

**SUMMARY REPORT OF TWO SPRUCE WEEVIL
SURVEYS IN TWELVE PLANTATIONS
IN THE KITIMAT VALLEY**

by

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FOREWORD

This report is one of a series of internal reports distributed by Forest Protection Branch, B.C. Ministry of Forests, to record accomplishments and interim or provisional results for the information of staff, colleagues, and others.

In the Canada-British Columbia Forest Resources Development Agreement (FRDA) 1985 to 1990, over 100 pest control projects were directly funded by the province and administered by protection staff. To facilitate application of the results, and development of improved forest health management strategies, the contractors reports have been edited and distributed as internal reports. Accordingly, any opinions and recommendations expressed are those of the contractor, and not necessarily those of the ministry or the FRDA management committee.

For details or more information about the report or project, please contact forest health staff at Protection Branch or at the forest region offices.

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The guidelines for internal reports outlined in the Protection Manual were adhered to as closely as possible. All manuscripts were altered to comply with a common format, but entire reports were not rewritten to conform to a standardized outline.

Most Executive Summaries were the work of Graham Hawkins of MoF Inventory Branch (formerly with Pacific Coast Forest Biology). All word processing was accomplished by Catriona Kaufman of Top Kat Services. Will Gordon of R. White Woods inc. prepared all maps and figures.

R. White, editor
R. White Woods inc.

ABSTRACT

To monitor the development of an outbreak of spruce leader weevil (*Pissodes strobi*) in the Kitimat valley, strip surveys were performed in the winters of 1986-87 and 1988-89. Thirteen and 12 plantations respectively were surveyed using a modified 5m wide strip survey. Plantations chosen for the survey had been surveyed annually from 1982.

The survey revealed that "low hazard zones" reported in PM-PR-5 did not remain lightly attacked but eventually achieved nearly the same level of attack as the "high hazard zones."

Annual survey data showed weevil populations grew exponentially from 1982 to 1988 until they reached their present level of approximately 30% new attacks per year. The impact of the weevil was greatest in areas where high levels of weevil attack occurred the longest. Upper valley (Block A) plantations will probably have less volume loss than those in the lower valley because the stems are free-growing and are well stocked. Nearly all lower valley spruce have been weevil-attacked at least once, resulting in a high incidence of multiple tops and forks. Brush competition is also very severe in the lower valley. Thus, weevil-attacked trees are readily overtopped.

The Forestry Canada SWAT (spruce weevil attack trial) model will be used to assess the impact of the weevil on volume production using the actual attack data.

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1 INTRODUCTION

This report is a compilation of two spruce weevil surveys performed in the Kitimat valley in 1986-87 and 1988-89 funded by Protection Branch-administered FRDA direct delivery funds. This report (compiled from information collected by Silvicon Services Ltd. (1986-87) and KDM Forestry Services (1988-89) is an update to the Prince Rupert Forest Region's internal report PM-PR-5, which summarized survey data from four annual surveys conducted in 1982 through 1986.

This report contains copies of the contract schedule work descriptions and the data summaries (Appendices A-E). Results are summarized and briefly discussed. Further analysis of the data will be done in the near future using the Spruce Weevil Attack Trial model (SWAT) developed by Dr. Rene Alfaro of Forestry Canada.

2 MATERIALS AND METHODS

A condensed reprint of each contract's schedule A follows:

2.1 Silvicon Services Ltd. (1986-87)

Conduct a 5m wide strip survey of each plantation using the following methods:

