Spruce Budworm (*Choristoneura Fumiferana* Clem.) Collections Shipped from the Great Lakes Forestry Centre (Sault Ste. Marie) to the Biosystematics Research Centre (Ottawa) from 1983 to 1989

G.T. Harvey

Forestry Canada
Ontario Region
Great Lakes Forestry Centre
Sault Ste. Marie, Ontario

1991

Miscellaneous Report 108

Catalogue No. Fo29-8/108E
ISBN 0-662-19067-X
ISSN 0832-7130

Additional copies of this publication are available at no charge from:

Communications Services
Great Lakes Forestry Centre
Ontario Region
Forestry Canada
P.O. Box 490
Sault Ste. Marie, Ontario
P6A 5M7

Microfiches of this publication may be purchased from:

Micro Media Inc.
Place du Portage
165, Hôtel-de-Ville
Hull, Quebec
J8X 3X2

Harvey, G.T. 1991. Spruce budworm collections shipped from the Great Lakes Forestry Centre (Sault Ste. Marie) to the Biosystematics Research Centre (Ottawa) from 1983 to 1989. For. Can., Ont. Region, Sault Ste. Marie, Ont. Misc. Rep. 108. 18 p.

ABSTRACT

This report describes the origins and characteristics of 10 shipments of spruce budworm (Choristoneura spp.) collections from Forestry Canada's Great Lakes Forestry Centre to the Biosystematics Research Centre from 1983 to 1989. In all, the collections comprised 12 species in genus Choristoneura.

RÉSUMÉ

Le présent rapport décrit l'origine et les caractéristiques dans 10 envois de spécimens de la tordeuse des bourgeons de l'épinette (Choristoneura spp.) que le Centre de foresterie des Grands Lacs a fait parvenir au Centre de recherches biosystémiques de 1983 à 1989. Les collections contenaient au total 12 espèces du genre Choristoneura.

TABLE OF CONTENTS

INTRODUCTION

A large collection of coniferophagous Choristoneura, described by Harvey and Roden (1979) was delivered to P.T. Dang at the Canadian National Collection of the Biosystematics Research Centre (BRC, Ottawa, Ontario in May 1983. Explanations of the sources, methods of collection and rearing, mating and labeling were described in that report. This material now forms an identified part of the Canadian National Collection and is being curated by P.T. Dang. It constitutes what is probably the largest assemblage of conifer-feeding Choristoneura anywhere in the world.

Subsequent to the shipment of that collection, a number of smaller collections were received by G.T. Harvey from several sources across North America. As before, these larval collections were reared to maturity and bred for experimental purposes. Some of the adults developing from field-collected larvae were saved, as were adults produced by rearing experiments. These adults include various hybrids and other valuable taxonomic material and have from time to time been shipped to be added to the previous material at BRC. Most of this material consisted of freshly eclosed adults kept frozen until shipment but unpinned. Techniques of their collection, rearing, labeling, etc., are detailed in Harvey and Roden (1979), and also apply to collections described herein. These shipments totaled approximately 1,750 insects.

In addition, there is material collected during field studies in the Yukon and northern British Columbia in 1986, 1987 and 1988 using pheromone-baited traps to sample local populations in a number of locations. Some of these insects were frozen and used for electophoresis, but insects in excess of our needs for electrophoresis, including many still stuck in the traps, were also included in shipments to P.T. Dang. Approximately 500 insects were included in this category. The identity of these insects has not been clearly established; information pertinent to establishing their identity (location and time of trapping and identity of the pheromone bait used) is included in the present report (Table 6). Further details of the trapping procedures and the presumed identity of the specimens based on allozyme characterization are described in Harvey (1991).

Details of all collected material shipped to P.T. Dang at various times between 1983 and the present have been summarized in this report (Table 1). Specific details about the stocks, whether they represent second diapause insects, etc. are also listed in Table 1. Parents designated as 'F' or 'F'84', etc. (often coupled with the location code of Tables 2 and 5) were adults eclosing in the laboratory from field-collected insects. Insects mated in the laboratory (all single-pair matings) produced the 'F1' generation of inter se or crossed families; most of these families include a family number, e.g. 0'6 ANE 25. Collection information for all the material in Table 1 is listed in Tables 2 and 3. A summary of all F1 hybrid material has also been prepared (Table 4), including the hybrids listed in Harvey and Roden (1979). An alphabetical listing of collection codes by species for all collections except the trapped males has been included (Table 5). Species names, with authorities and synonyms, are listed in Table 7 along with the abbreviations used for species identification in Tables 1-6.

