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Laboratory Report
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Massachusetts
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Charles P. Schwalbe	Laboratory Supervisor
Arthur P. Morris	Entomologist
Edward C. Paszek	Agriculturist
Larry L. Herbaugh	Agriculturist
Robert G. Reeves	Chemist
Othel T. Forrester	Entomologist
John A. Tanner	Entomologist
Winfred H. McLane	Biological Technician
Joseph G. R. Tardif	Biological Technician
Leonard F. Kennedy	Supervisory Biological Technician
Curtis R. Stacy	Biological Technician
Joyce A. Finney	Biological Aid
Rebecca Upton	Clerk-Stenographer
Judith Bonfield	Clerk-Typist
Robert N. Wassell	Maintenance Worker

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Project Number: GM 5.1.1
Project Title: Laboratory Screening of Candidate Pesticides
Report Period: January - June, 1975
Report Type: Interim
Project Leaders: Winfred H. McLane and Joyce A. Finney

The main objective of this laboratory screening project is to collect mortality data on experimental compounds potentially useful against the gypsy moth, evaluating the data a selecting suitable materials for field testing.

The following materials were tested against 2nd instar larvae on treated tender oak seedlings.

Material	Dosage lb/gal/A	Weather	Aging	Percent Mortality
Actellic (ICI America Inc.)	1.0			98 (3 days)
	0.5			99
	0.25			86
	0.125			58
	0.062			3
	Check			0
AC-206,769 (American Cyanamid)	1.0			100 (4 days)
	0.5			99
	0.25			100
	0.125			89
	0.062			63
	0.031			54
	0.015			20
	0.007			3
	Check			1
AC-206-797 (American Cyanamid)	1.0			96
	0.5			92
	0.25			88
	0.125			79
	0.062			76
	Check			0
Bactospeine (Rhodia)	1.0			100
	0.5			95
	0.25			96
	0.125			73
	0.062			81
	Check			0

Material	Dosage lb/gal/A	Weather	Aging	Percent Mortality
Bromophos (Celamerck GmbH Co.)	1.0			100 (4 days
	0.5			100
	0.25			79
	0.125			12
	0.062			0
	Check			0
CGA-13353 (CIBA-Geigy)	1.0			15 (6 days)
	0.5			10
	0.25			2
	0.125			8
	0.062			5
	Check			0
CGA-18809 (CIBA-Geigy)	0.5			100 (3 days)
	0.25			100
Diazinon ULV (Trans Chemic)	3.8 lb/64 oz			100 (2 days)
	1.9 lb/32 oz			100
	0.9 lb/16 oz			100
	0.4 lb/8 oz			100
	0.2 lb/4 oz			97
	Check			0
	3.8 lb/64 oz			88 (3 days)
	1.9 lb/32 oz			44
	0.9 lb/16 oz			43
	0.4 lb/8 oz			7
	0.2 lb/4 oz			0
	Check			0
	3.8 lb/64 oz			65 (2 days)
	1.9 lb/32 oz			22
	0.9 lb/16 oz			9
	0.4 lb/8 oz			2
	0.2 lb/4 oz			2
	Check			0
Dimilin-25 W/P (Thompson-Hayward)	0.062			68 (6 days)
	0.015			59
	0.007			72
	Check			0
Dimilin 2 Flowable	0.062			78 (6 days)
	0.015			65
	0.007			69
	Check			0

Material	Dosage lb/gal/A	Weather	Aging	Percent Mortality
Dimilin 25 W/P	0.062	Material mixed 38 days prior to treatment		73 (7 days)
	0.015			90
DS-244 65 (Diamond-Shamrock)	1.0	1"		66 (5 days)
	0.5	"		34
	0.25	"		13
	0.125	"		4
	0.062	"		3
	Check	"		0
Dylox-Standard Formulation (Chemagro)	1.0			100 (6 days)
	1.0		8 days	100
	0.5			100
	0.5		8 days	100
	0.125			100
	0.125		8 days	100
Dylox-New Molten Formulation	1.0			100 (6 days)
	1.0		8 days	100
	0.5			100
	0.5		8 days	100
	0.125			100
	0.125		8 days	34 (2 days)
	Check			0
Dylox-Standard Formulation	1.0	1"		99 (6 days)
	0.5	"		97
	0.25	"		59
Dylox-New Molten Formulation	1.0	1"		100 (6 days)
	0.5	"		97
	0.25	"		78
	Check			0
FMC-33297 (FMC-Niagara)	0.5			99 (3 days)
	0.25			97
	0.125			100
	0.062			99
	0.031			93
	0.015			69
	0.007			38
	0.003			35
	0.001			17
	Check			0
	0.25		21 days	100 (5 days)
	0.125		21 days	96

Material	Dosage lb/gal/A	Weather	Aging	Percent Mortality
FMC-33297 (FMC-Niagara)	0.25		52 days	99 (4 days)
	0.125		52 days	100
	1.0	1"		100 (3 days)
	0.5	"		99
	0.25	"		98
	0.125	"		81
	0.062	"		90
	0.031	"		86
	Check			0
	1.0			100 (3 days)
	0.5			100
	0.25			100
	0.125			97
	0.062			91
	0.031			65
	0.015			55
	0.007			39
	0.003			4
	Check			2
	1.0		8 days	100 (3 days)
	0.5			100
	0.25			98
	0.125			98
	0.062			80
	Check			0
	1.0	1"		100 (5 days)
	0.5	"		98
	0.25	"		98
	0.125	"		99
	0.062	"		98
	Check			0
	1.0	1"	7 days	72 (2 days)
	0.5	"		60
	0.25	"		39
	0.125	"		46
	0.062	"		25
	1.0	1"	15 days	99 (3 days)
	0.5	"		99
	0.25	"		98
	0.125	"		98
	0.062	"		80

Material	Dosage lb/gal/A	Weather	Aging	Percent Mortality	
Matacil (Chemagro)	1.0			100	(4 days)
	0.5			97	
	0.25			99	
	0.125			89	
	0.062			32	
	Check			0	
PP-557 (ICI)	0.5			100	(3 days)
	0.25			100	
	0.125			100	
	0.062			98	
	0.031			94	
	0.015			98	
	0.007			93	
	0.003			62	
	0.001			45	
	Check			0	
	0.031	1"		94	(3 days)
	0.015	"		95	
	0.007	"		74	
	0.003	"		55	
	0.001	"		17	
	Check			0	
SAN-197 (Sandoz Wander)	0.25	Material mixed 41 days before treatment		100	(4 days)
	0.06			69	
Sumithion (Stauffer)	1.0			100	(5 days)
	0.5			100	
	0.25			99	
	0.125			99	
	0.062			88	
	0.031			28	
	Check			0	
S-15126 (Gulf)	0.5			100	(4 days)
	0.125			100	
	0.5	Material mixed 43 days before treatment		100	(5 days)
	0.125			100	
	0.5	1"		100	(3 days)
	0.125	"		99	
	0.125	3"		97	
	0.125	4"		100	
	0.5	1"	14 days	100	(4 days)
	0.125	"	14 days	100	
	0.5	1"	23 days	100	
	0.125	"	23 days	88	
	Check			0	

Material	Dosage lb/gal/A	Weather	Aging	Percent Mortality
UC-51109 (Union Carbide)	1.0			100 (3 days)
	0.5			99
	0.25			99
	0.125			95
	0.062			91
	0.031			69
	0.015			17
	0.007			6
	0.003			2
	Check			0

The following materials gave no mortality after a 3 day exposure to 1.0 lb/gal/A.

A-13-18486
A-13-35522
A-13-35769
A-13-35700
A-13-35770
A-13-35771

SBP-1513, which is chemically the same as FMC-33297, was aged and exposed to UV light to compare its stability to that of Resmethrin.

Material	Dosage lb ai/gal/A	Hours UV Light	Percent Mortality
SBP-1513 (S.B. Penwick)	0.5	8	100 (3 days)
Resmethrin (S.B. Penwick)	0.5	8	100 "
SBP-1513	0.06	8	100 "
Resmethrin	0.06	8	24 "
SBP-1513	0.015	8	80 "
Resmethrin	0.015	8	21 "

Test data indicated that SBP 1513 is considerably more stable than Resmethrin when exposed to artificial ultraviolet radiation (290 to 320 nm) that induces pyrethroid destruction. This is especially true at the lower dosages that would be used with a pyrethroid treatment.

SBP 1513 also gave excellent mortality after various days of aging.

Material	Dosage lb/gal/A	Aging	Percent Mortality
SBP-1513 (S.B. Penick)	0.5		100 (3 days)
	0.25		100
	0.25	8 days	100
	0.25	25 "	100
	0.25	37 "	99
	0.125		99
	0.125	8 days	95
	0.125	25 "	100
	0.125	37 "	100
	0.062		93
	0.062	8 days	84
	0.062	25 "	100
	0.062	35 "	95
	0.031		79
	0.031	8 days	58
	0.031	25 "	79
	0.031	37 "	84
	0.015		84
	0.007		75
	0.003		60
	0.001		40

Tests were conducted to compare Sevin-4-Oil to liquid Sevin.

Material	Dosage lb/gal/A	Weather	Aging	Percent Mortality
Sevin liquid (Union Carbide)	1.0			98 (4 days)
	"	1"		100 (3 days)
	"	3"		100 (5 days)
	"		9 days	100 (5 days)
	"		14 days	60 (2 days)
	0.5			94 (4 days)
	"	1"		92 (3 days)
	"	3"		98 (5 days)
	"		9 days	98 (5 days)
	"		14 days	36 (2 days)
	0.25			93 (4 days)
	"	1"		74 (3 days)
	"	3"		92 (5 days)
	"		9 days	100 (5 days)
	"		14 days	45 (2 days)

Material	Dosage lb/gal/A	Weather	Aging	Percent Mortality
Sevin-4-Oil (Union Carbide)	1.0			100 (3 days)
	"	1"		99 (3 days)
	"	3"		99 (5 days)
	"		9 days	100 (5 days)
	"		14 days	88 (2 days)
	0.5			100 (4 days)
	"	1"		90 (3 days)
	"	3"		100 (5 days)
	"		9 days	100 (5 days)
	"		14 days	85 (2 days)
	0.25			99 (4 days)
	"	1"		91 (3 days)
	"	3"		100 (5 days)
	"		9 days	98 (5 days)
	"		14 days	74 (2 days)

Project Number: GM 5.1.2
Project Title: Field Evaluations of Insecticides Against the Gypsy Moth
Report Period: January - July, 1975
Report Type: Interim
Project Leaders: Larry L. Herbaugh, Winfred H. McLane, Curtis R. Stacy and Joyce A. Finney

Appendix 1 is a preliminary report detailing procedures and observations made to date.

Project Number: GM 5.1.3
Project Title: Laboratory Testing of Larval Repellents
Report Period: January - June, 1975
Report Type: Interim
Project Leader: A. P. Morris

Repellents of late instar gypsy moth larvae have potential use by preventing the larvae from pupating on recreational vehicles and equipment, thus minimizing hazards of spread of infestations.

The screening technique involved treating 8.3" x 13.3" strips of chromatography paper, tarpaulin, tar paper or light tent cloth with test compounds and lining 2 qt. ice cream cartons with the strips (inserts). Untreated inserts of the same materials, in separate containers, served as controls. Larvae were released into the cartons (bioassay chambers), and repellency determined from comparative counts of larvae observed on treated and untreated (control) surfaces.

The standard dosage tested was 250 mg/ft^2. If repellency was 90% or greater on chromatography paper, with acetone as the solvent, the compound was tested on tarpaulin, light tent cloth or tar paper and dosages adjusted according to the response. The elimination process was applied at all steps as the testing proceeded. The maximum dosage tested was 1000 mg/ft^2 on tar paper.

The selection process of compounds suitable for field testing included the evaluation of 7 insecticides. The treatment of surfaces with contact insecticides should prove efficient in reducing the incidence of pupation on those sites.

The results of these tests are given in Table 1. None of the compounds yielded greater than 90% repellency at 250 mg/ft^2 except 18486 and 35700. Although Chlordimeform showed only 82% repellency at 250 mg/ft^2, it was retained because of its residual property.

Chromatography paper is not a suitable substrate for field testing so 18486, 35700, and chlordimeform were tested on tarpaulin inserts at 500 mg/ft^2 and higher dosages. The dramatic reduction in repellency on the tarpaulin prompted tests of other materials suitable for outdoor experimentation. The compounds were next tested on light tent cloth and tar paper inserts. Results were relatively equal for both materials at 1000 mg/ft^2 on tar paper but it was again retained because of its long residual property.

The insecticides were tested on tar paper only. Test results with 4 of the 7 insecticides on tar paper, with acetone as the solvent, indicated that they were adequate for field tests at lower dosages than any of the repellents, i.e. FMC 33297 (98%), SBP 1382 (98%), and CGA 18809 (78%) at 50 mg/ft^2, and MGK Pyrethrins at 5 mg/ft^2 (92%). These reductions of percentage of larvae that were observed on the treated surfaces are, of course, due to insecticidal action and not to repellency.

The following compounds will be field tested for repellency of 5th and 6th instar gypsy moth larvae on tar paper with acetone solvent at the dosages indicated.

ARS Ent No. 18486 at 1000 mg/ft^2
ARS Ent No. 35700 at 1000 mg/ft^2
Nor-Am Chlordimeform at 1000 mg/ft^2
FMC 33297 at 50 mg/ft^2
SBP 1382 at 50 mg/ft^2
MGK Pyrethrins at 5 mg/ft^2

A final report of these field tests will be prepared for the next semiannual laboratory report.

Conclusions to date are that no materials suitable for inhibiting pupation on recreational vehicles have been tested. It is possible that further testing of compounds and formulation work with synergising materials will increase efficiency. However, the development of a repellent system for program use will require one or more years of additional effort.

Table 1. Repellancy of Selected Compounds to Late Instar Gypsy Moth Larvae

Compound	Date	Dosage mg/ft^2	Repellancy 1/ Maximum %	Time Hrs.	Substrate	Solvent
ARS 18486	2-6	250	92	+20	Ch. paper 2/	Acetone
	2-25 3/	"	20	0.5	" "	"
	2-21	"	98	+20	" "	"
	2-26 3/	"	10	0.5	" "	"
	2-21	375	96	+20	" "	"
	2-26 3/	"	6	3.5	" "	"
	2-21	500	100	+20	" "	"
	2-26	"	12	0.5	" "	"
	3-26	"	8	2.5	Tarpaulin	"
	3-28	"	94	6.0	Ch. paper	"
	4-22	"	60	+20	Light tentage	"
	4-25 3/	"	30	"	" "	"
	3-27	1000	38	"	Tarpaulin	"
	3-31 3/	"	18	"	"	"
	4-4	"	82	"	Tar paper	"
	4-22	"	92	"	Light tentage	"
	4-25 3/	"	72	"	" "	"
ARS 35700	2-25	250	88	+20	Ch. paper	"
	3-3	"	12	0.5	" "	"
	2-25	375	96	+20	" "	"
	3-3	"	20	0.5	" "	"
	3-26	500	10	+20	Tarpaulin	"
	3-28	"	100	4.0	Ch. paper	"
	4-22	"	98	+20	Light tentage	"
	4-25 3/	"	58	"	" "	"
	3-27	1000	18	"	Tarpaulin	"
	3-31 3/	"	12	1.5	"	"
	4-4	1000	96	6.0	Tar paper	"
	4-22	"	98	+20	Light Tentage	"
	4-25 3/	"	86	"	" "	"
Nor-Am Chlordimeform (99.3%)	2-7	50	62	+20	Ch. paper	"
	2-7	250	82	"	" "	"
	2-7	500	88	"	" "	"
	3-28	"	86	"	" "	"
	2-7	750	80	"	" "	"
	3-27	"	42	3.5	Tarpaulin	"
	3-31 3/	"	54	5.5	"	"
	3-27	1000	30	"	"	"
	3-31 3/	"	38	4.5	"	"
	4-4	"	64	+20	Tar paper	"

1/ Five replicates of 10 larvae (1/2 male 5th instar and 1/2 female 6th instar) were used for each treatment.
2/ Chromatography paper.
3/ Treated substrate retestes after aging to the date shown.

