quite a number of trees tallied as "red-tops" in reality were dead trees which had lost all needles. The actual number of bona-fide red-tops was near 2800 as determined by preliminary cruises. Considering the entire areas therefore, there was approximately one red-top for every two acreas and one green infested tree for every acre. The Healy Creek area proved to be the most heavily infested. Here there was one red-top for every two acres but three green infested trees per acre.

The results of the first season's control were most encouraging. Since all red-tops were removed and burned with the green infested trees, any trees colouring up during the summer of 1942 necessarily had to be green infested trees which had been missed by the control crews.

A survey made in July after infested trees had turned colour showed that there were only 100 red-tops on the total area worked. This meant that only 100 out of 5282 green infested trees had been overlooked, a control of slightly over 98%. 41

Recommendations for the control work of 1942-43 were as follows:

1) Completion of Area II (Castle Mt.)
2) Continuance of Area III A (Healy Creek) on up the creek as far as infestation extends.
3) Continuance of the Spray River area on up the river until the infestation ceases or as far as time will permit.
4) Working of Area III B. This is a new area which is practically contiguous to Area III A. It extends on the west side of Brewster Creek from its confluence with Healy Creek for 6400 feet up Brewster Creek with an average width of 2300 feet.
5) Recleaning Sulphur Mt. area and if possible the portion of the Spray area covered the previous season.

Control work was resumed in November 1942. Three camps of 40 men each were established, one at Castle Mt. just west of Hillsdale, one at the Youth Hostel Camp on Spray River, and one at Healy Creek. The crew at Castle commenced work on November 20, the Spray crew on November 23 and the Healy crew on November 27. These crews are working according to the recommendations already set forth. The work which was accomplished up to and including December 31, 1942 was as follows:

	Acreage Cruised	Red-tops tallied	Green Infested trees fallied
Camp No. 1 Brewster Creek Healy Creek	321.8 6.4	848 18	1089 55
Camp No. 2 Castle Mt.	697.8	863 *	516
Camp No. 3 Spray River	991.5	350	726
TOTALS	2017.5	2079	2386

* Through a misunderstanding the Castle crew tallied dead trees which had completely lost their needles as bona-fide red-tops. Consequently no per acre basis for red-tops can be given for this area as yet. From January 1, 1943 on, only bona-fide red-tops will be tallied.

Treating of the entire Brewster Creek area has been completed. The number of red-tops per acre averaged 2.6 with 3.4 green trees per acre. Castle Mountain area has averaged .7 green infested trees per acre while Spray River averaged .3 red-tops and .7 green infested trees per acre as far as the work has gone.

BARK BEETLE BROOD DEVELOPMENT IN KOOTENAY PARK -- 1942.

In the vicinity of Nixon Creek, Kootenay National Park most larvae were full grown by June 5 but pupae could be found in only one tree. At this time the ground was still frozen to a depth of 5 inches beneath the duff. By July 4, 10 to 20% of the brood was in the teneral adult stage with some commencing to turn dark brown. By July 15 practically all pupae had transformed to adults. Many had turned completely black. About half of the brood had fully coloured up by July 20 and some had started to bore out through the bark. Up to this time the rains had been so heavy that brood development obviously was retarded. Evidence of this was the long period over which pupation and colouring up of adults occurred.

First emergence did not occur until after July 20. A few warm sunny days occurred about the, but before many could emerge the rains and lower temperatures set in again and continued to August 1. The small percentage of the brood emerging just after July 20 (about 17%) attacked fresh trees but the bulk of fresh attack on new trees occurred during the first part of August. During rainy, cold weather the beetles, which were fully coloured up, excavated curious, irregular feeding galleries working out from the pupal cells. In some cases the pupal cell was merely enlarged, in others, several arms were projected.

The following table shows progress of brood emergence from 5 caged samples.

Table 1. Brood Emergence

Sample No.	Length ft.	Diam. inches.	Distance from ground ft. lower end	First Emergence	No. emerged to Aug.3	%	No. emerging after Aug.3	%
1	4	$30\frac{3}{4}$	4' 7"	July 23	34	17.9	156	82.1
2	4	24[illegible]	29' 1"	" 28	2	2.2	91	97.8
3	4	$32\frac{1}{2}$	8' 2"	" 23	35	34.6	66	65.4
4	4	$24\frac{1}{4}$	38' 3"	Aug. 2	2	20.0	8	80.0
5	4	33	5' 0"	July 31	8	14.0	49	76.0

It is evident from this and from interval examination of trees both standing and felled that the bulk of the brood did not emerge until after August 3.

First fresh attacks were noted on trees near Nixon Creek on July 26. These attacks were caused by the small percentage of the brood emerging just after July 20. By July 31 pitch tubes were thick on some attacked trees and it was noted that many of these were exceptionally large and of the white creamy variety which generally denotes drowning out.

The following data for four trees was taken on July 31.

Table 2. Initial Attacks of Brood--Examination July 31-'42.

Tree No. 1 - D.B.H. - 14". Crown - short, bushy, vigorous-
Attack - E. and N. side.

Gallery No.	Length inches	Attack successful	Attack unsuccessful	No. of eggs	No. parent beetles	Beetles drowned	Beetles gone	Character of pitch tube.
1	2.00		X	0	2	2	0	large cream
2	.625		X	0	0	0	2	" "
3	.75	X		0	2	0	0	small "
4	----	X		0	1	0	1	" reddish
5	2.75	X		6	2	0	0	large yellow-ish
6	1.25	X		2	1	0	1	" cream and red
7	.75		X	0	1	1	1	" " "
8	.75		X	0	2	2	0	" " "
9	1.00	X		1	2	0	0	small " "
10	0.00		X	0	0	0	2	large " "
11	.50		X	0	2	2	0	small yellow-ish
12	----		X	0	0	0	2	large cream and red
13	.875	X		0	2	0	0	small cream
14	0.00		X	0	1	1	1	" " and red
15	3.00	X		12	1	0	1	small cream
16	2.00	X		6	1	0	1	" "
17	.50		X	0	1	1	1	large cream and red
18	.25		X	0	2	2	0	" " "
19	0.00		X	0	0	0	2	large cream
20	1.50	X		0	1	0	1	small C
TOTALS		9	11	27	24	11	16	

Tree No. 2 - D.B.H. - 10". Crown, medium bushy, vigorous Only 3 Attacks on this tree.

Gallery No.	Length inches	Attack successful	Attack unsuccessful	No. of eggs	No. parent beetles	Beetles drowned	Beetles gone	Character of pitch tube
1	0		X	0	0	0	2	very large cream
2	0		X	0	0	0	2	" " "
3	0		X	0	0	0	2	small cream
TOTALS		0	3	0	0	0	6	

Tree No. 3.- D.B.H. - 12" Crown - short, bushy, vigorous. Attack all sides

Gallery No.	Length inches	Attack successful	Attack unsuccessful	No. of eggs	No. parent beetles	Beetles drowned	Beetles gone	Character of pitch tube
1	.25		X	0	1	1	1	very large cream
2	3.00	X		22	1	0	1	small cream & yellow
3	.75		X	0	0 0	0	2	large cream
4	1.25	X		5	1	0	1	small reddish
5	1.00		X	0	1	0	1	small cream and red
6	0.00		X	0	1	1	?	large cream
7	-----		X	0	1	1	?	" "
8	1.75	X		10	2	0	0	small reddish
9	.50		X	0	2 *	0	0	watery
10	1.00	X		5	1	0	1	small reddish
11	1.00	X		1	1	0	1	large cream
12	1.25	X		5	1	0	1	small reddish.
13	2.125	X		2	2	0	0	large "
14	.25		X	0	1 *	0	1	watery cream
15	.25		X	0	1	1	1	-------
16	.125		X	0	0	0	2	large cream
17	1.00		X	0	2 *	0	0	" " and red
18	1.50		X	0	0	0	2	large reddish
19	1.125	X		0	1	0	1	small "
20	1.75	X		4	2	0	0	------
TOTALS		9	11	54	22	4	16	

* Beetles covered with pitch, feeble

Tree No. 4 - D.B.H. - 9" Crown - medium, sparse with occasional dead branches - Appears unhealthy.
Attack all sides for 20 or 30 ft. up. Heavy boring dust at base

Gallery No.	Length inches	Attack successful	Attack unsuccessful	No. of eggs	No. parent beetles	Beetles drowned	Beetles gone	Character of pitch tube
1	3.00	X		9	2	0	0	small reddish
2	2.75	X		3	2	0	0	" "
3	1.50	X		6	1	0	1	" "
4	2.375	X		11	3 *	0	0	no tube
5	2.25	X		8	2	0	0	" "
6	1.875	X		3	2	0	0	" "
7	2.00	X		3	2	0	0	" "
8	1.50	X		0	1	0	1	small reddish
9	1.375	X		7	1	0	1	" "
10	.25		X	0	0	0	?	large cream
TOTALS				50	16	0	3	

* A second male immediately behind the first male in gallery entrance

In the above tables where only one beetle is recorded as present and one gone it is possible that there never was more than one, the female. Perhaps enough males had not emerged to enter all galleries started by the females. On the other hand, it is probable that some of these missing ones had been drowned out since beetles absolutely covered with pitch were found dead in bark crevices away from any tube. The ones marked "drowned" were those actually found dead in the pitch of the tube.

Note that the trees with vigorous crowns had thrown out a preponderance of large pitch tubes while the sickly tree had few large tubes and in some cases none at all. In the trees with vigorous crowns and large tubes, at least half of the earlier attacks were unsuccessful and many of the beetles were drowned, while in the sickly tree 90 per cent. were successful and not beetles were found drowned. However, even on the most vigorous trees there were often enough successful attacks to kill the trees, providing the eggs and larvae developed normally. In other words, while the vigorous crowned trees displayed greater resistance to attack, their susceptibility to attack did not appear to be less than trees with non-vigorous crowns.

On October 5 examination of trees sustaining these earliest attacks showed that larvae in some trees were nearly full grown while in others they were only half grown. The trees of later attack in August, however, showed brood development as exemplified by five trees near Nixon Creek marked with metal tags. These also were examined on October 5.

<u>Tree No. 1887</u> -- D.B.H. - 10"; all sides attacked.
Gallery No. 1 - S.E. side, unhatched eggs and 2 parent beetles (dead)
" No. 2 - N. side, all very young larvae
" No. 2 - S.E. side, many eggs and very young larvae

<u>Tree No. 1888</u> -- D.B.H. - 9"; all sides attacked.
Gallery No. 1 - S. side, very young larvae at beginning of gallery, eggs in top portion.

<u>Tree No. 1889</u> -- D.B.H. - 10"; all sides attacked.
Gallery No. 1 - E. side, only 1 egg, no larvae.
" No. 2 - E. side, no eggs or larvae, parent beetles still present(alive) Gallery only 2" long.

<u>Tree No. 1890</u> -- D.B.H. - 10"; N. side only attacked.
Gallery No. 1 - N. side, very young larvae only.
" No. 2 - N. side, " " " "
" No. 3 - S. side, a few larvae ¼ grown.
" No. 4 - W. side, no eggs laid.

Examination of trees in the Banff area in late November showed that brood development there coincided with conditions found in Kootenay Park. A considerable number of galleries were found where no eggs had been laid but the parent beetles were still alive in the galleries. In other galleries, there were eggs or very young larvae. A few galleries were found with larvae about a fourth grown. No full grown larvae were noted.

<u>Analysis of Samples.</u>

Sample analyses were made from trees near Nixon Creek (130-140 yr. class), near Dollyvarden Creek (110-120 yr. class) and near Plot IX (60-70 yr. class). Each sample was 1 foot long. The bark was carefully stripped from each one and practically all material found was recorded. The following tables give the results of these examinations.

<u>Table 3</u> -- <u>Tree Sample Analyses.</u>

<u>Tree No. 1</u> - D.B.H.- 10", total ht. 79', age 135 yrs. <u>Locality</u>- Nixon Creek, Kootenay National Park.

	Sample 1 3'7" from ground Circum. I.B. 2'7½". Examined June 5	Sample 2 29' from ground Circum. I.B.2'0" Examined June 7	Sample 3 13' from ground Circum. I.B.2'3½" Examined July 4
Dendroctonus larvae alive (full grown or nearly)	239	145	24

(Table 3 cont'd)

	Sample 1.	Sample 2.	Sample 3.
Dendroctonus larvae alive (partially grown)	73	42	0
Dendroctonus larvae dead	8	5	33
Dendroctonus pupae alive	0	2	81
Dendroctonus pupae dead	0	0	49
Dendroctonus adults alive (new brood)	0	0	55
Dendroctonus adults dead (old parent adults)	51	3	8
Dendroctonus adults dead (new brood)	0	0	9
Other bark beetle adults Ips latidens and interpunctus	7,1- 8	1	1
Coeloides larvae alive	0	0	13
Medetera larvae alive	3	0	0
Medetera pupae alive	0	0	2
Cerambycid larvae	1	0	1
Clerid larvae	1	0	0
Staphylinidae adults	32	15	1
Other Coleoptera adults	5	15	0

<u>Tree No. 2</u> - D.B.H. 8", total ht. 80', age 135 yrs. <u>Locality</u> - Nixon Creek, Kootenay National Park.

	Sample 1 - 6' 10" from ground, Circum. I.B. 2'1/8" Examined June 7	Sample 2 - 33'1" from ground, Circum. I.B. 1'9 3/8" Examined June 5.
Dendroctonus larvae alive (small to medium)	28	5 (full gr.)
Dendroctonus adults alive	0	0
Dendroctonus adults dead (parents)	23	4
Ips latidens adults alive	8	
Ips interpunctus adults alive		12

Table 3 - Tree No. 2 - cont'd)

	Sample 1	Sample 2
Pityogenes knechteli adults alive	11	251
Hypophloeus adults alive	1	0
Staphylinid adults alive	1	2
Lasconotus adults alive		1

Tree No. 3. - D.B.H. - 11", total ht. 72', age 117 yrs.
Locality - near Dollyvarden Creek, Kootenay National Park.

	Sample 1 - 7' 3" from ground Circum. I.B. 2' 8½" Examined June 7.	Sample 2 - 37' 3" from ground Circum. I.B. 2' ¼" Examined June 7.
Dendroctonus larvae alive (full grown)	114	10
Dendroctonus larvae alive (partially grown)	18	0
Dendroctonus larvae dead	9	29
Dendroctonus pupae alive	54	2
Dendroctonus adults alive	1	0
Dendroctonus adults dead (parents)	20	13
Ips interpunctus adults alive	3	0
Ips latidens adults alive	2	0
Ips adults dead	5	0
Pityogenes adults alive	2	0
Pityogenes adults dead	1	87
Clerid larvae alive	4	1
Coeloides larvae alive	3	0
Cerambycid larvae alive	3	0
Staphylinidae adults	7	1
Other Coleoptera adults	2	0

Table 3)

Tree No. 4 - D.B.H. - 10", total ht. 70', age 78 yrs.
Locality - 2.7 mi. S. of Vermilion Crossing, Kootenay Park.

	Sample 1 - 4' from ground Circum. I.B. 2' 9" Examined June 12.	Sample 2 - 34' from ground Circum I.B. 11½" Examined June 12
Dendroctonus larvae alive (fully grown)	113	5
Dendroctonus larvae alive (partially grown)	55	0
Dendroctonus larvae dead	77	0
Dendroctonus pupae alive	0	0
Dendroctonus adults dead (parents)	16	0
Pityogenes knechteli adults alive	1	160
Ips interpunctus adults alive		14
Staphylinidae adults alive	3	9
Other Coleoptera adults	5	0

Tree No. 5 D.I.B. (ground level) 10¼", total ht. 60' Age class 60-70 yrs. Locality - just off Plot 9 north of Dollyvarden Creek. Samples 1' long were taken consecutively from ground level to 6' (No's 1 to 6 inc) and then one at 10' (No. 7) and one at 14' (No.8).

