INVESTIGATIONS OF BLACK ARMY CUTWORM INFESTATIONS IN THE PRINCE RUPERT AND PRINCE GEORGE FOREST REGIONS

by

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Victoria, British Columbia
Forest Service Internal Report

PM-PB-58

Submitted March 1987

Not for Publication

March 1991

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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.

ACKNOWLEDGEMENTS

The author would like to express his gratitude to the following personnel for their complete cooperation and assistance:

Ministry of Forests:	Bob Hodgkinson Steve Hough Bob Richards Tim Ebata Bob Johnson Jean McKenzie Ivan Listar Alison Patch
Canadian Forestry Service:	Leo Unger
Forest Companies:	Chuck Payne - D. Groot Logging Ltd. Mike Breisch - Northwood Pulp and Timber Ltd.

EXECUTIVE SUMMARY

The black army cutworm, *Actebia fennica* (Tausch.) has infested numerous plantations throughout the province, causing delays in planting and defoliation of newly-planted seedlings. Interviews were held with district and licensee personnel in the Bulkley, Morice, Lakes, Prince George West and Prince George East forest districts.

File records for 70 known black army cutworm (BAC) infestations were examined to determine if any parameters associated with site preparation techniques or site characteristics were common to locations infested by the BAC.

Attempts to correlate site preparation (burning) conditions on BAC-infested plantations were unsuccessful due to a lack of adequate and comparable records. Sites infested by the BAC are not always preceded by broadcast burning, but rather some form of burning has occurred on-site or in adjacent areas.

Only 30% of the files examined had references/notes regarding the BAC; therefore, estimates of acreage affected or economic losses to date were not feasible. The locations infested by this pest occurred predominantly within three biogeoclimatic variants, but this association may merely reflect the current harvesting locations in the districts involved.

Information currently lacking with regard to BAC management (as identified by district/licensee personnel) includes training, impact of defoliation and a hazard-rating system.

Based on the results of this investigation, four recommendations are provided to improve the data collection, record keeping system and management options for future BAC infestations.

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1 INTRODUCTION

The black army cutworm, *Actebia fennica* (Tausch.) has infested numerous forest plantations within the Prince Rupert and Prince George Forest Regions. These infestations have occurred throughout a large geographical area but only on sites where some type of burning (broadcast, wildfire, windrows or landing piles) has taken place. Therefore, an investigation was undertaken to determine what data were available on file and if any characteristics were common to areas infested by the black army cutworm (BAC). Results of the investigation are presented in this report.

2 OBJECTIVES AND METHODS

The objectives of this investigation were:

1. to examine the documentation on file in five forest district offices in order to determine if any site parameters are generally associated with BAC infestations (as a preliminary step towards the development of a hazard-rating guide);

2. to interview district, regional and licensee personnel currently involved with BAC;

3. to provide recommendations for improvements to the record keeping systems (which would be desirable to monitor future infestations).

In order to accomplish these objectives, the following methodology was employed:

1. an initial consultation was held with regional entomologists to select the forest districts where the investigation would take place and to prepare a listing of all known BAC infestations in the selected districts;

2. visits were made to district offices and the appropriate ministry/licensee personnel were interviewed on all facets of the BAC;

3. a listing of BAC infestations was prepared in each district, including locations not formally listed in reports but known by the personnel involved;

4. all available timber files (referenced by cutting permit number) were examined to see if any parameters associated with site preparation (burning) were common to BAC-infested plantations;

5. cutting permit and block numbers were cross-referenced to obtain opening files and all documents were examined including:

   - F.S. 117 Site Preparation Guide
   - F.S. 117A Prescribed Burn Analysis
   - F.S. 393 History of Crop Establishment Record
   - F.S. 658 Regeneration Survey Summary
   - F.S. 704 Planting Inspection Report
   - F.S. 716 Survival Survey Summary
   - F.S. 739 Planting Site Prescription
   - F.S. 753-2 Planting Reports

3 RESULTS AND DISCUSSION

For each of the five forest districts examined, two tables were prepared to summarize the data collected (Tables 1-10). The first table presents condensed versions of the comments received during interviews and the frequency of relevant parameters; whereas the second table summarizes the geographical locations, site characteristics and information regarding the data for all known BAC infestations.