- (a) The strip will consist of a sample of 25 Sitka spruce that are within 2.5m of either side of the transect. The strip will be started at a pre-selected (given) random point along the line. Therefore, the contractor may move to each sample without walking to the stand margin.
- (b) Every Sitka spruce within the strip will be examined for the incidence of current and past weevil attacks. Past attacks must have positive evidence of weevil attack (dead top stubs) to be counted. The age of a past attack will be given by the number of whorls from the terminal bud to the whorl containing the damage. An attack code will be used to describe each tree. The total number of trees within each category will be summed for each strip.
- (c) Each plantation will have a minimum of 20 evenly-spaced, parallel transects running the width of the plantation. Intervals between transects (calculated by dividing the plantation length by 20) must be maintained. Transects do not require ribboning; however, the start and end of each strip on each transect will be ribboned and labelled with marking pen on the flagging. Strip number must be noted on this flagging. The centre of each circular plot should also be marked. The trail between strips will also be flagged to permit inspection of the work.
- (d) At the end or beginning of the strip (when the 25th tree is sampled), establish a standard 3.99m radius regeneration plot and count all coniferous and deciduous stems within the plot. In addition, record the incidence of weevil on all Sitka spruce within the plot as in "(b)." Circular plot data may be summarized on F.S. 658 cards.
- (e) Move the next pre-determined position in the plantation and repeat steps "a" to "e" until 20 strips and circular plots have been sampled. Repeat for all 13 plantations.

2.2 KDM Forestry Services (1988-89)

1. In Plantation A-1, obtain the ratio of leader length and longest lateral length measured at breast height for 100 non-attacked Sitka spruce by the following method:
 - (a) Randomly select spruce representing the average age and height of the stand.
 - (b) Measure at breast height, the length of the leader and the longest lateral originating from the same whorl. Measure only one year's growth.
 - (c) Tabulate the leader/lateral data and calculate the average ratio and the standard deviation.
2. Conduct a systematic strip survey in the 12 plantations using the following method:
 - (a) Determine the orientation and distance between plots given for each plantation.
 - (b) At the starting point along the first transect, install a point-of-commencement with flagging and label the flagging with "POC, Date, Plantation Number, Weevil Survey, Crew Initials, Bearing."
 - (c) Examine 25 planted spruce (of the average plantation age) in a 5m wide strip running along the transect line. The start and end of each strip will be marked with pink flagging. The flagging will be labelled with "start" or "end," and the plot number and date. Each tree examined will be flagged with a small piece of flagging. This will facilitate inspections.
 - (d) Each tree within the strip will be examined for new and old spruce weevil damage, the damage will be coded and the position of each attack will be designated by height-quarter.
 - (e) The total height of each tree will be divided into quarters by a visual estimation. The position of each attack will be identified by the tree-height quarter in which it occurs.
 - (f) Note current attacks which have extended beyond the second whorl, that is, weevil feeding has killed more than two years of leader growth.
 - (g) Using a height pole, obtain for each plantation an average tree height and dbh from at least 30 dominant and co-dominant planted spruce.

- (h) Once a plot is completed, a flagged line running the interval width at 90° from the direction of the transect, then the next plot is begun in the same manner as the previous plot. This process is completed until 20 plots have been placed.
- (i) If the plantation margin or a significant timber type change (i.e., less than 30% planted spruce) is encountered before the 25th tree is examined in a plot, end the plot temporarily and after travelling the interval distance along the margin or type boundary, re-continue the plot at 180° from the original plot's direction. Once this interrupted plot is completed, locate the next plot 10m from the end of the previous plot along the same transect.
- (j) If obstructions (i.e., swamps, creeks, ponds) prevent continuation of the plot, use the method of plot continuation. If it is impossible to fit two 5m wide plots into one transect, increase the strip width to 10m or more until two plots are accommodated. If this method still does not handle the problem, walk around the obstruction and begin or continue the plot from the obstruction edge.
- (k) Rate the overall tree form for each stem examined using the rating method.
- (i) At the end or beginning of each plot, count all of the planted stems in a 3.99m radius plot and calculate an average spacing for each plantation.

3 RESULTS AND DISCUSSION

Weevil attacks increased exponentially over the six-year survey period in the 12 plantations, as shown in the summary graphs in Appendix 3. Most damage occurred in the first (top) quarter of the trees, although not all of this damage could be accurately attributed to the weevil. (Maps and graphs of damage by individual tree quarter and plantation are not reproduced in this report but are available upon request from Forest Health Section, MoF Protection Branch, 31 Bastion Square, Victoria, B.C. V8W 3E7.) This suggests that weevil damage has only recently increased, which is verified by the annual survey data. The greatest change was found in the A-Blocks in the upper Kitimat valley. Until 1987, weevil attack was under 6% per annum. In 1988, it rose to an average of 16% in three of four plantations examined. The impact of this recent damage will probably be less severe than in stands that have been heavily weevil-attacked since 1982 (i.e., D-Blocks). The A-Block trees are well-stocked and are free-growing so that inter-tree competition should force laterals to achieve apical dominance faster than in more open grown stands. In the D-Blocks, the spruce are shorter due to repeated weevil attacks and multiple tops, both of which have exacerbated suppression of the spruce by competing vegetation in the lower valley. Because the heavily weevil-attacked spruce are stagnating in height growth, the district silviculturalists have been removing them during brushing and weeding and have been favouring the growth of natural hemlock ingrowth.