	Sample No. and Date Examined.							
	July 14 1	July 14 2	July 15 3	July 15 4	July 15 5	July 16 6	July 26 7	July 26 8
Circumference inside bark	2' 5¼"	2' 2⅜"	2' ¼"	2' 0"	1' 10¾"	1' 10½"	1' 10"	1' 8¾"
Dendroctonus larvae alive	5	0	4	1	0	1	0	0
Dend. larvae dead	158	40	131	115	150	56	129	87

Table 3 - Tree No. 5 - cont'd)

	No. of Sample and Date Examined.							
	July14 1	July 14 2	July 15 3	July 15 4	July 15 5	July 16 6	July 20 7	July 20 8
Dend. pupae alive	5	2	0	0	0	1	1	0
Dend. pupae dead	3	18	12	6	9	5	5	0
Dend. adults alive (new brood)	53	60	39	40	44	33	9	7
Dend. adults dead (new brood)	12	11	2	4	2	3	2	2
Dend. adults dead (parents)	35	24	35	32	23	19	11	12
Ips larvae alive	8	14	42	0	37	15	0	0
Ips larvae dead	0	0	2	6	0	2	0	0
Ips pupae alive	2	6	3	1	0	0	0	0
Ips pupae dead	0	0	0	3	0	0	0	0
Ips adults alive	5	18	19	18	12	6	0	0
Ips adults dead	0	2	2	2	0	2	0	0
Pityogenes larvae alive	0	0	3	0	0	1	Great many (not counted)	Many (not counted)
Pityogenes adults alive	0	1	3	4	1	2	"	"
Pityogenes adults dead	0	0	0	0	0	0	?	0
Clerid larvae alive	1	2	0	0	1	0	0	0

Table 3 - Tree No. 5 - cont'd)

	Sample No. and Date Examined							
	July 14 1	July 14 2	July 15 3	July 15 4	July 15 5	July 16 6	July 20 7	July 20 8
Coeloides larvae alive	0	0	1	0	0	0	1	0
Coeloides pupae alive	1	0	0	2	2	0	2	0
Medetera pupae alive	0	1	0	0	0	0	0	0
Hypophloeus adults alive	1	0	0	0	0	0	0	0
Hymenopterous parasite larvae (not Coel.) alive	0	0	1	3	5	1	0	0
Hymen. parasite pupae (not Coel.) alive	0	0	4	0	0	0	0	0
Cerambycid larvae alive	0	0	0	1	0	0	0	0

From Table 3 is calculated the average number per square foot of bark beetle stages, and parasites and predators, as shown in Table 4.

Table 4. -- Population per sq. ft. (Dendroctonus, parasites, & predators)

Tree No.	Sample No.	Date Examined	Living b.b. stages	Dead b.b. stages (parent)	Dead b.b. stages (new brood)	Medetera	Coeloides	Cleridae
	1	June 5	120	19.6	3.0	1.1	0.0	0.4
1	2	June 7	94.5	1.5	2.5	0.0	0.0	0.0
	3	July 4	67.8	3.4	38.5	0.8	5.5	0.0
	1	June 7	14.0	11.5	0.0	0.0	0.0	0.0
2	2	June 5	2.7	2.2	0.0	0.0	0.0	0.0

Table 4 cont'd)

Tree No.	Sample No.	Date Examined	Living b.b. stages	Dead b.b. stages (parent)	Dead b.b. stages (new brood)	Medetera	Coeloides	Cleridae
3	1	June 7	69.3	7.4	3.3	0.0	1.1	1.5
	2	June 7	6.0	6.5	14.5	0.0	0.0	0.5
4	1	June 12	62.2	6.0	28.5	0.0	0.0	0.0
	2	June 12	5.5	0.0	0.0	0.0	0.0	0.0
5	1	July 14	26.2	14.6	72.0	0.0	0.4	0.4
	2	" 14	28.2	10.9	31.3	0.4	0.0	0.9
	3	" 15	21.5	17.5	72.5	0.0	0.5	0.0
	4	" 15	20.0	16.0	62.5	0.0	1.0	0.0
	5	" 15	23.1	12.1	84.7	0.0	1.0	0.5
	6	" 16	18.4	10.0	33.7	0.0	0.0	0.0
	7	" 20	5.5	6.1	75.5	0.0	1.6	0.0
	8	" 20	4.1	6.5	52.3	0.0	0.0	0.0

Compare Tree No.5 with the other four. The basal sections of the former have produced less than half the living bark beetles which the latter produced. Furthermore, the mortality per square foot in Tree No. 5 was over twice that in any of the other trees. Examination of other trees in these three age classes indicated that these conditions prevailed in the majority of trees in each class. That is, trees in the 60 to70 year class suffered far greater mortality of bark beetles broods. The fact that this mortality was just as high below snow level as above suggests that it was not winter killing. Overcrowding may have been the cause, but the fact remains that the 60 to 70 year old trees have not caused much increase in the bark beetle population since only a few more bark beetles than the original attacking parents resulted

Results of these analyses also show that parasites and predators are very scarce, compared to the bark beetle population.

Conclusions.

1) Emergence of the bulk of bark beetle adults in 1942 was several weeks later than normal, due to extremely wet weather during June and July.

2) About 50% of the early attacks were unsuccessful and many of the beetles were drowned in pitch.

3) The majority of trees are apparently showing a response to increased precipitation of the past two years as indicated by increased resin flow producing very large pitch tubes. This apparent increase in vigour may be substantiated later by a study of increment.

4) A greater percentage of attacks are successful on trees unable to put forth large pitch tubes and these trees are correspondingly less vigorous. They do not appear to be more susceptible to attack than vigorous trees however.

5) The new brood went into the winter as eggs or very young larvae in about 80% of the trees. In the few early attacks, some of the larvae were three fourths to full grown.

WEATHER RECORDS

KOOTENAY PARK -- 1 9 4 2

Temperatures and humidity taken at Nixon Cr. Wardens' Cabin. Rainfall taken at Sinclair Wardens' Station -- 16 mi. west of Nixon Cr.

Date		Temperature Max.	Temperature Min.	Humidity Max.	Humidity Min.	Rainfall inches
June	3	60.5	34.0	95.0	46.0	.07
	4	60.0	40.0	97.0	64.0	.03
	5	66.5	44.0	97.0	36.0	---
	6	72.0	37.0	98.0	37.0	---
	7	74.0	48.0	89.0	39.0	---
	8	66.0	40.0	99.0	40.0	.01
	9	50.0	45.0	98.0	50.0	.25
	10	58.0	38.0	98.0	45.0	.33
	11	58.0	36.0	96.0	57.0	.65
	12	64.0	38.0	96.0	47.0	---
	13	72.0	43.0	96.0	34.0	---
	14	----	46.0	92.0	50.0	.12
	15	62.0	50.0	99.0	58.0	.45
	16	58.0	42.0	99.0	38.0	.03
	17	64.0	38.0	93.0	30.0	---
	18	59.0	39.0	96.0	53.0	.08
	19	53.0	40.0	97.0	59.0	.66
	20	52.0	36.0	99.0	58.0	.55
	21	----	39.5	99.0	----	.17
	22					---
	23					.13
	24					.06
	25		ABSENT			.35
	27					.16
	28	RECORDS	NOT	TAKEN		.19
	29					---
	30					---
July	1					---
	2					---
	3					---
	4	----	50.0			---
	5	87.5	50.5	----	----	---
	6	84.8	48.5	----	32.0	---
	7	85.5	47.5	99.0	28.0	---
	8	83.0	43.0	96.0	28.0	---

Date		Temperature		Humidity		Rainfall	
		Max.	Min.	Max.	Min.		
July	9	69.5	44.5	90.0	47.0	---	
	10	73.0	44.0	99.0	40.5	.18	
	11	79.0	46.0	99.0	78.0	.83	
	12	61.5	43.0	96.0	56.0	.08	
	13	57.0	37.0	95.0	38.0	.03	
	14	71.0	43.5	97.0	46.0	.20	
	15	74.0	52.0	99.0	58.0	.22	
	16	63.0	48.0	98.0	74.0	.28	
	17	60.5	41.0	98.0	68.0	.37	
	18	59.5	45.5	99.0	47.0	.02	
	19	69.0	40.0	99.0	35.0	---	
	20	71.5	42.0	97.0	28.0	---	Emergence
	21	83.0	42.5	96.0	28.0	---	20% of
	22	83.5	44.0	97.0	40.0	---	bark beetle
	23	82.0	43.0	99.0	29.0	---	brood
	24	85.0	46.0	96.0	37.0	---	
	25	81.5	54.0	99.5	54.0	.02	
	26	69.0	45.0	99.0	----	.01	
	27	71.5	39.0	----	45.0	.03	
	28	71.5	40.0	97.0	44.0	---	
	29	75.0	40.0	99.5	35.0	.78	
	30	73.0	51.0	98.0	64.0	.14	
	31	63.0	49.5	98.0	40.0	.17	
Aug.	1	73.0	49.5	97.0	51.0	.04	
	2	69.0	39.5	98.0	34.0	---	
	3	76.0	51.5	97.0	----	---	
	4	Warm weather from August 4 to August 24					

BARK BEETLE PROBLEMS IN

BANFF AND KOOTENAY NATIONAL PARKS.

Kootenay Park.

In order to evaluate various factors in the trend of a bark beetle outbreak, it is necessary to know as much as possible about the development of the affected stand of timber. The area under study is in the Kootenay National Park in British Columbia along the Kootenay Valley from Cross River on the South to Vermilion Pass on the North. The more intensive study was made on the area between Nixon Creek and Kootenay Crossing.

Starting a few miles south of Nixon Creek, there is a scar caused by a fire in the summer of 1917. This extends southward beyond the park boundary. It has been naturally reforested by lodgepole pine with a small percentage of spruce. From the edge of this fire scar northward to Dollyvarden Creek there is a mature stand (now mostly dead) of lodgepole pine with two distinct age classes. These were undoubtedly caused by successive fires. The first one occurred about 1800 and gave rise to an even-aged stand now 130 to 140 years old. This extends from south of Nixon Creek to a point two miles north of McLeod Meadow.

Another fire which occurred about 1820 burned from this point northward causing an even-aged stand 110 to 120 years old extending to Dollyvarden Creek. A third fire burned from Dollyvarden Creek northward about 1870 giving rise to another even-aged stand 60 to70 years old extending to Kootenay Crossing. Finally a fire occurred in 1926 which burned from Kootenay Crossing northward to Wardel Creek up Vermilion River and northwestward up the Kootenay Valley beyond the park boundary.

From Wardle Creek to Vermilion Summit a large percentage of spruce is mixed with the lodgepole pine and losses from bark beetle attack will not be serious. Thus from Nixon Ceek to Kootenay Crossing there are three zones of even-aged, progressively younger lodgepole pine stands caused by a succession of fires.

The present outbreak started about 1929 at the extreme southern end of the area near Pitts Creek. This is in the oldest stand of pine. By 1937 over 80% of the timber had been killed in this stand south of McLeod Meadow and between 40 and 50% north of this point. Up to 1938 the 110 to 120 year old stand had suffered less than 10% mortality. In 1939 and 1940 however, a sharp increase occurred in this zone and by 1941 three plots located here had a mortality of 46, 68, and 79% respectively, increasing from south to north. Thus the active center of infestation has followed the same progression as the fires which gave rise to the different age classes. At the present time, the center of infestation is in the northern end of the 110 to 120 age class and is passing into the zone with the 60 to 70 year old trees.

Unlike the Banff stands where the killing of trees was due almost entirely to Dendroctonus attack alone, the Kootenay stands now have four species of bark beetles with abnormal populations. These are Dendroctonus monticolae Hopk., Ips interpunctus Eich., Ips latidens Lec., and Pityogenes knechteli Sw. Nearly all trees attacked in 1941 by Dendroctonus have parts attacked by these other three species. The sequence of attack is as follows: Dendroctonus attacks trees one summer and the other three species attack parts of the same trees the following spring. In 1942 the attack by the two Ips species and Pityogenes occurred during the last part of May and early June. Dendroctonus and Ips interpunctus attack mainly on the lower third of the tree, Ips latidens on the upper part but also on all parts of small trees. Pityogenes is confined mainly to the upper third of the tree. Occasional mature trees have been found killed by Ips interpunctus alone and a few small trees have been killed by Pityogenes alone.

Judging from past experience, however, it is extremely doubtful if the epidemic would continue without the primary attack by Dendroctonus. None of the other three species have caused widespread epidemics by themselves. Outbreaks of Ips have occurred in young stands but these have been localized and of short duration.

One of the main objects of the Kootenay studies was to determine if the beetles exercised any selectivity in attacking the trees. Factors studied in this connection were:

1) Character and thickness of bark.
2) Character of crown.
3) Rate of growth of the various age classes.
4) Rate of growth of trees killed, of those escaping attack, and of those attacked but able to recover.
5) Diameter of trees and density of stands.

1) Character and Thickness of Bark.

The character and thickness of lodgepole pine bark varies considerably even between trees separated by only a few feet. There are three general types of bark:

a) Finely flaked usually only a few millimeters thick.
b) Coarsely flaked usually somewhat thicker.
c) Deeply fissured, quite thick. Some trees have the bark finely flaked throughout even basally; some are coarsely flaked throughout, but no trees are deeply fissured throughout and when present this is a basal condition. Trees deeply fissured basally may be either coarsely or finely flaked above. There are six combinations of these characters which can be fairly easily recognized viz:

Type (1) Coarsely flaked at base, coarsely flaked above.
" (2) " " " " , finely " " .
" (3) Deeply fissured " " , coarsely " " .
" (4) " " " " , finely " " .
" (5) Finely flaked " " , " " " .
" (6) " " " " , coarsely " " .

Type (1) is most common in mature stands with type (5) the next in point of numbers. Trees falling in type (6) were rare.

In order to evaluate the effect of these characteristics on bark beetle attack 79 trees were examined as follows:

20 trees killed by beetles in 1941 attack near Nixon Creek in the oldest age class.
20 trees escaping attack in the same locality.
20 trees killed by 1941 attack in the active part of infestation near Dollyvarden Creek--age class 110-20 years.
10 trees in 1941 attack near Plot IX--60-70 years.
9 trees escaping " " " " " " "

Results appear in Tables A. to E.:

TABLE A Trees Killed by 1941 Attack ------- Nixon Creek.

Tree No.	Bark Thickness. mm.		D.B.H. in.	Deeply fissured at base	Deeply fissured above	Coarsely flaked at base	Coarse flaked above	Finely flaked at base	Finely flaked above	Size of Crown
	At 6"	At DBH								
1	7	3	10			X	X			L
2	4	3	9			X	X			L
3	3	2	10			X	X			M
4	10	3	12	X					X	L
5	14	8	8	X			X			S
6	20	7	8	X			X			S
7	16	2	6	X					X	S
8	4	2	9			X	X			S
9	3	2	8			X	X			S
10	15	5	10	X			X			S
11	20	4	10	X					X	L
12	13	3	12	X					X	M
13	10	5	14			X	X			S
14	4	3	12			X			X	M

TABLE A)

15	10	4	10			X			X	S
16	5	3	6					X	X	L
17	14	3	10			X	X			M
18	10	2	10			X	X			L
19	15	3	14			X	X			L
20	5	4	12					X	X	M
TOTALS or Ave.	10.1	3.6	10	7		11	12	2	8	

TABLE B.