The overall impression received during the course of this investigation was that the BAC has not caused significant economic losses to date, although concern was noted in all districts for the potential of increased losses as higher levels of spring burning are undertaken. A majority of BAC infestations throughout the study area have occurred in the operating areas of only three licensees (The Pas Lumber Co., D. Groot Logging Ltd. and Northwood Pulp and Timber Ltd.), generating a greater degree of concern regarding this pest among staff employed by these firms.

It is readily apparent from the summary tables that very little data are currently available on MoF's files regarding BAC. In only 30% of the files examined (where BAC infestations are known to have occurred) were there any references/notes on this pest. Of particular concern is the lack of data regarding the area infested per site and whether damage to planted seedlings occurred. Consequently, it was not possible even to estimate the number of hectares affected or economic losses sustained due to BAC infestations.

As was anticipated, attempts to identify common parameters of site preparation (burning) among BAC-infested plantations were unsuccessful. Several items contributed to the inability to achieve this objective:

- records such as F.S. 117 and F.S. 117A forms were not kept for a large proportion of sites, or were not found on file;
- F.S. 117 forms were sometimes completed too far in advance of the actual burning date(s) to provide accurate, comparable data;
- F.S. 117A forms and weather records were located for less than 25% of the sites;
- written comments regarding burning conditions and burn characteristics (quality) were not comparable.
- burning records were often combined for several locations treated on the same date.

It was determined, however, that broadcast burning (either prescribed or wildfire) did not proceed all BAC infestations: some of the sites had been mechanically site prepared with either landing piles/windrows being burned or broadcast burning was carried out on an adjacent block. Therefore, it is concluded that BAC infestations are not limited to sites which have been broadcast burnt, but rather to all locations where some form of burning has occurred on-site or in adjacent areas.

As noted in the summary tables, the overall aspect of BAC-infested plantations is extremely variable, but most observers report the greatest incidence of seedling damage occurs on southern aspect ridges and slopes on coarse-grained soils.
Based on the extremely variable data available, there are no obvious correlations/ associations of site characteristics among BAC-infested locations. Analysis of location by biogeoclimatic variant classification indicated three predominant variants, usually in the 01 ecosystem association:

1. Babine Lake Moist Cool Central Sub-Boreal Spruce (SBSe2 - 42%)

2. Willow River Wet Cool Central Sub-Boreal Spruce (SBSj1 - 26%)

3. Fraser Basin Moist Cool Central Sub-Boreal Spruce (SBSe1 - 13%)

These trends should be viewed with caution for the following reasons:

(a) the variants indicated are also the ones where a vast majority of harvesting occurs; therefore, the relationship with BAC infestations may be merely a function of harvesting location;

(b) determination of ecosystem association (EA) is somewhat subjective in nature and several EAs may occur within a small cut block. Additionally, many of the EAs reported were determined after site preparation; and may, therefore, reflect the seral vegetation present rather than the species which existed on site prior to harvest.

An attempt was made to determine the frequency of BAC infestations based on the interval of time between site preparation and planting. Unfortunately, very few records are available to determine if BAC populations were present eight to twelve months after burning when planting did not occur until 20+ months. Consequently, the data available are not adequate for use in construction of a hazard-rating guideline at the present time.

From the district operational standpoint, the following items (in order of priority) are required to assist in BAC management:

1. training of all personnel (district, licensee and contractor);

2. impact of defoliation (risk-rating system);

3. probability of infestation (hazard-rating system).

In conclusion, it is readily apparent that there is no consistency in the level or method of record keeping systems for BAC among the districts. A substantially larger and more accurate database must be gathered before the development of both hazard and risk-rating systems can be undertaken.

4 RECOMMENDATIONS

Based on the interviews and data obtained during this investigation, the following items are recommended:

1. Establishment of a separate file (720-4-8) in each district office where the following (minimum) level of data for each BAC infestation is recorded:

   (a) geographical location;
   (b) licence cutting permit and block numbers;
   (c) opening file number;
   (d) month and year of planting;
   (e) date of discovery of BAC larvae;
   (f) map of area defoliated;
   (g) description of seedling damage;
   (h) evaluation of impact (one year after defoliation).

2. Allocation of a data block for pest management within the History of Crop Establishment Record (F.S. 393) where an alphanumeric code would be used to indicate pest damage, e.g., I08 for black army cutworm, D01 for dwarf mistletoe. This would enable computer rather than manual searches in subsequent years.