The "hazard zones" reported in PM-PR-5 no longer apply in the Kitimat valley because the weevil damage is now nearly uniform throughout the valley. This fact emphasizes the importance of long-term monitoring of spruce weevil populations post-free-growing to document the spread and severity of damage in new drainages. Based on an assessment of attack at free-growing, the risk of weevil attack on spruce in the Kitimat valley would have been grossly underestimated.

It is not known exactly how severe weevil infestations will be in new coastal and interior plantations outside of the areas already documented having weevil. As these stands become susceptible to weevil damage, the level of weevil incidence within each biogeoclimatic subzone should be recorded and correlated to ecosystem associations. The risk of spruce weevil damage within similar associations could then be made and used during the pre-harvest silvicultural prescription to plant the appropriate species.

The monitoring survey should be continued to maintain a complete record of weevil damage during the most susceptible age of the host. Studies on the southern coast of B.C. have shown that merchantable trees can be obtained from stands that have had a history of severe weevil attacks, but the stem quality and volume per tree were less than in undamaged stands. The current practice of converting weevil-damaged spruce stands may not be the best option for the Kitimat valley since valuable time and volume will be lost. The costs and benefits of treating these stands should be evaluated carefully.

**APPENDIX A COMMENTS ON THE 13 WEEVIL SURVEYED
PLANTATIONS IN THE KITIMAT VALLEY (SILVICON
SERVICES INC.)**

**Comments on the 13 Weevil Survey Plantations
in the Kitimat Valley (1986-87)**

Block

- | | |
|----------|---|
| A1, A8 | Both of these blocks are easily accessible and are easy to move around in. The current incidence of weevil attack is negligible. |
| A2 | The southern portion of this block has a very small spruce component and therefore should not be surveyed again. The northern portion has a good proportion of spruce trees; however, the incidence of weevil is low. As well, the northern portion is inundated with small swamps and wet areas created by beavers. In the future, weevil surveys should be concentrated in the northern portion of this block. From the road, there looks like better spruce plantations to the north of this block along the W-60 road. These areas may be more conducive to future surveying. |
| B1 | This block has easy access; it is easy to move around in and there is a moderate level of weevil attack. Therefore, this block is a good candidate for future surveys. |
| C9 | Although this block may have had a high incidence of weevil, it now lacks any spruce trees. Stand tending practices on this site have favoured hemlock and fir over spruce; therefore, no weevil surveys are necessary on this area in the future. |
| C11, C14 | Access to these blocks may be a problem for future spring surveys if there is no logging in the area. Both blocks have a moderate to high incidence of weevil. Block C14 is quite easy to move around in; however, the northern portion of Block C11 is covered by a series of swamps and wet areas which make movement difficult. These areas should be surveyed in the future as long as the access problem is addressed and if lower productivity for Block C11 is acceptable. |
| C13 | The weevil attack in this block is minimal; however, the stand is quite dense and therefore conducive to future surveys. The easy access to this block also makes it a good candidate for future surveys. One problem that does exist is the presence of a large swamp in the middle of this block. This swamp posed no problem during this survey as the ice was still solid; however, it must be kept in mind when planning future surveys. |

Block

- D1 Easy access and a high incidence of weevil make this block a prime candidate for future surveys. Except for a few creek crossings, travel within the block was easy.
- D3 Access to this block is not really a problem; however, travel within the block is very difficult due to the large wet area to the southwest and the steep terrain to the northeast. These factors must be considered when planning future surveys.
- D4 Stand tending has occurred in the central portion of this block and therefore, much of the spruce is gone. Strips in the western and eastern portions of the block were very long in order to get 25 trees. Future surveys in this block would not be worthwhile.
- D7 Access to this block can be a problem if the snow is deep. The incidence of weevil in this block suggests future surveys would be worthwhile; however, travel within the block can be difficult due to wet, swampy conditions.
- D9 This block is also inundated with swamps and wet areas which make travel difficult. The easy road access and incidence of weevil attack make this block a good candidate for future surveys.