The Trees Entirely Escaping Attack Nixon Creek										
Tree No.	Bark Thickness in mm. At 6"	AtDBH	D.B.H. inches	Deeply fissured base	Deeply fissured above	Coarse flaked base	Coarse flaked above	Finely flaked base	Finely flaked above	Size of Crown
1	3	2	8					X	X	M
2	7	3	10			X	X			S
3	6	3	12			X			X	S
4	4	3	12					X	X	M
5	17	7	9	X					X	S
6	7	3	9			X	X			L
7	18	5	10	X			X			S
8	5	2	8			X	X			M
9	5	3	10					X	X	M
10	18	7	12	X			X			M
11	7	3	10					X	X	L
12	5	3	10			X	X			L
13	9	3	10			X	X			M
14	5	4	9			X	X			M
15	18	5	10	X					X	S
16	7	5	12					X	X	S
17	14	5	9			X			X	M
18	6	4	10			X			X	M
19	4	2	8					X	X	L
20	16	4	10	X					X	L
TOTAL or Ave.	9.1	3.8	9.9	5		9	8	6	12	

TABLE C.

The Trees Killed by 1941 Attack -- near Dollyvarden Cr.										
Tree No.	Bark Thickness in mm.		DBH in	Deeply fissured base	Deeply fissured above	Coarse flaked at base	Coarse flaked above	Finely flaked base	Finely flaked above	Size of Crown
	At 6"	At DBH								
1	9	4	12			X	X			M
2	20	6	11	X			X			L
3	10	5	8			X	X			L
4	6	4	10					X	X	L
5	10	3	12			X			X	L
6	5	2	8					X	X	L
7	6	3	10					X	X	L
8	15	4	14	X			X			L
9	8	4	12			X	X			L
10	13	5	15	X			X			L
11	8	4	12			X	X			M
12	5	3	10					X	X	L
13	7	4	12			X	X			[illegible]
14	6	3	8					X	X	M
15	7	5	8			X	X			M
16	15	3	6	X					X	L
17	6	4	10			X	X			M
18	5	4	10			X	X			L
19	8	3	9					X	X	L
20	16	10	10	X			X			L
TOTALS or Ave.	9.3	4.1	11.9	5		9	12	6	8	

TABLE D

Trees Killed by 1941 Attack --- Near Plot IX.

Tree No.			D.B.H. inches.	Deeply fissured at base	Deeply fissured above	Coarse flaked at base	Coarse flaked above	Finely flaked at base	Finely flaked above	Size of Crown
1			8	X			X			L
2			8			X	X			L
3			8			X	X			L
4			18			X	X	X		L
5			10				X	X		L
6			8			X	X			L
7			10	X				X	X	L
8			10					X	X	L
9			10					X	X	L
10			8	X					X	L
TOTALS or Ave			8.8	3		4	6	3	4	

NOTE. Bark Thickness Not Taken in the Above Group.

TABLE E

Trees Escaping Attack -- Near Plot IX.

Tree No.			D.B.H. inches	Deeply fissured at base	Deeply fissured above	Coarse flaked base	Coarse flaked above	Finely flaked base	Finely flaked above	Size of Crown
1			8				X	X		L
2			8					X	X	S
3			6					X	X	M
4			8	X			X			M
5			8	X			X			M
6			8			X	X			S
7			6			X	X			L
8			8					X	X	M
9			8	X					X	M
TOTAL or Ave.			7.6	3		2	5	4	4	

NOTE. Bark Thickness Not Taken in the Above Group.

Table F shows the number and percentage of trees falling in each of the types (1) and (6) for the entire group of trees, for attacked and for unattacked trees.

TABLE F

Percentage of Trees in the Various Bark Categories.

TYPE	1		2		3		4		5		6	
	No. Tr.	%	No.Tr.	%	No.Tr.	%	No.Tr.	%	No.Tr.	%	No. Tr.	%
Entire Group 79 Trees.	29	37	6	8	12	15	11	14	19	24	2	3
Attacked Trees 50	21	42	3	6	8	16	7	14	10	20	1	2
Trees Escaping Attack 29	8	28	3	10	4	14	4	14	9	31	1	3

The percentages of attacked and unattacked trees of the three age groups falling in these various types agree closely enough to indicate definitely that bark sculpture cannot be used for the detection of susceptible trees, at least under the epidemic conditions such as obtained in the Kootenay district. In other words there is little if any selectivity on the part of the bark beetle because of differences in bark sculpture.

Bark Thickness: In tables A to E thickness of bark is recorded for 60 trees. Two measurements were taken for each tree, at 6 inches above ground level and at breast height. Forty of these trees were killed by the 1941 attack and 20 escaped attack. The results are contained in **Table G.**

Thickness of Bark 6" Above Ground Level.

		10 mm. or over					Less than 10 mm.				
	No.Tr.	No.Tr.	%	Max.	Min.	Ave.	No.Tr.	%	Max.	Min.	Ave.
Entire Group	60	25	42.	20	10	14.6	35	58.	9	3	5.7
Attacked Trees	40	19	47.5	20	10	14.0	21	52.5	9	3	5.8
Unattacked Trees	20	6	30.	18	10	16.8	14	70	9	3	5.7

TABLE G (part 2)

Thickness of Bark at Breast Height.

		5 mm. or over					Less than 5 mm.				
	No.Tr.	No.Tr.	%	Max.	Min.	Ave.	No.Tr,	%	Max.	Min.	Ave.
Entire Group	60	15	25	10	5		45	75	4	2	3.1
Attack ed Trees	40	9	22.5	10	5		31	77.5	4	2	3.2
Unattack ed Trees	20	6	30	7	5		14	70	4	2	3.0

This data indicates that the only difference which might prove significant under mathematical analysis is the bark thickness at the base of the trees. Thus it appears that 17% more attacked trees had basal bark over 10 mm. thick than unattacked trees. Likewise 17% more unattacked trees had basal bark less than 10 mm. thick than attacked trees. This might prove a rough basis for selecting less susceptible trees but much more data is needed before it could be recommended for this purpose. It should be noted that these measurements were made on the bark plates and not in the crevices.

2) Character of Crown:

The length and breadth of the crown in proportion to the size of the entire tree varies with the age and density of the stand, and in the case of lodgepole pine this alone cannot be used as an index to the vigour of the tree. In dense stands, lower branches have been shaded out and trees have short crowns and relatively narrow while open grown trees have crowns reaching near to the ground and of a broader type. In Tables A to E, the crown classes have been indicated by the three letters L--long, when the crown occupies half or over half of the total height; M--medium, when the crown occupies between one third and one half total height; S--short, when the crown is less than one third total height.

Table H. shows the number of trees falling in each of these categories.

TABLE H

The Crown Classes of Attacked & Unattacked Trees						
Entire Group						
Locality	No.of Trees	Ave.Tr.per acre	Crown Cl.	No. of Tr.	%	Age.Cl.
Nixon Cr. Dolly-varden Cr. & Plot IX	79	297	L	39	50	130-140
			M	24	30	
			S	16	20	
Trees Killed by 1942 Attack						
Locality	No.of Trees	Ave.Tr,per acre	Crown Cl.	No.of Tr.	%	Age Cl.
Nixon Creek	20	264	L	7	35	130-140
			M	5	25	
			S	8	40	
Dolly-varden Creek.	20	229	L	15	75	110-120
			M	5	25	
			S	0	0	
Plot IX	10	400	L	10	100	60-70
			M	0	0	
			S	0	0	
Unattacked Trees.						
Locality	No.of Trees	Ave.Tr.per acre	Crown Cl.	No.of Tr.	%	Age Cl.
Nixon Creek	20	264	L.	5	25	130-140
			M	9	45	
			S	6	30	
Plot IX.	9	400	L.	2	22	60-70
			M	5	56	
			S	2	22	

From the percentages no correlation is apparent between size of crown and susceptibility to attack.

There are two characteristics of crown which are more important than size in determining tree vigour; These are density and colour. Density is fairly constant for each tree over a considerable number of years, whereas colour varies somewhat with the variation in available soil moisture.

It has been noted that trees with thin crown due to dying out of branches here and there, have scant resin flow and hence less resistance to bark beetle attack.

However, scant resin flow may also be brought about in many trees with dense crowns by subnormal moisture conditions over a prolonged period. The colour of foliage of vigorous trees is a rich dark green while the foliage of trees receiving insufficient moisture is more of a yellow-green.

3) Rate of Diameter Growth of Different Age Classes:

As already noted there are three distinct, even-aged stands on the area, one 130 to 140 years old; one 110 to 120 years old; and one 60 to 70 years old. In the Tables J to M, the average decade growth in diameter for each of these stands is correlated with average diameter and density of the stand for the five decades 1891 to 1940 inclusive. Growth measurements were taken on an average radius and figures should be doubled for full diameter increase. Individual rings were measured from 1935 on, with a binocular microscope and micrometer disc in the eye piece. Decade measurements were made direct with a millimeter rule.

TABLE J.

Average Decade Growth in mm. -- Entire Group.									
Age Class yrs.	Trees per acre	No. in Class	Ave. diam. inches.	1891-1900	1901-1910	1911 1920	1921-1930	1931-1940.	
60-70	400	129	6.	18.5	14.2	9.3	6.3	6.2	
110-120	229	77	8.	5.6	6.6	5.0	4.3	5.4	(49)
130-140	220	106	11.	7.5	9.0	7.0	4.7	5.1	(82)

TABLE K

Average Decade Growth in mm. -- Bark Beetle Killed									
Age Class yrs.	Trees per acre	No. in Class	Ave. diam. inches	1891-1900	1901-1910	1911-1920	1921-1930	1931-1940	
60-70	400	42	8	21.5	16.8	11.2	7.2	6.8	
110-120	229	46	9	5.4	5.9	5.4	3.8	3.7	(14)

TABLE K) 66

130-140	220	74	12	8.4.	9.7	7.4	4.9	5.1

Growth Charts A, B, and C are based on data contained in Tables J to M.

Chart A.

In this chart it will be noted that the growth rate of the 60 to 70 year class is a smooth descending curve levelling off in the last two decades.

The curves for the two older age classes are S curves, the increase in growth between 1900 and 1920 apparently due to increased precipitation as indicated by the plus departures from normal shown at the bottom of the chart. These departures are based on Banff records since no early records are available for Kootenay Park. It will also be noted that there is a growth increase for both the older age classes for the last decade, when a decrease should be expected in view of the -17 departure from normal precipitation. Apparently, this increase is due to the killing of a certain percentage of trees by bark beetles during this decade, which acted as a release to the remaining trees and resulted in the slight growth rate.increase.

Chart B.

This chart compares the growth of trees killed, trees escaping attack, and trees attacked but still green because of resistance by drowning the beetles out. All of these trees are in the 60 to 70 year class.

Chart B. indicates that the bark beetles attack the fastest growing trees in the 60 to 70 year age class. It is in this age class where trees of marginal susceptibility to attack are found. Thus the average diameter of killed trees was 8 inches while those escaping attack averaged 5 inches in diameter. The question arises as to whether the attacked trees were selected because they were faster growing or simply because they were larger in size. The fact that the growth of all trees in the three age classes had become nearly equal in the last decade indicated that the selection is on the basis of size rather than rate of growth at the time of attack.

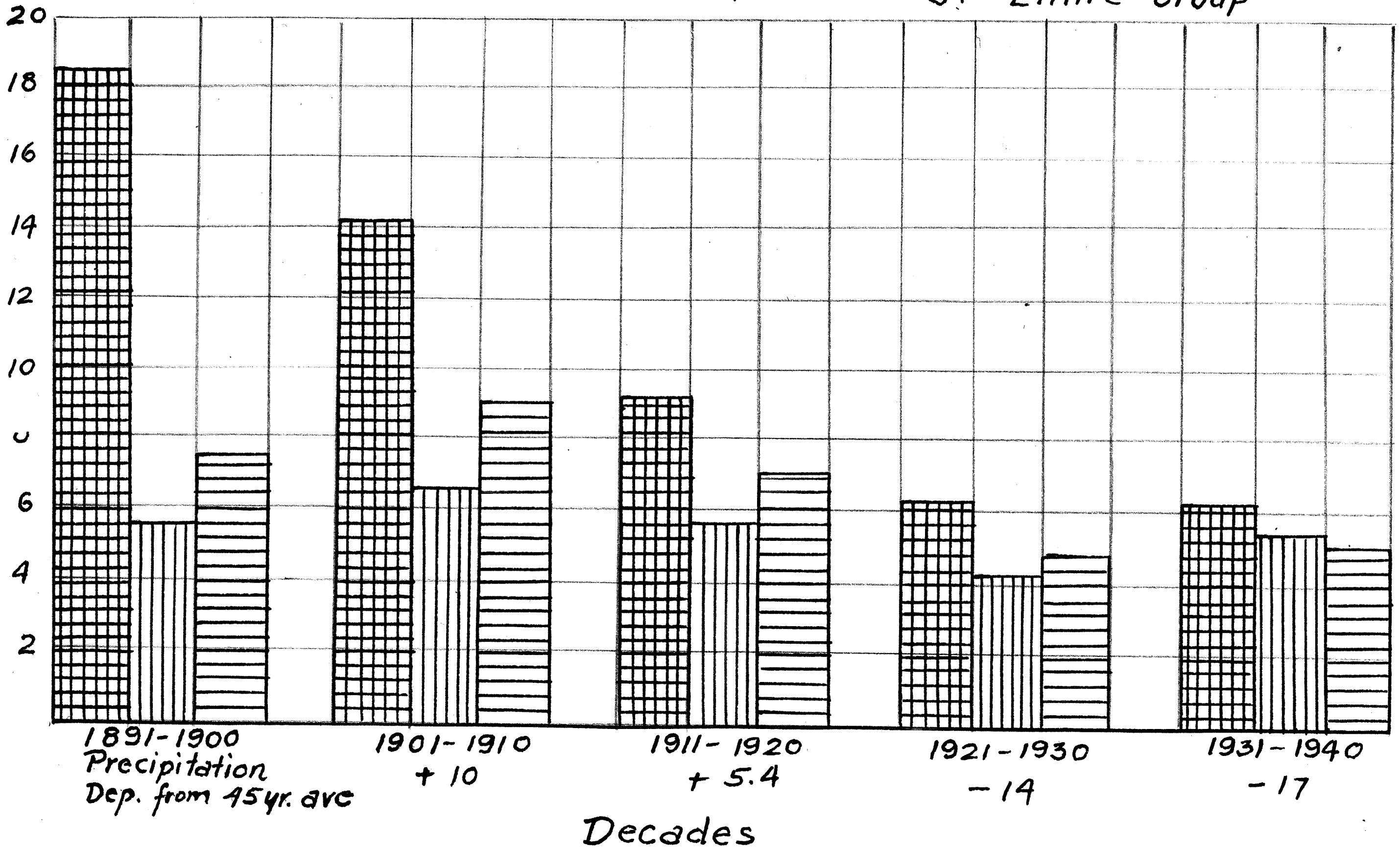
Chart C.

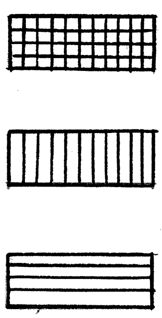
This chart shows no appreciable difference in growth between trees attacked and those escaping, except in the last decade. In this period, release of unattacked trees through killing of surrounding trees is probably responsible for the increase of growth of the former. Although no radical increase of growth rate is apparent, the average diameter of attacked trees is appreciably greater than unattacked trees.

Chart D.