3. Collection of damage appraisal data to provide district/licensee staff with information on the impact of seedling defoliation; to assist in the decision-making process when BAC infestations are discovered prior to or during planting.

4. Development of a vegetation preference rating over a wide variety of biogeoclimatic variants and ecosystem associations to be incorporated with damage appraisal data taken from similar variants and/or ecosystem associations.

TABLE 1 PRINCE GEORGE EAST FOREST DISTRICT SUMMARY

STAFF COMMENTS:
- large potential for increasing levels of damage
- currently minimal impact on program
- infestations usually restricted to S-SW slopes and ridges within infested locations
- require damage appraisal information

SUBZONE DISTRIBUTION OF BAC INFESTATIONS:		
	j1	63%
	f	32%
	e2	5%

PREDOMINANT ECOSYSTEM ASSOCIATION: 01

FREQUENCY OF BAC: 8 of 19 = 42%

NOTES ON FILES

TABLE 2 SUMMARY OF SITE CHARACTERISTICS FOR BAC-INFESTED PLANTATIONS IN THE PRINCE GEORGE EAST FOREST DISTRICT

Location		Opening Number	Area (ha)[1]		Aspect	BGC[2] Subzone	Assoc.	Burn Type[3]	Burning Date	Planting Date	Source[4]	File Notes	File Map	Seedling Damage
TFL 30	CP 2B-10	93J 1g-01	108		SE	SBS j1	01/08	N	Aug. 81	June 83	D	No	No	N/A
	CP 7B-6	93I 4e-30	94		SW	SBS j1	N/A	L	Oct. 84	June 86	D	No	No	Yes
	CP 8G-26	93J 8a-03	205		SW	SBS j1	N/A	B	Sept. 81	May 83	L + D	Yes	No	Yes
	CP 18-6	93I 3d-03	109		SW	SBS f	01	N	July 81	June 83	L + D	Yes	No	N/A
FL A18165	CP 217-2	93H 92-10	156		S	SBS j1	01/06	B	Sept. 81	May 82	D	No	No	No
	CP 341-1	93H 43-35	188		SW	SBS f	01/05	B	June 84	June 85	R	No	No	Yes
	CP 344-1+4	93H 52-27	170		NW	SBS f	N/A	B	Aug 85	June 86	R + D	No	No	No
	CP 345-16A	93H 52-49	11	(11)	Flat	SBS f	01	N	June 85	June 86	L + R	Yes	No	Yes
	CP 371-1	93H 63-31	43		W	SBS f	05/06	N	July 85	June 86	R	No	No	N/A
FL A181866	CP 33	93H 42-32	220		NE	SBS j1	N/A	B	Oct. 83/84	May 85	D	No	No	N/A
TSHL A04019	CP 12	93G 60-48	87		Var.	SBS j1	07	B	Oct. 81	May 83	R + D	No	No	Yes
TSHL A04463	CP 30	93G 69-23	257		NW	SBS j1	01	N	June 82	May 84	D	No	No	N/A
TSHL A04020	CP 35	93G 39-50	98		Var.	SBS e2	07	B	Fall 81	June 83	D + R	No	No	Yes
TSHL A04041	CP 106A	93H 31-01	133		NE	SBS j1	01	W	Fall 81	Naturals	F + D	No	No	N/A
TSHL A09662	CP "Q"	93H 97-09	121	(49)	NW	SBS f	N/A	B	Sept. 81	June 83	L + D	Yes	Yes	Yes*
TS A08577	CP "K"	93H 41-39	176		S	SBS j1	05/06	N	Sept. 81	April 83	L + D	Yes	Yes	Yes
TS A08577	CP "M"	93H 42-01	113		SE	SBS j1	N/A	B	Sept. 81	May 83	L + D	Yes	Yes	Yes
TS A09674	CP "E"	93G 9L-20	146		W	SBS j1	N/A	N+W	Aug. 81	May 83	L + D	Yes	No	Yes
TSL A08570	CP "A"	93G 90-13	29		S	SBS j1	N/A	B	Aug. 81	May 83	D	Yes	No	No

1 When available, the area defoliated is shown in parentheses
2 Abbreviation for biogeoclimatic
3 Definitions of abbreviations: B=broadcast, L=landing piles, W=windrows, N=wildfires
4 Definitions of abbreviations: R=regional staff, D=district staff, F=FIDS Rangers, L=licensee staff
* Planting delayed