Table 1. continued

Compound	Date	Dosage mg/ft^2	Repellency[1] Maximum %	Repellency[1] Time Hrs.	Substrate	Solvent
FMC 33297 3.2 EC	5-16	50	98	5.0	Tar paper	Acetone
	5-19[3]	"	96	+20	" "	"
	5-16	500	100	2.5	" "	"
	5-19[3]	"	98	4.0	" "	"
MGK Pyrethrins (20%)	5-8	5	30	2.5	Tar paper	"
	5-14[3]	"	10	0.5	" "	"
	5-8	25	92	1.5	" "	"
	5-14[3]	"	26	4.0	" "	"
SBP 1382 (24%)	5-12	5	14	5.0	Tar paper	"
	5-19[3]	"	24	+20	" "	"
	5-12	50	98	6.0	" "	"
	5-19[3]	"	6	2.0	" "	"
	5-8	500	98	+20	" "	"
	5-14[3]	"	34	2.5	" "	"
	5-8	1000	100	1.5	" "	"
	5-14[3]	"	76	5.0	" "	"
	5-19[3]	"	44	+20	" "	"
CGA 18809 Tech 97.8%	5-12	5	10	1.0	Tar paper	"
	5-12	50	16	0.5	" "	"
50 WP	5-16	5	14	"	" "	H_2O+Triton x 100
	5-16	50	78	+20	" "	" " "
	5-19[3]	"	22	"	" "	" " "
TH 6040 W 25	5-16	50	30	2.5	Tar paper	Acetone
	5-16	500	40	3.5	" "	"
Eastman Citral	1-15	50	6	0.5	Ch. paper[2]	Acetone
	1-29	"	8	"	" "	"
	1-29	250	18	1.0	" "	"
	1-15	500	72	+20	" "	"
	1-29	"	54	"	" "	"
	1-29	750	68	"	" "	"
Solvay Para-dichloro-benzene	1-31	50	22	0.5	Ch. paper	"
	1-31	250	22	"	" "	"
	1-31	500	18	"	" "	"
	1-31	750	22	"	" "	"

1/ Five replicates of 10 larvae (1/2 male 5th instar and 1/2 female 6th instar) were used for each treatment

2/ Chromatography paper

3/ Treated substrate retested after aging to the date shown

Table 1. continued

Compound	Date	Dosage mg/ft^2	Repellency[1] Maximum %	Repellency[1] Time Hrs	Substrate	Solvent
Eastman d-Camphor	1-15	50	10	1.0	Ch. paper[2]	Acetone
	1-15	500	6	3.5	" "	"
ARS 35769	2-4	250	82	+20	Ch. paper	"
	2-21	500	88	"	" "	"
	2-26[3]	"	16	0.5	" "	"
	5-5	"	30	"	Tar Paper	"
	5-5	1000	26	"	" "	"
ARS 35770	2-7	250	68	+20	Ch. paper	"
	2-25	500	18	"	" "	"
	5-5	500	24	0.5	Tar paper	"
	5-5	1000	34	"	" "	"
Sandoc Thuricide 16B/gal	5-21	50	26	0.5	Tar paper	H_2O+Triton x 100
	5-21	500	30	0.5	" "	" " "
Abbott Dipel WP (16,000 Bd u/mg)	5-21	50	18	0.5	Tar paper	" " "
	5-21	500	26	0.5	" "	" " "
ARS 35771	2-6	250	70	5.5	Ch. paper	Acetone
	2-24	250	44	6.0	" "	"
	2-24	375	62	6.0	" "	"
	2-24	500	62	5.5	" "	"
ARS 35522	2-4	250	80	+20	Ch. paper	"
	2-24	375	64	5.5	" "	"
ARS 35645	2-4	250	16	0.5	Ch. paper	"
ARS 32849	2-7	250	52	6	Ch. paper	"
ARS 35616	2-6	250	42	+20	Ch. paper	"
ARS 35659	2-6	250	12	1.5	Ch. paper	"
ARS 35658	2-5	250	44	0.5	Ch. paper	"
ARS 34289	2-5	250	22	0.5	Ch. paper	"

1/ Five replicates of 10 larvae (1/2 male 5th instar and 1/2 female 6th instar) were used for each treatment.
2/ Chromatography paper

Table 1. continued

Compound	Date	Dosage mg/ft^2	Repellency[1] Maximum %	Repellency[1] Time Hrs.	Substrate	Solvent
ARS 34288	2-5	250	34	0.5	Ch. paper[2]	Acetone
ARS 35651	2-5	250	20	+20	" "	"
ARS 35898	2-4	250	18	0.5	" "	"
ARS 35768	2-3	250	28	6.0	" "	"
ARS 35614	2-3	250	58	6.0	" "	"
ARS 4203	2-3	250	20	0.5	" "	"
ARS 1016	2-3	250	8	4.5	" "	"

1/ Five replicates of 10 larvae (1/2 male 5th instar and 1/2 female 6th instar) were used for each treatment

2/ Chromatography paper

Project Number: GM 5.1.5
Project Title: Fumigation of Gypsy Moth Eggs with Methyl Bromide
Report Period: January - June, 1975
Report Type: Interim
Project Leader: Larry L. Herbaugh, Curtis R. Stacy

No work was performed on this project during this reporting period.

Project Number: GM 5.1.8
Project Title: Evaluation of Pesticides for Brown-tail Moth
Report Period: January - June, 1975
Report Type: Interim
Project Leader: Winfred H. McLane and Joyce A. Finney

The primary objective of this project is to screen candidate materials effective against the brown-tail moth.

Based on laboratory test data (Table 1.) the entire detectable brown-tail moth infestation on Sandy Neck in the town of Barnstable, Mass. was treated with Sevin 80S at 1 lb ai/5 gal to the point of runoff on May 22nd and 23rd, using back-pack mistblowers. Chevron spray sticker was used in the formulation at 3 percent. Weather conditions were good at the time of treatment and foliage was expanded 10 percent. Larvae were generally second and third instar.

General observations 3 weeks after treatment indicate complete control may have been realized. The area will be trapped during July and fall web counts made for final evaluation of the treatment.

Table 1. Mortality of 3rd and 5th Instar Brown-tail Moth Larvae Exposed to Treated Oak Seedlings

Material	Dosage ai/gal/A	Instar	% Mortality
Sevin 80S	1.0 lbs	3rd	100 (6 days)
	0.5 "	"	100
	0.25 "	"	100
	0.12 "	"	99
	0.16 "	"	87
Check	-	"	2
Sevin 80S	1.0 lbs	5th	96 (5 days)
	0.5 "	"	96
	0.25 "	"	89
	0.12 "	"	72
	0.06 "	"	49
	0.03 "	"	28
	0.01 "	"	8
Check	-	"	1

Project Number: GM 5.1.9
Project Title: Field Testing of Ground Applied Insecticides
Report Period: January - June, 1975
Report Type: Interim
Project Leaders: Larry L. Herbaugh, W. H. McLane, C. R. Stacy

A roto mist blower mounted on a 1 1/2 ton truck was used to apply chemical insecticides to "simulated campground" areas. In most cases this was a densely wooded country lane, heavily infested with gypsy moth.

The following chemicals were applied when the majority of the insects were in the 3rd instar and the oak foliage completely expanded.

Material	Application Rate	Plots
ABG-6010	0.250 lb/5 gal/A	1 - 9 - 30
Encap. Diazinon	1.000 lb/5 gal/A	2 - 11 - 31
Encap. Resmethrin	0.125 lb/5 gal/A	3 - 12 - 32
Encap. Sumithion	1.000 lb/5 gal/A	4 - 13 - 33
FMC 33297	0.060 lb/5 gal/A	5 - 14 - 34
" "	0.010 lb/5 gal/A	6 - 15 - 35
MC-9087	0.500 lb/5 gal/A	7 - 16 - 36
SBP-1513	0.250 lb/5 gal/A	8 - 17 - 37
" "	0.125 lb/5 gal/A	19 - 18 - 38
" "	0.060 lb/5 gal/A	20 - 27 - 44
Sevin 80S	5.000 lb/5 gal/A	21 - 41 - 45
" "	3.500 lb/5 gal/A	23 - 25 - 42
" "	2.000 lb/5 gal/A	22 - 39 - 43
" "	1.000 lb/5 gal/A	24 - 26 - 29
Control	-	10 - 28 - 40

Data and results are incomplete at this writing. A report detailing procedures, data, and conclusions will be forthcoming for this project.

Project Number: GM 5.2.1
Project Title: Field Testing of Disparlure in Remote Infestations - Michigan
Report Period: January - September, 1975
Report Type: Interim
Project Leaders: C. P. Schwalbe, C. Stephens, B. Kesler

A comprehensive program of survey and detection, control and research and development has been in progress in Central Michigan since 1973. These activities have been, for the most part, cooperative efforts of USDA, APHIS, and Michigan Department of Agriculture. The Methods Development aspects have been directed toward development of treatment systems effective against very low-level, remote infestations. Treatments under study include microencapsulated disparlure, both alone and in combination with chemical insecticides, saturation trapping, and refinement of survey and treatment evaluation techniques.

Certain areas had been identified as proposed disparlure test sites in the July - December, 1974 Laboratory Report. However, circumstances dictated cancellation of pheromone application and, therefore, all evaluations and monitoring conducted in 1975 were in plots with histories of various treatments in 1973 and 1974. No pheromone was applied in 1975. This report will review the "history" of the program from 1973-1975 and present survey and treatment monitoring data collected.

GYPSY MOTH CONTROL PROGRAM--MICHIGAN

KEY TO TREATED AREAS

D74

Sprayed with disparlure, 1974.

SD74

Sprayed with Sevin 4-Oil and disparlure, 1974.

S74

Sprayed with Sevin 4-Oil, 1974.

S75

Sprayed with Sevin 4-Oil, 1975.

T74-75

Mass traps, 1974 and 1975.

C74-74

Control plots, 1974 and 1975.

Control Rosebush

Wings of sentinels scented with disparlure in locations A, C, D, F and J at sites 1, 5, 9, 13 and 17, 1975.

ST74

Sprayed with Sevin 4-Oil, 1974. Traps, 1974.

EX 1-75

Wings of sentinels scented with disparlure at odd sites, 1975.

Ex 2 & 3

Moths placed inside sticky GM traps at odd sites. At even sites, moths placed inside non-sticky GM traps, 1975.

EVALUATION OF GYPSY MOTH CONTROL PROGRAMS MICHIGAN - 1975

	Female Moth				Male Moth	Egg Masses	
Female Moth Location No.	Placed in Field Date No.	Recovered Date No.	%	Mated No.	Caught No.	Collected No.	Fertilized No.
D74	890	255	29	0	0	85	
SD74	935	329	35	0	0	60	
S74	900	295	33	0	0	42	
S75	990	287	29	0	0	68	
T74-75	960	306	32	1	1	118	
C74-75	1040	342	33	1	2	44	
Control Rosebush	730	116	15	0	0	23	
ST74	1240	561	45	0	0	54	
EX 1-75	740	372	50	7	4	61	
EX 2 & 3	120	114	95	0	0	2	
Total	8545	2977	35	9	7	557	

EVALUATION OF GYPSY MOTH CONTROL PROGRAMS MICHIGAN - 1975

	Female Moth				Male Moth	Egg Masses	
Female Moth Location No.	Placed in Field Date No.	Recovered Date No.	%	Mated No.	Caught No.	Collected No.	Fertilized No.
D74-D75 A	100	22	22	0	0	4	
D74-D75 B	100	41	41	0	0	6	
D74-D75 C	100	48	48	0	0	5	
D74-D75 E	100	32	32	0	0	5	
Total	400	143	37	0	0	20	

MOTH RECOVERY BY TREE TYPE *

Tree	No. moths put up	No. moths recovered	%
Apple	15	2	13
Ash	219	63	29
Aspen	618	180	29
Basswood	129	46	36
Beech	487	158	32
Birch	18	5	28
Box elder	63	22	35
Cedar	161	51	32
Cherry	162	61	37
Cottonwood	22	2	9
Elm	264	77	29
Hawthorne	55	11	20
Hemlock	18	6	33
Hickory	156	66	42
Horse Chestnut	18	4	22
Ironwood	160	49	30
June Berry	1	1	100
Maple	1416	466	33
Oak	1824	615	33
Pine	72	25	35
Poplar	565	210	37
Sassafras	76	31	41
Tamarack	6	2	33
Walnut	37	20	54
Witch Hazel	14	7	50

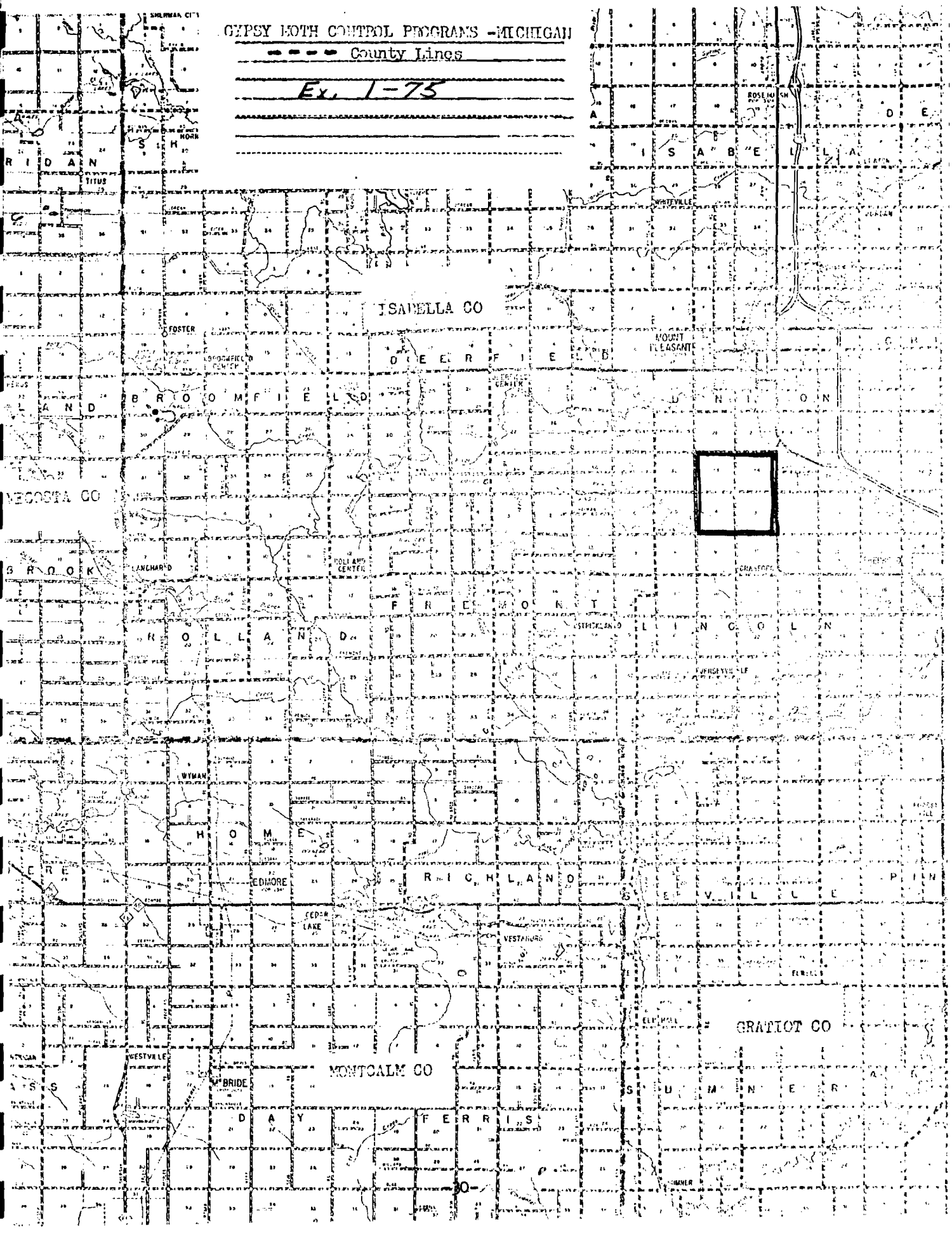
*Representative Sampling Only

In 1975 a 4 square mile area was selected to compare female sentinels treated with 50 μg of Disparlure to untreated female sentinels. A total of 20 females were placed at each of 4 locations. Females positioned at uneven sites were treated with 50 micrograms of Disparlure, while the even numbered females were left untreated. This area was selected for comparison on its history of moth catches in 1973 and 1974. Eight male moth were caught in 10 detection traps in 1973, and 3 moth were caught in 3 traps in 1974. No moth were caught in detection traps in 1975. There were 6 female sentinels mated and 4 male moth caught in the monitoring--comparison plots. No native egg masses have been found to date in these 4 sections. Four treated females were mated and 2 untreated females were mated.

GYPSY MOTH CONTROL PROGRAMS -MICHIGAN

---- County Lines

Ex. 1-75



GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: Ex1-75
Isabella County, Union Twp., sec 33 & 34, Lincoln Twp., sec 3 & 4.