LITERATURE CITED

Harvey, G.T. 1985. The taxonomy of coniferophagous Choristoneura (Lepidoptera: Tortricidae): a review. p. 16-59 in C.J. Sanders, R.W. Stark, E.J. Mullins and J. Murphy, Ed. Recent advances in spruce budworms research. Proc. CANUSA Res. Symp., Bangor, Maine, 16-20 Sept. 1984.

Harvey, G.T. 1991. Field studies of spruce budworms in Yukon and British Columbia, 1986, 1987 and 1988. For. Can., Ont. Region, Misc. Rep. (in preparation).

Harvey, G.T. and Roden, P.M. 1979. Special collection of coniferophagous Choristoneura species and hybrids at the Great Lakes Forest Research Centre, Sault Ste. Marie, Canada. Dep. Environ., Can. For. Serv., Sault Ste. Marie, Ont. Inf. Rep. O-X-293. 27 p. + Appendix.

Powell, J.R. and DeBenedictis, J. 1982. Taxonomic relationships and pheromone isolations among western spruce budworm populations. Canada/U.S. Spruce Budworms Program-West. Portland, OR. Final Report. 40 p.

Table 1. Choristoneura specimens delivered to P.T. Dang (BRC) after May 1983 in separate shipments, as designated.

Identity	Parents	Females	Males
Shipment 1, Part 1: Adults delivered by Dave Kennington, 5 October 1982			
1. Field-collected material			
C. occidentalis			
F'82 ALK	F	–	4
F'82 ASH	F	5	–
F'82 PIM	F	9	3
C. orae			
F'82 KIS	F	2	–
2. Adults from laboratory stocks			
C. orae: Post-second-diapause insects. Numbers shipped were not recorded; numbers shown are total adults obtained, of which not all may have been shipped.			
0'6 ANE 25 Diap	F'0-ANE	(12	18)
0'6 ANE 42 Diap	F'0-ANE	(2	8)
0'6 ANE 43 Diap	F'0-ANE	(4	12)
0'6 ANE 67 Diap	F'0-ANE	(8	10)
Adults from a second-diapause experiment. Families were split at entrance into storage 24 July 1981. Part I was reared 1 February 1982 (27 weeks). Part II was reared 23 April 1982 (38 weeks). Adults developed in both parts but there were high levels of second diapause. Diapausing insects from both parts were stored and reared 3 February 1983 (48 and 38 weeks, respectively). Freshly eclosed adults were frozen and sent to BRC, probably from three portions of this experiment: (1) adults developing without second diapause from Part I; (2) adults developing after a second diapause from Part I; and (3) adults developing after a second diapause from Part II. (Adults from 2 and 3 appear to have been shipped later, as indicated.)			
Section 1. (Non-second diapause)			
1'6 ANC 1A	F'1-ANC	0	2
1'6 ANC 2A	F'1-ANC	3	2
1'6 ANC 4A	F'1-ANC	6	5
1'6 ANC 7A	F'1-ANC	9	9
1'6 ANC 10A	F'1-ANC	1	9
1'6 ANC 11A	F'1-ANC	4	3
1'6 ANC 15A	F'1-ANC	0	1
1'6 ANC 17A	F'1-ANC	1	0
1'6 ANC 20A	F'1-ANC	6	11

(cont'd)

Table 1. Choristoneura specimens delivered to P.T. Dang (BRC) after May 1983 in separate shipments, as designated (cont'd).

Identity	Parents	Females	Males
Shipment 1, Part 2: Approximately 18 March 1983, or later, perhaps as part of Shipment 2.			
Section 2. Post-second-diapause, Part A			
1'6 ANC 1A	F'1-ANC	3	3
1'6 ANC 2A	F'1-ANC	1	4
1'6 ANC 4A	F'1-ANC	0	4
1'6 ANC 7A	F'1-ANC	1	1
1'6 ANC 10A	F'1-ANC	8	3
1'6 ANC 11A	F'1-ANC	0	2
1'6 ANC 15A	F'1-ANC	1	5
1'6 ANC 17A	F'1-ANC	6	1
1'6 ANC 20A	F'1-ANC	0	2
Section 3. Post-second-diapause, Part B			
1'6 ANC 1B	F'1-ANC	1	4
1'6 ANC 2B	F'1-ANC	0	7
1'6 ANC 4B	F'1-ANC	1	2
1'6 ANC 7B	F'1-ANC	4	5
1'6 ANC 10B	F'1-ANC	4	1
1'6 ANC 11B	F'1-ANC	1	3
1'6 ANC 15B	F'1-ANC	6	8
1'6 ANC 17B	F'1-ANC	0	0
1'6 ANC 20B	F'1-ANC	7	1
Shipment 2: Adults from laboratory-reared families delivered May 1983			
C. occidentalis			
2'6 ASH	F'2-ASH	10	20 (3 families)
2'6 PIM	F'2-PIM	10	18 (4 families)
Shipment 3: Post-diapause adults in progenies of laboratory-reared families delivered by Leslie Cree, May 1984.			
C. occidentalis			
2'6 ASH	F'2-ASH	3	7 (1 family)
C. orae			
2'6 KIS	F'2-KIS	11	12 (2 families)