TABLE 3 PRINCE GEORGE WEST FOREST DISTRICT SUMMARY

STAFF COMMENTS:

- currently a minimal problem in relation to overall planting program and availability of alternate planting sites
- total of $17 000 seedling losses to date
- first reports of BAC usually received from licensee personnel
- require damage appraisal data to assist in the decision-making process when BAC is present at time of planting
- more training required for planters, district and licensee personnel

SUBZONE DISTRIBUTION OF BAC INFESTATIONS:		
	e2	54%
	j1	38%
	f	8%

PREDOMINANT ECOSYSTEM ASSOCIATION: 01

FREQUENCY OF BAC: 7 of 13 = 54%

NOTES ON FILES

TABLE 4 SUMMARY OF SITE CHARACTERISTICS FOR BAC-INFESTED PLANTATIONS IN THE PRINCE GEORGE WEST FOREST DISTRICT

Location		Opening Number	Area (ha)[1]	Aspect	BGC[2] Subzone	Assoc.	Burn Type[3]	Burning Date	Planting Date	Source[4]	File Notes	File Map	Seedling Damage
FL A18171	CP 122-40	93J 10e-12	282	Var.	SBS e2	N/A	B	Sept. 29/84	Aug. 85	R + D	No	No	N/A
	CP 123-31	93J 10e-13	229	Var.	SBS e2	N/A	B	Sept. 29/84	July 86	R + D	No	No	N/A
	CP 602-12	93J 7c-33	94	SW	SBS e2	01/07	B	Sept. 9/83	June 84 (BAC adults in 84)	R + D	No	No	No
	CP 603-6	93J 7f-15	62	Var.	SBS e2	Var.	L	Sept. 83	June 84 (BAC adults in 84)	R + D	Yes	No	No
	CP 781-M4	93J 9a-08	142	SW	SBS f	01	B	Sept. 30/84	June 85	L + D	Yes	No	N/A
	CP 902-42	93J 9f-38	84	SE	SBS j1	01	B	Aug. 28/82	June 84	L + D	No	No	N/A
TSHL A00916	CP 46-17	93J 9f 23	77	Var.	SBS j1	06	B	Oct. 81	May 83	R + D	Yes	Yes	Yes
	CP 64-9	93J 15f-15	93	NE	SBS j1	N/A	L	Summer 80	June 81 (BAC in 82)	R + D	Yes	No	Yes
	CP 65	93J 15f-14	157	NE	SBS j1	N/A	B	Fall 81	June 82	R + D	Yes	No	No
TSHL A04449	CP 126-11	93J 15e-509	64	N	SBS j1	01	B	Fall 81	May 83	L + D	No	No	No*
	CP 128-6	93J 11h-03	133	NE	SBS e2	01	B	Sept. 22/82	Aug. 83	R + D	Yes	No	No
	CP 134-7	93J 10e-10	178	SE	SBS e2	01	B	Sept. 25/82	July 83	L + D	Yes	No	Yes
	CP 135-2	93J 10c-32	68	Var.	SBS e2	01/08	B	Sept. 20/82	Aug. 83	L + D	No	No	Yes

1 When available, the area defoliated is shown in parentheses
2 Abbreviation for biogeoclimatic
3 Definitions of abbreviations: B=broadcast, L=landing piles, W=windrows, N=wildfires
4 Definitions of abbreviations: R=regional staff, D=district staff, F=FIDS Rangers, L=licensee staff
* Planting delayed

TABLE 5 LAKES FOREST DISTRICT SUMMARY

STAFF COMMENTS:
- very minor problem at present time
- infestations have had minimal effect on stocking
- little attention paid to this pest due to insignificant impact

SUBZONE DISTRIBUTION OF BAC INFESTATIONS:

ESSF k	60%
SBS e1	40%

PREDOMINANT ECOSYSTEM ASSOCIATION: 01

FREQUENCY OF BAC: 0 of 5 = 0%

NOTES ON FILES

TABLE 6 SUMMARY OF SITE CHARACTERISTICS FOR BAC-INFESTED PLANTATIONS IN THE LAKES FOREST DISTRICT

Location	Opening Number	Area (ha)[1]	Aspect	BGC[2] Subzone	Assoc.	Burn Type[3]	Burning Date	Planting Date	Source[4]	File Notes	File Map	Seedling Damage
FL A16823 CP 38-1	93K 6b-27	68	SW	SBS e1	N/A	B	Sept. 83	June 86 (BAC in 85)	F	No	No	No
FL A16823 CP 105-2	93K 12d-02	38	E	ESSF k	01	B W	Fall 81 Sept. 83	May 84	F	No	No	No
FL A16823 CP 105-3	93K 12d-03	64	NE	ESSF k	01	B W	Fall 81 Sept. 83	May 84	F	No	No	No
FL A16823 CP 105-4	93K 12d-04	133	E	ESSF k	01	B	Fall 82	May 84	F	No	No	No
FL A18623 CP 118-1	93k 12c-12	68	W	SBS e1	N/A	B B	Sept. 83 Sept. 83	July 85	F	No	No	No

1 When available, the area defoliated is shown in parentheses
2 Abbreviation for biogeoclimatic
3 Definitions of abbreviations: B=broadcast, L=landing piles, W=windrows, N=wildfires
4 Definitions of abbreviations: R=regional staff, D=district staff, F=FIDS Rangers, L=licensee staff

TABLE 7 MORICE FOREST DISTRICT SUMMARY

STAFF COMMENTS:

- small problem currently; have had to replant six or eight blocks due to BAC losses
- potential for increasing damage when spring burning program is accelerated
- may be a larger problem than thought, if infestation occurs after planting
- require biological information and procedures for pheromone trapping
- training for district/licensee/planters is desirable
- planting delay is feasible early in season; not an option later (June)

SUBZONE DISTRIBUTION OF BAC INFESTATIONS:

e1	88%
d	8%
ESSF 1	4%

PREDOMINANT ECOSYSTEM ASSOCIATION: 01

FREQUENCY OF BAC: 5 of 24 = 21%

NOTES ON FILES

TABLE 8 SUMMARY OF SITE CHARACTERISTICS FOR BAC-INFESTED PLANTATIONS IN THE MORICE FOREST DISTRICT

Location		Opening Number	Area (ha)[1]		Aspect	BGC[2] Subzone	Assoc.	Burn Type[3]	Burning Date	Planting Date	Source[4]	File Notes	File Map	Seedling Damage
FL A16827	CP 50-1	93E 96-17	15		W	SBS e1	01	B	Sept. 83	May 84	F	No	No	No
	CP 103-3	93E 97-14	103		N	SBS e1	01	B	Sept. 83	May 84	F	No	No	Yes
	CP 106-1	93L 06-08	102		SW	SBS e1	01	N	June 84	Not planted	F	No	No	N/A
	CP 107-2	93L 06-03	18		SW	SBS e1	01	B	Sept. 83	May 85	L	Yes	No	Yes
	CP 114-3	93E 96-07	90		SE	SBS e1	01	B	Sept. 83	May 84	F	No	No	No
	CP 148-2	93L 05-08	57		E	SBS e1	01	B	Sept. 83	May 84	L	No	No	No
	CP 148-3	93E 95-01	32		SW	SBS e1	01	B	Sept. 83	May 84	F	No	No	No
	CP 151-3	93E 96-29	32		SW	SBS e1	01	B	Oct. 85	Aug. 86	L	No	No	N/A
	CP 503-1, 2, 3	93L 03-01	275		W	ESSF 1	01/06	B	Fall 80/ 81/82	Aug. 83	F	No	No	Yes
FL A16828	CP 27-1	93L 14-02	60		SW	SBS e1	01/06	B	Aug. 20/85	June 86	L	No	No	N/A
	CP 37-1, 2, 3	93L 78-14, 15, 18	192		NE	SBS e1	07	B	Fall 82	May 84	F	No	No	No
	CP 3705	93L 78-19	128		NE	SBS e1	08	B	Sept. 83	May 84	F	No	No	No
	CP 105-1	93L 56-01	8		NE	SBS e1	01/09	B	Fall 82	May 83/84	F	No	No	No
	CP 110-4, 5	93M 19-04, 05	123		Flat	SBS e1	07	B	Sept. 83	May 85	F	No	No	No
	CP 160-1	93L 88-10	292	(47)	Flat	SBS e1	01/07	B	Fall 80	June 82	L	Yes	Yes	Yes
	CP 221-1	93L 26-04	33		W	SBS d	01	N	June 82	May 84	F	No	No	No*
	CP 221-2	93L 26-23	26	(6)	W	SBS d	01/08	N	June 82	May 84/85	F + L	Yes	No	Yes
	CP 307-1	93L 56-04	21		SE	SBS e1	01/06	B	Sept. 83	June 85	F	No	No	No
	CP 307-2	93L 56-02	43		NE	SBS e1	01	B	Sept. 83	June 84	F	No	No	Yes
	CP 399-1A	93L 78-01	87		NE	SBS e1	01	B	Fall 80	June 82	L	No	Yes	N/A
	CP 504-4	93L 04-10	114		NE	SBS e1	01	B	Fall 82	Aug. 83	F + L	Yes	Yes	Yes
THSL A09289	CP 502-10	93L 04-03	37		NW	SBS e1	01	B	Sept. 83/84	June 85	L	No	No	N/A
THSL A03625	CP 157.10	93E 98-06	51		SE	SBS e1	01	B	Fall 81	May 83	L	Yes	No	Yes
THSL A01479	CP 143-10	93L 06-07	86		NE	SBS e1	01	B	Fall 82	May 84	L	No	No	N/A