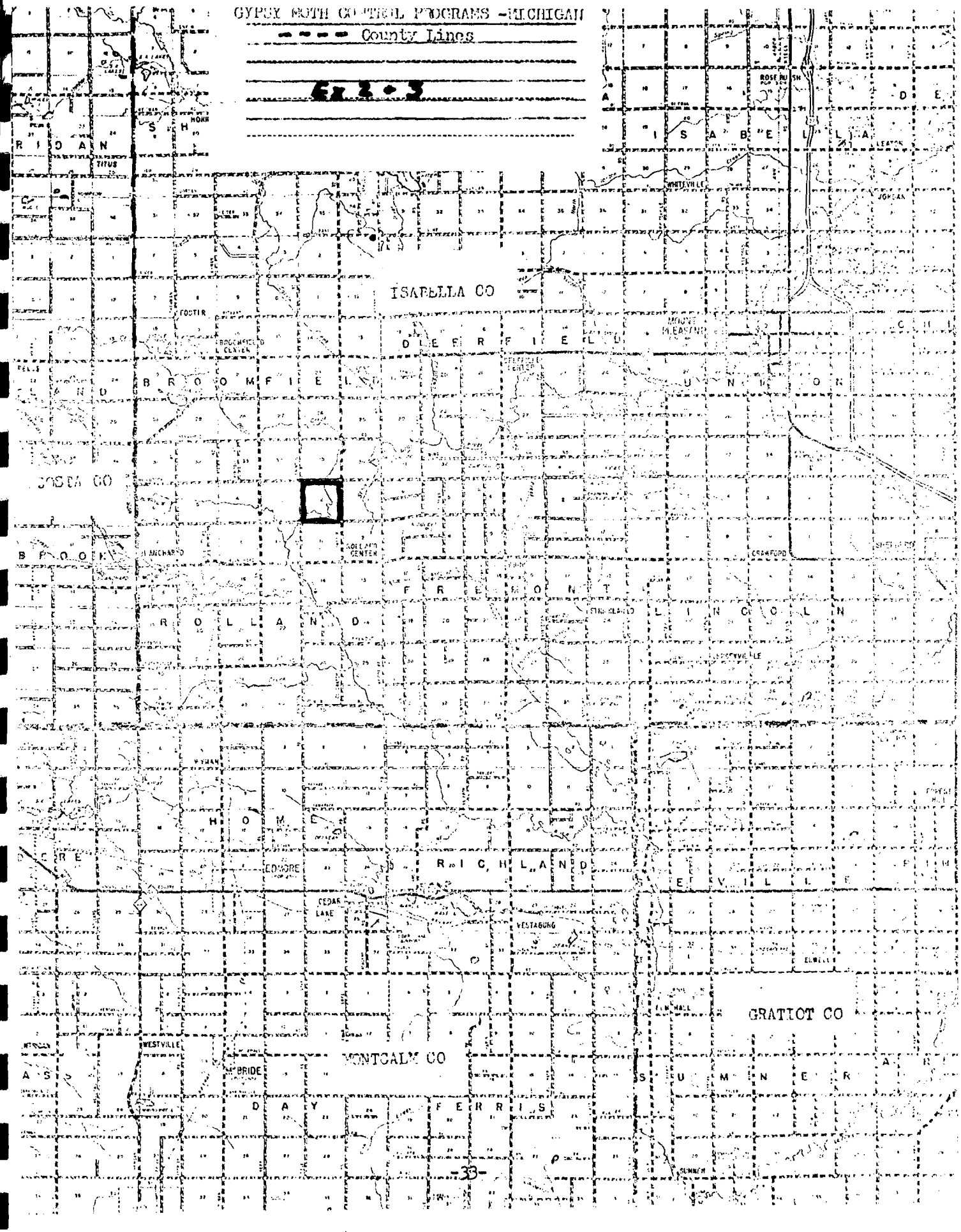
YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1973	Lincoln	3	1	1	none	none		
		4	4	8				
	Union	33	3	1				
1974	Lincoln	3	0	1	none	none		
		4	1	1				
	Union	33	1	1				
		34	1	1				
1975	Lincoln	3	0	4	none	4	6	
		4	0	4		0	0	
	Union	33	0	4		0	1	
		34	0	4		none		

A two-fold test was conducted in section 2 Rolland Twp., Isabella County. First to search for an area to treat with Disparlure for adult male confusion and second to see if females placed in the tac-trap could survive and attract male moth to the trap. Two locations were selected with 20 female sentinels placed at each location. Females were placed on their ventral side directly in the tac-trap in each of the uneven trap sites. At the even trap sites females were placed in traps without any tac-trap in them. Both the females in tac--trap and in the trap without tac-trap survived the 3--4 day exposure period. All moth were examined for the presence of sperm and found to be negative. This comparison was carried out for 9 days with sentinels replaced at 3 day intervals, with 92% and 98% recovery. No females were mated. This location was selected because a female was mated in the next section East along with a number of males caught in August of 1975.

GYPSY MOTH CONTROL PROGRAMS - MICHIGAN

County Lines

Ex 3-3



GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Ex 2 & 3
Location: Isabella County, Rolland Twp., sec 2.

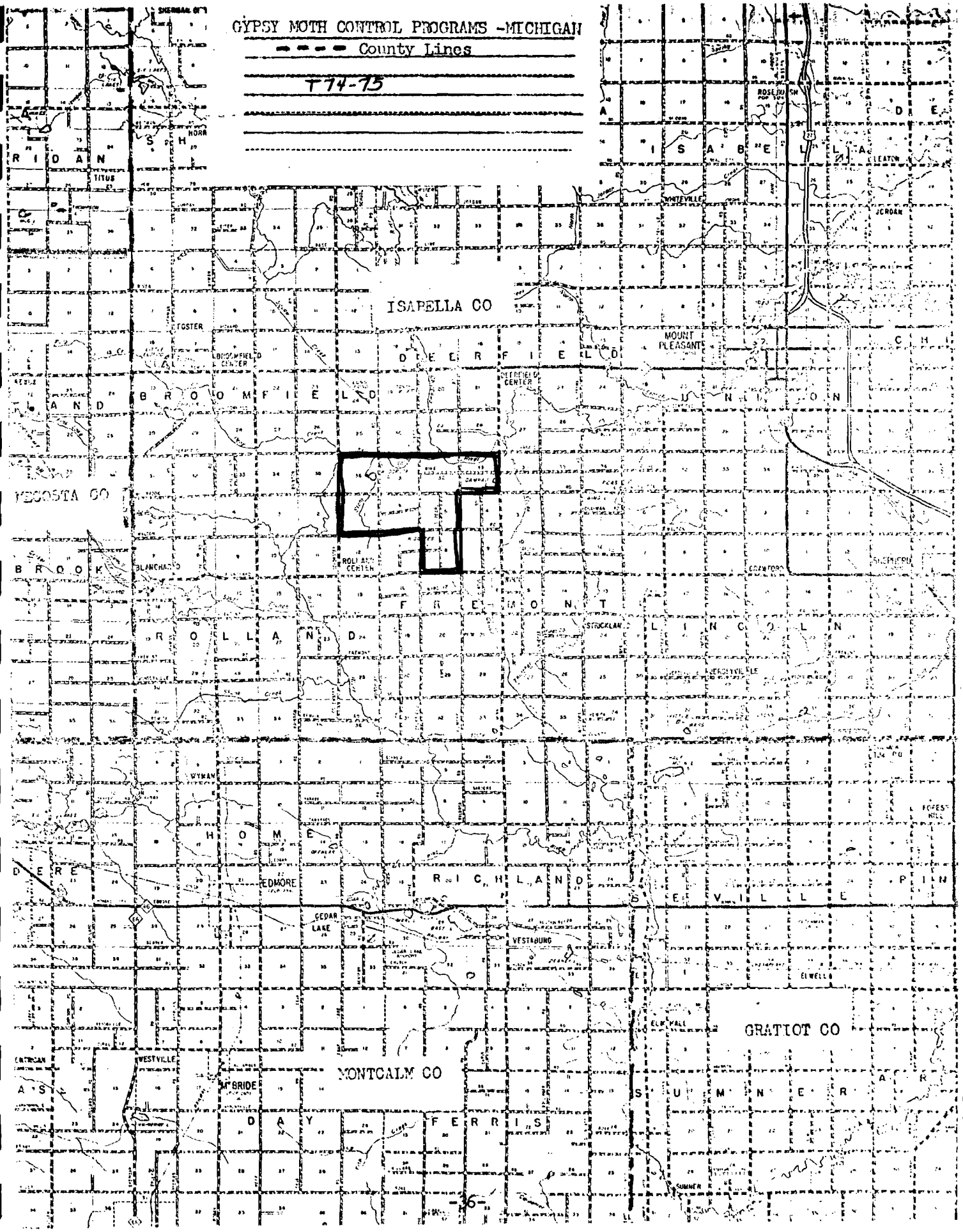
YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSE
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1973	Rolland	2	5	4	none	none		
1974		2	0	1				
1975		2	0	4				

Mass trapping was used as a control technique in 8 square miles N. W. of Winn in 1974 and 1975. Traps were placed at a rate of 9/acre or 5,760 traps/sq. mile if a section was completely wooded. However these sections are 60--70% wooded. The total number of traps set amounts to approximately 30,000. In 1973 detection traps caught 77 moth through the use of 28 detection traps. In 1974 a total of 373 moth were caught in the 30,000 mass traps set. The monitoring consisted of 10 locations, with 10 female sentinels and 10 GM traps at each location, resulting in the mating of 6 females.

GYPSY MOTH CONTROL PROGRAMS -MICHIGAN

County Lines

T74-75



GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

T74-75

Location: Isabella County, Broomfield Twp., sec 36, Rolland Twp., sec 1, Deerfield Twp., sec 31, 32 & 33, Fremont Twp., sec 5, 6, & 8.

YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1973	Broomfield	36	9	4	none	none		
	Fremont	5	16	4				
		6	14	4				
		8	5	3				
	Rolland	1	11	4				
	Deerfield	31	3	2				
		32	10	3				
		33	9	4				
1974					mass traps 9 traps/acre no. moths caught			
	Broomfield	36			4	0	1	
	Fremont	5			4	0	~~0~~2	2
		6			13	0	0	
		8			38	0	~~0~~1	

GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: T74-75

YEAR			DETECTION		TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.	mass traps 9 traps/acre no. moths caught	# male caught	# female mated	
1974	Rolland	1			14	0	0	
	Deerfield	31			53	0	0	
		32			39	0	0	
		33			209	0	3	
1975	Rolland	1				1	1	
	Broomfield	36				0	0	
	Fremont	5				0	0	1
		6				0	0	
		8				0	0	
	Deerfield	31				0	0	
		32				0	0	
		33				0	0	

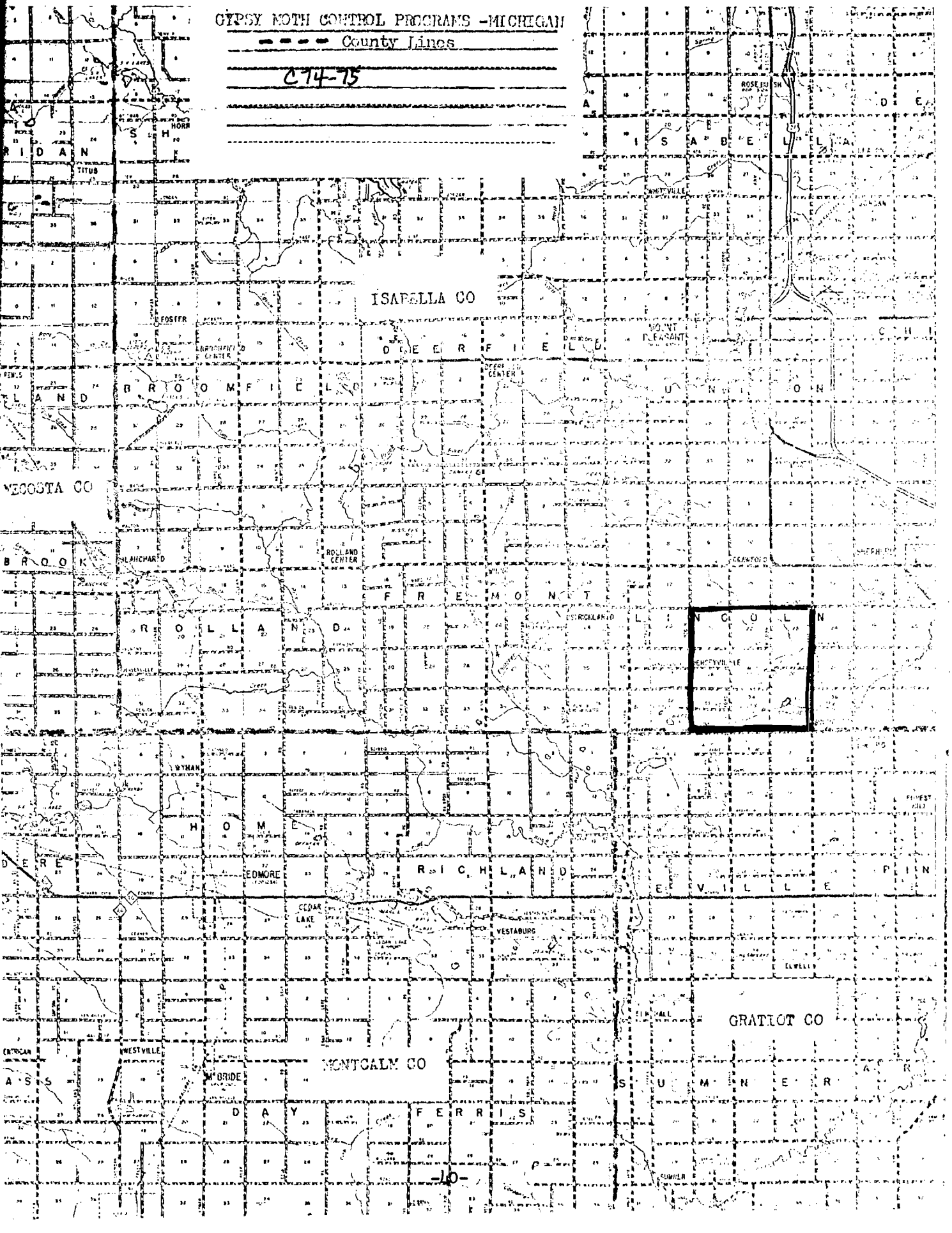
A nine square mile block in Lincoln twp., Isabella County was designated as a check area for comparing populations with treatment areas. The check areas history follows:

> In 1973 detection traps caught 44 moth in 28 traps. The 1974 detection survey found one moth. However there were 9 male moth caught by traps placed out in connection with the sentinel females. Also 2 female sentinels were mated. In 1974 10 locations with 10 sterilized female sites and 10 GM trap sites were placed at each of the 10 locations.. During the 1974-75 winter survey one small egg mass was found in the check area in sec. 22 of Lincoln twp., Isabella County. This egg mass was removed before egg hatch. During the 1975 detection survey only one male moth was found. Monitoring traps caught 2 and one female sentinel was mated. No treatment has been applied to this area to date.

GYPSY MOTH CONTROL PROGRAMS -MICHIGAN

County Lines

C74-75



GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: C74-75: Isabella County, Lincoln Twp., sec 21, 22, 23, 26, 27, 28, 33, 34, & 35.

YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1973	Lincoln	21	7	3	none	none		
		22	4	3				
		23	5	3				
		26	7	3				
		27	6	3				
		28	11	4				
		33	4	3				
		34	6	4				
		35	4	2				
1974		21	0~~0~~	0	none	3	2	
		22	1	1		1	0	
		23	0	1		2	0	
		26	0	1		0	0	
		27	0	1		0	0	
		28	0	1		1	0	

GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: C74-75

YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1974		33	0	1		0	0	
		34	0	1		1	0	
		35	0	1		1	0	
1975		21	0	4	none	0	0	
		22	0	4		1	1	1
		23	0	4		0	0	
		26	0	4		0	0	
		27	0	4		1	0	
		28	1	4		0	0	
		33	0	4		0	0	
		34	0	4		0	0	
		35	0	4		0	0	

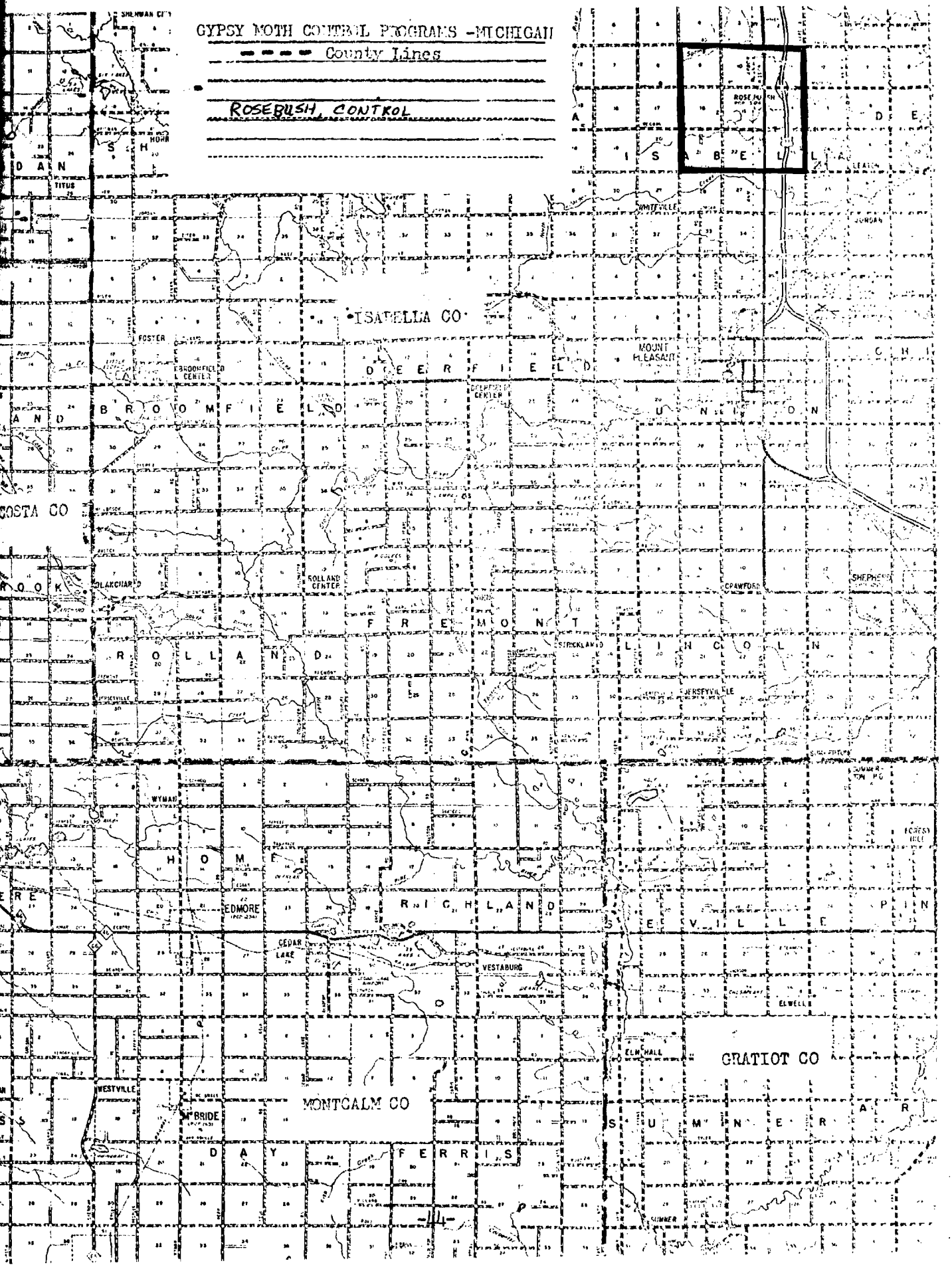
Rosebush Control Block

A nine square mile area encompassing the small village of Rosebush was selected for treatment by Disparlure in 1975. However, it was not treated and since the monitoring locations were already set up the area was used as a second check block for 1975. The history of this block showed a small number of moth for the past 2 years. In 1973 three moth were caught in detection and in 1974 a total of 4 moth were caught. The 1975 detection and monitoring produced no male moth or mating.

