SPECIAL COLLECTION OF CONIFEROPHAGOUS CHORISTONEURA SPECIES AND HYBRIDS AT THE GREAT LAKES FOREST RESEARCH CENTRE, SAULT STE. MARIE, CANADA

G. T. HARVEY AND P. M. RODEN

GREAT LAKES FOREST RESEARCH CENTRE

SAULT STE. MARIE, ONTARIO

REPORT O-X-293

CANADIAN FORESTRY SERVICE

DEPARTMENT OF THE ENVIRONMENT

JUNE 1979

Copies of this report may be obtained from:

Information Office,
Great Lakes Forest Research Centre,
Canadian Forestry Service,
Department of the Environment,
Box 490, Sault Ste. Marie, Ontario.
P6A 5M7.

ABSTRACT

This report catalogues pinned adult material of several coniferophagous species of *Choristoneura* retained at the Great Lakes Forest Research Centre in Sault Ste. Marie, Canada. The collection of nearly 9,500 specimens consists of field-collected insects as well as laboratory- and field-reared progenies, including several generations of *inter se* matings and various crosses. The catalogue provides identifications and sufficient detail of host and collection location to facilitate their further study. The collection is accessible to entomologists for study.

RÉSUMÉ

Le présent rapport sert à répertorier le matériel adulte épinglé de plusieurs espèces de *Choristoneura* conifĕrophages conservées au Centre de recherche forestière des Grands lacs, à Sault Ste-Marie, Canada. La collection qui compte près de 9,500 spécimens comprend des insectes pris sur le terrain et des descendants de ceux-ci élevés tant en laboratoire qu'en plein champ, ainsi que plusieurs générations d'accouplement *inter se* et divers croisements. Le catalogue fournit les identifications et suffisamment de détails sur les collections d'hôtes et de sites pour en faciliter l'étude plus poussée. La collection est à la disposition des entomologistes pour étude.

ACKNOWLEDGMENTS

The cooperation of many persons, particularly the Forest Insect and Disease Survey technicians, who supplied most of the insects which comprise this collection, was acknowledged earlier (Harvey 1967, Stehr 1967). We wish to express to them, and to others who contributed more recent collections, our sincere thanks for their assistance. The assistance of H.J. Weir and K.C. Hall in rearranging the material and preparing the catalogue is acknowledged with thanks. The assistance of other members of the staff of the Great Lakes Forest Research Centre in preparing this report is appreciated.

TABLE OF CONTENTS

INTRODUCTION

From 1951 until his death in 1970, Dr. G. Stehr assembled coniferophagous *Choristoneura* species from across North America as part of his study of the population genetics of this group of species. The collection consisted of field-collected insects and laboratory- and field-reared progenies of these species. In addition there were several generations of progenies of matings within species and of various crosses between species.

Since the death of Dr. Stehr, the senior author has added substantial numbers of some species. This collection of almost 9,500 insects is retained at the Great Lakes Forest Research Centre, Sault Ste. Marie, Canada. It contains potentially useful material for taxonomic studies of *Choristoneura*, a genus which presents difficulties because of the extensive polymorphism in adult maculation. In particular, the family groups in the collection show both within- and between-family variation in maculation for most of the species represented.

The labelling of the specimens in the collection does not conform, for the most part, to standard museum practice. The catalogue provides identification and sufficient details of collections to make their further study almost as easy as if labelling were of the conventional form.

The collection is available in whole or in part to research scientists who demonstrate suitable qualifications and an interest in studying the systematic taxonomy of *Choristoneura* spp.

METHODS

Most of the field-collected insects in this collection were obtained as late-instar larvae and shipped by air express or mail to Sault Ste. Marie. In a few cases collections were made at another stage, i.e., egg or adult. Larvae were allowed to complete their development in the laboratory under controlled conditions (Stehr 1954) on foliage included with the collection, if suitable, or alternatively on fresh white spruce (*Picea glauca* [Moench] Voss), balsam fir (*Abies balsamea* [L.] Mill.) or jack pine (*Pinus banksiana* [Lamb.]) obtained in the vicinity of Sault Ste. Marie. Until about 1965 field collections received late in the season after local foliage had completed its development were reared on freshly thawed balsam fir shoots, as described by Stehr (1954). More recently an artificial diet (McMorran 1965), or a modification of it, has been used to permit such larvae to complete their development. The remainder of the collection, i.e., the laboratory lines, hybrids, backcrossses, etc., completed their development on freshly thawed balsam fir shoots or artificial diet.

The methods used to obtain these collections and the possible sources of errors associated with them were discussed by Stehr (1967). Several of the collections contained more than one taxon, as determined by laboratory study of the adults and of their progenies. In most cases it was possible to distinguish and separate adults from the original collection and to place them with the appropriate species group. However, such adults have been identified as coming from "mixed collections", and are marked with an asterisk (*) in Table 1.

The collections consist of pinned adults housed in three entomological cabinets and four separate glass-topped trays. They have been divided into separate sections housed in the cabinets as follows:

Cabinet 1: Field-collected *Choristoneura* species (Table 1)

Cabinet 2 and separate trays 3 and 4:

Hybrids, including backcrosses, etc. (Table 2)

Cabinet 3: Laboratory inbred lines within species

(principally *C. fumiferana*) (Table 3)

Separate trays 1 and 2:

Adults from the field cage experiment

(Harvey and Stehr 1971) (Table 4)

Many of the pinned insects are accompanied by the empty pupal case from which they eclosed. These are contained in a gelatin capsule and mounted on the same pin. The numbers of insects arranged by species, etc., are summarized in Table 5 and the F^1 and F^2 crosses in Table 6. For the convenience of the reader, all tables are placed at the end of this Report, just before the References.

The pinned adults in the collection constitute only a portion of the collections or families from which they came; other adults from the same collection or family were used for matings or other purposes and were unsuitable for pinning. Mating attempts were carried out as described by Stehr (1954).

The numbers of pinned hybrid adults of the F^1 and F^2 generations are summarized in Table 6. No data are available at present on the number of attempted matings or of infertile matings for these crosses. However, all adults shown serve as evidence that fertile matings of the designated crosses were obtained. In all but two or three combinations both sexes are included among the pinned series. The progenies

of more than one successful mating are represented for most crosses. The absence of representatives of some crosses signifies only that no pinned adults are present in the collection: most of the possible combinations have been attempted and almost all that were attempted have produced some fertile progenies, though not all with equal ease.

Most of the pinned insects in the collections do not have the standard individual museum-type labels, showing collection location, host, collector, etc., although a small proportion do. The tables provide this information through the use of the insect name code which appears on a printed label on each pinned insect, e.g., F'2-CYP-1, 5' F-WA or 8'6-PYR-11.

The insect name code, developed for ease in retaining identity during the laboratory breeding program, consists of three parts. The first, consisting of two digits or a letter and a digit, provides a time reference and shows whether the insect represents a field or a laboratory generation. Insects from field collections are designated by a letter, usually 'F'. The digit indicates the year of the collection; hence, F'2 insects were field collected in 1962. For insects collected during the 1960s the digital year follows the letter; for insects collected during the 1950s and the 1970s the digit precedes the letter, as in 5'F. When the first part of the name code consists of two or three digits, the insect represents a laboratory generation, the digits specifying the month of the laboratory matings that produced the family. Hence, 1'12 is applied to a family produced by a mating in the first year of the decade and the twelfth month, i.e., December 1961. The name code does not allow differentiation of the decade, i.e., 1961 or 1971; when necessary this information can be determined from other collection records.