This chart again bears out the general evidence that the

CHART A - From Growth Data in Table J. - Entire Group





60-70 yr. age class

110-120 yr. age class

130-140 yr. age class

CHART B - From Growth Data in Tables K to M - 60-70 yr. class

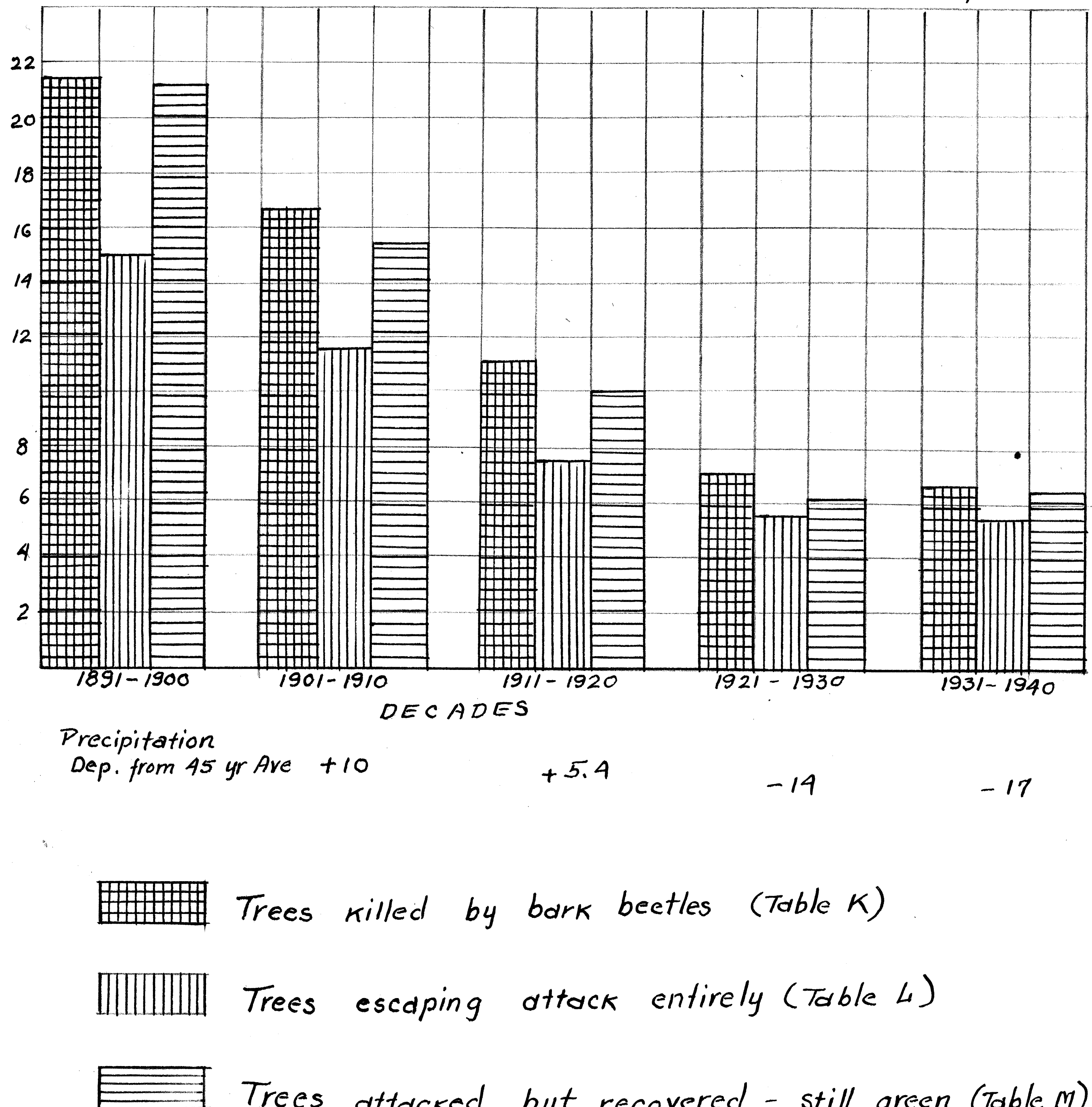
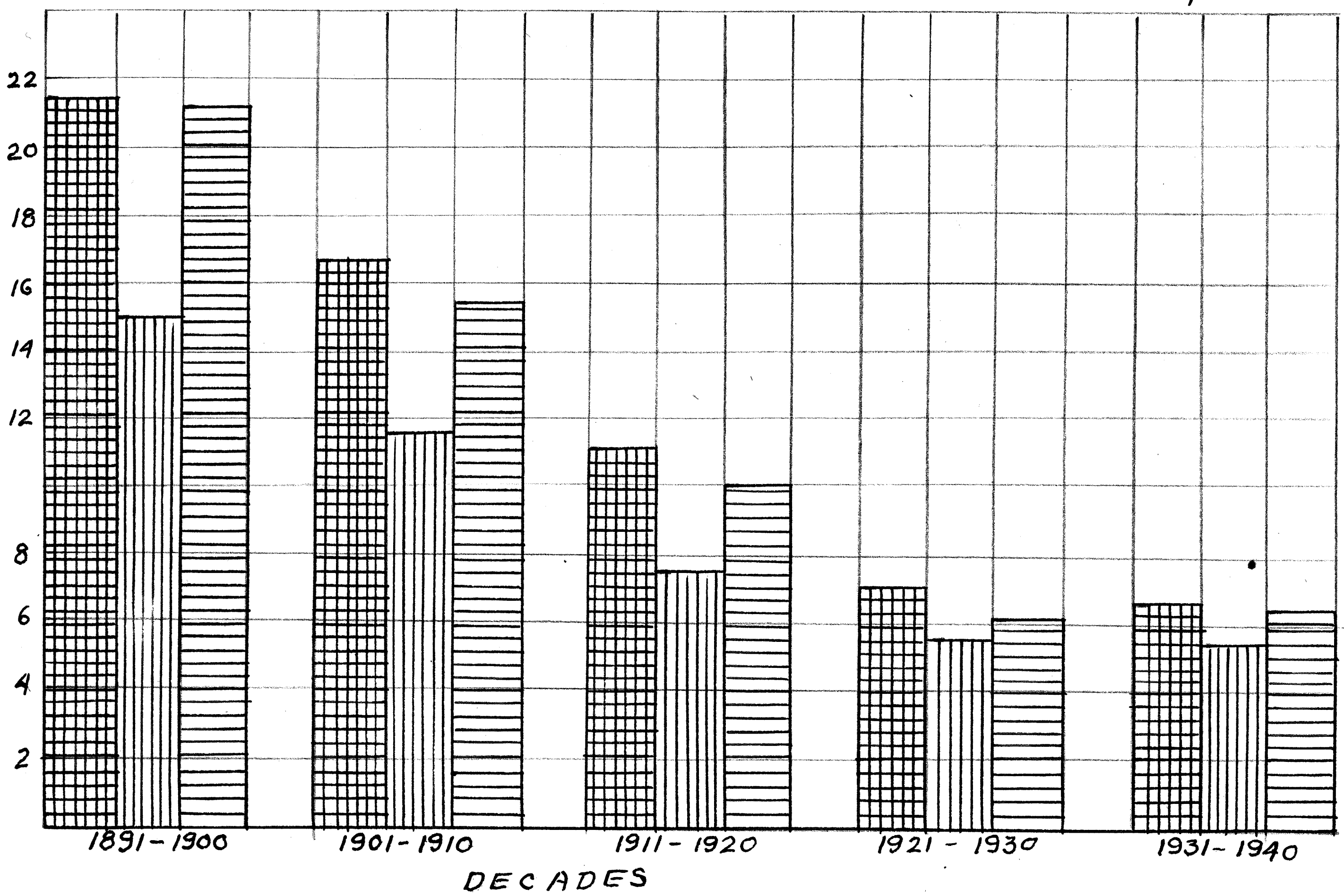


CHART B - From Growth Data in Tables K to M - 60-70 yr. class



Precipitation
Dep. from 45 yr Ave +10 +5.4 -14 -17

Trees killed by bark beetles (Table K)

Trees escaping attack entirely (Table L)

Trees attacked but recovered - still green (Table M)

CHART C - From Growth Data in Tables K and L - 110-120 yrs.

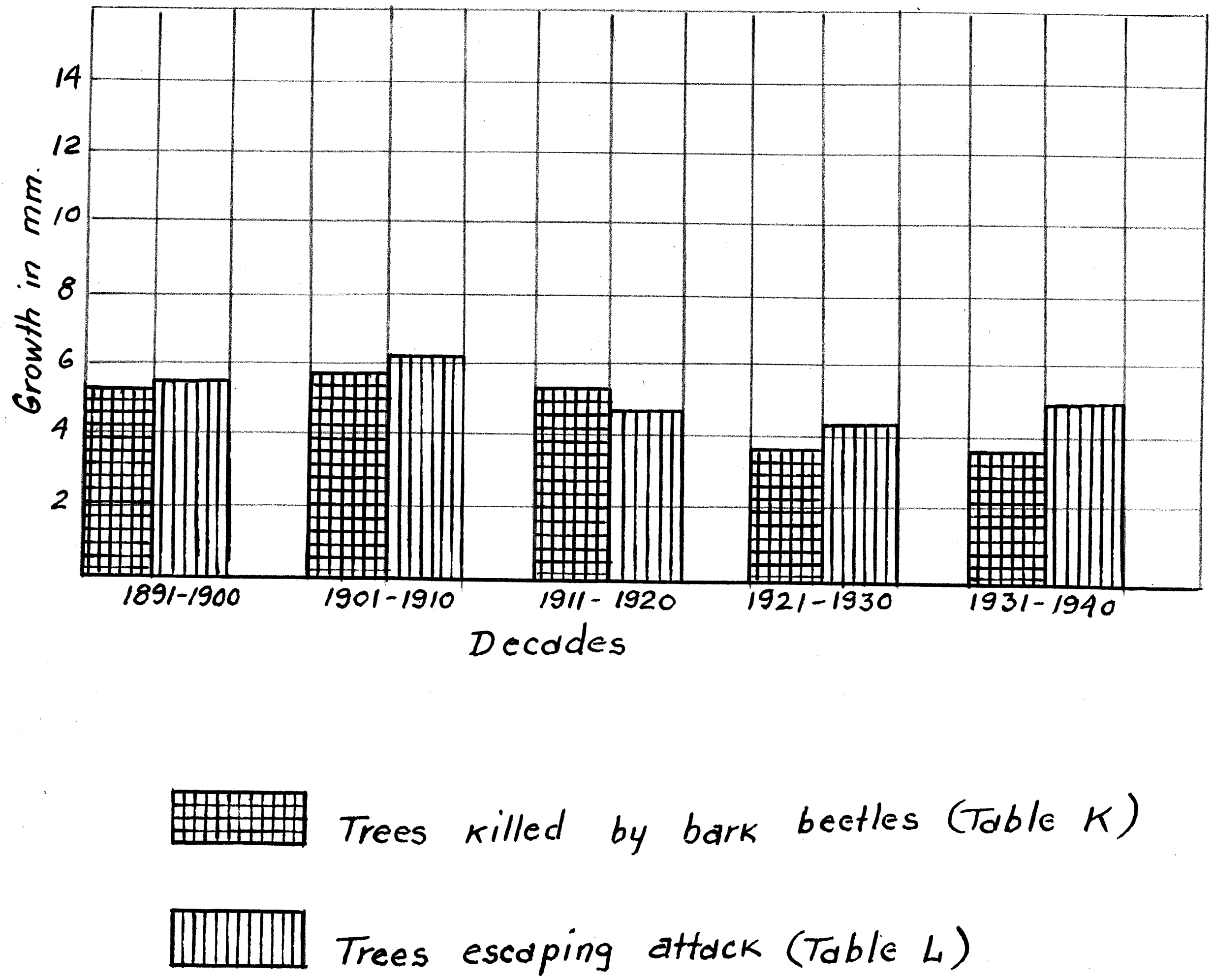


CHART D - From Growth Data in Tables K to L - 130-140 yr. Class.

trees which have had the faster growth are chosen for attack.

TABLE L.

Average Decade Growth - in mm. - Trees Escaping								
Age Class in years.	Trees per acre.	No. in Class	Ave. diam. inches.	1891-1900	1901-1910	1911-1920	1921-1930	1931-1940
60-70	400	59	5	15.0	11.6	7.7	5.7	5.6
110-120	229	31	7	5.5	6.1	4.9	4.3	4.9
130-140	220	32	10	5.4	7.1	5.6	4.1	5.0

TABLE M.

Average Decade Growth in mm.--Attacked trees resisting by drowning out beetles								
Age Class in yrs.	Trees per acre.	No. in Class	Ave. diam. inches.	1891-1900	1901-1910	1911-1920	1921-1930	1931-1940.
60-70	400	28	8	21.3	15.5	10.0	6.2	6.5

The selection of the larger trees becomes significant only when considered in relation to the distribution for the stands in the three age classes and the percentage attacked in each diameter class. Table N gives this distribution for the stands in the three age classes and the percentage attacked in each diameter class.

TABLE N.

No. of Trees in Various Diameter Classes in Stands Belonging to Three Age Groups. Data on 60 to 70 yr. Plot includes through 1942. Data on the remainder through 1942.

D.B.H. inches.	Stand 60 to70 yrs. One Plot ½ acre.			Stand 110-120 yrs. 3 Plots-1 acre ea.			Stand 130-140 yrs. Four Plots --1 acre ea.		
	Total Trees.	Att. Trees.	% Att.	Total Trees	Att. Trees	% Att.	Total Trees	Att. Trees.	% Att.
2									
3	6	1	16.6						
4	14	5	35.6				17	13	76.5
5	20	6	30.0	45	9	20.0			
6	26	12	46.1	167	50	30.0	63	49	77.7
7	14	10	71.4						
8	16	13	81.2	269	200	74.3	159	103	64.8
9	4	4	100.0						
10	3	3	100.0	137	127	92.7	244	165	67.6
12				42	41	97.6	222	179	80.6
14				21	21	100.0	102	88	86.3
16				5	5	100.0	38	33	86.8
18				1	1	100.0	17	17	100.0
20							11	11	100.0
22							4	4	100.0
24							2	2	100.0
26									
TOTALS	103	54	52.4	687	454	66.1	879	664	75.5

From an inspection of Table N, the indication that the bark beetles select the larger diameter trees may not be as apparent as when considered on an average diameter basis. Thus in the first age class (60-70 yrs.), the average diameter is 6 inches. In the stand, about 51% are 6 inches D.B.H. or below and 49%, 6 inches or above. Under random selection this same rationshould appear in the attacked trees. But the ratio here is 33 1/3% of the attacked trees 6 inches D.B.H. or below and 66 2/3% 6 inches or above indicating a marked preference for the larger diameters.

In the next even-aged stand (110-20 yrs.), the average diameter is approximately 8 inches. In this stand there are 346 trees 8 inches or below and 340, 8 inches or above in diameter and it would be expected that, under random selection, the same 50-50 ratio would apply. Actually there were 295 attacked trees 8 inches or above and only 159 trees 8 inches or below, a ratio of nearly 2 to 1. This again indicates a selectivity for the trees of larger diameters.

In the 130 to 140 yr. age group the average diameter is about 11 inches. The diameters of 483 trees fall below this and 396 fall above, a ratio of about 1,2 to 1. In attacked trees 330 fall below the average diameter and 334 fall above it, a ratio of about 1 to 1. Selectivity is not apparent here possibly because this stand is in the oldest part of the infestation where the bark beetles may have been forced to attack more trees in the smaller dimensions, when thos of larger diameters were no longer available. This leads to the speculation that sequence os attack in any stand may also be an index of the selection of certain diameter classes.

TABLE P

Sequence of Attack on Various Diameter Classes in Each Plot.

Plot	Diameter class	Total Trees in Class.	Year of Attack and No. of Trees. 1934 & prior to	1935	1936	1937	1938	1939	1940	1941	1942
Plot IX-60-70 Yrs.	2										
	3	6									1
	4	14						3			2
	5	20						3			3
	6	26						3	1		7
	7	14						1		2	7
	8	16						1	2	5	5
	9	4							1	2	1
	10	3							2		1
Plot IV-110-120 Yrs.	5	8						1		1	
	6	33						7	6	6	0
	8	67						48	10	6	0
	10	48	1					46	0	0	0
	12	12	1					11	0	0	0
	14	9	1					7	1	0	0
	16	2						2	0	0	0
	18	0									
Plot V-110-120 Yrs.	5	22							3	3	0
	6	89							18	33	0
	8	101							56	31	0
	10	35							27	5	0
	12	11	3						7	1	0
	14	6	1						5	0	0
	16	1	1						0	0	0
	18										
Plot [illegible]-110-120yrs	5	15						4	1	1	0
	6	45		1	1		1	9	7	5	4
	8	101				1	5	71	8	6	3
	10	54	1			2	9	40	1	0	0
	12	19	2	2	1	2	4	8	0	0	0
	14	6				3	1	2	0	0	0
	16	2					2	0	0	0	0
	18	1					1				

Table P gives the sequence in which trees of the various diameter classes were attacked, in each of the age classes.