(cont'd)

Table 1. Choristoneura specimens delivered to P.T. Dang (BRC) after May 1983 in separate shipments, as designated (cont'd).

Identity	Parents	Females	Males
Shipment 4: Adults delivered by G.T. Harvey, 22 September 1985.			
1. Field collections			
C. orae			
F'84 ANO	F received as adults	21	78 (dead)
F'84 KEN	F	4	14
F'84 KIT	F	1	4
F'85 Alaska (COP-1)	F	19	17
C. occidentalis			
F'85 HAR-1	F	14	20
F'85 HAR-2	F	2	15
F'85 SAV	F	10	17
F'85 Colorado	F	8	20
F'85 POB	F	3	9
F'85 POL	F	–	8
C. carnana californica			
F'85 CAR	F	6	9
C. fumiferana			
F'85 Fort Nelson	F	3	4
2. Laboratory-reared Stocks			
C. orae			
2'6 KIS 209 J3	F'82 KIS	1	–
4'7 ANO A1	F'84 ANO	1	6
4'7 ANO B2	F'84 ANO	3	–
4'7 KIT 124 C8	F'84 KIT	2	–
4'7 KIT 126 D7	F'84 KIT	1	–
C. fumiferana			
4'7 SIT 64 F3	F'84 SIT	1	–
4'7 SIT 66 H6	F'84 SIT	1	–
4'7 SIT 67 J7,J11,J2	F'84 SIT	2	1
4'7 SIT 68 K2,K5,K5	F'84 SIT	–	3
Hybrids	Female X male		
0'6 ORPI 243	F'80-ANE X GIL	1	1
0'6 ORPI 244	F'80 ANE X JOM	–	1
0'6 ORFU 248	F'80 ANE X MAN	–	3
0'6 ORFU 249	F'80 ANE X MAC	–	1
0'6 ORFU 251	F'80 ANE X KIR	–	2
4'7 ORPI 128	F'84 KIT X KIR	–	4
4'7 ORPI 130	F'84 KIT X KIR	1	–

(cont'd)

Table 1. Choristoneura specimens delivered to P.T. Dang (BRC) after May 1983 in separate shipments, as designated (cont'd).

Type	Family identity	Parents (Female X Male)[a]	Adults sent F	M	Box
Shipment 5: Adults delivered by D.R. Wallace, 6 April 1987.					
1. Laboratory-reared families: A. Interspecies crosses					
OCPO	5'6 OCPO 201	F'85 COL X POL	4	2	1
	5'6 OCPO 202	F'85 COL X POB	2	3	1
	5'6 OCPO 203	F'85 COL X POB	0	1	1
	5'6 OCPO 212	F'85 HAR X POB	10	35	3
OCPI	5'6 OCPI 147	F'85 COL X FLA	1	1	1
	5'6 OCPI 149	F'85 COL X FLA	0	1	1
FUPO	5'6 FUPO 219	F'85 TER X POB	1	8	1
	5'6 FUPO 230	F'85 TER X POL	0	10/28	1/3
FUPI	5'6 FUPI 243	F'85 TER X RAJ	10	20	1
	5'6 FUPI 246	F'85 TER X RAJ	15	16	1
	5'6 FUPI 249	F'85 TER X RAJ	6	14	1
	5'6 FUPI 250	F'85 TER X RAJ			
PIFU	5'6 PIFU 239	F'85 RAJ X TER	3	3	1
1. Laboratory-reared families: B. Inter-se stocks					
C. occidentalis					
	5'6 COL 86	F'85 COL	2	0	1
	5'6 COL 107	F'85 COL	1	1	1
	5'6 HAR 255	F'85 HAR	8	9	1
C. orae					
	5'6 COP 11	F'85 COP	2	1	1
	4'7 ANO 1A	F'84 ANO	10	11	1
	4'7 ANO 2B	F'84 ANO	4	4	1
	4'7 KIT 124	F'84 KIT	0	1	1
	4'7 KIT 126	F'84 KIT	3	1	1

(cont'd)

Table 1. Choristoneura specimens delivered to P.T. Dang (BRC) after May 1983 in separate shipments, as designated (cont'd).