GYPSY MOTH CONTROL PROGRAMS -MICHIGAN

County Lines

ROSEBUSH CONTROL



GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: Rosebush, Control
Isabella County, Isabella Twp., sec 9, 10, 11, 14, 15, 16, 21, 22, & 23.

YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1973	Isabella	9	1	1	none	none		
		10	2	1				
1974		9	1	1	none	none		
		10	0	1				
		11	1	1				
		14	0	1				
		15	1	1				
		16	0	1				
		21	0	1				
		22	0	1				
		23	1	1				
1975		9	0	4	none	0	0	
		10	0	4		0	0	
		11	0	4		0	0	

GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: Rosebush, Control

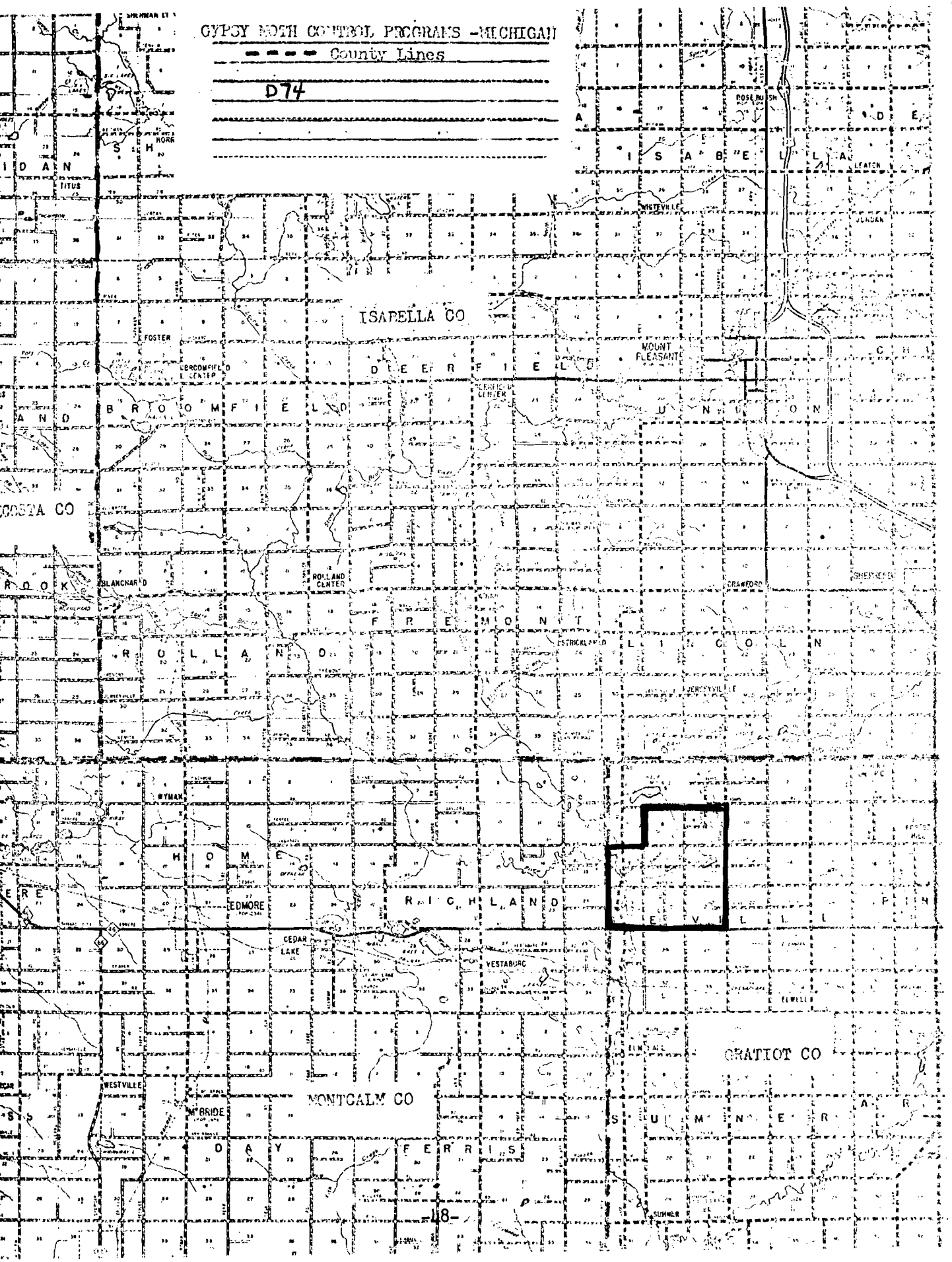
YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1975		14	0	4		0	0	
		15	0	4		0	0	
		16	0	4		0	0	
		21	0	4		0	0	
		22	0	4		0	0	
		23	0	4		0	0	

In 1974 an eight square mile area was treated with 3½ grams of Disparlure, with 2 applications, one in mid July and the second the first part of August. The history on this block shows 93 moth were caught in 28 detection traps in 1973. No moth were caught in detection traps in either 1974 or 1975. However 3 males were caught in monitoring traps placed out in connection with the female sentinels. Also 2 females were mated in 1974. No moth were found in 1975 monitoring and no female sentinels were mated.

GYPSY MOTH CONTROL PROGRAMS - MICHIGAN

County Lines

D74



GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

D74
Location: Gratiot County, Seville Twp., sec., 8, 9, 16, 17, 18, 19, 20 & 21

YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1973	Seville	8	18	4	none	none		
		9	16	4				
		16	8	4				
		17	10	4				
		18	10	4				
		19	16	4				
		21	15	4				
1974		8	0	1	3 ½ grams disparlure, 2 applications	0	0	
		9	0	1		1	1	
		16	0	1		0	0	
		17	0	1		0	1	
		18	0	1		0	0	
		19	0	1		1	0	
		21	0	1		1	0	

GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: D74

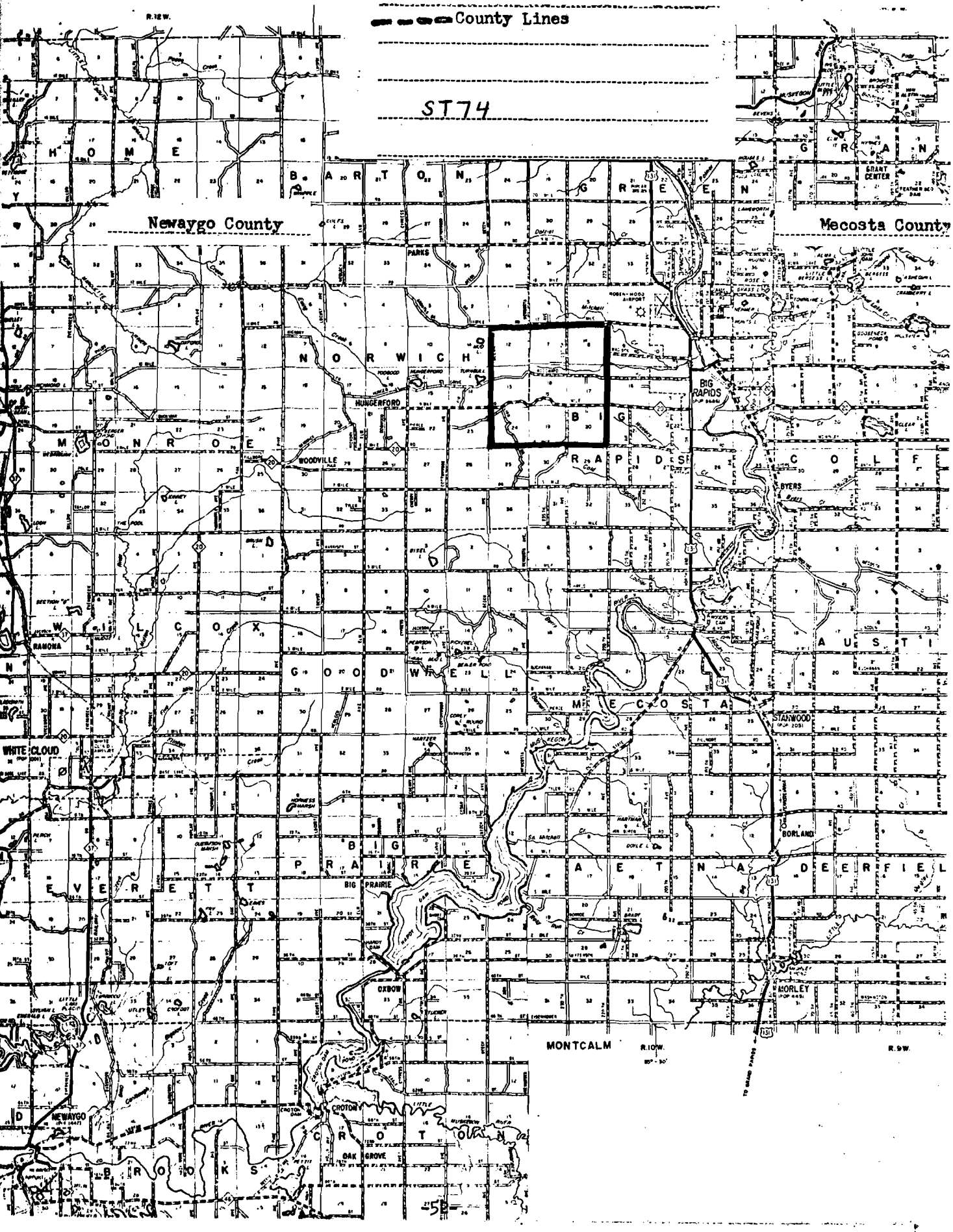
YEAR		DETECTION			TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1975		8	0	4	none	0	0	
		9	0	4		0	0	
		16	0	4		0	0	
		17	0	4		0	0	
		18	0	4		0	0	
		19	0	4		0	0	
		21	0	4		0	0	

ST74 the 9 square miles just west of Big Rapids had the following sequence of events. In 1973, 4 male moth were caught in detection traps. Dec. 14, 1973 six egg masses were found in sec. 18, Big Rapids Twp., Mecosta County. During the spring of 1974 the 9 square mile area was treated with Sevin-4-oil and mass traps were placed at a rate of 9/per acre. The area was monitored through the use of sterilized female Gypsy Moth placed in 10 different locations, with 10 sites at each location consisting of one sterilized female and one GM trap. A total of 14 females were mated--no males were caught.

In 1975 a total of 50 traps were placed per square mile for additional monitoring--no moths were found. Also 10 monitoring locations were set with 20 sterilized females and 20 GM traps at each location. No female moth were mated and no male moth were caught.

County Lines

ST74



GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: St74
Newaygo County, Norwich Twp., sec 12, 13, & 24, Mecosta County, Big Rapids Twp., sec 7, 8, 17, 18, 19, & 20.

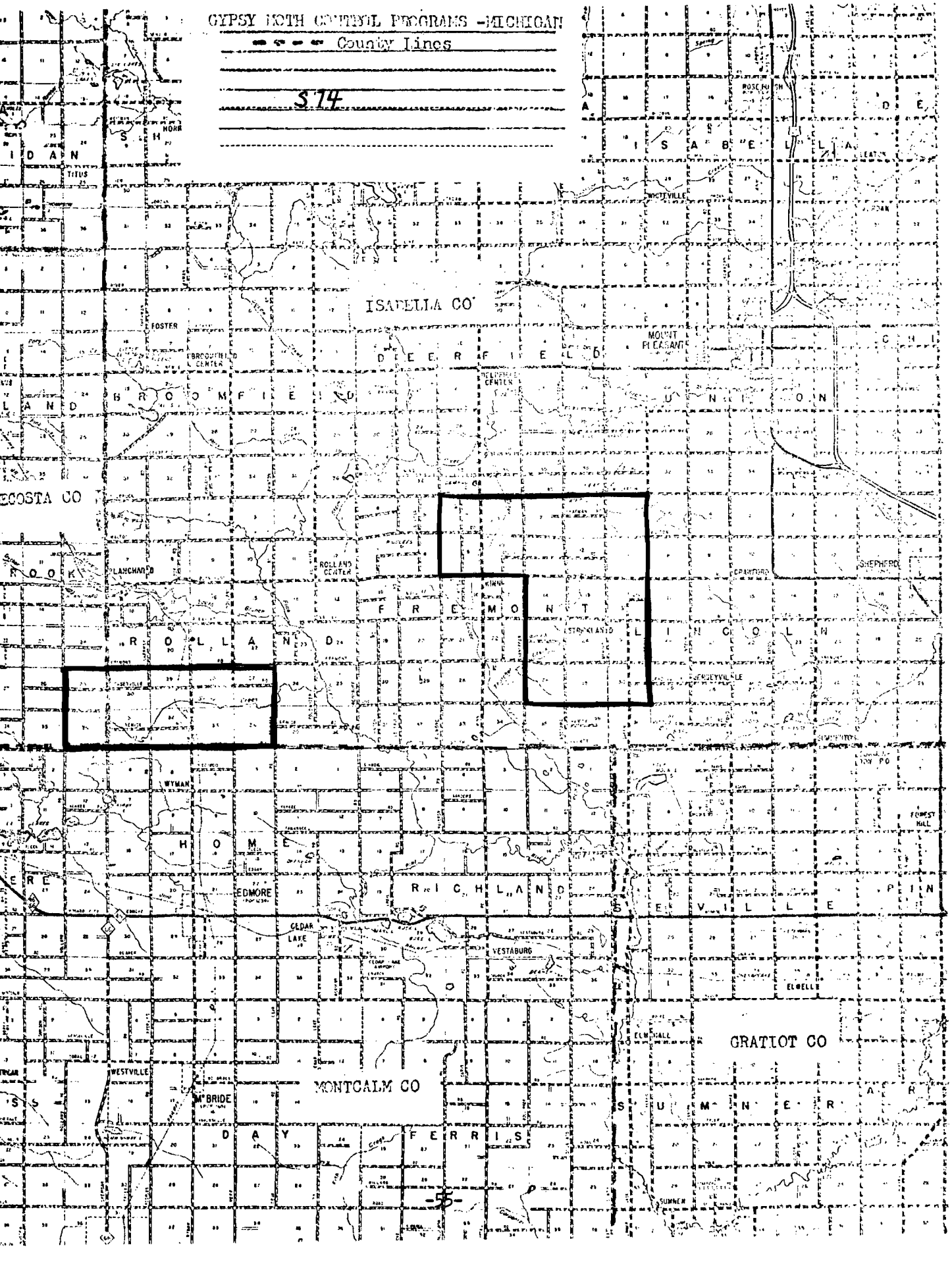
YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1973	Norwich	13	4	2	none	none		
1974		12			Sevin-4-oil & mass traps 9 traps/acre, no moths caught	0	4	
		13				0	0	
		24				0	0	
	Big Rapids	7				0	1	
		8				0	1	
		17				0	8	
		18				0	0	6
1975	Norwich	12			none	0	0	
		13				0	0	
		24				0	0	
	Big Rapids	7				0	0	
		8				0	0	
		17				0	0	
		18				0	0	
		19				0	0	
		20				0	0	

A 29 square mile area was treated with one application of Sevin-4-oil in 1974. In 1973 detection traps caught 107 moth in 81 traps. One egg mass was found during the winter survey of 1972-73 in sec. 25, Fremont Twp., Isabella County. The 1974 detection survey caught 3 moth, one male moth was caught in a monitoring trap and 5 sterilized females were mated. A Biometric egg mass survey was conducted during the winter of 1973-74 resulting in 34 egg masses being found. One 1/4 sec. was found reinfested with 9 egg masses during the 1974-75 egg mass survey and this 1/4 sec. was treated with Sevin-4-oil in conjunction with the 1975 Sevin-4-oil treatment program. Detection traps found only 3 moth in this area in 1975 and no mating or male moth were caught in the 10 locations where sentinel females and monitoring traps were placed.