**APPENDIX B SUMMARY OF WEEVIL ATTACKS BY YEAR FROM
RECTANGULAR (25-TREE) STRIPS AND 50m² CIRCULAR
PLOTS (SILVICON SERVICES INC.)**

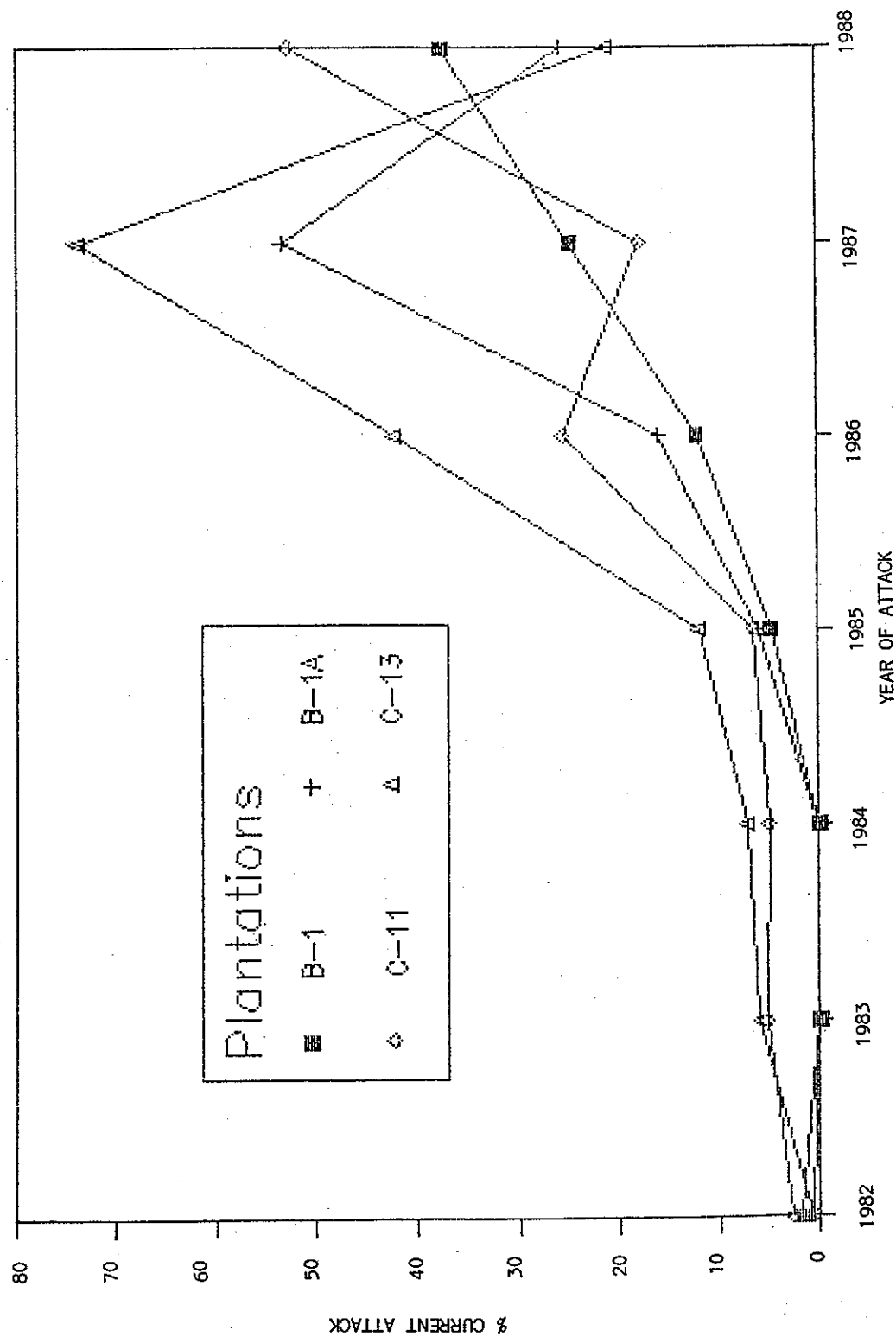
Plantation	% of Stems Attacked											
	Rectangular Plot					% of Stems Attacked			Circular Plot ² (3.99mR)			
	1986	1985	(*)	1984	1983 ¹	1x	2x	3x	1986	1985	1984	1983
A-1	0.0	0.0	(.3)	0.0	0.0	-	-	-	0.0	0.0	0.0	0.0
A-2	2.4	0.2	(.5)	0.2	0.0	100.0	-	-	0.0	0.0	0.0	0.0
A-8	0.8	0.0	(.3)	0.0	0.0	100.0	-	-	0.0	0.0	0.0	0.0
B-1	11.5	3.8	(5.5)	0.1	0.0	94.6	4.0	1.4	10.6	2.3	0.0	0.0
C-9	-	-	(1.8)	-	-	SS	Removed	-	-	-	-	-
C-11	7.4	0.4	(4.0)	0.0	0.0	97.4	2.6	-	9.0	0.0	0.0	0.0
C-13	6.3	0.2	(1.6)	0.2	0.2	93.9	6.1	-	4.2	0.5	0.5	0.5
C-14	14.9	7.6	(7.9)	2.4	0.0	99.1	0.9	-	14.2	5.0	2.5	0.8
D-1	12.2	3.0	(4.7)	2.1	0.0	93.2	2.7	4.1	0.2	0.2	0.0	0.0
D-3	16.0	2.2	(6.0)	1.0	0.6	91.8	4.1	4.1	9.9	6.6	0.0	0.0
D-4	14.9	2.6	(9.6)	0.3	0.0	98.4	0.6	-	3.6	5.4	0.0	0.0
D-7	25.8	3.4	(6.5)	0.0	0.0	95.8	4.2	-	39.8	2.4	0.0	0.0
D-9	42.4	5.1	(12.0)	0.4	0.2	91.9	7.6	0.5	25.0	0.0	0.0	0.0