The second part of the name code, consisting of two to four letters, indicates the origin of the insects, or their parental background. For field-collected insects the two or three letters are usually taken from the location designation. For example, F'1 FRE represents a collection at French Lake, Ontario in 1961. Where several collections originate from an identical or similar location the code may be altered slightly, as in F'1 TIM, F'2 MIT, F'2 TAM -- all these insects came from Kitimat Station, B.C. in 1961 and 1962. For laboratory-reared lines the portion of the name code designating location has been retained. Name codes for crosses are made up from the name codes or species of the parents, and may also indicate the generation. For example, the FU X VI crosses in Cabinet 2 (Table 2.1) originated from crosses of CYP ♀ X ORE ♂ individuals and are named CYOR. Similarly, in Cabinet 2, FU ♀ X OC ♂ crosses are named BD. At the time they were named the known entities of coniferophagus *Choristoneura* were fewer and were frequently designated by a single letter: FU - 'B'; OC - 'D'; PI - 'J' and BI - 'D_2'. In later crosses

the names indicate both parents and the direction of the cross (♀ first) in the two-letter code now used here (Sanders et al. 1977); for example, FU ♀ X SU ♂ is named FUSU, as in the Separate Tray 4 (Table 4). Details of this species naming code are presented at the beginning of Table 2.

The third part of the code name is a single or double digit indicating a collection division or family number. Hence, all insects designated F'1 MAY-1 and F'1 MAY-2 came from the same location and were collected at the same time, though from different hosts, and should be considered as coming from the same population. Among the laboratory-reared insects the final digit is a family designation, and all insects named 0'7 - CYP - 1 are brothers and sisters, as are all those named 0'7 - CYP - 2, etc. (Cabinet 3, Tray 1); these insects are the first laboratory generation from matings in July of insects collected in 1960 in Cypress Hills, Sask. In the catalogue these digits that are part of the family name are listed in parentheses after the family names. Other digits or letters on the insect labels show additional details of sex, rearing sequence or individual identification, further explanation of which seems unnecessary for use of the collection.

The lists of field-collected insects, housed in Cabinet 1, show, with the appropriate name code, the collection location, host from which the collection was made, date of receipt of the collection, and the collector(s) (Table 1). The actual date of collection of the insects is the same as, or within 7 days of, the date or receipt. When collections came from more than one host this is indicated.

Lists of laboratory-reared generations of *Choristoneura* species in Table 3 (Cabinet 3 and Trays 3 and 4) show the family code name, family numbers, and the date and location of the original collection. Also given is the number of laboratory generations represented by the pinned adults. As explained above, adults of the first laboratory generation are those produced by laboratory matings of the field-collected insects. Although the parents of this first generation may have been reared in the laboratory through a considerable portion of their development, genetically they represent the field population and are still considered to be the field generation here. The first laboratory generation is the first generation to be spent wholly in the laboratory.

Lists of the various hybrids (Table 2) include the same information as those in Table 3, but are arranged by the type of cross they represent, the female parent being identified first in all cases. Family names and numbers are listed as well as the generation number of the cross; there is no indication of the relationship to field or laboratory generation number, although this can be calculated in many cases from the two-digit part of the family code name.

(After completion of the cataloguing of the collections, a selection of the field-collected insects was sent to the British Museum to be incorporated in its collection. These insects, which have not been deleted from the tables, are listed separately in the Appendix.)

TAXONOMY

Most of the insects in the collection were seen and identified by Stehr. Naming of the *Choristoneura* species corresponds to that of Freeman (1967), except for a number of insects from the western United States and Canada which Freeman did not name. These insects are named in accordance with the discussion by Stehr (1967). Insects received more recently have been classified in the same groupings as were used by Stehr. This generalization applies to insects listed as *C. subretiniana* Obr., which Powell (1964) treats as a subspecies of *C. lambertiana* (Busck) Free.; Stehr (1967) discusses reasons for his use of the full species designation for this entity. No attempt has been made to differentiate subspecies of *C. lambertiana* as described by Powell (1964). However, one collection received in 1977 (F'7-PAN) was identified as *C.l. ponderosana* by the collector R.E. Stevens. Stehr's (1967) notes on these subspecies are based to a large extent on the rest of the pinned adults of this group in the collection.

Additional information exists for most of the insects included in the collections. Haemolymph colors and pigmentation of pupal cases of most of the insects were included in the analysis of these characters by Harvey and Stehr (1967) and have been recorded for many of the insects received since that time. Developmental performance data (development time, survival, etc.) were recorded for most of the insects reared in the laboratory; pupal weights have been recorded for some of the reared material. Summarization and analysis of these results have not been completed. The data are still on hand and are accessible through the present authors.

ADDITIONAL MATERIAL

In addition to the pinned insects catalogued here, there are several thousand pairs of adult forewings mounted with rubber cement on white cards and stored in slide file boxes in Sault Ste. Marie. They are intended for studies of adult maculation and are in fairly good condition, although the cement has yellowed considerably in some cases. They represent principally laboratory stocks; many of them represent several generations and include hybrids. Identification is by collection code names on the cards which can be related to collection location and breeding history through other records in the collection.

There are, in addition, close to 300 color slides, mostly of adults. Most of these are adequately labelled to permit identification, and collection details are provided, but not all are good quality slides. A few slides of larvae and pupae are included.

Table 1. Field-collected *Choristoneura* species

Cabinet 1

Species: *C. fumiferana* (Clem.) *sensu stricto* (Freeman 1967)

Tray No. 1

Code	Collection location	Host	Date received	Collector	Number of adults on pins
F'5 ASU	Iskwasum L., Man.	*Picea glauca*	June 30/65	R.W. Hancox	1
F'1 BAT	Blackwater R., N.W.T.	*Picea glauca*	June 23/61	C.E. Brown, A. Machuk	21
F'1 ELK	Elkwater, Cypress Hills, Alta.	*Picea glauca*	June 27/61	E. Gautreau	11
F'1 FIS	Jackfish, Ont.	*Picea glauca*	July 4/61	V. Jansons	2
F'1 FRE	French L. (near exp. cage) Ont.	*Abies balsamea*	July 14/61	G.T. Harvey	30
F'1 GER	Ruffle L. Geraldton, Ont.	*Abies balsamea*	June 22/61	V. Jansons, J.E. McDonald	1
(8'F) GRE	Green River Watershed, N.B.	*Abies balsamea*	July 13/58	C.A. Miller	1
F'1 LAL	1 mi S. of Killala L., Geraldton, Ont.	*Abies balsamea*	July 3/61	V. Jansons	86
F'2 LON	Near Longlac (exp. cage) Ont.	*Abies balsamea*	July 16/62	G.T. Harvey	7
F'2 MUD	Jct. Muddy/Wabiskan rivers, Alta	*Picea glauca*	June 23/62	N.W. Wilkinson	7
6'F NOR	Northcote, Renfrew, Ont.	*Picea glauca*	June 19/56	M.J. Thomson, L.S. MacLeod	1
F'1 PYR	Cypress Hills, West Block, Sask.	*Picea glauca*	June 16/61	Hildahl, Pratt	59
F'2 RAW	Rawdon Twp, Ont.	*Abies balsamea*	June 5/62	W.J. Miller	20
F'3 REN	French River, Ont.	*Populus tremuloides*	June 10/63	C.A. Barnes J.R. McPhee	1
(8'F) SAG	Mowe Lake, Ont.	*Abies balsamea*	July 2/58	K. Hall	5
(8'F) VEB	Indian Lake Rd., Langton Twp, Ont.	*Abies balsamea*	July 5/58	D. Bowen	2

(cont'd)

Table 1. Field-collected *Choristoneura* species (cont'd)

Cabinet 1

Species: *C. fumiferana* (Clem.) *sensu stricto* (Freeman 1967) (concl.)