Type	Family identity	Parents (Female X Male)[a]	Adults sent F	Adults sent M	Box
2. Field-collected insects					
C. fumiferana					
	F'86 NEL	F	29	30	2
C. occidentalis					
	F'86 SAB	F	6	12	2
	F'86 CAB	F	0/14	11/10	2/3
	F'86 IND	F	21	21	2
	F'86 JON	F	0/1	2/1	2/3
C. biennis					
	F'86 BON	F	5/1	6/1	2/3
	F'86 BOP	F	6/7	7/3	2/3
	F'86 DET	F	10	20	2
	F'86 WIL	F	0/5	1/2	2/3
C. lambertiana ponderosana					
	F'86 LAP	F	0	10	2

Location	Bait	Number of moths	Code	Tentative identity
3. Hand-collected moths, Yukon 1986. Special coded series. (Insects labeled by code only.)				
Kathleen Lake	'fob'	13	1	C. biennis?
Kathleen Lake	'orae'	54	2	C. orae
Carmacks	'fob'	8	3	C. fumiferana
Minto Landing	'fob'A	9	4A	C. fumiferana
Minto Landing	'fob'B	1	4B	C. fumiferana
Minto Landing	'orae'A	15	5A	C. orae
Minto Landing	'orae'B	8	5B	C. orae

(cont'd)

Table 1. Choristoneura specimens delivered to P.T. Dang (BRC) after May 1983 in separate shipments, as designated (cont'd).

Family identity[bc]		Parents (Female X male)	Adults sent Females	Males	Box
Shipment 6: Moths shipped 28 October 1987					
1. Laboratory-reared moths					
HYBRIDS					
BIPI	6'6 BIPI 249	F'86 BOP X YAJ	8	8 M	A
			2	6	A
	6'6 BIPI 251	F'86 DET X YAJ	12	13 M	A
			9	17	A
BIPO	6'6 BIPO 187	F'86 BON X LAP	3	2 M	A
	6'6 BIPO 201	F'86 BOP X LAP	2	4 M	A
			1	6	A
FUPO	6'6 FUPO 191	F'86 EAR X LAP	0	1	A
OCOR[d]	6'5 OCOR 10	5'6 HAR-264 X COP-11	1	16	B
	6'5 OCOR 46	5'6 HAR-264 X COP-18	15	15	B
OROC[d]	6'5 OROC 57	5'6 COP-11 X HAR 264	1	0	B
	6'5 OROC 66	5'6 COP 11 X HAR-264	7	11	B

	Code	Parents	Females	Males	Box
2. Adults from field-collected insects					
C. biennis	F'86 WIL	F	2	5	A
C. fumiferana	F'87 NEL	F	3	14	A
	F'87 NES	F	2	5	A

(cont'd)

Table 1. Choristoneura specimens delivered to P.T. Dang (BRC) after May 1983 in separate shipments, as designated (cont'd).

Location[f]	Bait[e]	Approximate Collection date	number of males
Shipment 7: Moths shipped 28 October 1987. Trapped moths from Yukon locations, collected in July 1987. (Box C)			
Treatment A. Moths on sticky traps - labels on traps			
Moose Creek	fob	11 July 1987	50
Dawson 'A' (Rock Cr.)	fob	11 July 1987	10
Tok, AK	fob	14 July 1987	10
Moths probably not spruce budworm			
Dawson 'A' (87-12)	ora	12 July 1987	6
Dempster Hwy (87-11)	ora	12 July 1987	6
Beaver Creek (87-19)	ora	15 July 1987	3
Chistochina, AK (87-15)	ora	14 July 1987	4
Treatment B. Moths caught in IPL traps (not sticky) in snap-cap vials (S collections)[f]			
S-3 Moose Creek	fob	11 July 1987	20
S-4 Chistochina, AK	ora	14 July 1987	8
S-6 Carmacks	fob	10 July 1987	26
S-7 Haines Junction	fob	16 July 1987	1
S-8 Tutshi Lake, B.C.	Pi female	20 July 1987	4
Treatment C. Moths from sticky traps, transferred to snap-cap vials			
poly 34 Tutshi Lake	ora	20 July 1987	14
Shipment 8: Shipped 10 November 1987 by courier. Other species (not spruce budworm). Collected in traps at Haines Junction (location 87-21).			
8 Moths: Tentative identification: Archips spp.			