In the connection it was impossible to use Plots I, II, and III, and VII, which are located in the older part of the infestation, because here a peak of attack was reached prior to 1934 and data is not available as to the year of attack of each tree.

From Table P it is evident that on Plots V and Iv, the attack occurred as the result of a sudden invasion of bark beetles from contiguous areas, whereas on Plots VI and IX, it was more of an infiltration over several years prior to the peak attack. On all of the Plots, with the possible exception of IX, where there are no trees over 10 inches, D.B.H., there is definite evidence that trees of the larger diameters are selected first. Further attack often occurs on the smaller diameters after the larger diameter trees have become exhausted. On Plot IV practically no trees were attacked until the peak year 1939. Then all but two of the trees above 8 inches D.B.H. were attacked, while only 56 of the 108 trees 8 inches .DB.H. and under were attacked. In 1940 and 1941 all but 3 of the remaining 8 inch trees suffered attack when larger diameter trees were no longer available. Attack on Plot V followed a similar procedure. Plot VI provides further evidence. Trees above 8 inches diameter were selected first (in 1937 nd 1938) before the peak year 1939. During the period 1934 to 1938 inclusive, 30 trees were attacked above 8 inches in diameter, while only 9 were attacked 8 inches or below, in spite of the fact that the trees in the latter group outnumbered the larger diameter trees 2 to 1.

Another indication of greater susceptibility of the larger trees is furnished by the numbers of trees in the various diameter classes which have survived one or more attacks and have remained green up to the time of the last examination in October 1942. (See Table Q for this data).

TABLE Q.

Recovery of Attacked Trees in Various Diameter Classes.

D.B.H. INCHES	Stand 110-120 years old. Three Plots--1 acre ea.				Stand 130-140 years old. Four Plots--1 acre each.			
	Total Trees	Attacked Trees.	Trees Rec'd	% Rec.	Total Trees	Attacked Trees.	Trees Rec'd	% Recovery.
4					17	13	0	0
6 *	212	59	48	81.3	63	49	1	2.0
8	269	200	43	21.5	159	103	8	7.8
10	137	127	9	7.0	244	165	20	12.1
12	42	41	1	2.4	222	179	10	5.6
14	21	21	0	0.0	102	88	7	8.0
16	5	5	0	0.0	38	33	1	3.0
18	1	1	0	0.0	17	17	0	0.0
20					11	11	0	0.0
22					4	4	0	0.0
24					2	2	0	0.0

* In 110-120 year Class the 5 inch Trees have been included in the 6 inch Diameter Class, since there were only 9 Attacked.

Table Q. gives this data for each age class. Attack on Plot IX was too recent to obtain survival figures.

This table indicates that a greater percentage of the attacked trees of smaller diameter recovered than those of larger diameter. Notable exceptions are the 4 and 6 inch trees in the older stand. Evidence shows that these trees were decidedly suppressed and probably would not have survived many years even without any attack. The recovery of these smaller trees does not indicate resistance to attack but rather less susceptibility. It was noted that most of these trees had only partial attacks which killed a strip up the trunk but still allowed the tree to remain green and continue growth.

From the foregoing study the following conclusions appear to be justified:-

1) The infestation started in the oldest stand and progressively attacked younger stands in sequence.

2) Thickness or character of bark cannot be used to determine the degree of susceptibility to attack under epidemic conditions.

3) Size and condition of crown cannot be used to determine the degree of susceptibility to attack under epidemic conditions.

4) In an even-aged stand in an active infestation, larger trees which have grown faster are more susceptible to attack than smaller trees which have had slower growth.

5) Of the attacked trees a greater percentage of the smaller diameter trees recover than the larger diameter trees except small trees which have been more drastically suppressed.

6) The only practical criterion for recognizeing the degree of susceptibility of trees to attack is on the basis of diameter growth.

7) The probability is that in lodgepole pine stands approaching maturity or overmature, the removal and utilization of all trees above ten inches in diameter would reduce the bark beetle hazard materially. An even greater reduction in the hazard could probably be attained by utilization of all trees above eight inches in diameter. This would accomplish two desirable things. It would remove high hazard trees and at the same time create ideal conditions for spruce reproduction, producing a much more desirable stand for park purposes and one much less susceptible to bark beetle attack than a pure stand of lodgepole pine.

Plot I

0.2 mi. S. Meadow Cr. Bridge

Year	Dead	Fresh Attack	Total	Not att. or recovered	Total	Trees down	Trees removed
1934	83	79	162	29	191	0	
1935	147	10	157	34	191	0	
1936	153	10	163	28	191	0	
1937	156	3	159	32	191	4	
1938	159	0	159	32	191	10	
1939	159	0	159	32	191	10	94 *
1940	159	0	159	32	191	10	
1941	159	0	159	32	191	11	
1942	160	3	163	28	191	12	1 ?

* These trees were removed in clearing operations around the McLeod Meadow camp ground. It includes 3 down trees.

Plot II

0.4 mi. N. Meadow Cr. Bridge.

Year	Dead	Fresh Attack	Total	Not att. or recovered	Total	Trees down	Trees removed
1934	80	11	91	139	230	0	
1935	85	8	93	137	230	0	
1936	91	12	103	127	230	0	
1937	101	2	103	127	230	19	
1938	103	2	105	125	230	25	
1939	105	2	107	123	230	35	
1940	107	72	179	51	230	36	
1941	177	4	181	49	230	52	
1942	184	8	192	38	230	52	58

Plot III

0.9 mi. N. of Meadow Cr. Bridge.

Year	Dead	Fresh Attack	Total	Not Att. or recovered	Total	Trees down	Trees removed
1934	80	7	87	250	337		
1935	85	5	90	247	337		
1936	89	9	98	239	337		
1937	97	9	106	231	337	4	
1938	100	19	119	218	337	8	
1939	113	41	154	183	337	14	
1940	147	116	263	74	337	18	
1941	263	28	291	46	337	24	
1942	279	2	281	56	337	25	87

Plot IV

4.0 mi. N. Meadow Cr. Bridge.

Year	Dead	Fresh Attack	Total	Not att. or recovered	Total	Trees down	Trees removed
1934	--	3	3	176	179	0	
1935	2	1	3	176	179	0	
1936	3	0	3	176	179	0	
1937	3	0	3	176	179	0	
1938	3	0	3	176	179	0	
1939	3	123	126	53	179	0	
1940	114	26	140	39	179	0	
1941	140	16	156	23	179	0	
1942	139 *	0	139	40	179	0	0

* Error in tallying 1 green tree as dead in 1941.

Plot V

5.1 mi. N. Meadow Cr. Bridge.

Year	Dead	Fresh Attack	Total	Not Att. or recovered	Total	Trees down	Trees removed
1934	--	5	5	260	265	0	0
1935	3	2	5	260	265	0	0
1936	5	0	5	260	265	0	0
1937	5	0	5	260	265	0	0
1938	5	0	5	260	265	0	0
1939	5	0	5	260	265	0	0
1940	5	117	122	143	265	0	0
1941	122	73	195	70	265	0	0
1942	131 *	6	137	128	265	0	0

* Error in tallying 3 green trees as dead in 1941.

Plot VI

3.6 mi. N. Meadow Cr. Bridge

Year	Dead	Fresh Attack	Total	Not att. or recovered	Total	Trees down	Trees removed
1934	--	3	3	240	243	0	0
1935	3	3	6	237	243	0	0
1936	6	2	8	235	243	0	0
1937	7	8	15	228	243	0	0
1938	15	24	39	204	243	0	0
1939	35	135	170	73	243	0	0
1940	144	21	165	78	243	0	0
1941	165	32	197	46	243	1	0
1942	190	13	203	40	243	4	47

Plot VII

1.5 mi. S. Meadow Cr. Bridge.

Year	Dead	Fresh Attack	Total	Not att. or recovered	Total	Trees down	Trees removed
1934	--	32	32	89	121	0	
1935	13	13	26	95	121	0	
1936	19	7	26	95	121	0	
1937	25	9	34	87	121	0	
1938	28	6	34	87	121	0	
1939	34	0	34	87	121	2	
1940	35	2	37	84	121	2	
1941	38	6	44	77	121	9	
1942	47	54	101	20	121	9	14

Plot VIII

Established 1942-June 8 -- .7mi. N. Vermilion Crossing (½ acre)

Year	Dead	Fresh Attack	Total	Not att. or recovered	Total	Trees down	Trees removed
1941	1 *	20	21	39	60	0	0
1942	11	5	16	44	60	0	0

* 1940 attack

Plot IX

Established 1942-July 6 -- 1.1 mi. N. of Dollyvarden Cr. (¼ acre)

Year	Dead	Fresh Attack	Total	Not att. or recovered	Total	Trees down	Trees removed
1940	11	6	17	86	103	0	0
1941	16	11	27	76	103	0	0
1942	18	31	49	54	103	0	8

Plot X

Established 1942-July 20 -- .6 mi. N. of Dollyvarden Cr. (1/16 acre)

Year	Dead	Fresh Attack	Total	Not att. or recovered	Total	Trees down	Trees removed
1941	0	0	~~56~~ 0	66	66	0	0
1942	1 *	17	18	48	66	0	0

* Porcupine killed

From the above figures for 1942 it will be seen that the most active parts of the infestation are near Nixon Creek (Plot VII) and north of Dollyvarden Creek (Plots IX and X).

SUPPLEMENTARY EVIDENCE OF INCREASED TREE VIGOUR (KOOTENAY PARK).

Further evidence of increased tree vigour apparently due to increased annual precipitation since the fall of 1941 was obtained by measuring the leaders of young trees on the fire scar north of Kootenay Crossing. This fire occurred in 1926. These measurements were taken on August 4, after terminal growth for the current season was completed.

Leader growth of 10 Douglas fir trees

4' to 10' high (ininches)

	1941	1942
1	8.5	13.0
2	10.0	13.5
3	14.0	14.5
4	11.0	14.75
5	7.5	10.0
6	8.25	9.0
7	12.0	14.5
8	7.5	10.5
9	6.5	11.0
10	9.5	14.5

Leader growth of 10 Lodgepole pine trees

4' to 8' high (in inches)

	1941	1942
1	12.5	16.5
2	8.0	14.0
3	12.5	18.0
4	13.5	23.5
5	18.0	34.0
6	23.5	29.0
7	7.5	9.0
8	10.5	17.5
9	9.25	13.0
10	17.25	28.25

Stand near Mixon Creek, Kootenay Park
after 10 yrs. of bark beetle activity.

Stand near Mixon Cr. showing type of spruce
reproduction which has come in on a large part of the
infested area.

Large pitch tubes formed on majority of trees in 1942 attack.

Large creamy white pitch tube which nearly always indicates drowning out of attacking beetles.

Illustrating deeply fissured type of bark at base of some lodge-pole pine trees.

Most active portion of infestation in 1941 and 1942 --North of Crook's tourist camp.

Illustrating finely flaked bark of some trees (referred to in report)

Illustrating coarsely flaked bark of some trees (referred to in report)

Plot VII -- Trees 805 and 806 have escaped attack entirely. 807 and 809 escaped until 1942 when they were attacked.

Plot I, Trees 77 and 78. These trees have entirely escaped attack through 10 yrs. of bark beetle activity. Note stumps from clearing dead trees from highway.

Tree No. 1 Plot I. This tree has not suffered a single attack during 10 yrs. of bark beetle activity.

Trees 88 and 89, Plot I. Tree 88 shows attack one side in 1941. Tree 89 has escaped attack entirely.

E. 30. 27 - 2 -- Forest Product Insects

G.R. HOPPING.

Lyctus damage:

In February an enquiry from Gordon and Belyea Ltd., of Vancouver was forwarded to the Vernon Laboratory through the Forest Products Laboratory at Vancouver. This firm deals in hardwood tool handles and damage by Lyctus developed in some of their stock handles. On investigation it was learned that all smaller handles such as pick, axe, hatchet, hammer, etc., are imported from the east and come in corrugated board cases containing 24 handles. Most of this stock would not run much over 1 inch thick in the smallest dimension and except for the tool end, has been given a coat of wax or some similar treatment. Ordinarily only one case is broken at a time, and on opening a case of second quality handles--which grade admits no heart--the Lyctus borer holes were found.

An examination of several lots of exposed handles of various kinds in three grades showed only an occasional exit hole in the two higher grades. The No. 3 grade admits heart and a coarse grain, and no holes were found in this stock. The manager stated that all handles are subject to careful inspection when packed and the specifications do not permit any borer holes. He said it would be impossible for the handles to be shipped in the condition found. Therefore, while the stock may have been infested between the time of manufacture and packing, it may conceivably have been infested during storage either at the manufacturer's plant or at the warehouse of Gordon and Belyea. Undoubtedly the beetles had made exit since packing.

The fact that one large peavy handle which had been in storage at Gordon and Belyea's for about two years was simply riddled with Lyctus holes suggested that infestation of the other handles had probably occurred in the warehouse of Gordon and Belyea.

It was recommended that this concern follow control measures set forth in Farmers' Bulletin No. 1477, U.S. Dept. of Agriculture or leaflets Nos. 3 and 13 of the Forest Products Research Laboratory, Princes Risborough, England.

Criocephalus productus:

One inquiry was received concerning this wood borer from the Forest Products Laboratory, Vancouver. Some damage was done by the emerging adults to the roof and structural timber of a house in Vancouver. Last summer an adult of this species emerged from the base board of one of the rooms in a house in Vernon. This house was built at least 30 years ago. It seem probable that the adults lay eggs in wood after it is in place in a structure.

C.V.G. MORGAN

Observations on the seasonal history and development of wilt disease of the Douglas fir tussock moth, Notolophus pseudotsugata Mc D. were continued in 1942.

One egg mass was obtained in the fall of 1941 from the rearing of 87 larvae. This egg mass containing 237 eggs, was laid August 18-19, 1941. On November 7, 1941 it was placed in an overwintering chamber until May 18, 1942, when it was removed to the insectary.

Eggs bagan to hatch on June 14, 1942 and continued through June 17 until 226 larvae had emerged. Eleven eggs failed to develop.

The color of the thorax and abdomen of a newly hatched larva is a light greyish-yellow. After an elapse of about 2½ hours, however, it turns a much darker grey. Measurements taken of 2 hour-old larvae showed that the width of the head capsule is fairly constant, approximating .520 mm. The total length of the body varies between 2.750 mm. and 2.800 mm. Both the thorax and abdomen of these larvae are covered on the pleura and abdomen by hairs of two sizes: (1) those about as long as the body, and (2) those not half as long as the body. The newly born larvae are also characterized by two very prominent protuberances, one on each side of the prothorax, from which extend a number of long hairs. Other features are the slightly tapering body and the presence of one small prominent brown spot on the venter of each of several abdominal segments.

Further observations were made on the feeding habits in addition to those recorded in 1941. Twenty-four hours after hatching most of the larvae were congregated along the stem of the new growth. Some of these fed on the soft succulent stem, indicating that this is where the first feeding probably occurs. A few feeding scars were also evident on the new needles, but up to this time, the areas fed upon, which were not more than ⅛" long, did not extend more than ¼" toward the tip of the needle. These feeding scars were all on the under side of the needle and confined to the stomatal areas. Two days after hatching, feeding was still limited to the stomatal surfaces, and the feeding scars were not extended more than 1/2 the way along the needle. The upper epidermis, above the feeding scars, is later thrown into convolutions due to wilting, and the edges of the needle in the same area shrink. This area of the upper epidermis soon turns brown, while the rest of the needle remains green for a short time thereafter. Eventually, however, the whole needle wilts and browns, and takes on the appearance of having been frost-bitten.