(*) Results of 1985/86 weevil survey added for comparison.

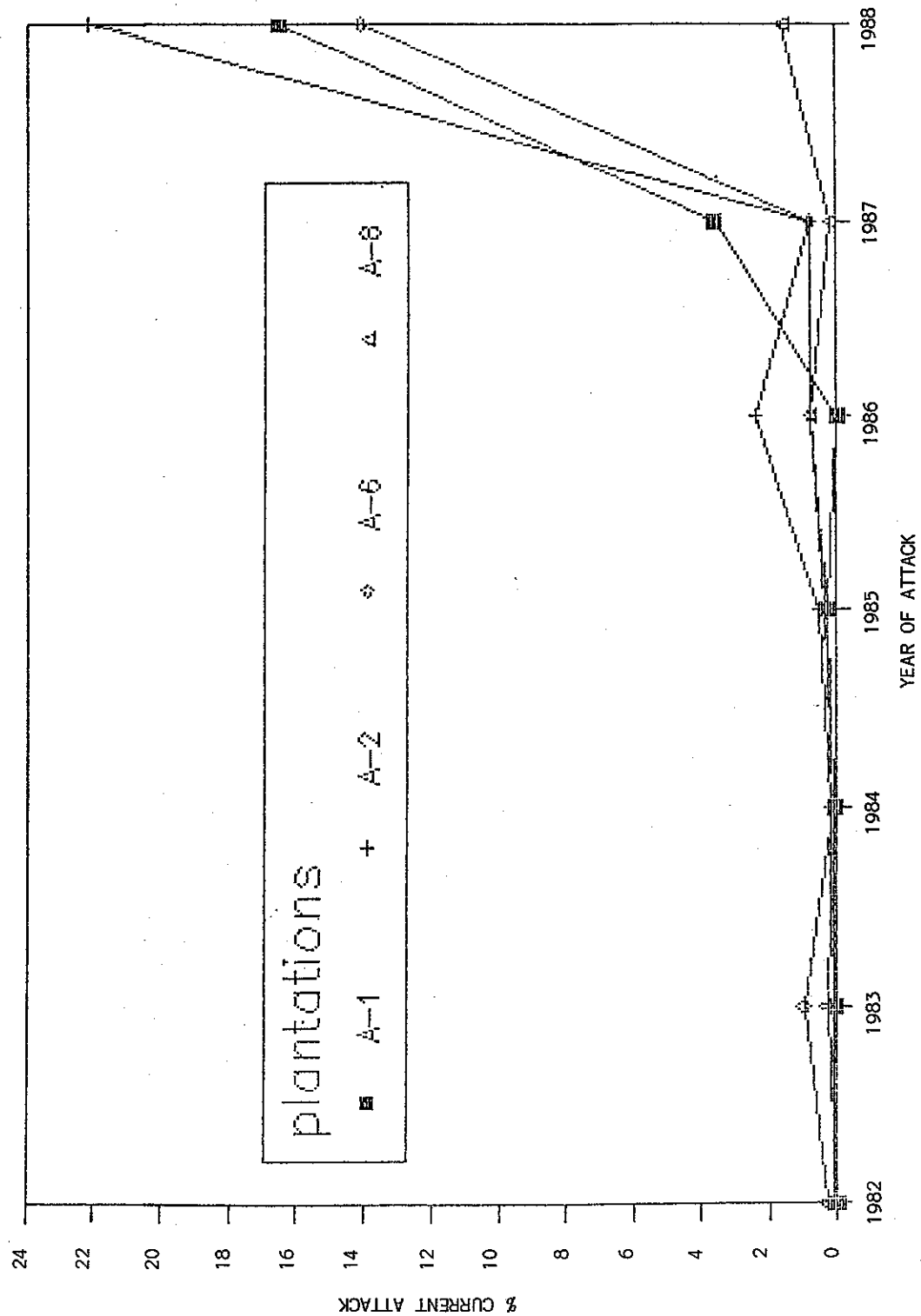
¹ N.B. Past attacks were only counted if positive evidence of weevil attack was present (i.e., dead tops). Therefore, past attacks may have been more frequent than noted here.

² Circular plot data was considered inferior to the strip data.