GYPSY MOTH CONTROL PROGRAMS -MICHIGAN

County Lines

S 74



GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

S74

Location: Mecosta County, Millbrook Twp., sec 25 & 26; Isabella County, Rolland Twp., sec. 27, 28, 29, 30, 31, 32, 33, & 34, Fremont Twp., sec. 1, 2, 3, 4, 9, 10, 11, 12, 13, 14, 23, 24, 25, 26, Lincoln Twp., 6, 7, 18, 19, & 30.

YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1973	Millbrook	25	1	1	none	none		
		~~26~~ 36	1	1				
	Lincoln	6	2	2				
		7	7	3				
		18	5	3				
		19	15	3				
		30	3	2				
	Fremont	1	5	3				
		2	8	4				
		3	5	2				
		4	10	4				
		9	20	4				
		10	8	4				
		11	13	3				
		12	4	2				

GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: S74

YEAR		DETECTION			TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1973		13	10	3				
		14	5	3				
		23	7	3				
		24	10	4				
		25	8	3				1
		26	4	3				
	Rolland	27	7	2				
		28	3	2				
		29	12	4				
		30	12	4				
		31	5	2				
		32	4	2				
		33	8	4				
		34	2	1				

GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: S74

YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1974	Millbrook	25	0	1	Sevin-4-oil	none		
		~~26~~36	0	1				
	Lincoln	6	0	1		0	0	
		7	0	1		0	0	
		18	1	1		1	1	
		19	0	1		0	0	
		30	1	1		0	1	
	Fremont	1	0	1		0	0	
		2	0	1		0	0	
		3	0	1		0	0	
		4	0	1		0	0	8*
		9	0	1		0	0	1*
		10	0	1		0	0	1*
		11	0	1		0	0	
		12	0	1		0	0	

*Biometric survey

GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: S74

YEAR			DETECTION		TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1974		13	0	1		0	1	
		14	0	1		0	0	
		23	0	1		0	0	
		24	0	1		0	0	
		25	0	1		0	1	
		26	0	1		0	1	
	Rolland	27	0	1		none		
		28	0	1				
		29	0	1				
		30	1	1				
		31	0	1				24*
		32	0	1				
		33	0	1				
		34	0	1				

*biometric survey

GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: S74

YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1975	Millbrook	25	1	4	none	none		
		36	1	4				
	Lincoln	6	0	4		0	0	
		7	1	4		0	0	
		18	0	4		0	0	
		19	0	4		0	0	
		30	0	4		0	0	
	Fremont	1	0	4		0	0	
		2	0	4		0	0	
		3	0	4		0	0	
		4	0	4		0	0	
		9	0	4		0	0	
		10	0	4		0	0	
		11	0	4		0	0	
		12	0	4		0	0	

GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: S74

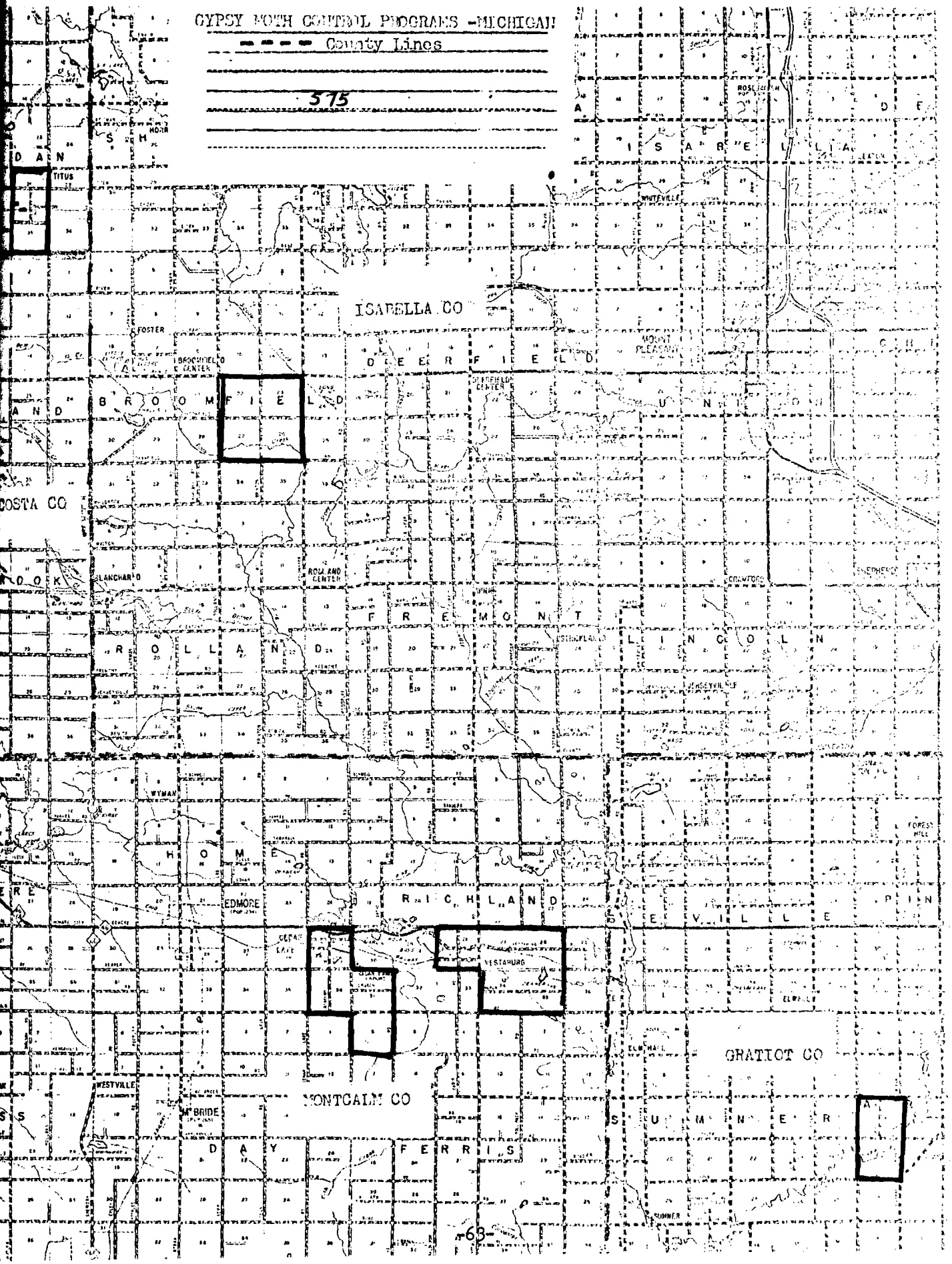
YEAR		DETECTION			TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1975		13	0	4	none	0	0	
		14	0	4		0	0	
		23	0	4		0	0	
		24	0	4		0	0	
		25	0	4		0	0	
		26	0	4		0	0	
	Rolland	27	0	4		none		
		28	0	4				
		29	0	4				
		30	0	4	none			
		31	0	4	NW ¼ Sevin-4-oil			9
		32	0	4	none			
		33	0	4	none			
		34	0	4	none			

The 17 square mile area treated with Sevin-4-oil in 1975 had the following history. In 1973 detection traps caught 49 male moth in 20 traps. The 1974 detection survey produced 45 moth in 17 detection traps and 2 additional traps placed in section 27 of Richland Twp., Montcalm County to compare the cotton wick to the plastic wick. Both traps caught equal numbers of moth. The Cedar Lake, Vestaburg and Arcada treatment areas were monitored through the use of 20 sterilized gypsy moth females and 20 gypsy moth traps at 12 locations. No females were mated and no moth were caught. The total Sevin-4-oil area was scheduled for treatment with disparlure, but was not treated. The 2 square miles in Sheridan Twp. and the 4 square miles in Broomfield Twp. were set up for monitoring with sterilized females and gypsy moth traps amounting to 8 more locations. No sterilized female were used, but the traps were placed out and recovered with no male moth caught. Only 2 moth were caught in the spray area by detection traps and were found in section 22 and 27 of Broomfield Twp., Isabella County.

GYPSY MOTH CONTROL PROGRAMS -MICHIGAN

County Lines

375



GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

S75

Location: Mecosta County, Sheridan Twp., sec. 26 & 35; Montcalm County, Home Twp., sec. 25 & ~~26~~ 36, Richland Twp., sec. 26, 27, 28, 31, 34, 35, Ferris Twp., sec. 6; Gratiot County, Arcada Twp., sec. 18 & 19; Isabella County, Broomfield Twp., sec. 22, 23, 26, & 27.

YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1973	Home	25	5	2	none	none		
		~~26~~ 36	1	1				
	Richland	27	5	2				
		28	3	1				
		31	12	4				
		34	8	3				
		35	1	1				
	Ferris	6	2	1				
	Arcada	18	7	2				
		19	4	2				
	Sheridan	35	1	1				
1974	Home	25	6	1	none	none		
		~~26~~ 36	3	1				
	Richland	26	6	1				
		27	22	3				

GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: S75

YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1974		28	0	1				
		31	2	1				
		34	0	1				
		35	0	1				
	Ferris	6	0	1				
	Arcada	18	5	1				
		19	0	1				
	Sheridan	26	3	1				
		35	0	1				
	Broomfield	22	5	1				
		23	2	1				
		26	1	1				
		27	0	1				
1975	Home	25	0	4	Sevin-4-oil	0	0	1
		~~26~~ 36	0	4		0	0	

GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: S75

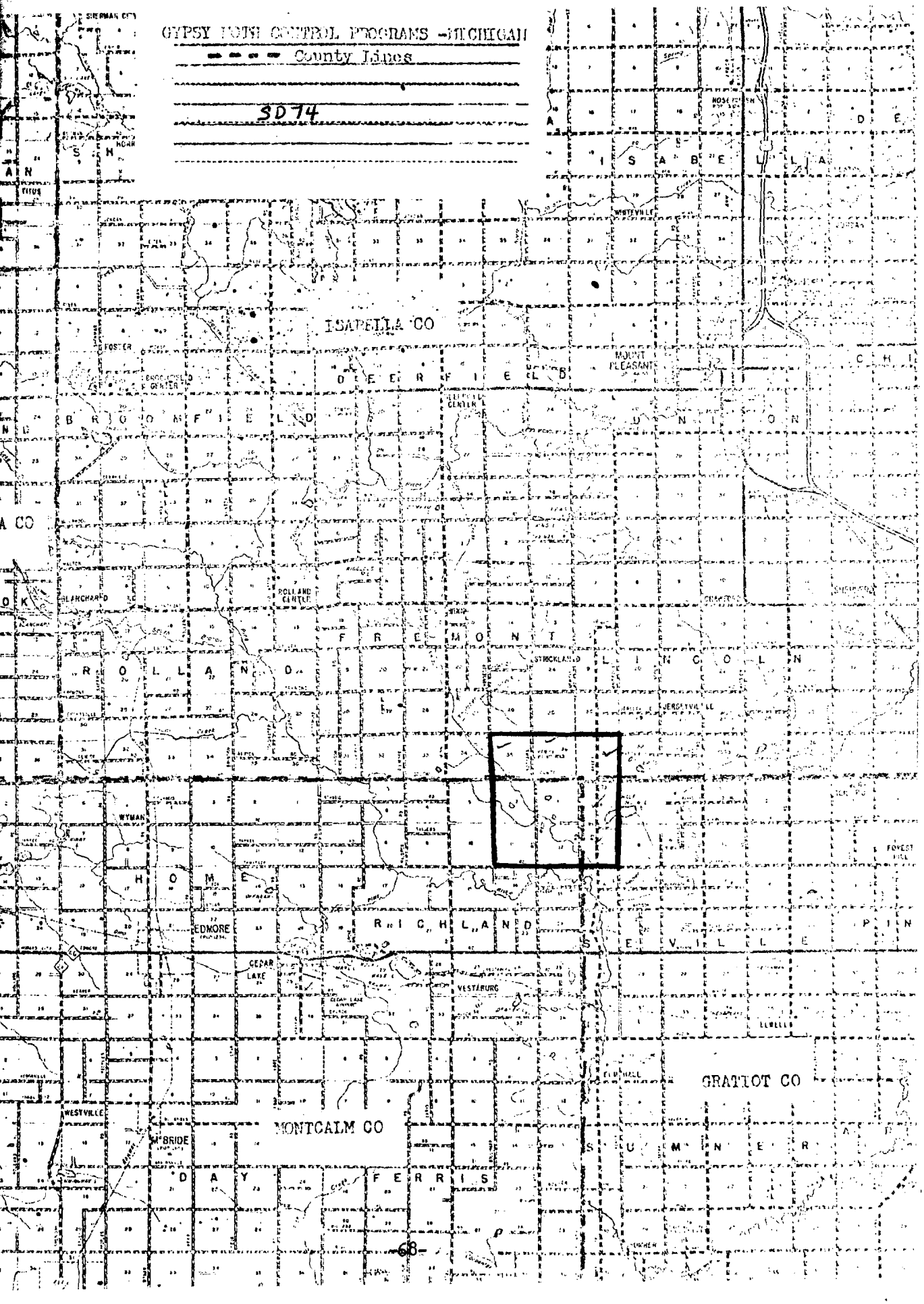
YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1975	Richland	26	0	4		0	0	
		27	0	4		0	0	1
		28	0	4		0	0	
		31	0	4		0	0	
		34	0	4		0	0	
		35	0	4		0	0	
	Ferris	6	0	4		0	0	
	Arcada	18	0	4		0	0	
		19	0	4		0	0	
	Sheridan	26	0	4		none		
		35	0	4				
	Broomfield	22	0	4				
		23	0	4				
		26	0	4				
		27	0	4				

In 1974 a nine square mile area was treated with one application of Sevin-4-oil for the larval stages of Gypsy Moth and later treated with disparlure to confuse the surviving male moth. Disparlure was applied at 3½ grams/acre with 2 applications, one in mid-July and the second in early August. The detection traps caught 58 moth in 17 traps in 1973, no moth in 1974 detection traps and only 1 in 1975 detections. No females were mated and no male moth were caught in either 1974 or 1975 monitoring sites.

GYPSY MOTH CONTROL PROGRAMS - MICHIGAN

County Lines

SD74



GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

SD74

Location: Isabella County, Fremont Twp., sec 35 & 36, Lincoln Twp., sec 31; Gratiot County, Seville Twp., sec 6 & 7; Montcalm County, Richland Twp., sec 1,2, 11, 12.

YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1973	Lincoln	31	3	2	none	none		
	Fremont	35	5	2				
		36	6	4				
	Richland	1	22	3				
		2	8	2				
		11	2	1				
		12	12	3				
1974	Lincoln	31	0	1	Sevin-4-oil & disparlure	0	0	
	Fremont	35	0	1		0	0	
		36	0	1		0	0	
	Seville	6	0	1		0	0	
		7	0	1		0	0	
	Richland	1	0	1		0	0	
		2	0	1		0	0	
		11	0	1		0	0	

GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: SD74

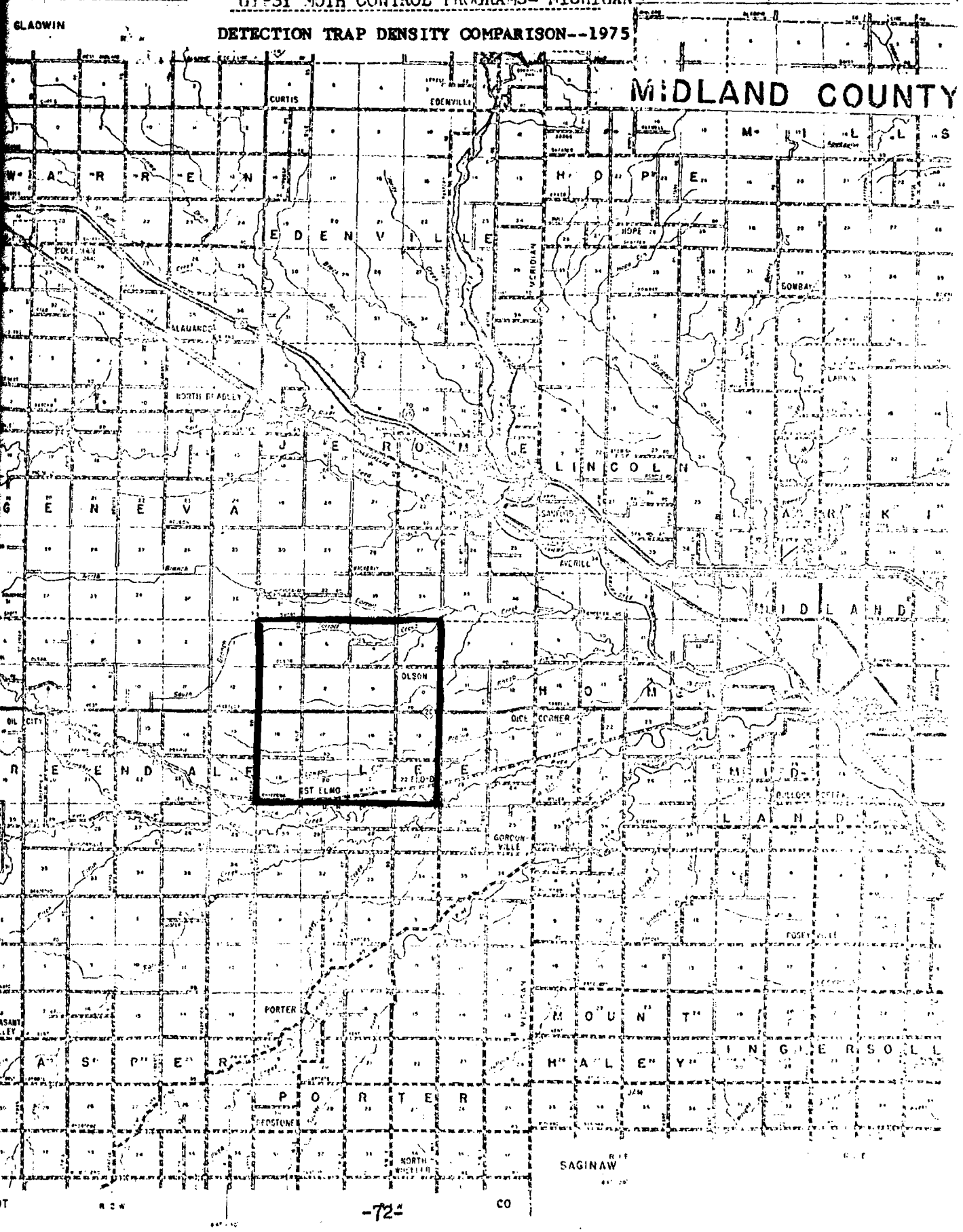
YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
		12	0	1		0	0	
1975	Lincoln	31	0	4	none	0	0	
	Fremont	35	0	4		0	0	
		36	0	4		0	0	
	Seville	6	1	4		0	0	
		7	0	4		0	0	
	Richland	1	0	4		0	0	
		2	0	4		0	0	
		11	0	4		0	0	
		12	0	4		0	0	

Detection Trap Density Comparison 1975

A 16 square mile area in Lee Twp., Midland County was designated for comparing 4 traps per square mile to 20 traps per square mile. This area produced 5 male moth in 1973, 3 moth in 1974, and 4 were caught in 1975. It is believed at this time that the Gypsy Moth population in this 16 square mile area is too low to show any significant difference in the attracting power of multiple trap sets.