Cocooning commenced on August 5, 1942 and continued until August 24, 1942.

Date	Number of Cocoons Formed
August 5, 1942	3
" 6, "	0
" 7, "	13

August 10, 1942	27
" 13, "	24
" 15, "	15
" 17, "	0
" 19, "	2
" 24, "	2
TOTAL	86

Adults began to emerge on August 26, 1942 and continued until September 10, 1942 as shown below.

Date	Sex	
	Male	Female.
August 26	1	-
" 27	1	1
" 28	-	-
" 29	3	3
" 30	-	-
" 31	2	1
Sept. 1	-	1
" 2	10	-
" 3	6	-
" 4	2	2
" 5	1	-
" 6	-	-
" 7	-	-
" 8	4	2
" 9	1	-
" 10	1	-
TOTAL	32	10
%	76.19	23.81

Moths were obtained from 48.83% of the cocoons; of the others 2 pupae molded, 5 prepupae failed to pupate, 3 males emerged from the pupae but died in the cocoons, and the rest of the pupae died of wilt disease.

Observations throughout the period of emergence showed definitely that at least 75% of the adults emerged between noon and 6:00 P.M. of each day. Although the adults were not provided with food, the first males did not die until September 8, 1942, and the first females not until September 11, 1942.

Six egg masses were obtained from the rearings of 1942. The first eggs were laid on August 29; the last egg mass was completed on September 9. Some females began to lay eggs 3 hours after emerging from the cocoon, others rested on the cocoons for 2 days before any eggs were deposited.

Most egg masses were completed within one day from the time the first eggs were laid.

This year the wilt disease did not do so much damage as in 1941. It made its first definite outward appearance on July 7, 1942. During the season 29.6% of the larvae succumbed to this disease as follows:

Date	Larvae definitely known to have wilted	Death due to unknown causes.
July 7	9	42
" 13	10	11
" 20	--	11
" 22	--	3
" 23	1	2
" 31	4	1
Aug. 3	4	3
" 5	5	-
" 6	4	-
" 7	6	-
" 10	6	-
" 15	1	-
" 17	1	-
" 19	6	-
" 24	3	-
" 27	3	-
" 28	2	-
Sept. 8	2	-
TOTAL	67	73
% of total larvae	29.64	32.30

Pupal mortality due to wilt disease amounted to at least 34 pupae, or 39.53% of the total number of cocoons formed.

The total larval and pupal mortality definitely accounted for by wilt in 1942 was 44.69%

E. 30.50 - 2 -- Time of Felling in Relation to Parasites and Predators of the Douglas Fir Bark Beetle.

G.R. HOPPING & W.G. MATHERS

This study was commenced in 1941 at the Trinity Valley Field Station, object being to evaluate some of the factors which determine the amount of parasitism by Coeloides brunneri Vier. in the broods of the bark beetle Dendroctonus pseudotsugae Hopk. It was likewise designed to study the development and numbers of such predators as Enoclerus sphegeus Lec., Temnochila virescens var. chlorodia Mann., and Medetera aldrichii Wheeler. It was hoped that if trap trees were felled at the proper time and under proper conditions, it might be possible to produce a sufficiently high parasitism by Coeloides which, together with the predators, might be a control factor to bring timber losses to a minimum over a given area.

In 1941 two trees were felled on each of the following dates: May 20, June 20, July 22 and August 20 but only the trees felled on May 20 and June 20 were attacked by bark beetles heavily enough to justify the analyses of the trees. 20 per cent analyses were made and the results were given in the Annual Report for 1941.

Moreover, in 1941 observations on the life history and habits of Coeloides brunneri and Medetera aldrichii were made in considerable detail which were also presented in the Report for 1941.

This year the work on this project was curtailed due to the pressure of other work. However, one Douglas fir was felled and one girdled on each of the following dates: February 27, April 25 and May 29. and a 10 per cent analysis was made in the fall of each of the felled trees. Moreover, 4-foot sections from the shaded and unshaded portions of Trees No. 1 and 2, felled May 20 and June 20, 1941, were caged in April in order to correlate emergence of bark beetles, parasites and predators with the analysis counts. Supplementary observations on Coeloides and Medetera were also made this year.

Tree Analyses

Data on the trees used in 1942 are contained in the following table on the next page.

Tree Descriptions -- 1942

	Tree Number 5	6	7
Date Felled	Feb. 27	April 25	May 29
Total height	80' 9"	101'	90' 4"
Stump diameter	13"	16"	14"
Height of stump	15"	18"	16"
Length clear log	33' 6"	17'	31'
" crown	46'	82' 6"	59'
" of tree to 6" top	59'	54' 6"	57'
Age	140 years	146 years	---
Ave. width growth last decade	13.5 mm.	18 mm.	12 mm.
Vigour of growth	fair	good	fair
Disease	heart rot	none	heart rot
Mechanical injury	none	none	none
Defects	slight sweep	none	bad sweep
Direction of lie	E & W	N & S	W & E

The D B H of the three girdled standing trees, No. 5A, No. 6A and No. 7 A, were 13", 15" and 10" respectively. Very little bark beetle attack occurred on the girdled trees while tree No. 5 was so heavily attacked by Pseudohylesinus that subsequent attack by Dendroctonus was largely prevented. Tree No. 6 was heavily attacked in May by Dendroctonus and Tree No. 7 was also heavily attacked by the Douglas fir bark beetle in mid-summer.

Examinations of Trees No. 5, No. 6 and No. 7 were made after the middle of October and the results are summarized in the following tables.

Log Sample Analyses (10%) - 1942

	Area in sq. feet	Total living Dendroctonus	Total Coeloides	Total Cleridae	Total Medetera	Total Temnochila	Total Parasites and Predators	Living Dendroctonus per square foot	Coeloides per sq. foot	Cleridae per sq. foot	Medetera per sq.ft.	Temnochila per sq. foot.	Parasites and Predators per sq. foot
					TREE NO. 5								
Upper side	3.35	0	0	0	0	0	0	0	0	0	0	0	0
Lower side	3.35	10	0	2	6	0	8	3.0	0	.6	1.8	0	2.4
North side	3.35	4	0	1	14	0	15	1.2	0	.3	4.2	0	4.5
South side	3.35	0	0	0	2	0	2	0	0	0	.6	0	.6
Totals or Average	13.40	14	0	3	22	0	25	1.0	0	.2	1.6	0	1.9
					TREE NO. 6								
Upper side	4.54	27	2	1	28	1	32	5.9	.4	.2	6.2	.2	7.0
Lower side	4.54	51	9	0	30	0	39	11.2	2.0	.0	6.6	.0	8.6
East side	4.54	40	7	0	43	0	50	8.8	1.5	.0	9.5	.0	11.0
West side	4.54	27	5	0	9	0	14	5.9	1.1	.0	2.0	.0	3.1
Totals or Average	18.16	145	23	1	110	1	135	8.0	1.3	.1	6.1	.1	7.4
					TREE NO. 7								
Upper side	3.36	67	5	0	19	0	24	19.9	1.5	.0	5.7	.0	7.1
Lower side	3.36	83	31	0	16	0	47	24.7	9.2	.0	4.8	.0	14.0
North side	3.36	58	51	0	18	0	69	17.3	15.2	.0	5.4	.0	20.5
South side	3.36	88	30	0	11	0	41	26.2	8.9	.0	3.3	.0	12.2
Totals or Average	13.44	296	117	0	64	0	181	22.0	8.7	.0	4.8	.0	13.5

Longitudinal Distribution
Bark beetles, Parasites, Predators
Log Analyses - 1942

Section	Circumference (inches)	Bark Thickness (mm)	Area (square feet)	Total living Dendroctonus	Total Coeloides	Total Clerids	Total Medetera	Total Temnochila	Total Parasites and Predators	Living Dendroctonus per sq. ft.	Coeloides per sq. ft.	Clerids per sq. ft.	Medetera per sq. ft.	Temnochila per sq. ft.	Parasites and Predators per sq. ft.
TREE NO. 5															
1	31.0	15.0	2.58	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0
3	29.5	12.0	2.46	4	0	0	10	0	10	1.6	.0	.0	4.1	.0	4.1
5	29.0	10.5	2.42	10	0	3	5	0	8	4.1	.0	1.2	2.1	.0	3.3
7	27.0	10.0	2.25	0	0	0	3	0	3	.0	.0	.0	1.3	.0	1.3
9	24.5	8.5	2.04	0	0	0	2	0	2	.0	.0	.0	1.0	.0	1.0
11	20.0	7.5	1.67	0	0	0	2	0	2	.0	.0	.0	1.2	.0	1.2
Totals or Ave.			13.42	14	0	3	22	0	25	1.0	.0	.2	1.6	.0	1.9
TREE NO. 6															
1	37.0	20.5	3.08	13	8	0	17	0	25	4.2	2.6	.0	5.5	.0	8.1
3	35.0	13.5	2.92	11	2	0	9	0	11	3.8	.7	.0	3.1	.0	3.8
5	34.0	12.0	2.83	12	5	0	16	1	22	4.2	1.8	.0	5.7	.4	7.8
7	32.0	11.0	2.67	25	0	0	20	0	20	9.4	.0	.0	7.5	.0	7.5
9	31.5	10.0	2.63	25	0	0	13	0	13	9.5	.0	.0	4.9	.0	4.9
11	26.5	10.0	2.21	49	1	1	18	0	20	22.2	.5	.5	8.1	.0	9.0
13	22.0	7.5	1.83	10	7	0	17	0	24	5.5	3.8	.0	9.3	.0	13.1
Totals or Ave.			18.17	145	23	1	110	1	135	8.0	1.3	.1	6.1	.1	7.4
TREE NO. 7															
1	34.0	19.0	2.83	61	15	0	7	0	22	21.6	5.3	.0	2.5	.0	7.8
3	30.0	11.0	2.50	65	17	0	13	0	30	26.0	6.8	.0	5.2	.0	12.0
5	28.0	9.0	2.33	53	5	0	17	0	22	22.7	2.1	.0	7.3	.0	9.4
7	26.0	9.0	2.17	66	33	0	14	0	47	30.4	15.2	.0	6.5	.0	21.7
9	24.0	9.0	2.00	36	16	0	5	0	21	18.0	8.0	.0	2.5	.0	10.5
11	19.5	8.0	1.63	15	31	0	8	0	39	9.2	19.0	.0	4.9	.0	23.9
Totals or Ave.			13.46	296	117	0	64	0	181	22.0	8.7	.0	4.8	.0	13.4

For comparison with the results obtained in the examinations made in 1941, the analysis counts for 1941 and 1942 have been summarized in the following table.

Summary

Log Analyses - 1941 and 1942

Tree No.	Stump Diameter	Date Felled	Date Analysed	Percent Analysed	Area analysed sq. ft.	Living Dendroctonus per sq. ft.	Coeloides per sq. ft.	Clerids per sq. ft.	Medetera per sq. ft.	Temnochila per sq. ft.	Parasites & Predators per sq. ft.
1	13"	May 20/41	July/41	20	23.83	46.4	10.6	5.2	8.9	.3	25.0
1A	18"	"	"	20	21.97	48.6	1.6	4.5	9.8	.2	16.2
2	22"	June 20/41	Sept./41	20	42.23	45.3	6.6	.4	3.8	.4	12.1
2A	18"	"	Nov./41	20	24.37	23.1	6.8	.0	2.2	.0	11.0
5	13"	Feb. 27/42	"	10	13.42	1.0	.0	.2	1.6	.0	1.9
6	16"	Apr. 25/42	Oct./42	10	18.17	8.0	1.3	.1	6.1	.1	7.4
7	14"	May 29/42	Nov./42	10	13.46	22.0	8.7	.0	4.8	.0	13.4

The results obtained this year indicate that under the conditions of the experiment, trees felled prior to the month of May were less attractive to both Dendroctonus and Coeloides than trees felled in May and June. Otherwise, this year's results verify the main findings of last year. For instance, Coeloides evidently prefer the thinner bark portion of the logs and also concentrate on the lower and north sides. The absence of Clerids may be explained by the fact that they had migrated to the forest floor prior to the time of examination.

1942

Emergence from Caged Log Sections.

On April 20 four-foot sections from the unshaded and shaded portions of Trees No. 1 and No.2 were caged in cheesecloth cages under field conditions. A summary of the emergence together with analysis counts of comparable portions of the same trees are given in the following table.

Tree Number	Portion of Tree	Area square feet	Total Dendroctonus	Total Coeloides	Total Clerids	Total Medetera	Total Temnochila	Total Parasites & Predators	Dendroctonus per sq. ft.	Coeloides per sq. ft.	Clerids per sq.ft.	Medetera per sq. ft.	Temnochila per sq.ft	Parasites and Predators per sq.ft.
	1942 -Emergence from Caged Log Sections													
1	Unshaded	9.17	74	5	3	14	0	22	8.1	.5	.3	1.5	.0	2.4
	Shaded	8.00	55	1	1	11	0	13	6.9	.1	.1	1.4	.0	1.6
2	Unshaded	12.00	160	5	0	31	0	36	13.3	.4	.0	2.6	.0	3.0
	Shaded	13.67	428	0	0	3	0	3	31.3	.0	.0	.2	.0	.2
	Analysis Counts - 1941													
1	Unshaded	7.64	491	43	28	64	0	135	64.3	5.6	3.7	8.4	.0	17.7
	Shaded	6.77	467	6	65	78	0	149	69.0	.9	9.6	11.5	.0	22.0
2	Unshaded	14.10	338	176	0	42	34	252	24.0	12.5	.0	3.0	2.4	17.9
	Shaded	16.83	1064	29	13	53	12	107	63.2	1.7	.8	3.1	.7	6.4

The dates of emergence of *Dendroctonus*, *Coeloides* and *Medetera* from the caged logs were as follows:-

Emergence from Caged Log Sections

Date		Dendroctonus	Coeloides	Medetera.
April	20	42	-	-
	23	10	-	-
	28	2		
May	5	9		
	6	78		
	8	52		
	12	46		
	15	8		
	18	14		
	20	157		1
	21	106		0
	23	34		1
	29	51		17
	31	3		6
June	2	43	1	10
	3	1	0	0
	4	5	1	2
	5	31	2	2
	9	8	0	1
	10	1	0	2
	12	5	0	1
	13	6	1	2
	15	0	0	3
	16	0	1	1
	18	0	0	1
	22	3	1	1
	26	2	1	0
	30	0	1	3
July	1	0	1	0
	2	0	0	1
	6	0	1	2
	7	0	0	2
TOTALS		717	11	59

The small number of Coeloides recovered from the caged logs is due to the fact that first generation adults emerged in 1941.

Medetera aldrichii Wheeler

Observations in the field on April 25 showed that Medetera were commencing to pupate beneath the bark. Pupation occurs in cells hollowed out in the frass of bark beetles and usually a thin transparent cocoon is formed. By May 20 nearly all Medetera had pupated in the field and on this date, the first adult was recovered from the caged logs. Emergence from the latter continued until July 7; but with the heaviest emergence occurring before June 3.

On May 5 a series of 10 specimens were taken from under bark and placed in separate vials. Data concerning the specimens were as follows:

No.	Larva	Pupa	Adult
1	-	May 5	May 29
2	-	" 5	June 2
3	-	" 5	" 9
4	May 5	" 6	" 6
5	-	" 5	" 9
6	May 5	" 6	" 9
7	" 5	-	" 15
8	" 5	May 8	" 6
9	" 5	" 8	" 9
10	" 5	" 12	" 9

The duration of the pupal period varied from 4 to 5 weeks.

PHENOLOGICAL OBSERVATIONS

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

Year: 1942
Observers: C.V.G.Morgan
Before June 2: G.R.H.& W.G.M.