Tray No. 1

Code	Collection location	Host	Date received	Collector	Number of adults on pins
5'F WA	Wenasaga L., Sioux Lookout, Ont.	*Abies balsamea*	June 13/55	E. Buchan	1
F'7 WAT	Alaska Hwy. mi 514, Watson Lake, N.W.T.	*Picea glauca*	June 21/77	Unger	1
7'6 WAT	F^1 progeny of F'7 WAT				11
F'1 WOO	Woodhouse, Lake Erie, Ont.	*Picea glauca* *Abies balsamea*	June 9/61	H.R. Foster	22

Species: *C. occidentalis* Free.

Tray No. 2

Code	Collection location	Host	Date received	Collector	Number of adults on pins
F'1 MAY I	Yakima I.R., WA	*Abies concolor*	June 22/61	A.E. Cameron	48
F'1 MAY II	Yakima I.R., WA	*Pseudotsuga menziesii*	June 22/61	A.E. Cameron	129
F'1 SAL	Dahlonega Cr., Salmon N.F., ID	*Pseudotsuga menziesii*	June 27/61	W.F. Mineau	15
F'8 UAW[1]	Baker, Wallowa-Whitman N.F., OR	*Abies concolor*	June 18/58	J. Whiteside	4
F'8 UMS-3*	Dry Range, Helena N.F., MO	*Pseudotsuga menziesii*	June 18/58	H.R. Dodge	8
F'8 UMS-5*	Cramer Cr., Blackfoot MT	*Pseudotsuga menziesii*	July 1/58	H.R. Dodge	1
F'8 UPW*	Wallowa-Whitman N.F., Baker, OR	*Pinus ponderosa*	June 18/58	R.W. Cowlin J. Whiteside	1

(cont'd)

Table 1. Field-collected *Choristoneura* species (cont'd)

Cabinet 1

Species: *C. occidentalis* Free. (cont'd)

Tray No. 3.

Code	Collection location	Host	Date received	Collector	Number of adults on pins
F'1 COL	5.6 mi up canyon, Boulder, CO	*Pseudotsuga menziesii*	June 20/61	B. Poole	6
F'1 FOO	Blackfoot area, MT	*Pseudotsuga menziesii*	June 30/61	R.E. Denton	8
F'3 MIL*	Drummond Unit, MO	*Pinus contorta*	July 23/63	R.E. Denton	1
F'2 MON	Brewster Cr., Granite Co., MT	*Pseudotsuga menziesii*	July 3/62	A.E. Cameron	48
F'2 NUT	Rio Nutritas, Carson N.F., NM	*Pseudotsuga menziesii* *Picea glauca*	June 19/62	R. Dalleske, C. Slater	40
F'2 PAG	San Juan N.F., Pagosa Springs, CO	*Abies concolor*	June 27/62	B.H. Wilford	3
F'1 PHU	White Sulphur Springs, MT	*Pseudotsuga menziesii*	June 29/61	R.E. Denton	3
F'1 RUM	Ten Mile Cr., Drummond Unit, MT	*Pinus contorta*	June 30/61	R.E. Denton	13
F'2 SAF-1	Aspen Hill, Santa Fe N.F., NM	*Abies concolor*	June 1/62	D. Jennings	8
F'2 SAW	Bounds Cr., Sawtooth N.F., ID	*Abies concolor*	July 13/62	W.E. Mineau	20
F'2 TAR	Stoddart Cr., Targhee N.F., ID	*Abies concolor*	July 10/62	W.E. Mineau	20
F'2 VAN	Ovando, Blackfoot Forest, MT	*Pseudotsuga menziesii*	July 3/62	A.E. Cameron	37

(Additional F'2 VAN in Tray 4)

(cont'd)

Table 1. Field-collected *Choristoneura* species (cont'd)

Cabinet 1

Species: *C. occidentalis* Free. (cont'd)

Tray No. 4

Code	Collection location	Host	Date received	Collector	Number of adults on pins
F'3 COR	Gold Cr., Missoula, MT	*Larix occidentalis*	June 24/63	R. Denton	3
F'4 COT	Cottonwood Lakes, MT	*Larix occidentalis*	July 20/64 July 23/64	D.G. Fellin	19
F'3 LAR*-1	Roosevelt N.F., Poudre Canyon, Larimer, CO	*Pinus ponderosa*	July 11/63 July 26/63	C.J. Germain	2
F'2 ROK	Slide Rock Mt., Granite Co., MT	*Pinus albicaulis* *Pinus flexilis* *Abies lasiocarpa* *Pseudotsuga menziesii*	Aug. 24/62	G.T. Harvey D.G. Fellin	56 (individual labels)
F'2 VAN	Ovando, Blackfoot Forest, MT	*Pseudotsuga menziesii*	July 3/62	A.E. Cameron	33
	(Additional F'2 VAN in Tray 3)				
	The following specimens all have individual labels.				
	Big Johns Flat, Beaver, UT	*Abies lasiocarpa*	July 22/65	M.D. McGregor L.O. Sandin (Hopkins 51-313#)	15
	Cimarron Canyon, Colfax Co., NM	Light trap 7900'	July 9, 11/62	E. & I. Munroe	2
	Raton, Colfax Co., NM	Light trap 6660'	July 5/62	E.G. Munroe	2
	S. Fk. Beaver Ck. Beaver, UT	*Pseudotsuga menziesii*	July 14/65	M.D. McGregor L.O Sandin (Hopkins 51-313#)	5
	Thousand L. Mt., Loa, UT	*Abies lasiocarpa* *Pseudotsuga menziesii*	Aug. 5/62	M.D. McGregor L.O. Sandin (Hopkins 50-846#)	5
	Various locations MO (adults unstretched - all with Hopkins numbers).	Several	1957, 1959	D.G. Fellin	61

(cont'd)

Table 1. Field-collected *Choristoneura* species (cont'd)

Cabinet 1

Species: *C. occidentalis* Free. (concl.)

Tray No. 5

Code	Collection location	Host	Date received	Collector	Number of adults on pins
F'4 AOL*	North Truckee, Sect 7-8, CA	*Abies concolor*	July 4/64	A.E. Cameron	1
F'6 BOS	Kwolek Creek, Boston Bar, B.C.	*Abies lasiocarpa*	June 29/76	J. Mowts	11
F'4 HID	Hidden Lakes, Enderby, Kamloops, B.C.	*Tsuga heterophylla*	July 20/64 July 23/64	J. Grant	12
F'6 HUP	Silver-Skagit Road, Hope, B.C.	*Pseudotsuga menziesii*	June 30/76	E. Morris	11
F'4 MIU	Drummond Unit, MT	*Pinus contorta*	July 17/64 July 20/64	D.G. Fellin	9
5'7 MIU	F^2 progeny of F'4 MIU	(see above)			1
F'6 SUM	Adams Lake, Kamloops Dist., B.C.	*Pseudotsuga menziesii*	June 17/76	Andrews	11
F'4 WILL-2	Salmon N.F., ID	*Pinus contorta*	July 30/64 Aug. 2/64	K. Lister	22
	The following specimens have individual labels				
	Clinton, MO SpBw Plot		August '56	Dodge & Paxton	4
	New Meadows, ID	*Abies grandis*	July 10/23 reared in lab	J.C. Evenden (Hopkins 16964b)	3
	New Meadows, ID	*Pseudotsuga tamifolia*	July 10/23 reared in lab	J.C. Evenden (Hopkins 16965b)	4
	Priest L., ID	*Tsuga heterophylla*	July 12/22 reared in lab	H.J. Rust (Hopkins 16926a)	3
	Priest L., ID	*Pinus monticola*	July 12/22 reared in lab	H.J. Rust (Hopkins 16922b, 16925b)	2
	Priest L., ID	*Abies grandis*	July 12/22 reared in lab	H.J. Rust (Hopkins 16922b)	2
	Yellowstone N.P., WY	*Picea engelmannii*	July 24/23 reared in lab	J.C. Evenden (Hopkins 16967b)	7

(cont'd)

Table 1. Field-collected *Choristoneura* species (cont'd)

Cabinet 1

Species: *C. orae* Free.