GYPSY MOTH CONTROL PROGRAMS- MICHIGAN

DETECTION TRAP DENSITY COMPARISON--1975



MOTH CATCH HISTORY

Location: Midland County, Lee Twp., sec 3, 4, 5, 6, 7, 8, 9, 10, 15, 16, 17, 18, 19, 20, 21 & 22.

YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
1973	Lee	15	2	1	none	none		
		18	3	1				
1974		3	1	1	none	none		
		4	0	1				
		5	0	1				
		6	0	1				
		7	1	1				
		8	0	1				
		9	0	1				
		10	0	1				
		15	0	1				
		16	1	1				
		17	0	1				
		18	0	1				
		19	0	1				

GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: Midland County

YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
		20	0	1				
		21	0	1				
		22	0	1				
1975		3	0	20	none	none		
		4	0	4				
		5	0	20				
		6	0	4				
		7	1	20				
		8	1	4				
		9	0	20				
		10	1	4				
		15	0	20				
		16	0	4				
		17	0	20				
		18	0	4				
		19	0	20				

GYPSY MOTH CONTROL PROGRAM--MICHIGAN

MOTH CATCH HISTORY

Location: Midland County

YEAR	DETECTION				TREATMENT	MONITORING		EGG MASSES
	Twp.	Sec.	# male moth caught	#/traps/Sec.		# male caught	# female mated	
		20	1	4				
		21	0	20				
		22	0	4				

Project Number: GM 5.2.2
Project Title: Field Testing of Disparlure in Fringe Infestations - Maryland
Report Period: January - September, 1975
Report Type: Final
Project Leader: C. P. Schwalbe

APHIS participation in this project has been negligible since the early planning sessions and, therefore, no further mention of this work will be made in these reports. Data collection and interpretation is conducted through the Agricultural Research Service.

Project Number: GM 5.2.3
Project Title: Field Testing of Disparlure in Remote Infestations - Virginia
Report Period: January - September, 1975
Report Type: Preliminary
Project Leaders: C. P. Schwalbe and A. P. Morris

Gypsy moth survey and detection programs at Dayton, Virginia have, since 1972, demonstrated the presence of adult male moths. Captures totaled 11 moths in 1974. However, intensive egg mass surveys have been predictably negative. This study has been recently initiated to attempt spot eradication of the insect from the urban area through the use of saturation trapping. Preliminary meetings with VA Department of Agriculture and APHIS, PPQ cooperators resulted in the following treatment plan. In approximately 2 mi^2 over and around the town of Dayton, gypsy moth Delta traps were hand placed at 9-10 traps/acre. A peripheral area (ca 10-15 mi^2) surrounding this "core" was trapped on a grid system at 3 traps/acre. Only forested plots in the peripheral area were trapped. Effectiveness of this treatment will be judged on the basis of data obtained in succeeding years from similar trap placement patterns.

During June 1975, 11,281 commercial delta traps were placed in the above described area. Trap recovery is uncompleted but indications are that very few male moths will be captured.

Project Number: GM 5.2.5
Project Title: Multiple Mating by Male and Female Gypsy Moth Adults
Report Period: January - September, 1974
Report Type: Preliminary
Project Leaders: E. C. Paszek, J. A. Tanner, L. F. Kennedy

Multiple mating of 29 single ♂ gypsy moths with 2 to 7 ♀♀ resulted in 141 matings. (Reported in the July - December issue, Laboratory Report, page 54). The resulting egg masses were allowed to embryonate and were refrigerated for 180 days to break diapause. The egg masses were incubated and the percentage hatch of the resulting larvae is in the process of tabulation.

Project Number: GM 5.2.6
Project Title: Trap Design and Evaluation
Report Period: January - August, 1975
Report Type: Final
Project Leader: J. G. R. Tardif

Several trap designs were tested this period. The types of traps tested were essentially of the basic Delta design with the following differences. Type #2 traps were smaller on each side by 1.9 cm. The 3.18 cm opening was the same as the Delta but the angle of the opening was more recessed. Type #1 traps were the same size as the #2 traps but had an opening recess similar to the original Delta (Fig. 1.). Three series of tests were conducted. The first consisted fo 2 each normal length (18.2 cm) Delta, Type 2, Type 1, and Johnson traps. The traps were placed in random order in a bioassay test chamber approximately 1 M apart and 65 cm high. Three releases of 200 ♂♂ each were made and data recorded at various intervals. The second test consisted of the type #1 Delta in 5, 7.6, 10.2, 12.7, 15.2 and 18.2 cm length and the Delta type in 7.6, 10.2, 12.7, 15.2 and 18.2 cm lengths. Two replicates of each were tested. One of each type was placed in each of two chambers as in Test #1. Four hundred moths were released in each chamber and data were recorded at 45 minute and 24 hour periods. The third series consisted of testing only the two extreme lengths of the above (5 cm and 18.2 cm for the Type 1 and 7.6 cm and 18.2 cm for the Delta). Two replicates of each were placed in one chamber with 200 released ♂♂. Data were recorded at 1/4, 1/2 and 24 hr periods.

Results are shown in Tables I through IV. The data in Table 1 indicate no differences between traps. The Delta appeared to be less effective in the two last releases. Similar results were obtained in Test II. However, in this case the Delta demonstrated very high activity in the 48 hour reading. Such "hot spots" sometimes develop in a bioassay chamber and the causes are not known at this time. Table III shows results when comparing the extremes of Test II with Johnson traps. Table IV shows a statistical analysis performed on the Table III data.

From the foregoing data there appear to be no significant differences in trap attractiveness among the types tested. Confirming outdoor tests are necessary.

Table I. Efficacy of Modified Delta Traps

Trap Type	Release #1*			Release #2*			Release #3*			Total
	1/2hr	1hr	48hr	1/2hr	1hr	48hr	1/2hr	1hr	48hr	
Johnson	9	9	11	3	3	6	5	9	11	28
Johnson	7	8	20	5	6	10	6	11	16	46
Type 2	3	5	9	2	2	13	5	13	15	37
Type 2	5	5	11	1	2	9	5	6	12	32
Type 1	4	4	7	4	5	14	6	7	12	33
Type 1	4	4	7	1	1	5	5	5	15	27
Delta	9	11	16	6	6	8	3	4	9	33
Delta	6	7	11	4	4	5	9	10	10	26
Totals										
Johnson			31			16			27	74
Type 2			20			22			27	69
Type 1			14			19			27	60
Delta			27			13			19	59

* Traps cleared for each release - results are cumulative

Table II. Efficacy of Delta Trap Length vs. Type 1 Length

Trap Type	Chamber #1 45min	Chamber #1 24hr	Chamber #1 48hr	Chamber #1 Sub Total	Chamber #2 45min	Chamber #2 24hr	Chamber #2 48hr	Chamber #2 Sub Total	Totals
Type 1									
2"	6	4	0	10	5	3	0	8	18
3"	2	4	0	6	6	4	0	10	16
4"	4	2	0	6	5	9	1	15	21
5"	13	8	0	21	1	2	2	5	26
6"	5	4	0	9	12	9	2	23	32
Standard	5	3	0	8	5	6	0	11	19
Delta									
3"	5	8	0	13	10	4	1	15	28
4"	6	7	0	13	3	4	1	8	21
5"	13	8	0	21	6	7	3	16	37
6"	8	4	0	12	6	7	1	14	26
Standard	13	3	18	34	7	3	3	13	47

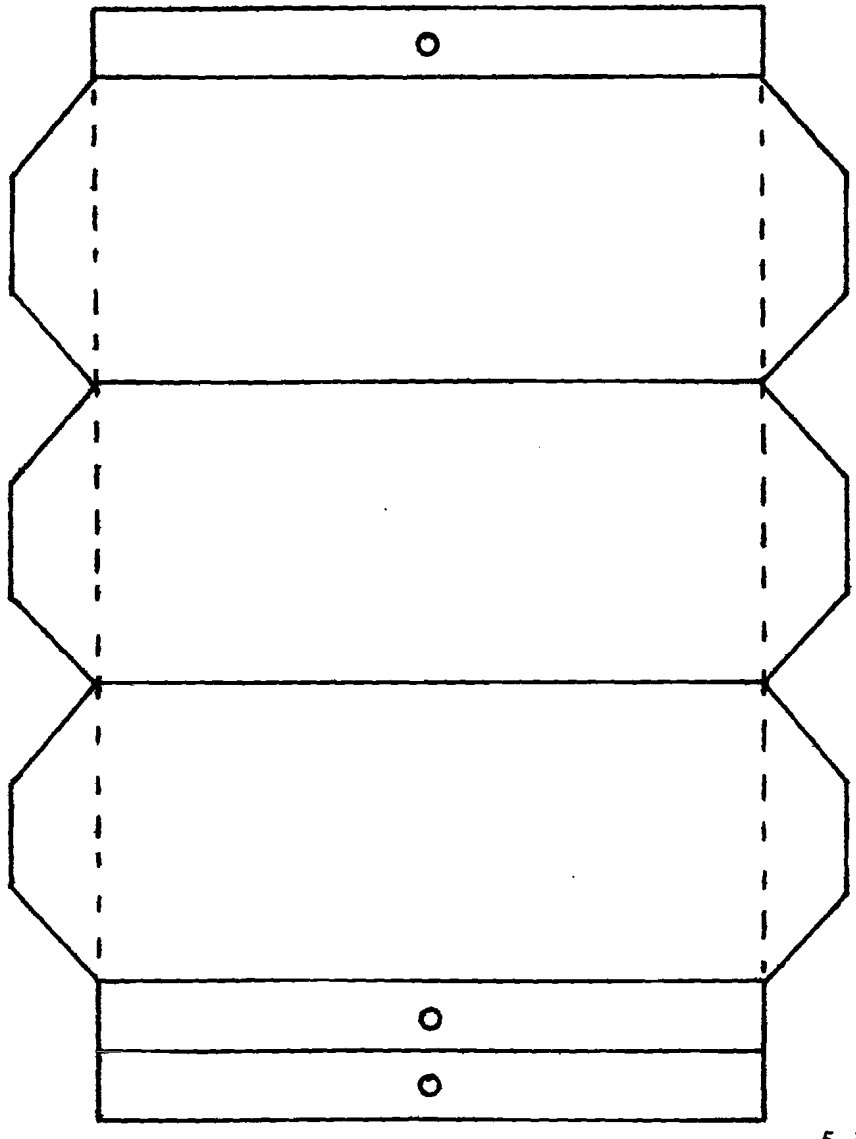
Table III. Comparison of 3" and 7" Delta Traps vs. 2" and 7" Type 1 Traps

Trap Type	Time 15 min	30 min	24 hour	Treatment Total
8" Type 1	2	0	2	4
" "	0	1	1	2
7" Type 1	2	0	0	2
" "	0	0	0	0
3" Delta	4	0	2	6
" "	1	0	2	3
7" Delta	5	1	0	6
" "	3	3	5	11
Johnson	6	3	2	11
"	2	0	3	5
Total Time	25	8	17	50

Table IV. Analysis of Variance

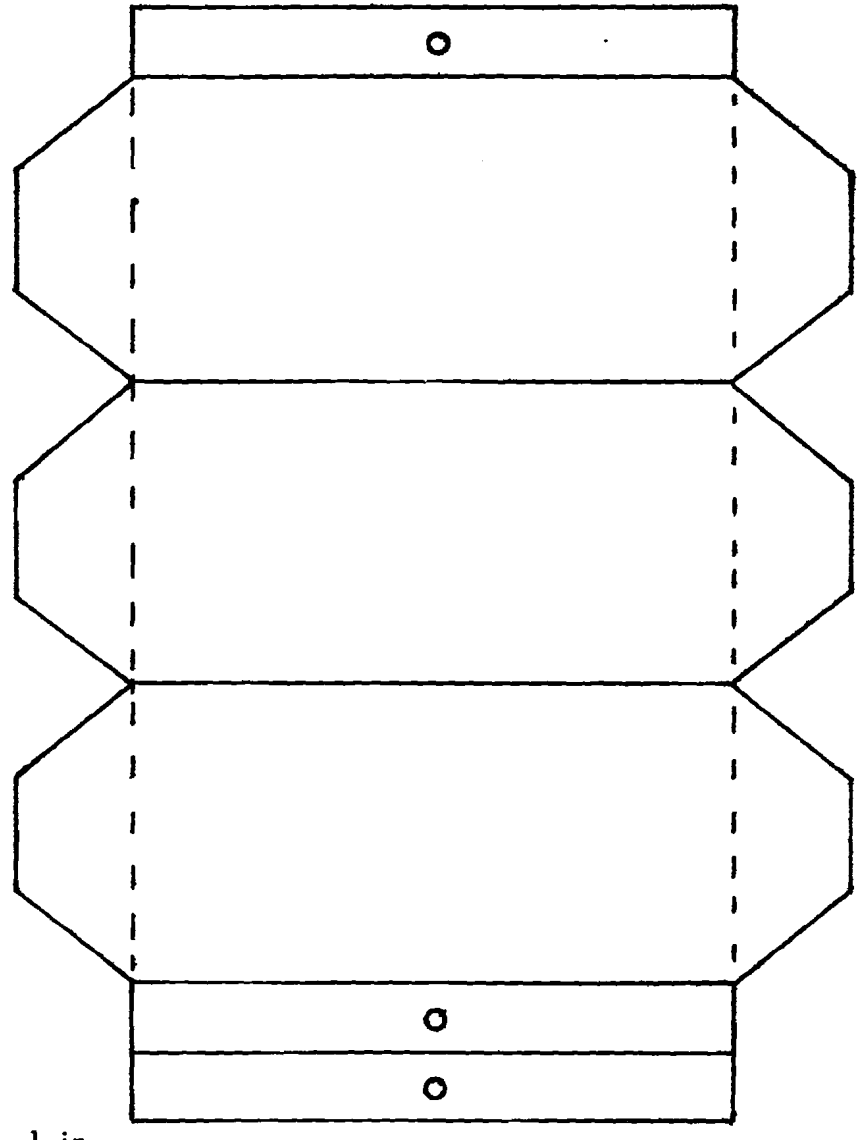
Source	df	ss	ms	cal. f.
Total	29	86.67		
Treatment	9	40.67	4.518	2.58
Time	2	14.47	7.235	4.13*
Error	18	31.53	1.75	

* Significant @ 1% Confidence level



Type 1

.5 in = 1 in



Type 2

Project Number: GM 5.2.9
Project Title: Mating Enhancement of Female Gypsy Moths with Small Amounts of Disparlure
Report Period: January - September, 1975
Report Type: Interim
Project Leaders: E. C. Paszek, J. A. Tanner, L. F. Kennedy

The attractiveness of laboratory reared ♀♀ gypsy moths was enhanced by the topical application of small amounts of disparlure to their wings. Mating behavior of treated ♀♀ and untreated controls was observed. Relative attractiveness, length of time of copulation and fertility of egg masses were recorded. (Reported in the October - December, 1974 Laboratory Report, page 60). One hundred and ten egg masses from the 5 ug, 2.5 ug and 1 ug treatments and 68 untreated controls were incubated and the hatch rate of those eggs is in the process of tabulation.