Sta.	Species	Observations	Date	Remarks
1	Picea engelmanii	First bud-scales shed	May 8	
		First staminate flowers shedding pollen		Datum not available
		Terminal growth completed	July 17	Third week of July
		New buds almost completely swollen	July 24	
2	Pinus contorta latifolia	First bud-scales shed	Apr. 23	
		First staminate flowers shedding pollen		Datum not available
		Terminal growth comleted.	Aug. 5	First week of August
		Old needles turning colour	Sept 10	
		Old needles falling	Sept 22	
3	Abies lasiocarpa	First bud-scales shed	May 5	
		First staminate flowers shedding pollen		Datum not available
		Terminal growth completed	July 15	Third week of July
4	Larix occidentalis	First staminate flowers shedding pollen		Datum not available
		Needles separated in bud	Apr. 23	
		Terminal growth completed	July 27	Fourth week of July
		Needles turned--first	Oct. 5	On mature trees
		Needles turned--100%	Oct. 26	On all trees.
		Needles dropped--10%	Nov. 9	
		Needles dropped--90%	Nov. 16	
		All trees leafless	Nov. 23	

Sta.	Species	Observations	Date	Remarks
5	Pyrus sitchensis	First flower open	May 29	
		85% flowers open	June 2	
		First fruit ripe	Sept 2	
		Foliage turned--25%	Sept 14	
		Foliage turned--50%	Sept 18	
		Foliage turned--75%	Sept 21	
		Foliage turned--90%	Sept 25	
		Foliage turned--100%	Oct. 5	
		Tree leafless	Oct. 22	
9	Clintonia uniflora	Plants 2-3" high	May 5	
		First flower open	June 6	
		Fruit ripe--first	Aug. 1	
		Fruit ripe--30%	Aug. 5	
		Fruit ripe--100%	Aug. 14	
10	Cornus canadensis	Plants 2" high, leaves not separated	May 5	
		Plants 3-3½" high, leaves beginning to separate	May 15	
		First floret open	June 4	
		First fruit ripe	July 29	
		90% fruit ripe	Aug. 5	
		Leaves turning red	Sept 15	
		Some plants still in flower	Sept 25	
11	Solidago canadensis	First flower open	Aug. 10	
		Flowers common in region--90%	Aug. 16	
12	Epilobium angustifolium	First flower open	July 4	
		Flowers common in region--50%	July 24	
		First seed being shed	July 30	
		50% pods shedding seed	Aug. 17	
	Acer glabrum	First flower open	May 12	
		Foliage turned--75%	Sept 23	
		Foliage turned--100%	Oct. 26	
		Tree leafless	Nov. 9	

Sta.	Species	Observations	Date	Remarks
	Achillea lanulosa	First flower open 100% flowers open	June 20 July 20	
	Amelanchier alnifolia	100% flowers open First fruit ripe Foliage turned--100% Tree leafless	May 20 July 27 Oct. 5 Oct. 23	
	Anaphalis margaritacea	First flower open 25% flowers open 75% flowers open	July 2 July 24 Aug. 17	
	Aquilegia formosa	First flower open Seeds ripe and being shed	June 4 July 24	
	Aralia nudicaulis	First flower open Foliage turned--100%	June 2 Sept 21	
	Aster wilsonii	80% flowers open	Aug. 17	
	Berberis aquifolium	First flower open Flowers common--75% 100% fruit ripe	May 12 May 20 Aug. 14	
	Betula occidentalis	Foliage turned--80%	Sept 24	
	Carduus arvensis	First flower open 90% flowers open	July 21 Aug. 17	
	Carduus edulis	First seeds being shed 75% flowers open & 10% seeds being shed	Aug. 14 Aug. 17	
	Ceanothus sanguineus	25% flowers open	June 2	

Sta.	Species	Observations	Date	Remarks
	Chimaphila umbellata	First flower open First fruit turning red	July 6 Aug. 17	
	Coralloriza multiflora occidentalis	80% flowers open	June 16	
	Corylus californica	Flowers shedding pollen Foliage turned--80%	Apr. 14 Sept. 24	
	Cypripedium montanum	100% flowers open	June 14	
	Disporum trachycarpum	First fruit yellowing 25% fruit yellowed First fruit ripe	July 18 July 25 Aug. 12	
	Epilobium angustifolium	First flower open 50% flowers open First seed being shed All flowers over & 50% pods shedding seeds	July 4 July 24 July 30 Aug. 7	
	Fragaria chiloensis	Flowers common--50%	May 12	
	Gentiana acuta	First flower open	June 16	
	Habenaria orbiculata	100% flowers open	July 22	
	Lathyrus ochroleucus	10 % flowers open	June 2	
	Lilium parviflorum	First flower open First seed cases split	June 16 Aug. 20	
	Linnaea borealis var. americana	First flower open	June 16	
	Lonicera ciliosa	First flower open	June 14	
	Lonicera involucratum	100% fruit ripe	July 20	

Sta.	Species	Observations	Date	Remarks
	Lonicera utahensis	Flowers common--50% First fruit ripe	Apr. 20 June 12	
	Lupinus sp.	First flower open	June 5	
	Melampyrum lineare	First flower open	June 27	
	Pachystima myrsinites	75% fruit ripe	Aug. 17	
	Peramium decipiens	90% flowers over	Aug. 17	
	Pinus monticola	First bud-scales shed Candles ¼" long Candles 4" long Old needles turning colour Old needles dropping	Apr. 23 May 5 May 20 Sept 8 Sept 22	
	Pseudotsuga taxifolia	First bud-scales shed Terminal growth completed	May 20 July 23	Fourth week of July
	Pyrola chlorantha	First flower open	June 16	
	Ranunculus macounii?	First flower open 95% petals shed	June 6 July 22	
	Ribes lacustre	First fruit ripe 100% fruit ripe	July 23 Aug. 15	
	Rosa melina	First flower open	June 3	
	Rubus parviflorus	First flower open First fruit ripe 50% foliage turned	June 13 Aug. 3 Sept 4	

Sta.	Species	Observations	Date	Remarks
	Shepherdia canadensis	90% flowers open	May 5	
		First fruit ripe	June 25	
		80% leaves dropped	Sept 25	
		Tree leafless	Oct. 15	
	Smilacina racemosa	First flower open	May 29	
		75% flowers open	June 2	
		Fruit turning red	July 25	
		10% fruit ripe	Aug. 17	
	Spiraea lucida	First flower open	June 19	
		All flowers over & 80% seeds well-formed --most seeds greenish-brown	Aug. 17	
	Taraxacum officinale	First seeds being shed	June 2	
	Thuja plicata	Old foliage turning	Sept 11	
	Tragopogon pratensis	First flower open	June 12	
		100% seeds ripe and many being shed	Aug. 15	
	Vaccinium sp.	100% fruit ripe	July 21	
	Verbascum thapsus	First flower open	July 19	

Disappearance of winter's snow in open	Mar. 25
" " " " " forest	Apr. 10
Last spring frost	May 20
First fall frost	Sept 18
First snow to fly in air	Oct. 27
First snow to whiten ground	Nov. 2

Miscellaneous Notes

Canal Flats to Kimberley, B.C. — Oct. 6, 1942--altitude 2,665' to 3,662'--east and west exposures

Larix occidentalis Nutt.--100% needles turned.

Cranbrook, B.C. — Oct. 6, 1942--altitude 3,013'--no slope

Larix occidentalis Nutt.--75% needles of young trees & 10% of mature trees turned.

Gray Creek, B.C. — Oct. 7, 1942--altitude 1,850'--west exposure

Alnus sp. --10% foliage turned
Larix occidentalis Nutt.--Needles of young trees just beginning to turn.
Populus tremuloides Michx.-100% foliage turned.
Populus trichocarpa T & G-75% foliage turned
Salix sp. --foliage not yet turned.

Nelson, B.C. — Oct. 7, 1942--altitude 1,766'--west exposure

Larix occidentalis Nutt.--Needles just beginning to turn on mountain tops.

(observer-G.R.H.)

Nixon Creek, B.C. (Kootenay National Parks) --altitude 3,700'--no slope

Picea engelmanni Engelm.	--Bud scales shedding on young trees	--June 5
	New growth on leaders 8-10" long; lateral shoots 4-5" long on young trees	--July 4
Shepherdia canadensis Nutt.	-Fruit formed and green	--June 5
	Fruit still green, now filled out	-July 4
	First fruit turning red	-- " 12
	90% fruit ripe	-- " 22
Pinus contorta Dougl.	--Candles average 1" long on laterals of old trees; candles 3" long on reproduction	--June 5
	Candles of laterals 6" long; of leaders 8-10" long on young trees	--July 4
Amelanchier alnifolia Nutt	-First flowers opened during last ten days	--June 5
Cornus canadensis L.	--Plants 3-4" high	--June 5
	90% flowers open	--July 4

TRINITY VALLEY FIELD STATION

Winter, 1941- 1942.

	Outside			Low Temperature Chamber			
	Max. Max.	Min.	At time of Reading	Max.	Min.	At time of Reading	Snow on Ground
Nov. 3, 1941 4 P.M.	--	--	--	--	--	40.0	
7, 1941 10 A.M.	52.0	27.0	25.0	41.0	39.0	39.0	
12, 1941 3:30 P.M.)	44.0	25.0	33.0	40.0	38.0	38.0	
21, 1941 10:45 A.M.)	45.0	23.0	33.0	39.0	35.5	36.0	½"
30, 1941 3 P.M.	45.0	11.0	38.0	37.0	32.0	37.0	½"
Dec. 9, 1941 11 A.M.	47.0	30.0	39.0	38.0	35.0	35.0	1"
16, 1941 10:30 A.M.	39.0	12.0	34.0	36.0	33.0	35.0	2"
Jan. 6, 1942 "	36.0	-5.0	13.0	35.0	25.5	26.0	5½"
30, 1942 10:00 A.M.	38.0	2.0	31.0	32.0	25.0	32.0	
Feb.17, 1942 10 A.M.	41.0	12.0	20.0	33.0	31.0	31.0	6"
27, 1942 2 P.M.	37.5	10.0	33.5	32.0	28.0	31.5	8"
Mar.25, 1942 10:30 A.M.	48.0	19.5	29.0	34.5	31.5	33.0	snow patchy.
Apr.10, 1942 9:30 "	63.0	20.0	43.0	37.0	32.5	36.0	all snow disappeared
11, 1942 9:30 "	70.0	32.0	45.0	--	--	--	
13, 1942 9:30 "	66.0	29.0	40.0	40.0	36.5	38.0	
16, 1942 10 A.M.	55.0	29.0	40.0	--	--	--	
17, 1942 "	67.0	38.0	44.0	--	--	--	
20, 1942 "	72.5	30.0	49.0	41.0	38.0	40.0	
23, 1942 "	77.0	24.0	40.0	44.0	40.0	40.5	

	Outside			Low Temperature Chamber.		
	Max.	Min.	At Time of Reading	Max.	Min.	At Time of Reading
Apr. 25, 1942 9:30 A.M.	55.0	33.0	41.0	--	--	--
28, 1942 3:00 P.M.	60.5	47.0	26.0	--	--	--
May 5, 1942 3:00 P.M.	65.6	56.0	28.5	--	--	--
6, 1942 5:00 P.M.	72.5	68.5	30.0	--	--	--
8, 1942 "	70.0	68.0	35.0	--	--	--
12, 1942 2:00 P.M.	68.0	63.0	34.5	47.0	44.0	39.5
15, 1942 4:20 P.M.	64.0	30.0	59.0	--	--	--
18, 1942 9:45 .AM.	63.0	26.5	49.0	--	--	--
20, 1942 10:00 A.M.	65.0	26.0	53.0	49.0	43.0	45.0
21, 1942 "	75.0	43.0	60.0	--	--	--
23, 1942 9:30 A.M.	80.0	58.0	53.5	--	--	--
26, 1942 3:45 P.M.	71.5	46.5	50.0	--	--	--
29, 1942 4:00 P.M.	67.0	42.0	60.0	--	--	--
31, 1942 "	63.0	34.5	61.0	--	--	--

TEMPERATURE RECORDS

for

TRINITY VALLEY, B.C.

1 9 4 2

(June to November)

	Outside Insectary			Inside Insectary		
	Max.	Min.	At time of Reading	Max.	Min.	At time of Reading
June 2 - 8:00 A.M.	76.0	40.5		75.0	40.5	
" 3 - "	54.0	46.0	50.0	53.5	46.5	50.0
" 4 - "	70.5	41.0	48.0	70.5	41.5	47.5
" 5 - "	79.0	43.0	50.0	78.5	44.5	49.5
" 6 - "	78.5	53.5	58.0	78.0	54.0	58.0
" 7 - "	64.5	50.5	56.0	64.0	51.0	55.5
" 8 - "	57.0	44.0	53.0	56.5	45.0	52.0
" 9 - "	61.5	41.0	49.0	60.5	41.5	49.0
" 10 - "	61.5	34.5	41.5	61.0	35.5	40.5
" 11 - "	61.0	44.0	46.0	61.0	44.5	45.5
" 12 - "	69.0	45.0	52.0	68.0	45.5	51.0
" 13 - "	74.0	50.0	56.0	73.0	51.0	55.0
" 14 - "	68.5	49.0	46.0	68.0	50.0	45.0
" 15 - "	67.0	49.5	45.0	67.0	50.5	45.5
" 16 - "	67.5	42.0	45.5	67.5	42.5	45.0
" 17 - "	68.0	34.0	43.0	68.0	35.5	41.5
" 18 - "	59.5	42.0	48.0	59.0	42.0	47.0
" 19 - "	61.0	45.0	46.5	60.5	45.0	46.5
" 20 - "	60.5	42.5	48.0	60.5	43.0	47.5
" 21 - "	67.5	42.5	46.5	67.0	43.0	46.0
" 22 - "	70.5	36.0	46.0	70.5	36.5	45.0
" 23 - "	68.5	42.5	49.0	68.5	43.5	47.5
" 24 - "	65.0	38.0	46.5	65.0	39.0	45.0
" 25 - "	62.0	42.0	48.5	62.0	43.0	48.0
" 26 - "	66.5	48.0	51.5	66.5	48.5	51.0
" 27 - "	82.5	41.0	52.0	82.0	42.0	50.5
" 28 - "	83.0	48.5	59.0	82.5	49.5	57.5
" 29 - "	86.5	48.0	60.0	86.0	49.0	58.0
" 30 -	90.5	47.0	57.0	90.0	48.5	55.0

Temperature Records (Continued)

	Outside Insectary			Inside Insectary.		
	Max.	Min.	8. A.M.	Max.	Min.	8. A.M.
July 1	93.5	49.0	62.0	93.0	50.5	59.0
2	93.5	54.0	60.0	93.0	55.0	58.5
3	94.5	50.0	61.0	93.0	52.0	59.0
4	92.5	54.0	61.0	92.0	55.0	59.5
5	84.5	51.0	59.0	84.0	52.0	57.5
6	86.0	49.5	57.0	85.5	50.0	55.5
7	80.5	43.5	49.5	80.5	45.5	48.5
8	78.0	49.0	55.0	78.0	49.5	53.5
9	78.5	49.0	56,5	77.5	50.0	55.0
10	81.5	48.0	54.0	81.0	49.5	53.5
11	62.0	47.5	51.0	62.0	48.0	52.0
12	62.0	47.5	49.0	61.5	47.5	48.5
13	73.5	49.5	55.0	73.0	50.0	54.0
14	73.0	52.5	57.5	72.5	53.0	57.0
15	70.0	52.5	58.0	69.0	53.0	57.5
16	58.0	54.0	54.5	58.0	54.0	54.5
17	55.5	49.5	52.0	55.5	50.0	52.0
18	52.5	51.0	53.0	52.5	51.5	53.0
19	78.0	45.0	53.0	77.5	46.0	52.0
20	84.5	47.5	54.0	84.0	48.5	52.5
21	88.0	48.5	55.0	87.5	50.0	54.5
22	87.5	50.0	57.5	87.5	51.5	56.0
23	85.5	49.5	56,5	85.0	50.5	55.0
24	83.5	47.0	54.0	83.0	49.0	53.0
25	82.0	49.5	56.0	81.5	50.5	55.5
26	80.5	48.5	55.0	80.0	50.0	54.0
27	71.5	48.5	56.0	71.0	50.0	55.0
28	73.5	48.0	55.0	73.0	49.0	54.5
29	75.0	50.5	55.0	74.5	51.5	54.5
30	62.5	50.5	56.0	62.5	51.0	56.5
31	75.0	51.0	54.5	75.0	51.5	54.5
Aug. 1	74.5	50.5	54.0	74.0	51.0	53.0
2	81.0	46.0	53.5	80.5	47.0	52.5
3	81.5	47.0	55.0	81.0	48.0	53.5
4	83.5	46.0	53.0	83.0	47.5	51.0
5	85.0	48.0	54.0	84.5	49.0	53.0
6	83.5	49.5	55.0	83.0	51.0	53.5
7	84.0	48.0	53.0	83.5	49.0	53.0
8	87.5	49.0	53.0	87.0	50.5	53.0
9	88.0	49.5	55.0	87.5	51.0	54.5
10	86.5	55.0	69.5	86.0	56.5	68.0