(cont'd)

Table 1. Choristoneura specimens delivered to P.T. Dang (BRC) after May 1983 in separate shipments, as designated (cont'd).

Location[f]	Code	Bait	Collection date	Approximate number of males to: P.T. Dang	R.F. Shepherd
Shipment 9: Moths shipped 29 August 1988. Trapped moths from Yukon locations, collected in July 1988.					
Treatment A. Moths on sticky traps - labels on traps.					
Smith River	88-12	fob	09 July 1988	22	30
Crossing	88-16	fob	11 July 1988	53	54
Liard River	88-17	fob	11 July 1988	27	48
Fort Nelson,	88-24	ora	13 July 1988	14	-
Location 2	88-26	fob	13 July 1988	32	44
	88-33	Pi fem	14 July 1988	28	-
	88-34	Fu fem	14 July 1988	36	42
	88-36	fob	14 July 1988	31	54
McKenzie Junction	88-58	ora	20 July 1988	18	10 (flattened)
Davie Lake	88-41	ora	18 July 1988	5	-
	88-60	ora	20 July 1988	24	25
	88-59	fob	20 July 1988	-	9
Bear Lake	88-39	ora	18 July 1988	5	-
	88-61	ora	20 July 1988	6	18
Treatment B. Moths caught in IPL traps (not sticky). In snap-cap vials.					
Liard River	88-10	fob	09 July 1988	10	0
Fort Nelson, Location 2	88-27	fob	14 July 1988	23	0
Treatment C. Adults from field-collected larvae (Shepherd/Harvey study).					
C. biennis	F'88	MAC	21 June 1988	30	13
	F'88	TUM	25 June 1988	15	17
C. fumiferana	F'88	LID	23 June 1988	30	40
	F'88	NEL	21 June 1988	30	43
	F'88	EAR	10 June 1988	16	16
Treatment D. Voucher specimens from special collection. (Larvae collected by N. Mills, Commonwealth Institute for Biological Control.)					
C. murinana	F'88	SIN	10 June 1988	20+20	0

(cont'd)

Table 1. Choristoneura specimens delivered to P.T. Dang (BRC) after May 1983 in separate shipments, as designated (concl.)

	Identity	Parents	Females	Males
Shipment 10: Adults delivered by G.T. Harvey, February 1989				
1. Adults from field-collected larvae				
C. biennis	F'88 MAC	F	1	9
C. fumiferana	F'88 LID	F	8	4
	F'88 NEL	F	1	22
C. murinana	F'88 SIN	F	4	15

[a] Crosses between adults eclosing in the laboratory from field-collected larvae.

[b] "F" parents were adults eclosing in the laboratory from field-collected larvae. M = mated pairs. The 5'6 parents were the first laboratory generation from a 1985 collection.

[c] None of these insects were post-second diapause.

[d] Although our records seem to be in order, some results we have obtained from these hybrids and their parents do not conform to previous results from C. orae.

[e] All these baits were made in 1987 by T. Gray.

[f] Treatment of captured moths: A = Traps stored in cold room except during travel and shipment. B = Moths stored in standard freezer. C,D = Moths frozen in liquid nitrogen, transferred to low-temperature freezer until transfer to snap-cap vials, 1 October 1987.

Table 2. Locations of Choristoneura larval collections.