Tray No. 6

Code	Collection location	Host	Date received	Collector	Number of adults on pins
F'1 CEM	Emsley Cove, Kitimat Twp, B.C.	*Picea sitchensis*	June 23/61	D.S. Ruth	2
F'2 MIT	Kitimat, B.C.	*Picea sitchensis*	June 15/62	E.G. Harvey	48 (4 cap)
F'2 TAM	Kitimat, B.C.	*Abies amabilis*	May 16/62	E.G. Harvey	47
F'1 TIM	Kitimat Stn., B.C.	*Abies amabilis*	June 21/61	J. Jardine	23

Species: *C. pinus pinus* Free.

Tray No. 7

Code	Collection location	Host	Date received	Collector	Number of adults on pins
F'1 JAW	Frenchette Sctn, Forestry Farm, Walsingham, Ont.	*Pinus sylvestris*	June 22/61	H.R. Foster	14
F'1 JCO	Colchester S., Lot 6, Con V, Ont.	*Pinus sylvestris*	June 19/61	H.R. Foster	19
F'1 JEX	Eaux Claire Lakes, WI	*Pinus banksiana*	June 20/61	I.M. Campbell	10
F'1 JOG	Dogfly L., Ont.	*Pinus banksiana*	July 12/61	—	22
0'7 JOL	F^1 progeny of 0'F JOL Lowe Lake Ft. Frances, Ont.	*Pinus banksiana*	July 14/60	M.J. Hildebrand	2
I'5 JOL	F^2 progeny of 0'F JOL				3
F'2 JUS	8 mi N. of Spooner, WI	*Pinus banksiana*	June 18/62	I.M. Campbell	11
F'1 RAJ-1	Raco, MI	*Pinus banksiana*	June 21/61	T. Lisson, G.T. Harvey	41
F'1 SAJ	Sauble, Lake Huron, Ont.	*Pinus sylvestris*	June 6/61	R.L. Bowser	2

(cont'd)

Table 1. Field-collected *Choristoneura* species (cont'd)

Cabinet 1

Species: *C. pinus pinus* Free. (concl.)

Tray No. 7

Code	Collection location	Host	Date received	Collector	Number of adults on pins
F'1 SOJ	Sioux Narrows, Ont.	*Pinus banksiana*	July 11/61	G. Jackson	1
F.I.S.:044-798	Sultan, Ont.	--	July 10/44	—	1
BC 49-816	Cranbrook, B.C.	*Pinus contorta*	July 25/49	—	1
BC 52-1851-01	Meldrum Cr., B.C.	*Pinus contorta*	July 30/52	—	1
FIS A778 D	Burmis, Alta.	*Pinus flexilis*	July 16/52	—	1
FIS A 1221 C	Elkwater, Alta.	*Pinus contorta*	July 26/52	—	1
Species: *C. pinus maritima*					
F'1 PAR	Barnstaple, MA	*Pinus rigida*	June 24/61	T.N. Freeman	17
F'1 PTM	Blain, Perry Co., PA	*Pinus pungens*	May 23/61	J.C. Nelson	4
F'1 PVA	Wardensville, WV	*Pinus virginiana*	June 8/61	H.M. Kulman	1
F'1 PVP	Hogestown, Cumberland Co., PA	*Pinus virginiana*	June 8/61	J.C. Nelson	18
Species: *C. murinana*					
F'2 MUR	Black Forest, Germany	*Abies alba*	May 7/62	O.F. Niklas	44
3'11 MUR	F^2 Progeny of F'2 MUR				28

(cont'd)

Table 1. Field-collected *Choristoneura* species (cont'd)

Cabinet 1.

Species: *C. biennis* Free.

Tray No. 8

Code	Collection location	Host	Date received	Collector	Number of adults on pins
8'F DSM	Smithers Landing Rd., Smithers, Babine L., B.C.	*Picea glauca*	June 7/58	D. Collins	3
F'7 HOK	Mi 20, Holmes River Rd, McBride, B.C.	*Abies lasiocarpa*	June 13/77	R. Wood	18
F'1 KAP	Hart Hwy, Mi 93, Parsnip R. Region, B.C.	*Abies lasiocarpa*	June 19/61	O. Morris	1
F'6 KAR	Hendrix Lake, B.C.	*Abies lasiocarpa*	July 5/76	J.J. Allen	7
F'1 KAS	Pine Pass, Summit L. Rd., B.C.	*Abies lasiocarpa*	June 21/61	O. Morris	7
F'1 KIT-1	Nilkitkwa R. Trail, Babine, B.C.	*Abies lasiocarpa*	June 11/61	E.G. Harvey, R.L. Fiddick	5
F'1 KOW	Willow R. Rd., Mile 23, B.C.	*Abies lasiocarpa*	June 19/61	O. Morris	2
F'2 LAK	Lake Louise, Sask. R. Crossing, Banff Nat. Park, B.C.	*Picea glauca* var. *albertiana*	June 12/61	J. Petty	30 (3 caps)
F'7 SIK	McMurdo Creek, Golden, B.C.	*Abies lasiocarpa* (out-of-phase population)	June 21/77	M. Cotrell	14
F'1 SMK	Smithers Landing, B.C.	*Picea glauca* var. *albertiana*	June 7/61	E.G. Harvey, R.L. Fiddick	2
F'1 SUK-2	Suskwa R. Trail, Babine, B.C.	*Picea glauca* var. *albertiana*	June 12/61	E.G. Harvey, R.L. Fiddick	9
F'1 TPK	Topley Landing, B.C.	*Abies lasiocarpa*	June 6/61	E.G. Harvey, R.L. Fiddick	1

(cont'd)

Table 1. Field-collected *Choristoneura* species (cont'd)

Cabinet 1.

Species: *C. lambertiana* (Busck) Free.

Tray No. 9

Code	Collection location	Host	Date received	Collector	Number of adults on pins
4'8 BAL	F^1 progeny of F'4 BAN				1
F'4 BAN	Crowsnest, 3.4 mi E of Burmis, Alta.	*Pinus flexilis*	June 29/64	J. Petty Dr. J. Smith	7
F'3 BUR-1	Crowsnest, Alta.	*Pinus flexilis*	July 12/63	J. Petty	1
F'4 CLP	Larimer County, CO	*Pinus contorta*	July 6/64	M.E. McKnight	2
8'6 LAM-8	F^1 progeny of 8'F UPW (*C. lambertiana*, see Tray 2)				1
F'3 LAR* - 1,2	Roosevelt N.F., Poudre Canyon, Larimer Co, CO	*Pinus contorta* *Pinus ponderosa*	July 11/63 July 26/63 Aug. 2-13/63	C.J. Germain	24
F'1 LIP	Mammoth Hot Springs Yellowstone Nat Park, WY	*Pinus flexilis*	July 7/61 Aug. 05/61	R.E. Denton	7
F'4 MAM	Mammoth Hot Springs, Yellowstone Nat Park, WY	*Pinus flexilis*	Aug. 4/64	D.G. Fellin	7
F'3 MIL 1	Drummond Unit, MT	*Pinus contorta*	July 23/63	R.E. Denton	1
F'4 MIU*	Drummond Unit, MT	*Pinus contorta*	July 17/64 July 20/64	D.G. Fellin	4
F'2 NES	Burmis, Crowsnest F.R., Alta.	*Pinus flexilis*	July 6/62 July 20/62	E. Gautreau	2
F'7 PAN-1**	St. Vrain River Drainage, CO	*Pinus ponderosa*	June 23/77	R.E. Stevens	63

(cont'd)

Table 1. Field-collected *Choristoneura* species (cont'd)

Cabinet 1

Species: *C. lambertiana* (Busck) Free. (concl.)