Temperature Records (Continued)

	Outside Insectary			Inside Insectary.		
	Max.	Min.	8 A.M.	Max.	Min.	8 A.M.
Aug. 11	82.5	49.5	54.5	82.5	51.0	54.5
12	72.0	46.0	57.0	71.5	47.5	56.5
13	77.0	39.0	43.5	76.5	41.0	43.0
14	82.5	43.5	46.0	81.5	45.0	46.0
15	86.0	44.5	48.5	85.5	46.0	48.0
16	87.5	49.5	54.5	87.0	51.5	54.5
17	86.5	46.5	52.0	85.5	48.5	52.0
18	87.5	50.5	54.5	87.0	52.0	54.5
19	88.5	50.0	54.0	88.0	51.5	54.0
20	75.5	61.5	62.0	74.5	62.0	62.0
21	77.5	47.5	57.0	77.0	48.0	57.0
22	80.5	39.5	44.5	80.0	41.5	45.0
23	86.0	46.5	51.5	85.0	47.5	51.5
24	73.5	51.0	59.5	72.5	52.5	59.0
25	59.5	48.5	50.0	59.0	49.5	51.0
26	57.0	44.0	45.0	57.0	45.0	45.5
27	65.5	34.5	38.5	65.0	35.5	38.0
28	62.5	48.5	44.5	62.0	49.0	45.5
29	67.5	38.0	43.0	67.0	39.0	42.5
30	68.0	41.5	46.0	67.5	43.5	45.5
31	68.0	34.5	37.5	67.0	36.0	37.5
Sept. 1	60.5	38.0	43.0	60.5	39.5	43.0
2	76.0	46.0	49.0	75.5	47.0	49.0
3	77.0	40.5	43.0	77.0	42.5	43.0
4	79.0	40.0	43.0	78.5	42.0	43.0
5	76.5	43.0	46.5	76.0	44.0	46.0
6	71.5	41.5	44.0	71.0	42.5	43.5
7	73.0	38.0	41.5	73.0	39.5	41.0
8	77.0	41.5	44.5	76.0	43.5	44.0
9	66.5	44.5	49.5	66.0	45.5	49.0
10	65.0	39.0	43.0	64.0	41.0	42.5
11	71.5	34.0	37.0	70.5	36.0	36.5
12	73.0	34.0	37.0	72.5	40.5	42.0
13	61.5	50.5	52.5	61.0	51.5	52.5
14	56.5	47.5	48.0	56.5	48.0	48.0
15	60.0	41.0	49.5	59.0	42.5	49.0
16	55.0	38.5	42.0	54.5	39.5	41.5
17	59.5	33.5	35.0	59.5	34.5	35.0
18	51.0	29.0	30.5	51.0	30.0	30.5
19	67.5	39.5	41.5	66.5	41.0	41.5
20	69.5	41.0	41.5	68.5	42.5	42.5

Temperature Records (Continued)

	Outside Insectary			Inside Insectary.		
	Max.	Min.	8 A.M.	Max.	Min.	8 A.M.
Sept. 21	69.0	36.0	36.0	68.5	37.5	37.5
22	72.0	37.5	39.0	72.0	39.0	39.5
23	74.0	38.0	40.0	73.0	39.5	40.0
24	72.0	38.0	40.0	71.5	39.5	40.0
25	73.0	37.5	39.5	72.0	39.0	39.5
26	73.0	36.0	38.0	72.0	37.5	38.0
27	73.0	35.0	37.0	72.0	37.0	37.5
28	71.5	36.0	38.0	70.0	38.0	38.5
29	66.0	36.0	38.0	65.0	37.0	37.5
30	55.5	40.0	43.0	55.0	40.5	42.0
			At time of Reading			At time of Reading
Oct. 1 - 8:00 A.M.	57.5	40.5	43.0	57.0	41.0	41.0
5 -10:30 A.M.	54.0	34.5	52.0	53.5	36.0	51.0
8 - "	63.0	32.0	43.5	62.0	33.5	43.0
12 -12:00 noon	60.0	26.0	43.0	60.5	27.0	42.0
13 -11:00 A.M.	52.5	24.5	40.5	52.5	26.0	39.5
14 - 8:00 A.M.	53.5	34.5	39.5	53.5	35.0	39.0
15 - "	46.5	34.0	35.0	46.0	35.0	35.5
16 - "	57.0	28.5	29.0	56.5	29.5	29.5
17 - "	51.5	29.5	29.5	51.0	30.5	30.5
19 -10:30 A.M.	56.5	29.0	48.0	54.0	30.5	46.0
26 -11:10 A.M.	58.5	23.5	40.0	57.0	24.0	38.0
Nov. 2 -10:30 A.M.				43.0	26.0	30.0
3 -10:00 A.M.				35.0	30.5	33.0
4 -10:15 A.M.				42.0	25.5	28.0
5 -10:00 A.M.				34.0	25.5	28.0
6 - "				32.5	28.5	29.5
7 -10:15 A.M.				33.5	28.0	31.0
9 - 9:30 A.M.				37.5	21.0	27.5
16 -10:30 A.M.	45.0	19.0	31.0			

RAINFALL RECORDS

for

TRINITY VALLEY, B. C.

1 9 4 2

(April to November)

		Rainfall in Inches	Remarks
April 10			Rain gauge set up
13	-9:30 A.M.	Nil	
16	-10:00 A.M.	0.720	
17	10:00 A.M.	0.045	Fell during night of 16-17
20	"	Nil	
23	"	0.070	Fell on April 22
25	9:30 A.M.	0.080	Fell on April 24
Total for period		0.915	
May 5	3:00 P.M.	0.400	
12	2:00 P.M.	1.300	
15	4;20 P.M.	0.83	
18		0.000	- trace--light shower in P.M.
20	10:00 A.M.	0.095	
21	"	Nil	
23	9:30 A.M.	0.340	
26	3:45 P.M.	1.100	- still raining
29	2:45 P.M.	0.835	
31	4:00 P.M.	0.210	
Total for period		5.110	
June 2	4;30 P.M.	0.010	- fell previous to 9:AM of June 2/42.
2-3	9 A.M. - 9 A.M.	0.080	- fell in late P.M. of June 2 and A.M. of June 3
3-4	"	0310	- fell between 9 A.M. & 3 P.M. of June 3/42
4-5	"	0.000	- Trace fell at 5:00 P.M. of June 4/42
6-9	"	1.105	- fell between 5:00 P.M. of June 6 and 9:00 A.M. of June 9.
9-10	"	0.000	- Trace fell at 4:30 P.M. of June 9/42
10-11	"	0.245	- fell between 11:30 P.M. of June 10 and 9 A.M. of June 11.

Rainfall Records (Continued)

	9 A.M. to 9 A.M.	Rainfall in inches.	Remarks
June	12-13	0.000	- trace fell at 3:00 P.M. of June 12/42.
	13-14	0.015	- trace fell at 12:30 P.M.; then light shower fell between 2:40 P.M. & 2:50 P.M. of June 13/42.
	14-15	1.425	- fell between 3:30 P.M. of June 14 & early A.M. of June 15/42
	17-18	0.115	- fell between 5:00 P.M. & 8:00 P.M. of June 17/42
	18-19	0.120	- fell between 11:00 A.M. & 3:10 P.M. of June 18 as showers.
	19-21	0.475	- fell between 9:00 A.M. of June 19 & 9:00 A.M. of June 21/42.
	23-24	0.610	- fell between 12:20 P.M. & 3:30 P.M. of June 23/42
	25-26	0.165	- fell between 3:30 P.M. & 7:30 P.M. of June 25/42
Total for June		4.675	
July	4-5	0.140	- fell between 4:00 P.M. & 6:00 P.M. of July 4/42
	8-9	0.005	- fell in early A.M. of July 9/42
	10-11	0.680	- trace at 4:30 P.M. & 8:30 P.M. of July 10/42 rain in A.M. (up to 9:00 A.M.) of July 11/42
	11-13	1.670	- 0.995 " fell between 9:00 A.M. & 3:00 P.M. of July 11/42. 0.675" fell mostly between 3:00 P.M. of July 11/42 and early A.M. of July 12/42.
	13-14	0.010	- fell in early A.M. (before 7:00 A.M.) of July 14/42
	14-15	0.680	- trace at 10:15 A.M. of July 14/42. rain, as showers, fell between 2;45 P.M. of July 14 & 9:00 A.M. July 15/42.
	15-16	0.410	- .095" fell between 9:00 A.M. &11:00 A.M. of July 15/42. Traces at 2:15 P.M. & 3.30 P.M. of July 15/42. rain fell as showers between 9:00 P.M. of July 15 and 9:00 A.M. of July 16/42
	16-17	1.375	- fell between 9:00 A.M. of July 16 & 9:00 A.M. of July 17 as showers.
	17-19	0.290	- 0.075" fell between 9:00 A.M. & 4:00 P.M. of July 17 as light showers. 0.215" fell between 4:00 P.M. of July 17 and 9:00 A.M. of July 19/42.

	9 A.M. to 9 A.M.	Rainfall in inches	Remarks
July	26 - 27	0.105	- fell between 5:00 A.M. & 7:00 A.M. of July 27/42.
	27 - 28	0.275	- traces between 1:30 P.M. & 3:30 P.M. of July 27/42 rain between 4:30 P.M. July 27 & early A.M. of July 28/42
	28 - 29	0.010	- fell between 6:30 P.M. & 7:00 P.M. of July 28/42
	29 - 30	0.475	- trace at 11:10 A.M. of July 29/42 light showers between 3:25 P.M. & 5:20 P.M. of July 29/42 showers in A.M. (up to 9:00) of July 30/42.
	30 - 31	0.500	- fell as showers between 9:00 A.M. & 6:20 P.M. of July 30/42.
Total for July		6.625	
Aug.	19 - 20	0.000	- trace fell in early A.M. of August 20/42
	20 - 21	0.000	- trace between 2:00 P.M. & 2:30 P.M. of Aug.20
	23 - 24	0.005	- fell between 4:00 P.M. & 6:00 P.M. of August 23/42.
	25 - 26	0.240	- traces between 9:25 A.M. ' 10:30 A.M. of August 25/42. light showers between 2:05 P.M. & 3:10 P.M. of August 25/42. light showers in A.M. (up to 9:00 A.M.) of August 26/42
	26 - 27	0.125	- fell between 9:00 A.M. & 12:30 P.M. of August 26/42.
	27 - 28	0.055	- fell in early A.M. of August 28/42.
	28 - 29	0.040	- fell between 11:30 A.M. & 6:40 P.M. of August 28/42 as light showers.
	29 - 30	0.025	- fell between 7:30 P.M. & 9:00 P.M. of August 29/42.
	30 - 31	0.145	- heavy showers fell between 2:40 P.M. & 4:45 P.M. of August 30/42. traces fell between 7:10 P.M. & 7:30 P.M. of August 30/42.
	31 - Sept.1	0.000	- traces fell after 8:15 P.M. until 10:00 P.M. of August 31, 1942.
Total for August		0.635.	

Rainfall Records (Continued)

	9 A.M. to 9 A.M.	Rainfall in inches.	Remarks
Sept.	1 - 2	0.015	- traces between 10:45 A.M. to 10:55 A.M. of September 1/42. traces between 1:40 P.M. & 2:15 P.M. of September 1/42. light showers fell between 9:35 P.M. &10:00 P.M. of September 1/42.
	5 - 8	0.160	- showers in P.M. (after 3 P.M.) of Sept.5/42. light showers fell in late P.M. of Sept.7/42.
	9 - 10	0.000	- trace fell between 3:15 P.M. & 3:25 P.M. of September 9/42.
	10 - 11	0.000	- trace fell between 2:10 P.M. & 2:20 PM. of September 10/42.
	12 - 14	0.285	- fell in P.M. of Sept. 12/42 & P.M. of Sept 13/4 traces fell in A.M. of Sept. 14/42.
	14 - 15	0.005	- light shower fell in early A.M. of Sept.15/42. traces fell throughout A.M. of Sept. 15/42.
	15 - 16	0.100	- light showers from 12:05 P.M. to 2:05 P.M. & from 4:55 P.M. to 5:20 P .M.of Sept. 15/42 traces fell between 7:15 P.M. & 7:30 PM. of Sept. 15/42.
	16 - 17	0.055	- light showers from 1:30 P.M. to 2:20 P.M. and from 3:50 P.M. to 3:55 P.M. of Sept. 16/42.
	17 - 18	0.000	- trace fell at 4:30 P.M. of Sept. 17/42.
	29 - Oct.1	0.275	- apparently all fell on Sept. 30/42.
	Total for Sept.	0.895	
October	5 - 10:30 AM.	0.270	-
	8 - "	0.000	- trace
	12 - 12 noon	0.040	
	15 - 9:00 AM.	0.220	- fell between 11:00 A.M. of Oct. 4 & 10:00 P.M. of October 14/42.
	19 - 10:30 AM.	0.005	- fell in A.M. of October 19/42.
	26 - 11:15 AM	0.000	- No rain in gauge.
		1.000	- See below.
	Total for October	1.535	
November	9 -4:00 P.M.	.620	- estimate 1" before Nov. 1--rain gauge dismantled--½" snow on ground.

SUMMARY - WEATHER RECORDS
Trinity Valley Field Station

-1942-

	Month						
	April	May	June	July	Aug.	Sept.	Oct.
No. of days recorded	--	11	30	31	31	30	31
Max. Temp. of month	77.0	80.0	90.5	94.5	88.5	79.0	63.0
Min. Temp. of month	--	26.0	34.0	43.5	34.5	29.0	23.5
No. of days with frost	--	--	0	0	0	1	17
No. of days with snow	--	--	0	0	0	0	--
No. of days with hail	--	--	0	0	0	0	--
No. of days with rain	--	--	18	14	8	12	--
Total precipitation in inches	0.915 *	** 5.110	4.675	6.625	0.635	0.895	1.535

* For 21 days
** For full month.

RAINFALL
Trinity Valley Field Station

	1940		1941		1942	
Month	No. of days recorded	Total precip.	No. of days	Total precip.	No. of days	Total precip.
April	8	0.615"	28	0.620"	21	0.915"
May	31	2.365"	31	3.565"	31	5.110"
June	30	0.345"	30	4.070"	30	4.675"
July	31	1.790"	31	0.925"	31	6.625"
Aug.	31	0.085"	31	1.885"	31	0.635"
Sept.	30	1.240"	30	4.790"	30	0.895"
Oct.	31	2.710"	31	1.535"	31	1.535"
Totals		9.150"		17.390"		20.390"

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