Location	Code	UTM Grid	Host	Date	Collector
C. fumiferana					
McCron Twp, 5 miles west White River, Ont.	MAC	16 61 539	Sw	12/6/80	W.D. Biggs
Manitouwadge, Ont.	MAN	16 58 539	Bf/Sw	05/6/80	G.T. Harvey
Terrace Bay, Ont.	TER	16 49 540	Sw	24/6/85	V. Jansons
Ear Falls, Ont.	EAR	15 48 560	Bf	11/6/86	D. Constable
	EAR	15 48 560	Bf	10/6/88	C. Jones
Fort Nelson, B.C.			Sw	24/6/85	J. Loranger
Fort Nelson, B.C.	NEL	10 48 653	Sw	24/6/86	R. Garbutt
(Fort Nelson River)	NEL	10 48 658	Af	16/6/87	R. Turnquist
'NES'	NEL	10 48 655	Sw	17/6/87	R. Turnquist
	NEL	10 48 657	Sw	21/6/88	R. Turnquist
Liard River Hot Springs, B.C.	LID	09 67 659	Sw	23/6/88	R. Turnquist
Smith River, NWT	SIT	09 60 662	Sw	23/6/84	J. Loranger
C. occidentalis					
Kamloops, B.C.	HAR	10 70 562	Df	09/7/85	R.O. Erickson
Savona, B.C.	SAB	10 64 563	Df	30/6/85	R.F. Shepherd
	SAB	10 65 563	Df	18/6/86	R.O. Erickson
	IND	10 64 561	Df	18/6/86	R.O. Erickson
	CAB	10 65 563	Df	18/6/86	R.O. Erickson
Ashcroft, B.C.	ASH	10 62 559	Df	23/6/82	P.T. Dang
Pimainis Hills, B.C.	PIM	10 62 559	Df	25/6/82	P.T. Dang
Johnstone Creek Prov. Park, B.C.	JON	11 35 543	Df	18/6/86	J. Vallentgoed
Lyons, Boulder, Col.	COL	13 63 444	Df	28/6/85	R.E. Stevens
Lyons, Boulder, Col.	POB	13 63 444	Df	21/6/85	R.E. Stevens
Estes Park, Larimer, Colorado	POL	13 63 444	Pp	24/6/85	R.E. Stevens
C. biennis					
Pinkerton Mountain, Upper Fraser, B.C.	BOP	10 61 594	Df	11/6/86	R. Garbutt et al.
Mackay River (Bowron Park)	MAC	10 65 580	Df	21/6/88	R.O. Erichson
Tumerich Road	TUM	10 59 595	Al	25/6/88	R. Ferris
Bowron Coal Road, km 99 Prince George, B.C.	BON	10 58 594	Sw	04/6/86	R. Garbutt
Dietrich Creek, Canam Lake Cariboo District, B.C.	DET	10 65 578	Al	13/6/86	R. Andrews
Willow River Wells, Cariboo, B.C.	WIL	10 57 589	Al	16/6/86	R. Andrews

(cont'd)

Table 2. Locations of Choristoneura larval collections (concl.)

Location	Code	UTM Grid	Host	Date	Collector
C. carnana californica					
Trinity County, CA	CAR	10 53 450	Df	10/5/85	W.J.A. Volney
C. orae					
Kispiox, B.C.	KIS	09 56 615	Th	29/6/82	P.T. Dang
Dahl Creek, Kitimat, B.C.	KIT	09 51 600	Al	05/7/84	N. Humphreys
Kenny Lake, Copper River Basin, AL	KEN	07 40 675	Sw	18/5/84	A.G. Gordon
Anchorage, AL	ANE		Sw	13/6/80	E. Holsten
Anchorage, AL	ANC		Sw	3/6/81	E. Holsten
Anchorage, AL	ANO		Sw	11/6/84	E. Holsten
Anchorage, AL	COP	06 38 668	Sw	17/7/85	E. Holsten
C. pinus					
Kirkwood Twp, Ont.	KIR	17 30 513	Pj	03/7/84	P. Roden
Raco, MI	RAJ	16 67 522	Pj	28/6/85	G.T. Harvey
Gillespie Tree Farms, Orillia, Ont.	GIL	17 61 493	Pj	16/6/80	M. Applejohn
Somersville Nursery Loretto, Ont.	JOM	17 58 487	Ps	18/6/80	M. Applejohn
Yaremko Twp, Ont.	YAJ	17 37 518	Pj	25/6/86	P.M. Roden, G. Lucuik
Flame Lake Hwy, Ont.	FLA	17 33 523	Pj	18/6/85	V. Nealis
C. lambertiana ponderosana					
Lyons, Boulder, Col.	POB	13 63 444	Pp	21/6/85	R.E. Stevens
Estes Park, Larimer, Col.	POL	13 63 444	Pp	21/6/85	R.E. Stevens
Fort Collins, Col.	LAP	13 63 444	Pp	12/6/86	D.A. Leatherman
C. lambertiana subretiniana					
Burns, OR (Lab collection)	BUR	11 38 490	Pp	15/8/87?	(R. Beckwith)
C. species near lambertiana?					
McLeod Lake, B.C.	WIJ	10 50 600	Pc	29/6/89	T. Gray
C. species near pinus?					
Ladner, B.C. (Lab collection)	TOM	10 49 544	Pr	14/2/84	(T. Gray)
C. murinana					
Sion, Switzerland	SIN	----------	Aa	10/6/88	N. Mills

Table 3. Collection details for trapped males[a].