Tray No. 9

Code	Collection location	Host	Date received	Collector	Number of adults on pins
F'4 PON	Poudre Dist., CO	*Pinus contorta*	June 25/64	M.E. McKnight	10
F'4 RFL	Red Feather Lake, Larimer Co., CO	*Pinus contorta*	July 6/64	M.E. McKnight	9
8'F UMS-2) 8'F USM-2)	Helena N.F., MT	*Pinus flexilis*	July 19/58	H.R. Dodge	2
F'4 WILL*	Salmon N.F., ID	*Pinus contorta*	July 30/64	K. Lister	3
	The following specimens have individual labels:				
	Bechler R.	*Pinus contorta* *Pinus albicaulis*	Aug. 1, 1929		3
	Sugar Loaf, CO	*Pinus ponderosa*		J.A. Beal (Hopkins 17701b)	6
	Long Pines Carter Co., MT	*Pinus ponderosa*		H.R. Dodge	1
	Mammoth, WY	*Pinus flexilis*	Aug. 1955	H.R. Dodge	3
	Yellowstone N.P. WY	*Pinus flexilis*	Aug. 1955	(no label - poss. H.R. Dodge)	2
	Unlabelled			(Hopkins 18649)	2

(cont'd)

Table 1. Field-collected *Choristoneura* species (cont'd)

Cabinet 1.

Species: *C. subretiniana* Obr. (Obraztsov 1962)

Tray No. 10

Code	Collection location	Host	Date received	Collector	Number of adults on pins
F'4 AOL*	North Truckee, Sect 7-8, CA	*Abies concolor*	July 4/64	A.E. Cameron	6
F'5 AVE	Beaver County, UT	*Abies concolor*	July 14/65	F. Honing	9
F'4 LAM	Benton Meadows, 15 mi N.E. of Alturas, CA	*Pinus contorta*	July 2/74	G. Daterman	4
4'7 LAM	F^1 progeny of F'4 LAM (see above)				18 from yellow pupae 18 from green pupae
	All *C. subretiniana* male pupae have yellow wing pads. Female pupae may be yellow or green—the ratio among these progeny of 4'7 LAM was 68.5% yellow: 31.5% green. The pinned adults here are distinguished as from 'yellow' pupae or 'green' pupae, in view of the possible inclusion of hybrids among the latter. (See the explanatory note under Cabinet 2: Separate Tray #3).				
F'3 MTL	Mt. Rosa, NV	*Pinus contorta*	Aug. 2/63	C. Wray	5
F'4 PEY	North Truckee, Sect 7-8, CA	*Pinus jeffreyi*	July 4/64	A.E. Cameron	2
F'4 PUR	North Truckee, Sect 7-8, CA	*Pinus murrayana*	July 4/64	A.E. Cameron	10
4'8 PUR	F^1 progeny of F'4 PUR				1
3'6 RET	F^1 progeny of F'3-MTL from Washoe County, Mt Rose, Reno, NV	*Pinus contorta*	July 8/63	C. Wray	19
4'1 RET	F^1 progeny of 3'6 RET				25
F'5 SUR	Benton Meadows, OR	*Pinus contorta*	July 24/75	G. Daterman	4 (+ 3 larvae)

(cont'd)

Table 1. Field-collected *Choristoneura* species (concl.)

Cabinet 1.

Species: *C. subretiniana* Obr. (Obraztsov 1962) (concl.)

Tray No. 10

Code	Collection location	Host	Date received	Collector	Number of adults on pins
5'6 SUR	F^1 progeny of F'5 SUR				11
6'4 SUR	F^2 progeny of F'5 SUR				2
8'F UPW-1	Wallowa-Whitman N.F., OR	*Pinus ponderosa*	July 2-16/58	R. Cowlin	8
F'3 WAS	Mt. Rosa, NV	*Pinus washoensis*	July 21/63	C. Wray	2

Species: *C. viridis* Free.

Tray No. 11

Code	Collection location	Host	Date received	Collector	Number of adults on pins
F'2 COC	Horse Mtn, Warner Mtns, Modoc N.F., CA	*Abies concolor*	July 12/62	C.B. Eaton, B.E. Wickman	46
F'1 ODO	Bidwell Cr. Ft. Bidwell P.O., Modoc, CA	*Abies concolor*	July 6/61	B.E. Wickman	21
F'3 OGL	Warner Mtns, 8 mi S of Eagleville, CA	*Abies concolor*	June 20/63	C. Wray	1
F'5 VEM	Benton Meadows, OR	*Abies concolor*	July 24/75	G. Daterman	27 (+ 6 larvae)
F'6 VIS	Lakeview, OR	*Abies grandis*	July 22/76	G. Daterman	21

* Contained more than one *Choristoneura* species.
** Identified as *C. lambertiana ponderosana* by R.E. Stevens and J.A. Powell (personal communication).

Table 2. Hybrids, including backcrosses

Cabinet 2. Various hybrids between *Choristoneura* species

Definitions:

Species Code

Fu	*C. fumiferana*
Oc	*C. occidentalis*
Or	*C. orae*
Bi	*C. biennis*
Pi	*C. pinus*
Su	*C. subretiniana*
La	*C. lambertiana*
Vi	*C. viridis*

Generation Code

F^1: first generation produced by the cross.
F^2: second generation produced by *inter se* matings of the F^1.

Hybrid	Generation number	Name (Families)	Adults pinned	
Trav 1				
Fu x Oc	F^1	0'12 BDC (1,2,3,4,5,6,7,8)	197	
Fu x Oc	F^2	1'9 BDC (1,2,3,4,8,9,10,11,15)	91	
Trav 2				
Fu x Oc	F^2	1'9 BDC (1,2,3,5,7,8,9,10,11,13,15,16)	39	
Fu x Oc	F^1	1'7 BD (29,31,32,34,35,36,44,45,46, 47,50,66,67)	156	
Trav 3				
Fu x Oc	F^1	1'5 CD (4)	1	
Fu x Oc	F^1	0'7 BGA (2,7,9,11,12,13,15,16)	85	
FuOc x Oc	F^1	6'1 BD-B (=D) (30)	1	chimera
FuOc x Oc	F^1	6'1 BD-D (30)	1	chimera
Oc x Fu	F^1	1'7 DB (55,57,58)	47	
Oc x FuOc	F^1	6'1 D-BD (62)	1	
Fu x Pi	F^1	1'7 BJ (1)	7	
Or x Pi	F^1	1'7 BJ (2,3,4,5)	57	
Trav 4				
Fu x Vi	F^1	0'7 CYOR (1,2,3,4,5,6,7,8,9,10)	217	
Vi x Pi	F^1	1'12 OJ (1)	2	
Vi x Pi	F^2	1'5 ORJ (1,2,5,6,7,8,9,10,11,13, 15,16,18)	67	
Trav 5				
Fu x Vi	F^2	1'5 CYOR (1,2,3,4,5,6,7,16)	135	
Fu x FuVi	F^1	1'5 CYOR (14,15)	99	

(cont'd)

Table 2. Hybrids, including backcrosses, etc. (cont'd)

Cabinet 2. Various hybrids between *Choristoneura* species (cont'd)