Project Number: GM 5.2.10
Project Title: Comparative Trapping Efficiency of Commercially Prepared Delta Traps, Prototype Delta Traps and Graham Traps
Report Period: January - September, 1975
Report Type: Final
Project Leader: J. G. R. Tardif and O. T. Forrester

Conflicting reports of the efficiency of commercially manufactured delta traps prompted further comparisons with its prototype and the Graham trap. Some physical differences noted were: white interior, glossy coating on lighter weight paper, UV light reflective, and serrated baffle creases for the commercial as opposed to solid orange color in and out, dull matted finish on heavier stock, surfaces unreflective to UV light, and solid creases at the baffle ends of the prototype tested in 1974.

The study was conducted in 3 tests: Test I - six of each of the aforementioned trap types similarly treated with pheromone dispensers and Tack Trap® were individually placed five meters apart along the sides of a wooded road in a natural infestation; Test II - a repeat of Test I with five replicates each; Test III - four additional replicates of each trap type with similar treatment as above, but placed in a totally wooded area at five meter intervals in an uninfested area. Lab-reared moths were released and observed. Determinations of the numbers of moths approaching within one meter, numbers that contacted and numbers that entered each trap were made.

Test I

Trap Type		Time Elapsed 30 min	1 hr	2 hr	3 hr	4 hr	Total
Graham	#1	0	1	1	0	0	2
	2	0	1	1	0	0	2
	3	0	1	0	4	0	5
	4	0	0	0	0	0	0
	5	0	0	0	2	0	2
	6	0	0	1	0	1	2
Total		0	3	3	6	1	13
Delta (Prototype)	#1	0	0	0	1	0	1
	2	1	0	0	1	0	2
	3	0	0	0	1	1	2
	4	1	2	1	4	2	10
	5	0	0	1	0	0	1
	6	0	0	0	0	0	0
Total		2	2	2	7	3	16
Delta (Commercial)	#1	0	0	0	0	0	0
	2	0	0	1	0	0	1
	3	0	0	0	0	0	0
	4	0	0	0	0	0	0
	5	0	1	0	0	0	1
	6	0	0	0	0	0	0
Total		0	1	1	0	0	2

Test II

Trap Type		Time Elapsed 2 hr	7 days	Total
Graham	#7	0	7	7
	8	0	9	9
	9	0	7	7
	10	0	9	9
	11	0	6	6
Total		0	38	38
Delta (Prototype)	#7	0	6	6
	8	0	2	2
	9	0	1	1
	10	0	4	4
	11	1	4	5
Total		1	17	18
Delta (Commercial	#7	0	0	0
	8	0	0	0
	9	0	0	0
	10	0	1	1
	11	0	1	1
Total		0	2	2

Test I and II results demonstrate the commercially prepared trap to be far less efficient in capturing moths when compared to the Graham or prototype. The prototype is also shown to be only 50% as efficient as the Graham in Test II but superior in Test I.

Test III

	Commercial Delta			Prototype Delta			Graham		
Date-Trap#	1 meter	Contact	Enter	1 meter	Contact	Enter	1 meter	Contact	Enter
8/15* 12	4	0	0	3	2	1	52	20	2
13	1	0	0	7	1	0	9	4	3
14	31	9	0	5	1	0	20	11	1
15	22	1	0	17	6	0	16	11	6
Control	15	7	0	3	1	0	33	17	1
8/18** 12	6	3	0	5	4	1	17	13	12
13	6	5	0	6	4	3	7	3	0
14	26	7	0	13	2	1	7	6	2
15	7	3	0	16	9	6	15	10	4
Control	3	3	0	2	1	0	19	10	3
Totals									
Baited Traps	103	28	0	72	29	12	143	78	30
Controls	18	10	0	5	2	0	52	27	4

* 1000 released lab-reared male moths
** 850 released lab-reared male moths

Test III results also demonstrate a greatly reduced response of male moths to commercial delta traps, compared to the Graham or prototype delta. The Graham traps captured 60.7% and the prototype delta caught 39.3% of the total catch. The Graham and prototype delta traps captured 11.9% and 15.3%, respectively, of male moths that approached within one meter of the traps.

Results of a continuation of test one are in the following table and Figure 1. The legend to Figure 1 is: A = Graham; B = Delta Prototype; C = Delta Commercial.

Table 1. Total Catch by Trap and Sample Period

Date	Delta Commercial	Delta Prototype	Graham
8/1	5	23	35
8/8	15	24	29
8/11	0	15	18
8/13	2	0	6
8/15	0	6	8
8/18	3	1	6
Total	25	69	102

Commercial delta traps, prototype delta traps and Graham traps captured 12.8, 35.2, and 52.4%, respectively, of the total catch.

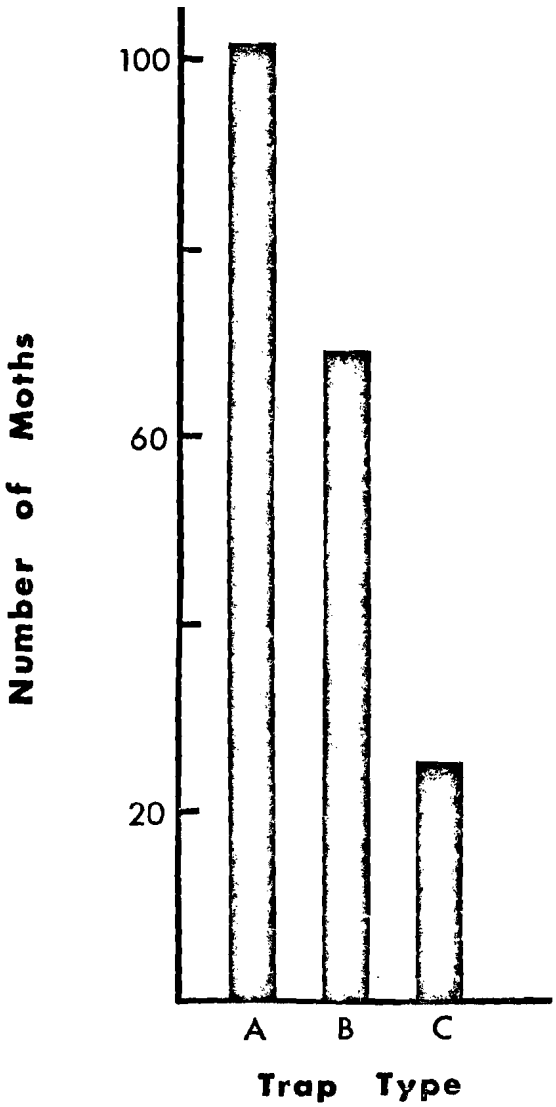


Figure 1. Comparative captures of native male gypsy moths by Graham (A), Delta Prototype (B) and Delta Commercial (C) Traps.

Project Number: GM 5.2.11
Project Title: Effect of Interior Color on Efficiency of Commercial Delta Traps
Report Period: July - August, 1975
Report Type: Final
Project Leader: J. G. R. Tardif

Preliminary experiments indicated that commercially produced delta traps were less efficient than laboratory prepared prototypes of similar dimensions. One of the changes that occurred in the commercial trap from the prototype was that of internal color. The prototype remained orange both inside and out, while the commercial was produced with an orange exterior and a white interior. It was, therefore, hypothesized that inside color is a factor contributing to trap efficiency and performance (the Graham also exhibits a dark interior).

Twelve replicates each of interior dark and light-colored traps were baited and tack treated alike. The traps were then placed in three 70 foot diameter circles in a natural infestation. Each circle contained eight traps, four of each treatment alternately placed around the circumference of the circle. The infestation was that of a declining moderate flight.

Results are shown in Table I. From the data one can only conclude that traps with light colored interiors are more attractive than those with interiors dark. Traps were bioassayed the same day of painting and it is possible that certain paint components are repellent to male gypsy moths, resulting in suppressed moth captures.

Table I. Effect of interior color of delta traps on male moth captures.

	Time (Hours)						
	0.5	1.0	2.0	3.0	27.0	49.0	72.0
Light	5	16	25	28	89	105	138
Dark	0	4	4	7	35	39	77

Project Number: GM 5.2.12
Project Title: Comparison of Hercon®, FRL Capillary and Combined Hercon® - FRL Baitings of Delta Traps
Report Period: January - August, 1975
Report Type: Final
Project Leader: J. G. R. Tardif

A recent test of a newly developed capillary pheromone dispenser (Fabric Research Laboratories, Dedham, Mass.) indicated that the new dispenser was superior to Hercon® dispensers when tested in Graham traps. The same test revealed reduced catches when more capillary tubes were used. The following test was designed to verify these results and determine if a single capillary "outperforms" the standard Hercon® and, if applied in combination, would enhance or mask the Hercon®.

Five replicates of each of the following treatments were conducted with commercially prepared Delta traps. These were the following:

a) One Hercon® wick stapled by one corner;
b) One FRL capillary tube on masking tape stapled by one corner;
c) One of each of the above fastened similarly next to each other.

Traps were randomly placed along the circumference of a 150 foot circle in a natural infestation. Results are shown in Table I.

From the data, it appears that the capillary fibers were slightly more attractive than the Hercon®, and Hercon®-capillary combination for the first 27 hours. This may be explained by the rapid rate of emission of pheromone by fibers shortly after activation. However, the combination of Hercon® and FRL fibers in a single trap evidently suppressed attractiveness. Further tests are necessary to confirm this observation.

Table 1. Cumulative male gypsy moth catches in delta traps baited with Hercon® laminated dispensers (Herculite Protective Fabrics, New York) and FRL hollow fibers (Fabric Research Laboratories, Dedham, Mass.)

	Time (Hours)							
	0.5	1.0	2.0	3.0	4.0	27.0	48.0	72.0
Hercon	7	8	10	10	10	21	23	33
FRL	10	11	18	19	22	36	37	54
Hercon-FRL	7	8	10	12	14	29	37	54

Project Number: GM 5.2.13
Project Title: Effect of Emission Rates of Disparlure on Response of Male Gypsy Moths to Traps
Report Period: January - July, 1975
Report Type: Final
Project Leader: O. T. Forrester

The objectives of this project are to determine the optimum rate of disparlure emission for trapping male gypsy moths and to determine moth response to increasing pheromine emission rates.

Five replicates of circles 64 feet in diameter were established 50 feet apart in a heavily wooded area near Rehobeth, Mass. Commercially prepared delta traps were placed at 20 foot intervals around the circles, 24" above the ground. Two traps of each treatment were used in each replicate. The treatments were 1, 5, 50, and 100 FRL fibers containing 1975 formulation of disparlure, and one unbaited trap as a control. Each FRL fiber releases approximately 1.5×10^{-6}cc/day at 70°F. Traps were rotated at each servicing, after the second check. When the traps became saturated with male moths, the existing bait was placed in a new trap. Data from these tests are shown in Table 1.

Table 1. Total number of moths captured by treatment and sample period - 7/22 - 7/31/75[1/]

	Treatment - Number Fibers/Trap					
Date	1	5	50	100	Control-0	Totals
7/24	56	43	19	20	7	145
7/25	31	54	20	18	2	125
7/29	100	134	133	98	20	485
7/31	33	35	31	24	7	130
Totals	220	266	203	160	36	885

1/ Capture is the total of 10 traps except the control which is for 5 traps.

Figure one is a graphic representation of total catch by treatment. The greatest moth response was to traps baited with 5 FRL fibers. One fiber was slightly more effective than 50 fibers and 100 fibers per trap were the least effective. If the trend indicated in Figure 1 were extrapolated at a rate of 50 fibers/trap, then 0 catch could be expected at slightly over 225 fibers/trap. Confirmatory tests to be conducted will include traps containing 1 through 5 fibers and traps with 50, 100, 200, and 300 fibers per trap.

The FRL dispenser is an effective method of dispensing disparlure. Some problems were experienced in activating this system. Cutting the fibers in stacks of five or more caused some of the fibers to be re-sealed. (An average of 7.5% in 100 fiber traps. The commercial delta trap became soft and had a tendency to lose shape following rains).

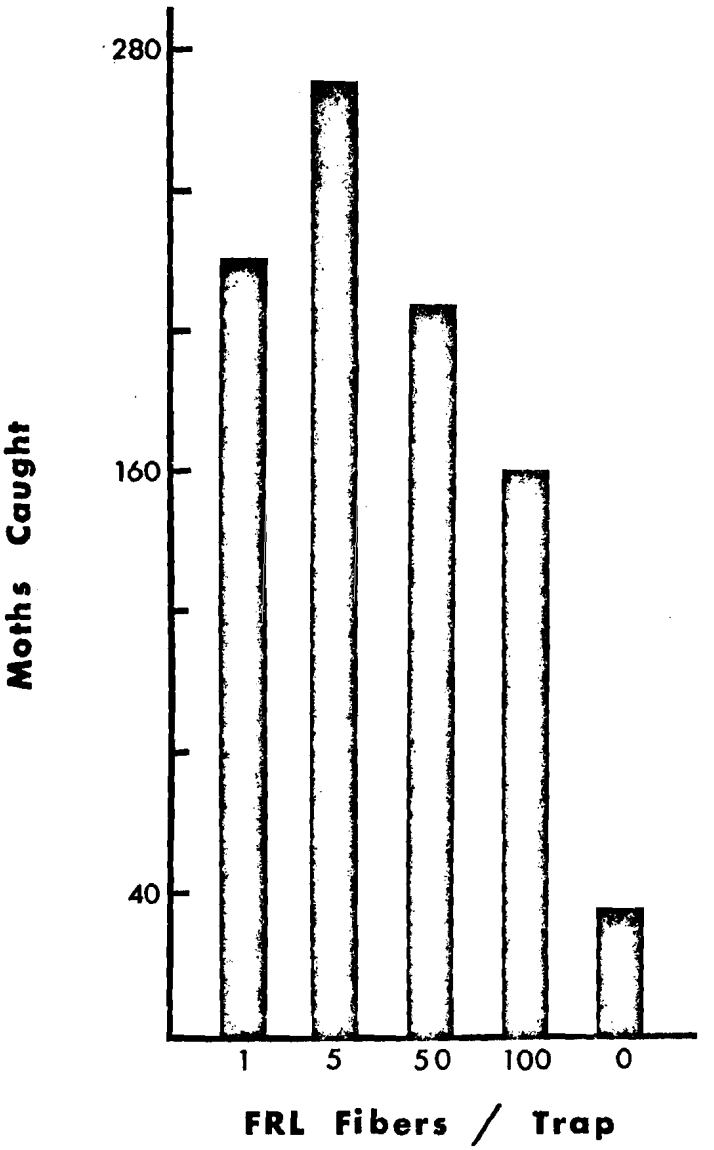


Figure 1. Effect of disparlure emission rates on response of native male gypsy moth to traps.

Project Number: GM 5.2.14
Project Title: Comparison of Hercon and FRL Disparlure Dispensers
Report Period: January - July, 1975
Report Type: Final
Project Leader: O. T. Forrester

The objectives of this test were to compare Hercon and FRL disparlure dispensers and to check the effectiveness of the 1974 and the 1975 disparlure formulations for attractiveness.

Five replicates consisting of circles 64 feet in diameter were established in a heavily wooded area near Rehobeth, Mass. The replicates were 50 feet apart. Commercial delta traps were placed around the circles 20 feet apart and 24 inches above the ground. Hercon dispenser treatments were 0.5, 1, and 3 dispensers per trap; FRL with 1975 disparlure treatments were 5, 10 and 30 fibers per trap and FRL with 1974 disparlure treatments were also 5, 10, and 30 fibers per trap. Each FRL fiber releases approximately 1.5×10^{-6} cc of disparlure/day at 70°F. The release rate from Hercon has not been determined. Each replicate consisted of one trap of each treatment and one empty trap as a control. The traps were rotated at each sample date after 7/25.

Results of these tests are presented in Table 1.

Table 1. Total catch by treatment and sample period - 7/22 - 7/31/75

	Hercon 1975			FRL 1974			FRL 1975			Empty Trap
Date	0.5	1	3	5	10	30	37	37	30	
7/24	4	0	4	21	28	21	37	37	30	8
7/25	8	3	3	27	18	10	36	26	17	4
7/28	64	33	33	60	82	85	89	83	62	26
7/29	12	3	5	13	13	13	21	32	26	6
7/31	14	23	10	29	29	22	55	38	35	6
	102	62	55	153	170	151	238	216	170	50

Traps baited with 1975 disparlure in FRL dispensers captured more moths than those baited with 1975 Hercon and the 1974 disparlure in FRL dispensers. The higher rates of disparlure release tended to decrease moth capture. One and 3 Hercon dispensers were less effective than 0.5 Hercon dispensers. Higher rates of disparlure decreased capture in traps baited with FRL fibers containing 1975 disparlure but not with the 1974 formulation. Apparent differences in attractiveness of 1974 and 1975 disparlure in FRL fibers may be due to lack of uniformity of fiber length; most 1974 fibers were shorter than 1975 fibers.