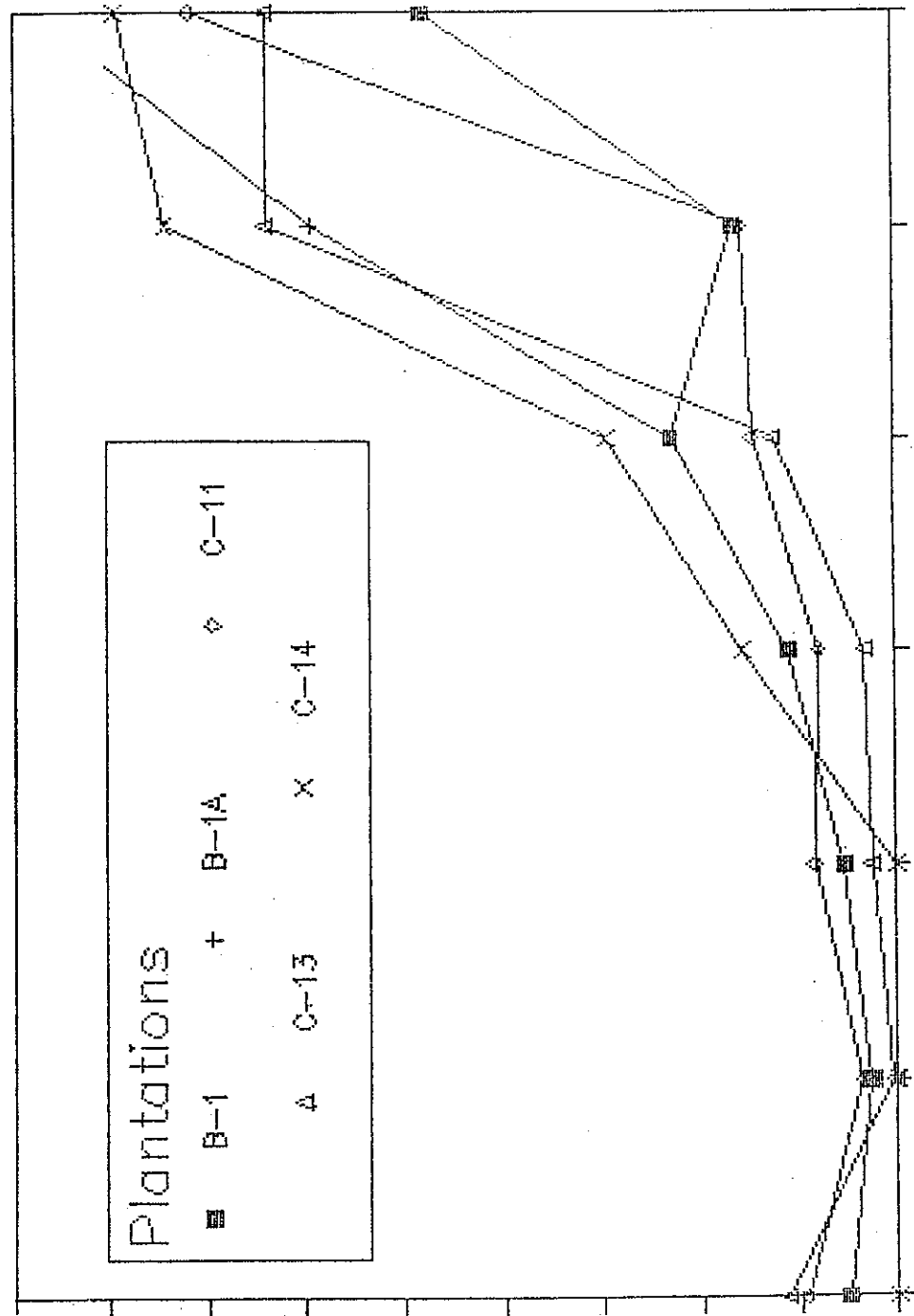
APPENDIX C ANNUAL SPRUCE WEEVIL ATTACK - D BLOCKS, KITIMAT VALLEY
(KDM FORESTRY SERVICES)



APPENDIX C ANNUAL SPRUCE WEEVIL ATTACK - A BLOCKS, KITIMAT VALLEY
(KDM FORESTRY SERVICES)



APPENDIX C ANNUAL SPRUCE WEEVIL ATTACK - B AND C BLOCKS, KITMAT VALLEY
(KDM FORESTRY SERVICES)



**APPENDIX D RATIO OF LEADER LENGTH TO LONGEST LATERAL
LENGTH MEASURE AT BREAST HEIGHT FOR 100 NON-
ATTACKED SITKA SPRUCE (KDM FORESTRY SERVICES)**

Plantation A-1

Tree #	Leader/Lateral Ratio	Tree #	Leader/Lateral Ratio	Tree #	Leader/Lateral Ratio
1	1.00	34	2.32	67	2.73
2	1.38	35	4.50	68	3.56
3	3.22	36	2.38	69	2.89
4	3.50	37	1.58	70	1.28
5	2.44	38	2.36	71	3.36
6	2.11	39	4.00	72	3.53
7	4.67	40	3.99	73	6.00
8	0.96	41	2.00	74	2.33
9	1.85	42	2.62	75	2.33
10	1.37	43	1.68	76	1.88
11	1.44	44	2.50	77	2.47
12	2.52	45	2.63	78	1.29
13	2.29	46	2.67	79	2.72
14	1.72	47	2.40	80	2.30
15	3.43	48	2.50	81	3.26
16	1.53	49	2.13	82	1.38
17	2.25	50	2.50	83	1.84
18	2.31	51	3.16	84	2.12
19	2.00	52	2.67	85	2.35
20	2.34	53	2.00	86	3.67
21	3.63	54	4.27	87	2.23
22	2.75	55	6.38	88	2.67
23	1.41	56	2.25	89	2.92
24	2.40	57	5.43	90	1.75
25	2.29	58	6.14	91	2.69
26	1.33	59	5.00	92	2.43
27	2.11	60	3.55	93	2.73
28	2.59	61	1.95	94	3.18
29	2.14	62	3.21	95	4.33
30	1.95	63	1.77	96	3.80
31	2.73	64	2.00	97	3.10
32	2.40	65	3.50	98	2.57
33	2.29	66	2.50	99	4.08
				100	2.67