Hybrid	Generation number	Name (Families)	Adults pinned
Tray 6			
Fu x Vi	F^1	1'5 CYOR (16)	31
Fu x FuVi	F^1	1'5 CYOR (12)	25
FuVi x Fu	F^1	1'5 CYOR (8,9,10)	224
Tray 7			
Fu x Vi	F^2	1'5 CYOR (17,18,19,20)	62
Fu x Vi	F^3	1'12 CYOR (1)	9
FuVi x Fu	F^1	1'5 CYOR (11,13)	98
(ViOc^2 x Oc)	F^2	0'5 UO (1,4,5,7,8,9,10,11)	58
Tray 8			
Fu x Vi	F^1	1'5 EDOR (1,2,3)	124
Fu x Vi	F^2	1'12 EDOR (1,2,3)	89
Tray 9			
Fu x Vi	F^1	0'7 BOR (2)	3
Fu x Vi	F^1	1'5 BOR (3)	18
Fu x Vi	F^3	3'4 BORF (1,2)	17
Vi x Fu	F^1	0'7 ORCY (1)	3
Vi x Fu	F^1	F'1 ORCY (2)	1
Vi x Fu	F^1	1'5 ORB (1)	2
Vi x Fu	F^2	1'5 ORCY (1,2,4,5)	23
Vi x Fu	F^2	2'4 FOB (3,4,5)	12
Vi x Fu	F^2	1'12 ORB (1,2,3,4,5,6,7)	33
ViFu x Fu	F^1	1'5 ORCY (3)	5
Vi x Or	F^2	2'4 FOB (1,2,6,8)	14
Vi x Or	F^3	1'7 CYO (1)	21
Bi x Vi	F^1	1'5 DMOR (1,2,3)	50
Tray 10			
Fu x Fu	F^1	1'5 NICY (11)	12
Fu x Fu	F^1	1'5 CYED (1,2,3,4)	79
Fu x Fu	F^1	1'5 CYNI (3)	9
Fu x Fu	F^1	1'5 CYNI (3) (labelled CNY1)	27
Fu x Fu	F^1	7'6 CHA (5)	2
Vi x Su	F^1	4'11 VISU (1)	11
Vi x Pi	F^2	3'2 VJF (3,6)	16
Vi x Oc	F^1	1'5 ORGA (3)	2
ViOc x Vi	F^1	1'12 ODOR (1)	21
FuFu x Su	F^2 x F^1	4'11 FUSU (1,2)	8
PiOr	F^2	2'4 JDS (4)	1

(cont'd)

Table 2. Hybrids, including backcrosses, etc. (concl.)

Cabinet 2. Various hybrids between *Choristoneura* species (concl.)

Hybrid	Generation number	Name (Families)	Adults pinned
Tray 11			
Oc x Pi	F^1	0'5 DJ (4)	12
Oc x Pi	F^1	1'7 DJ (5,6)	21
Oc x Pi	F^2	0'12 DJ (1,2,3,4,5,6,7,8,9)	127
Oc x Pi	F^3	1'9 DJ (5,8)	2
Oc x OcPi	F^1	2'4 DDJ (1,2,3)	66
OcPi x Oc	F^1	0'12 DJ (10)	5
Or x Pi	F^1	1'7 DJ (1)	17
Pi x Or	F^1	1'7 JD (4)	6
Pi x Fu	F^3	0'12 JB (1)	1
Tray 12			
Oc x Vi	F^1	0'7 GAOR (1)	3
Oc x OcVi	F^1	1'5 GAOR (1,2,4,5,6,7,8)	209
Oc x OcVi	F^2	1'12 GAOR (2,3,4)	5
OcOc x Vi	F^1	4'1 HYB (5)	2
Oc x Or	F^1	1'7 CD (6)	4
Oc x Or	F^1	2'4 CDF (68)	1
Or x Oc	F^2	2'4 DD (1)	1
Separate Tray #3			
Oc x Bi	F^1	6'6 OCBI (1,2,3,4)	27
Bi x Oc	F^1	6'6 BIOC (1,2,3,4)	8
Bi x Oc	F^1	7'12 BIOC (1)	1
Pi x Oc	F^1	7'2 PIOC (1,2,3)	7
Oc x Pi	F^1	7'2 OCPI (1,2,3,4)	35
Oc x Su	F^1	7'2 OCSU (1,2,3,4)	35
Su x Oc	F^1	7'2 SUOC (1,2,3,4)	40
Bi x Fu	F^1	6'6 BIFU (1,2,3,4)	20
Fu x Bi	F^1	6'6 FUBI (2,3,4,5)	15 + 1
(Vi x Su)	F^1	4'7 LAM Hybrids?	9

Note re above: These insects were progeny of the F'4 LAM collection from *Pinus contorta* from Benton Meadows, Modoc N.F., CA. The collection was considered to be *C. subretiniana*. These adults were mass mated; no detailed descriptive data were recorded. Their progeny were reared. During this rearing some larvae, pupae and adults were noted as being different from the rest (the rest were generally quite uniform in color). Those that differed bore a resemblance to *C. viridis*. On the basis of color of larvae, pupae, pupal cases and adults, these insects are tentatively considered to be Vi x Su; this implies that the original collection included some *C. viridis*, also native in Benton Meadows.

Separate Tray #4			
Su x Vi	F^1	6'4 SUVI (1,2,3,4)	22
Su x Fu	F^1	6'4 SUFU (1,2,3,4,5)	18
Fu x Su	F^1	6'4 FUSU (1,4,6)	6
Fu x La	F^1	7'6 FUPO (2)	4
Bi x Pi	F^1	6'6 BIPI (1)	3
Bi x La	F^1	7'6 BIPO (1,2,3,4)	34
Bi x Vi	F^1	6'6 BIVI (1,2)	17
Vi x Bi	F^1	6'6 VIBI (1,2,3)	8
Vi x Su	F^1	6'4 VISU (1,2,3,4,5,6,7)	31
Pi x Su	F^1	7'2 PISU (1)	12
Su x Bi	F^1	7'12 SUBI (1,2,3)	17
Bi x Su	F^1	7'12 BISU (1,2,3)	6

Table 3. Laboratory inbred lines within *Choristoneura* species

Cabinet 3.

Name	Family numbers	Laboratory generation	Collection site	Date	Number of adults
Tray 1	*C. fumiferana*				
0'7 CYP	(1,2,3,4,5,6,7)	1	Cypress Hills, Sask.	1960	284
Tray 2	*C. fumiferana*				
0'7 EDM	(2,7,8)	1	Fort Simpson, N.W.T.	1960	87
0'7 NBH	(1,6)	1	Doak, York Co., N.B.	1960	13
0'7 NBL	(2,3)	1	Mill Settlement, Sunbury Co., N.B.	1960	22
0'5 NB	(1,3)	1	Doak, York Co., N.B.	1960	52
0'5 RAL	(3,4)	1	Manitou Sound, Fort Frances, Ont.	1960	6
9'5 SLO	(1,3)	5	Sturgeon L. Rd., Sioux Lookout, Ont.	1957	10
5'8 MVB	(84)	1	Inverness, N.S.	1965	35
1'9 RAW	(1,14)	?	Rawdon Tp, Tweed, Ont.	1962	10
5'7 DUR	(1,2)	2	Durham, Ont.	1965	2
5'7 CHE	(1)	1	Chelmsford, Ont.	1965	1
1'5 QR	(14)	15	Quibell Rd., Kenora, Ont.	1950	1
1'12 QR	(7)	16	Quibell Rd., Kenora, Ont.	1950	1
Tray 3	*C. occidentalis*				
1'7 RUM	(1,2)	1	Ten Mile Cr., Drummond, MT	1961	95
1'7 FOO	(1,2,3)	1	Blackfoot Area, MT	1961	84
1'7 SAL	(1,2)	1	Dahlonega Cr., Salmon N.F., ID	1961	38
1'7 COL	(2,3,4)	1	Boulder, CO	1961	9
1'7 MAY	(1)	1	Yakima I.R., WA	1961	2

(cont'd)

Table 3. Laboratory inbred lines within *Choristoneura* species (cont'd)

Cabinet 3.