Location	Code	UTM Grid	Host	Dates
Bear Lake, B.C.	BBE	1050 600	Pc	18-20/7/88
Davie Lake, B.C.	BDA	1050 600	Sw/Pc	18-20/7/88
Fisher Creek, B.C.	BFI[b]	1056 609	Sw	18-20/7/88
Liard River, B.C.	BLA[b]	1036 657	Sw/Pc	9-11/7/88
Link Creek, B.C.	BLI	1054 609	Sw	18-20/7/88
Mackenzie Junction	BMA	1052 605	Sw/Pc	18-20/7/88
Moberly Lake, B.C.	BMO[b]	1058 612	Sw	16-18/7/88
Fort Nelson 1, B.C.	BNE[b]	1050 651	Sw	12-13/7/88
Fort Nelson 2, B.C.	BNO[b]	1050 650	Sw/Pc	14-14/7/88
Smith River Crossing, B.C.	BSR[b]	963 653	Sw	9-11/7/88
Black River, Ont.	PBL[b]	1655 539	Sw/Bf	20/7/79 8/7/80
Black Sturgeon Lake, Ont.	PBS[b]	1636 546	Sw/Bf	18/7/79 9/7/80
Lefroy Twp, Ont.	PDE[b]	1729 515	Sw/Bf	9/7/79 3/7/80
Gravel River, Ont.	PGR[b]	1644 541	Sw/Bf	18/7/79 10/7/80 24/7/81
Kirkwood, Ont.	PKI[b]	1730 513	Sw	4/7/88-8/7/88
Manitouwadge, Ont.	PMA[b]	1658 539	Sw/Bf	19/7/79 8/7/80
McCron Twp, Ont.	PMC	1661 539	Sw/Bf	16/7/79 11/7/80
Rainbow Falls, Ont.	PRA	1647 541	Sw/Bf	19/7/79 10/7/80
Sibley Pen., Ont.	PSI	1637 537	Sw/Bf	18/7/79 8/7/80
Swallow Lake, Ont.	PSW	1669 536	Sw/Bf	16/7/79 15/7/80
Beaver Creek, Yukon Terr.	YBE	751 686	Sw	15/7/87
Carmacks, Yukon Terr.	YCA	845 686	Sw	14/7/86 9/7/87 19/7/87
Chistochina, Alaska	YCH	740 675	Sw	14/7/87
North Klondike River, Yukon Territory	YDE	860 720	Sw	12/7/87
Rock Creek, Yukon Terr.	YDA	756 708	Sw	12/7/87
Flower Mountain, Yukon Terr.	YFL	843 688	Sw	14/7/86
Haines Junction, Yukon Terr.	YHA	838 671	Sw	20/7/86
			Sw	16/7/87
Klukwan, B.C.	YKL	847 658	Ss/Df	17/7/87
Moose Creek, Yukon Terr.	YMO	843 700	Sw	11/7/87
Ross River, Yukon Terr.	YRO	860 685	Sw	9/7/87
Swift River, Yukon Terr.	YSW	943 663	Sw/Af	18/7/86
Teslin, Yukon Terr.	YTE	860 660	Sw	12/7/86
Tok, Alaska	YTO	747 692	Sw	14/7/87
Tutshi Lake, B.C.	YTU	852 661	Sw/Af	20/7/87
Watson Lake, Yukon Terr.	YWA	951 661	Sw/	16/7/86, 10-11/7/88
Whitehorse, Yukon Terr.	YWH	849 672	Sw/Pc	9-18/7/86 8&19/7/87

[a] Collected by G.T. Harvey. Includes fumiferana, orae, biennis, and a lambertiana-like species, based on bait used and isozyme analysis as described in Harvey (1991).

[b] Data collected from both trapped males and larval collections.

Table 4. Summary of hybrid adults sent to P.T. Dang, BRC, from 1982 to 1989.

Female parent	Male parent									
	BIE	ORA	FUM	OCC	RET	PIN	SUB	PON	CAR	LAM
BIE	X	–	20	9	67	3 31/44[e]	6	– 6/12[e]	–	34
ORA	–	X	– 0/6[c]	– 8/11[e]	–	74 2/6[c]	– –	– –	– –	– –
FUM	17	–	X	439	393	7 31/50[d]	6	– 1/46[d] 0/1[e]	–	–
OCC	27	5 16/31[e]	47	X	3	68 1/2[d]	35	– 16/41[d]	–	–
RET	8	14	18	2	X	2	62	–	–	–
PIN	–	6	1 3/3[d]	7	–	X	12	–	–	–
SUB	17	–	18	40	22	–	X	12	–	–
PON	–	–	–	–	–	–	–	X	–	–
CAR	–	–	–	–	–	–	–	–	X	–

[a] Main entries show insects listed in Harvey and Roden (1979) (see Table 6).
[b] Entries show sex of shipped moths (females/males).
[c] For entries from Shipment #6, see footnote c under Table 1.
[d] shipment 4 from Table 1
[e] shipment 5 from Table 1
shipment 6 from Table 1

Table 5. Index list of identification codes[a].