$n = 100$ trees

$\bar{X} = 2.697$

S.D. = 1.060

$\Sigma X = 269.66$

$\Sigma X^2 = 839.1414$

$$S.D. = \sqrt{\frac{\Sigma X^2 - (\Sigma X)^2 / n}{n-1}}$$

APPENDIX E DEFECT AND STAND SUMMARY - ALL BLOCKS (KDM FORESTRY SERVICES)

Explanation of Defect Codes Used in Field Examination of Kitimat Valley Plantations

Code		Explanation
C1	Current attack	- 1 year's growth attacked
C2	Current attack	- 2 year's growth attacked
C3+	Current attack	- 3 or more year's growth attacked
Y1	1987 attack	- 1, 2, or 3 year's growth attacked
F	Fork	- not due to weevil attack
PF	Fork	- due to weevil attack
PFb	Fork with stub	- due to weevil attack
Mj	Major crook	- not due to weevil attack
PMj	Major crook	- due to weevil attack
PMjb	Major crook with stub	- due to weevil attack
Mi	Minor crook	- not due to weevil attack
PMi	Minor crook	- due to weevil attack
S	Scar	- due to weevil attack
Sb	Scar with stub	- due to weevil attack

APPENDIX E DEFECT AND STAND SUMMARY - ALL BLOCKS

Plantation	TREE FORM																SPRUCE STATS				
	(% OF STEMS)																HEIGHT±S.D.		D.B.H.±S.D.		
	C1	C2	C3+	Y1	F	PF	PFb	Mj	PMj	PMjb	Mi	PMi	PMib	S	Sb	TOTAL	G	M	P	Meters	Centimeters
A-1	30	52	1	18	27	102	5	6	13	1	7	70	1	0	0	333	57	37	6	6.54±0.76	10.09±2.10
A-2	6	87	18	4	7	11	2	0	2	0	16	35	3	0	0	191	54	44	2	5.90±1.21	8.10±3.21
A-6	15	56	0	4	4	26	1	0	3	0	6	11	1	0	0	127	66	33	1	6.78±0.92	11.20±2.35
A-8	5	3	0	1	69	90	7	4	5	0	105	45	3	0	0	337	73	20	7	5.00±1.36	7.48±1.45
TOTAL - A	56	198	19	27	107	229	15	10	23	1	134	161	8	0	0	988					
B-1	3	112	6	42	24	37	12	6	5	1	21	16	6	0	1	292	29	70	1	7.70±1.44	14.02±3.25
B-1A	4	194	20	149	64	2	38	3	0	2	8	0	1	0	0	486	57	40	3	5.80±1.57	9.11±2.45
TOTAL - B	7	306	26	191	88	39	50	9	5	3	29	16	7	0	1	778					
C-11	10	131	39	40	6	59	11	0	9	2	4	36	1	0	0	348	45	53	2	5.17±1.60	7.84±3.36
C-13	8	135	17	160	34	30	35	4	4	0	36	8	2	1	2	476	30	55	15	4.15±0.94	6.85±1.82
C-14	2	182	15	186	9	43	17	1	5	0	6	26	3	9	0	504	20	78	2	6.80±1.68	13.66±3.90
TOTAL - C	20	448	71	386	49	132	63	5	18	2	46	70	6	10	2	1328					
D-1	2	151	35	125	53	23	41	0	4	3	27	13	6	1	0	484	30	56	14	3.88±0.83	5.65±1.54
D-3	5	120	5	268	9	62	25	3	12	6	12	11	6	0	0	544	22	75	3	11.42±1.85	17.07±3.14
D-7	3	149	71	76	16	49	36	2	11	8	22	62	31	0	0	536	10	67	23	4.41±0.80	7.61±2.02
D-9	8	89	10	369	19	54	148	2	2	12	26	2	13	0	1	755	8	74	18	7.03±1.80	18.54±6.54
L-D	18	509	121	838	97	188	250	7	29	29	87	88	56	1	1	2319					