Name	Family numbers	Laboratory generation	Collection site	Date	Number of adults
Tray 4	*C. occidentalis*				
8'2 BCC	(15,24,25,26,36)	2	Pavilion Mt, B.C.	1957	9
0'5 BCC	(1,2,3,4,5,6,7,8,9)	5	Pavilion Mt, B.C.	1957	82
0'7 GAT	(1,2,4,5,6)	1	Hell's Gate, Hope, B.C.	1960	31
0'7 GAT	(7)	1	Hell's Gate, Hope, B.C.	1960	5
1'5 GAT	(1,2,4,5,6)	2	Hell's Gate, Hope, B.C.	1960	30
1'12 GAT	(1,2,4,5,7,8,9)	3	Hell's Gate, Hope, B.C.	1960	19
Tray 5	*C. occidentalis*				
4'1 SAF	(2)	3	Willow Cr., Santa Fe N.F., NM	1962	1
5'3 SAF	(3,4,6,7,8,11,12,14)	4	Willow Cr., Santa Fe N.F., NM	1962	74
5'3 SAF	(9)	4	Aspen Hill, Santa Fe, N.F., NM	1962	18
5'7 ROC	(4)	2	Lolo N.F., Granite Co., MT	1964	5
5'3 PAG	(1,2)	4	San Juan N.F., Pagosa Springs, CO	1962	9
5'3 NUT	(3,4,5,6,11,12)	4	Rio Nutritas, Carson N.F., NM	1962	18
6'6 SUM	(1,2,3,4)	1	Adams Lake, S. Kamloops Dist. B.C.	1976	24
Tray 6	*C. biennis, C. orae*				
C. biennis					
9'9 DM	(14)	2	Smithers Landing Rd., Smithers-Babine Lake, B.C.	1958	2
0'7 DM	(1,2,3)	3	Smithers Landing Rd., Smithers-Babine Lake, B.C.	1958	2
1'5 DM	(7)	4	Smithers Landing Rd., Smithers-Babine Lake, B.C.	1958	2
C. orae					
1'7 CEM	(1,2)	1	Emsley Cove, Kitimat Tp, B.C.	1961	8
1'7 TIM	(1,2,3,4,5,6,7, 8,9,10,12)	1	Kitimat Stn., B.C.	1961	111

(cont'd)

Table 3. Laboratory inbred lines within *Choristoneura* species (concl.)

Cabinet 3.

Name	Family numbers	Laboratory generation	Collection site	Date	Number of adults
Tray 7	*C. viridis*				
3'4 COC	(1,3,5,7,9)	2	Horse Mtn, Modoc N.F., CA	1962	39
4'1 COC	(1,2,3,5,6)	3	Horse Mtn, Modoc N.F., CA	1962	120
1'7 ODO	(2,3,4)	1	(Bidwell Cr, Modoc, CA (Horse Mtn, Modoc, CA	1962 1962	8
0'7 ORE	(6,11,13,16)	1	Kelly Cr. Plot, Lakeview, OR	1960	8
1'5 ORE	(1,13)	2	Kelly Cr. Plot, Lakeview, OR	1960	4
1'12 ORE	(1,2,3,7)	3	Kelly Cr. Plot, Lakeview, OR	1960	18
5'6 VEM	(A,B,D,E)	1	Benton Meadows, Oregon	1975	20
6'4 VEM	(1,2,3)	2	Benton Meadows, Oregon	1975	22
Tray 8	*C. fumiferana* - Red Eye Stocks				
0'5 R	(1,2,3,4,6,7,8,9) 12,13,14,16,17, 21,22,28)	many	Northwestern Ontario	1960	269
7'7 CR	(2,8)	many	Northwestern Ontario		2
Tray 9	*C. fumiferana* - Red Eye Stocks				
0'5 R	(30,33,34,35,39,40 27,44,46,47,48,49)	many	Northwestern Ontario	1960	91
0'9 R	(1)	many	Northwestern Ontario		1
1'9 R	(5,9)	many	Northwestern Ontario		2
2'6 OREDI	(1)		Northwestern Ontario	1960	1
Folded Wings	(See next entry)				247
Trays 9-13	*C. fumiferana*				
Various	Many	1,2	Several in Ontario	1950, 1951	1966
	(Folded wings - Stocks reared at Laniel, P.Q.)				
Tray 14	*C. subretiniana*				
0'5 LAM	(1,2,3,5)	4	From 8'F UPW from Baker, OR		66

Table 4. Collections associated with field cage experiment[a].

Code	Location	Host	Collected	Collector	Number of adults on pins
Separate Tray #1					
Midhurst Cage					
F'61-M-#[b]	Midhurst Nursery, Vespra Twp, Ont. Eggs collected outside cage	*Picea glauca*	July 18/61	A.A. Harnden	12
F'61-M-X-#	Eggs collected inside cage	*Picea glauca*	July 18/61	A.A. Harnden	9
F'2 'Midhurst'	Adults collected inside cage	*Picea glauca*	June 23/62	G.T. Harvey	9
French Lake Cage					
F'61-C-#	French Lake, Quetico Pk, Ontario Eggs collected outside cage	*Abies balsamea*	July 20/61	G.T. Harvey	51
F'61-K-#	Eggs collected outside cage	*Abies balsamea*	July 20/61	G.T. Harvey	6
F'61-E-#	Eggs collected inside cage	*Abies balsamea*	July 20/61	G.T. Harvey	6
French Lake	Adults collected inside cage	*Abies balsamea*	July 24/62	G.T. Harvey	12
Separate Tray #2					
F'61-E-#	Eggs collected inside cage (cont'd) (Includes FUOC hybrids)		July 20/61	G.T. Harvey	183

[a] For further details see Harvey and Stehr (1971). Experiments on field hybridization between western *Choristoneura occidentalis* Freeman males and native populations of eastern spruce budworm, *Choristoneura fumiferana* (Clem.) Freeman.

[b] Numbers (#) record separate egg clusters from which adults developed, and are roughly equivalent to families.

Table 5. Summary of pinned adults of *Choristoneura* species and hybrids.

Species	Field generation	Laboratory generations	Totals
FU	290	712	1102
OR	120	119	239
OC	719	553	1272
PI PI	130	-	130
PI MA	40	-	40
BI	99	6	105
LA	161	-	161
SU	134	66	200
VI	116	239	355
MUR	72	-	72
FU:Red-Eye	-	366	366
FU:Laniel	-	2213	2213
Hybrids, backcrosses, etc.		3204	3204
TOTAL			9459

Table 6. Summary of pinned adults of crosses of *Choristoneura* species[a]

Female parent	Male parent							
	BI	OR	OC	FU	VI	PI	SU	LA
BI	X	-	9	20	67	3	6	34
OR	-	X	-(1)	-	-	74	-	-
OC	27	5	X	47	3	68(127)	35	-
FU	17	-	439(130)	129[b]	393(286)	7	6	4
VI	8	14	2	18(68)	X	2(83)	62	-
PI	-	6	7	1	-	X	12	-
SU	17	-	40	18	22	-	X	-
LA	-	-	-	-	-	-	-	X

[a]Values indicate number of pinned specimens of the F^1 generation of the cross; values for the F^2 generation of *inter se* matings of the F^1 are given in parentheses.