Code	Year	Identification
ANE	1980	C. orae
ANC	1981	C. orae
ANO	1984	C. orae
ASH	1982	C. occidentalis
BON	1986	C. biennis
BOP	1986	C. biennis
BUR	1987	C. lambertiana subretiniana
CAB	1986	C. occidentalis
CAR	1985	C. carnana californica
COL	1985	C. occidentalis
COP	1985	C. orae
DET	1986	C. biennis
EAR	1986, 1988	C. fumiferana
FLA	1985	C. pinus
GIL	1980	C. pinus
HAR	1985	C. occidentalis
IND	1986	C. occidentalis
JOM	1980	C. pinus
JON	1986	C. occidentalis
KEN	1984	C. orae
KIR	1984	C. pinus
KIS	1982	C. orae
KIT	1984	C. orae
LAP	1986	C. lambertiana ponderosana
LID	1988	C. fumiferana
MAC	1980	C. fumiferana
MAC	1988	C. biennis
MAN	1980	C. fumiferana
NEL	1985, 1986, 1987, 1988	C. fumiferana
NES	1987	C. fumiferana
PIM	1982	C. occidentalis
POB	1985	C. lambertiana ponderosana
POB	1985	C. occidentalis
POL	1985	C. lambertiana ponderosana
POL	1985	C. occidentalis
RAJ	1985	C. pinus
SAB	1985, 1986	C. occidentalis
SIN	1988	C. murinana
SIT	1984	C. fumiferana
TER	1985	C. fumiferana
TOM	1984	C. species near pinus?
TUM	1988	C. biennis
WIJ	1989	C. species near lambertiana??
WIL	1986	C. biennis
YAJ	1986	C. pinus

[a] does not include trapped males

Table 6. Identification, constitution and sources of sex pheromone lures[a] used in Yukon 1986, 1987 and 1988[b].

Code	Conc. (%0	Pheromone	Origin	Date
Aldehyde Lures				
1986				
'fob'	5%	95:5 E/Z 11-14 Aldehyde	Gray and Shepherd	1985
'Fu'	0.03%	95:5 E/Z 11-14 Aldehyde	Sanders	1984
1987, 1988				
F1	5%	95:5 E/Z 11-14 Aldehyde	Gray and Shepherd	1987
F2	0.03%	as in F1.	Gray and Shepherd	1987
F3	5%	='fob' above	Gray and Shepherd	1985
F4	0.03%	='Fu' above	Sanders	1984
F5	0.03%	as in 'Fu'	Sanders	1987
Acetate lures				
1986				
'ora'	5%	82:9:9 E-Ac:Z-Ac:E-OH	Gray and Shepherd	1985
1987, 1988				
O1	5%	82:9:9 E-Ac:Z-Ac:E-OH	Gray and Shepherd	1987
O2	0.03%	as above	Gray and Shepherd	1987
O3	5%	='ora' above.		
O4	0.03%	76.5:13.5:8.5:1.5 E-Ac:Z-Ac:E-OH:Z-OH	P.Silk (J.Volney)	1987

[a] All lures consisted of sex pheromone (% by weight) in a polyvinyl chloride base. Lures used in 1987 were aged 7 days in a fume hood at room temperature, and were stored in freezer between seasons.

[b] G.T. Harvey (1991)

Table 7. Names, authorities and abbreviations for coniferophagous Choristoneura species contained in Tables 1-6. (Table reproduced, with some alterations, from Harvey [1985]).

Species and authority	Year	Synonyms	Code[a]
biennis Free.	1967	-	bie
carnana (B. and Bsk.)	1920	-	car
carnana californica Powell	1964	-	cal
fumiferana (Clem.)	1865	nigridia (Rob.), 1869	fum
lambertiana (Bsk.)	1915	-	lam
lambertiana ponderosana Obr.	1962	-	pon
lambertiana subretiniana Obr.	1962	-	sub
occidentalis Free.	1967	-	occ
orae Free.	1967	-	ora
pinus Free.	1953	-	pin
pinus maritima Free.	1967	-	mar
retiniana (Wlsm.)	1879	lindseyana Obr., 1962 spaldingiana Obr., 1962[b] viridis Free., 1967 n.syn.	ret

[a] abbreviations used in Tables 1-6
[b] After Powell and DeBenedictis (1982)