1 When available, the area defoliated is shown in parentheses
2 Abbreviation for biogeoclimatic
3 Definitions of abbreviations: B=broadcast, L=landing piles, W=windrows, N=wildfires
4 Definitions of abbreviations: R=regional staff, D=district staff, F=FIDS Rangers, L=licensee staff
* Planting delayed

TABLE 9 BULKLEY FOREST DISTRICT SUMMARY

STAFF COMMENTS:

- fairly adequate training at district and licensee staff to date
- planting commonly undertaken prior to defoliation; need hazard-rating system at time of pre-harvest assessment (first priority)
- damage concentrated in one drainage currently
- alternate sites presently available and planting delay usual in affected area in an effort to reduce losses
- may confuse BAC defoliation with vole damage
- damage appraisal studies should include stock type and should investigate subsequent growth form three to five years following defoliation
- potential losses due to brush competition not as great as BAC losses in currently affected area
- fireweed and colt's-foot are the preferred herbaceous species; very low levels of Indian hellebore/asters

SUBZONE DISTRIBUTION OF BAC INFESTATIONS:		
	e1	89%
	e2	11%

PREDOMINANT ECOSYSTEM ASSOCIATION: 06

FREQUENCY OF BAC: 1 of 9 = 11%

NOTES ON FILES

TABLE 10 SUMMARY OF SITE CHARACTERISTICS FOR BAC-INFESTED PLANTATIONS IN THE BULKLEY FOREST DISTRICT

Location		Opening Number	Area (ha)[1]	Aspect	BGC[2] Subzone	Assoc.	Burn Type[3]	Burning Date	Planting Date	Source	File Notes	File Map	Seedling Damage
FL A16829	CP 3-2	93L 15g-22	145 (69)	E	SBS e1	1.1	B	Sept. 11/80	May 81	F + L	Yes	No	Yes
	CP 3-6	93M 3d-13	6 (6)	E	SBS e2	06	B	Sept. 11/80	May 81	L	No	No	Yes
	CP 4-2, 6	93M 2c-09	595 (101)	E	SBS e1	06/07	B	Sept. 11/80	May 81	L	No	No	Yes
	CP 14-2	93M 2c-35	72 (72)	Flat	SBS e1	07/1.2	B	Sept. 81	May 83	L	No	No	Yes
	CP 15	93M 2c-33	320	E	SBS e1	Var.	B	Aug. 83	May 86	L	No	No	No*
	CP 18-1	93M 2c-40	97 (60)	S	SBS e1	1.1/08	B	Sept. 29/84	June 85 (BAC in 86)	F + L	No	No	Yes
	CP 22-1	93M 2e-08	88 (88)	SW	SBS e1	06	B	Sept. 27/84	May 86	F + L	No	No	Yes
	CP 23-2	93M 2e-13	90 (90)	SW	SBS e1	03/06	B	Sept. 27/84	June 85 (BAC in 85/86)	L	No	No	Yes
	CP 81	93M 2b-09	373	Var.	SBS e1	04/06	B	Sept. 19/81	May 83	L	No	No	No

1 When available, the area defoliated is shown in parentheses
2 Abbreviation for biogeoclimatic
3 Definitions of abbreviations: B=broadcast, L=landing piles, W=windrows, N=wildfires
4 Definitions of abbreviations: R=regional staff, D=district staff, F=FIDS Rangers, L=licensee staff
* Planting delayed