[b]Matings between individuals from different populations, all F^1.

REFERENCES

Freeman, T.N. 1967. On coniferophagous species of *Choristoneura* (Lepidoptera: Tortricidae) in North America. I. Some new forms of *Choristoneura* allied to *C. fumiferana*. Can. Ent. 99: 449-455.

Harvey, G.T. 1967. On coniferophagous species of *Choristoneura* (Lepidoptera: Tortricidae) in North America. V. Second diapause as a species character. Can. Ent. 99: 486-503.

Harvey, G.T. and Stehr, G.W. 1967. On coniferophagous species of *Choristoneura* (Lepidoptera: Tortricidae) in North America. III. Some characters of immature forms helpful in the identification of species. Can. Ent. 99: 464-481.

Harvey, G.T. and Stehr, G.W. 1971. Experiments on field hybridization between western *Choristoneura occidentalis* Freeman males and native populations of eastern spruce budworm, *Choristoneura fumiferana* (Clem.) Freeman. Dep. Fish. For., Sault Ste. Marie, Ont. Int. Rep. O-28. 68 p. + Appendices.

McMorran, A. 1965. A synthetic diet for the spruce budworm, *Choristoneura fumiferana* (Clem.) (Lepidoptera: Tortricidae) Can. Ent. 97: 58-62.

Obraztsov, N.S. 1962. New species and subspecies of North American Archipini, with notes on other species (Lepidoptera: Tortricidae). Am. Mus. Novit. 2101: 1-26.

Powell, J.A. 1964. Biological and taxonomic studies on Tortricine moths, with reference to the species in California. Univ. Cal. Press, Berkeley and Los Angeles, Univ. Calif. Publ. Ent. 32.

Sanders, C.J., Daterman, G.E. and Ennis, T.J. 1977. Sex pheromone responses of *Choristoneura* spp. and their hybrids (Lepidoptera: Tortricidae). Can. Ent. 109: 1203-1220.

Stehr, G. 1954. A laboratory method for rearing the spruce budworm, *Choristoneura fumiferana* (Clem.), (Lepidoptera: Tortricidae). Can. Ent. 86: 423-428.

Stehr, G. 1967. On coniferophagous species of *Choristoneura* (Lepidoptera: Tortricidae) in North America. II. Geographic distribution in accordance with forest regions. Can. Ent. 99: 455-463.

APPENDIX

Insects listed below were removed from the special collections and sent to the British Museum (Natural History) in London on March 23, 1979 to become part of that collection.

Code	Collection location	Host	Date received	Collector	Number of adults on pins
	C. fumiferana (Clem.) *sensu stricto* (Freeman 1967)				
F'1 BAT	Blackwater R., N.W.T.	*Picea glauca*	June 23/61	C.E. Brown, A. Machuk	1♀ 1♂
F'1 FRE	French L. (near exp. cage) Ont.	*Abies balsamea*	July 14/61	G.T. Harvey	1♀ 1♂
F'1 LAL	1 mi S. of Killala L., Geraldton, Ont.	*Abies balsamea*	July 3/61	V. Jansons	2♀ 2♂
F'1 PYR	Cypress Hills, West Block, Sask.	*Picea glauca*	June 16/61	Hildahl, Pratt	1♀ 1♂
	C. occidentalis Free.				
F'6 HUP	Silver-Skagit Road, Hope, B.C.	*Pseudotsuga menziesii*	June 30/76	E. Morris	1♀ 1♂
F'2 ROK	Slide Rock Mt., Granite Co., MT	*Pinus albicaulis* *Pinus flexilis* *Abies lasiocarpa* *Pseudotsuga menziesii*	Aug. 24/62	G.T. Harvey D.G. Fellin	1♀ 1♂

(continued)

(continued)

Code	Collection location	Host	Date received	Collector	Number of adults on pins
F'2 MON	Brewster Cr., Granite Co., MT	*Pseudotsuga menziesii*	July 3/62	A.E. Cameron	1♀ 1♂
F'2 NUT	Rio Nutritas Carson N.F., NM	*Pseudotsuga menziesii* *Picea glauca*	June 19/62	R. Dalleske C. Slater	1♀ 1♂
F'1 MAY I	Yakima I.R., WA	*Abies concolor*	June 22/61	A.E. Cameron	1♂
F'1 MAY II	Yakima I.R., WA	*Pseudotsuga menziesii*	June 22/61	A.E. Cameron	1♀ 2♂
	C. orae Free.				
F'2 MIT	Kitimat, B.C.	*Picea sitchensis*	June 15/62	E.G. Harvey	1♀ 1♂
F'2 TAM	Kitimat, B.C.	*Abies amabilis*	May 16/62	E.G. Harvey	2♀ 2♂
F'1 TIM	Kitimat Stn., B.C.	*Abies amabilis*	June 21/61	J. Jardine	1♀ 1♂
	C. pinus pinus Free.				
F'1 JAW	Frenchette Sctn, Forestry Farm, Walsingham, Ont.	*Pinus sylvestris*	June 22/61	H.R. Foster	2♂

(continued)

(continued)

Code	Collection location	Host	Date received	Collector	Number of adults on pins
F'1 JCO	Colchester S. Lot 6, Con V, Ont.	*Pinus sylvestris*	June 19/61	H.R. Foster	1♀ 1♂
F'1 JOG	Dogfly L.	*Pinus banksiana*	July 12/61	---	1♀
0'7 JOL	F^1 progeny of 0'7 JOL Lowe Lake Ft. Frances, Ont.	*Pinus banksiana*	July 14/60	M.J. Hildebrand	1♀
F'1 RAJ-1	Raco, MI	*Pinus banksiana*	June 21/61	T. Lisson, G.T. Harvey	1♀ 1♂
	C. biennis Free.				
F'7 HOK	Mi 20, Holmes River Rd, McBride, B.C.	*Abies lasiocarpa*	June 13/77	R. Wood	1♀ 1♂
F'2 LAK	Lake Louise, Sask. R. Crossing, Banff Nat. Park, B.C.	*Pinus albertiana*	June 12/61	J. Petty	2♀ 2♂
F'7 SIK	McMurdo Creek, Golden, B.C.	*Abies lasiocarpa* (out-of-phase population)	June 21/77	M. Cotrell	1♀ 1♂

(continued)

(continued)

Code	Collection location	Host	Date received	Collector	Number of adults on pins
	C. viridis Free.				
F'2 COC 1,2	Horse Mtn, Warner Mtns, Modoc N.F., CA	*Abies concolor*	July 12/62	C.B. Eaton, B.E. Wickman	2♀ 2♂
F'5 VEM	Benton Meadows, OR	*Abies concolor*	July 24/75	G. Daterman	2♀ 2♂
	C. lambertiana (Busck) Free.				
F'4 BAN	Crowsnest, 3.4 mi E of Burmis, Alta.	*Pinus flexilis*	June 29/64	J. Petty Dr. J. Smith	1♂
F'3 LAR-2	Roosvelt N.F., Poudre Canyon, Larimer Co, CO	*Pinus contorta* *Pinus ponderosa*	July 11/63 July 26/63 Aug. 2-13/63	C.J. Germain	1♀
F'4 MAM	Mammoth Hot Springs Yellowstone Nat Park, WY	*Pinus flexilis*	Aug. 4/64	D.G. Fellin	1♀
F'7 PAN-1	St. Vrain River Drainage, CO	*Pinus ponderosa*	June 23/77	R.E. Stevens	2♀ 2♂
	(Identified as *C. lambertiana ponderosana* by R.E. Stevens and J.A. Powell)				

(continued)