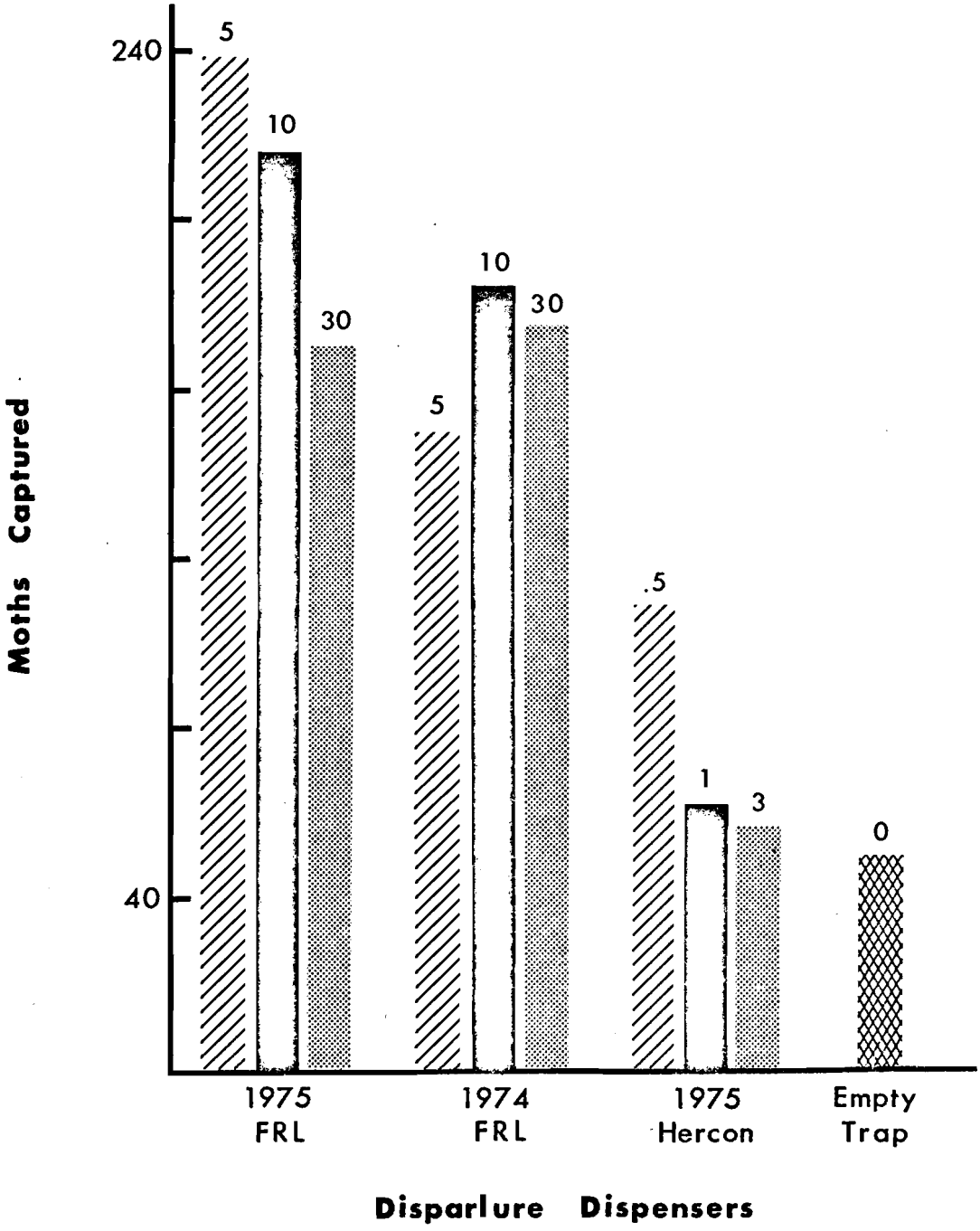


Figure 1. Comparison of FRL and Hercon® pheromone dispensers. The number above each bar indicates the number of dispenser units per delta trap.

Project Number: GM 5.2.15
Project Title: Comparison of Three Types of Gypsy Moth Traps
Report Period: January - July, 1975
Report Type: Final
Project Leader: O. T. Forrester

The objective of this test was to compare the efficiency of the commercial delta trap with the Graham and Johnson traps.

The test consisted of 10 traps of each type baited with 1975 disparlure in FRL dispensers. The traps were randomly distributed along a heavily wooded trail at 20' intervals, 24" above the ground. After the second sample period, the traps were located 20' apart and 24" above the ground around a circle 96 feet in diameter. The traps were rotated at each sample period thereafter.

Total catch by trap type and sample period 7/24 - 7/31/75

Date	Graham	#Traps	Commercial Delta	# Traps	Johnson	# Traps
7/25	325	10	120	10	126	8
7/28	266	10	109	10	19	3
7/29	140	10	14	10	95	9
7/31	114	10	32	10	21	7
	845	40	275	40	261	27

A large number of Johnson traps were lost following rain storms. The results in Figure 1 are average catches by sample period. (A=Graham, B=Commercial Delta, C=Johnson)

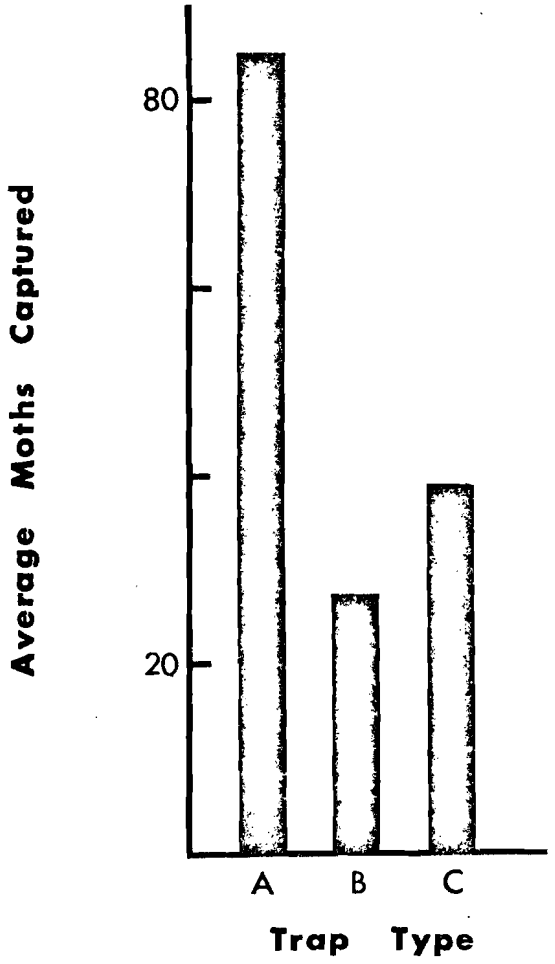


Figure 1. Number of native male gypsy moths captured in Graham (A), Commercial delta (B) and Johnson (C) traps.

Project Number: GM 5.2.16
Project Title: Mating Inhibition by Microencapsulated Disparlure and Saturation Trapping at Different Population Densities
Report Type: Preliminary
Project Leaders: O. T. Forrester, E. C. Paszek, C. P. Schwalbe

This series of tests was conducted to determine the population density of gypsy moth at which mating disruption by microencapsulated disparlure can be effected. Mating reduction by high density trapping was also tested. Twenty-two plots, each 40 acres square were established in naturally infested areas of varying population densities.

Population densities were determined by pre-season egg mass counts in 5 1/10 acre subplots in each plot. For purposes of discussion, 128-604 egg masses/acre, 12-62 egg masses/acre, and less than 11 egg masses/acre are considered heavy, moderate and light population, respectively.

Monitor females were placed on trees just outside of each subplot; 10/plot or 2/subplot. Two baffles around each tree, 18" apart and 3 feet above the ground, with a back flap placed between them, facilitated female moth recovery; 62.32% of the moths placed were recovered.

Two delta traps were placed at the midpoint between the subplots. One trap was 25 feet above the ground, the second was 3 feet above the ground. An aerial application of disparlure at 8 g/acre was applied to 3 plots of each population density on July 3, 1975. The 1975 microencapsulated formulation prepared by NCR was used.

Three plots were treated with 9 commercial delta traps/acre, baited with Hercon® dispensers.

Marked, laboratory reared female moths were placed in and recovered from the treated and control plots at three day intervals. Matings were determined by the presence of sperm in the bursa copulatrix and spermathica. Egg masses laid by the marked female moths were also collected and will be checked for embryonation.

Observations were terminated in the high and medium infestation plots on July 27, 1975 because mating in the treated and control plots were nearly equal.

The results from these tests are in the following tables.

Table 1. Effect of microencapsulated disparlure (8 g disparlure/A) on mating of gypsy moths at varying population densities

	High Infestation*		Medium Infestation*		Low Infestation	
	Treated	Control	Treated	Control	Treated	Control
Preseason Egg Mass Count	289.3/A	205/A	27.5/A	26/A	>10/A	>10/A
No. ♀♀ Placed	170	100	150	200	360	350
No. ♀♀ Recovered	124	67	102	151	225	185
No. ♀♀ Mated	56	35	27	39	8	58
% ♀♀ Mated	45.16	52.24	26.47	25.82	3.55	31.35
High Trap Capture	93/12	103/8	-	-	1/12	10/12
Low Trap Capture	235/12	201/8	27/12	52/16	8/12	34/12

* Monitoring Terminated 7/26/75

Table 2. Effect of microencapsulated disparlure on mating of gypsy moths at low population densities

	Treated	Control
Preseason Egg Mass Count	>10/A	>10/A
No. ♀♀ Placed	180	180
No. ♀♀ Recovered	87	91
No. ♀♀ Mated	5	28
% ♀♀ Mated	5.74	30.77
High Trap Capture	-	-
Low Trap Capture	4/4	4/4

Table 3. Effect of Pheromone Baited Traps Placed at 9 Traps/A on Mating of Gypsy Moths

	Treated	Control
Preseason Egg Mass Count	.66	1.33
No. ♀♀ Placed	290	360
No. ♀♀ Recovered	202	185
No. ♀♀ Mated	48	58
% ♀♀ Mated	23.76	31.35
High Trap Capture	-	10/12
Low Trap Capture	542/1080	34/12

Project Number: GM 5.2.17
Project Title: Bioassay of Hercon® Disparlure Dispensers Used in the 1975 Gypsy Moth Trapping Survey
Report Period: January - September, 1975
Report Type: Final
Project Leader: E. C. Paszek

The object of this bioassay was to test the activity of a random sample of the 252,000 Hercon® dispensers that were distributed in the United States and Canada for the 1975 gypsy moth trapping survey. Sixteen dispensers were selected (one each from 16 bags representing 1000 dispenser units per bag. These dispensers were hung in the new Delta traps and bioassayed 5/19/75 in 2 indoor chambers, using 400 laboratory reared moths per chamber for 8 traps. The dispensers were aged for 3 1/2 months in the Delta traps and bioassayed 8/27/75 outdoors with 4 unaged controls. On 9/3/75 these traps were brought indoors and bioassayed again in the 2 chambers with controls. The data shown in the following table indicates that these dispensers were initially active and remained active after 3 1/2 months of aging.

Activity of Hercon® Disparlure Dispensers Used in 1975

		Chamber Bioassay Unaged Samples	Chamber Bioassay Aged 3 1/2 Months	Field Bioassay Aged 3 1/2 Months
No. ♂♂ Released:		800 (5/19/75)	800 (9/3/75)	1400 (8/27/75)
		Number of Moths Captured in 24 Hours		
Sample	A	30	8	15
	B	34	11	12
	C	29	16	15
	D	32	19	9
	E	19	6	15
	F	30	14	4
	G	23	17	6
	H	12	11	15
	I	28	7	9
	J	26	17	19
	K	34	16	5
	L	30	15	8
	M	36	8	3
	N	26	22	6
	O	30	14	15
	P	37	26	7
			Unaged Controls	Unaged Controls
	K		12	6
	L		14	4
	O		10	4
	P		16	3
TOTAL		456 (57%)	279 (35%)	180 (13%)

Project Number: GM 5.2.18
Project Title: Bioassay and Field Observation of Behavior Mediated by cis-trans Disparlure Mixtures
Report Period: January - September, 1975
Report Type: Final
Project Leaders: E. C. Paszek, B. A. Bierl, J. G. R. Tardif, O. T. Forrester

The objective of this experiment was to determine the number of mothe each mixture captured in short periods of exposure to a moderate flight of moths and to observe if there was any difference in the apparent insect behavior mediated by the different isomer mixtures. A question arose as to whether the trans content of the mixture altered the insect response to disparlure. The 1974 commercial pheromone contained more of the trans isomer than 1975 material.

Twenty solutions containing various proportions of the cis-trans mixtures were made up by Dr. B. A. Bierl, Chemist, Organic Chemical Synthesis Laboratory, ARC, Beltsville, Md. (Table 1.). One hundred microliters of solution containing 10 ug of the lure mixtures were used to impregnate cotton wick dispensers which were baited into Graham traps. They were baited 7/22 and bioassayed in 3 replicates in a moderate infestation in Dighton, Mass., on 3 successive days during peak flight, 10 am - 2 pm 7/29 - 7/31/75. Three replicates of mixture numbers 1, 2, 3, 11, 12, 19 and 20 were divided into 6 groups and closely watched by 6 observers for 4 hours on 2 days, 7/30 and 7/31/75. Data recorded on the number of moths that flew within 1 meter of trap, number of moths that made contact with trap and number of moths that entered the trap (Table 2.).

Additional samples of the lure mixtures were received from Beltsville on 8/12/75 and they were baited into new traps 8/13 and bioassayed on 8/13, 8/19 and 8/21 in a light infestation in Sandwich with a supplemental release of laboratory reared moths within 25' of traps. Three replicates of mixture numbers 3, 11, 16, 17 and 20 were observed along with a blank trap (Table 3.).

Cis-trans disparlure mixtures are ranked by the total number of moths captured during the three 4 hour testing periods with 3 replicates of traps per period (Table 1.). This data indicates that the various proportions of the cis-trans disparlure mixtures are attractive to moths. Mixture #3, which contained 7.7% cis and 92.3% trans (by peak height) captured the least number of moths.

Close observation of these lures (Table 2.) on 7/30 - 7/31 indicates that mixture #3 was very weak in capturing moths but did attract moths to the vicinity of the traps.

On 8/13/75 the new samples of the cis-trans mixtures were again observed during three 4 hour testing periods. Mixture #3 ranked third in the total number of moths captured (Table 3.). In this case, the mixture containing 92.3% trans isomer elicited a strong response by male moths.

Data from the above tables indicate that cis-trans mixtures of various proportions are all attractive to gypsy moths.

Table 1. Comparison of 10 ug samples of various proportions of cis-trans mixtures - field bioassay conducted at peak native moth flight, 10 am - 2 pm, 7/29, 7/30, and 7/31/75.

Code No. of Mixture	By Peak Height % cis	% trans	Moth Captures (3 replicates) 7/29 4 hr	7/30 4 hr	7/31 4 hr	Total 12 hr	Rank
8	79.4	20.6	46	26	17	89	1
5	82.9	17.1	46	25	18	89	1
11	44.5	55.5	40	16	25	81	2
2	95.3	4.7	41	12	26	79	3
17	64.0	36.0	53	14	11	78	4
10	40.4	59.6	62	11	1	74	5
18	86.9	13.1	48	16	5	69	6
7	64.7	35.3	23	27	13	63	7
14	87.3	12.7	34	12	13	59	8
13	82.0	18.0	22	20	13	55	9
12	88.6	11.4	30	18	6	54	10
4	72.6	27.4	25	23	6	54	10
20	97.8	2.2	16	21	14	51	11
16	32.8	67.2	28	15	8	51	11
9	90.5	9.5	20	22	5	47	12
6	57.2	42.8	22	14	9	45	13
1	82.2	17.8	14	16	14	44	14
19	93.0	7.0	19	15	6	40	15
15	72.2	27.8	6	12	14	32	16
3	7.7	92.3	7	0	2	9	17
21(blank)	0	0	0	0	0	0	18

le 2. Field observation of cis-trans mixtures in a moderate native infestation

e	% cis	% trans	3 Reps. Aged 7 Days 7/30			3 Reps. Aged 8 Days 7/31			Combined Total			Rank
			1 M	C	T	1 M	C	T	1 M	C	T	
	82.2	17.8	44	25	17	33	23	17	77	48	34	4
	95.3	4.7	35	16	12	45	23	26	80	39	38	2
	7.7	92.3	32	2	0	21	4	2	53	6	2	7
	44.5	55.5	31	21	16	51	42	35	82	63	51	1
	88.6	11.4	37	25	17	24	17	13	61	42	30	5
	93.0	7.0	44	19	15	20	10	6	64	29	21	6
	97.8	2.2	42	25	20	37	29	16	79	41	36	3

le 3. Field observation of cis-trans mixtures in a light native infestation supplemented with laboratory moths released at a 25' distance from traps.

e	% cis	% trans	3 Reps. Unaged 8/13			3 Reps. Aged 6 Days 8/19			3 Reps. Aged 8 Days 8/21			Combined Total			Rank
			1 M	C	T	1 M	C	T	1 M	C	T	1 M	C	T	
	7.7	92.3	108	82	62	24	10	7	13	6	4	145	98	73	3
	44.5	55.5	79	45	18	27	23	18	22	20	14	128	88	50	5
	32.8	67.2	75	57	37	30	19	13	25	20	14	130	96	64	4
	64.0	36.0	97	66	46	30	18	16	23	17	16	150	101	78	2
	97.8	2.2	141	93	49	36	22	19	29	25	16	206	140	84	1
nk	0	0	67	26	11	11	3	3	5	3	0	83	32	14	6

: - Moths counted that flew within 1 meter of trap
- Moths that actually made contact with trap
' - Number of moths that entered trap

Project Number: GM 5.3.1
Project Title: Insect Production and Distribution
Report Period: January - September, 1975
Report Type: Interim
Project Leader: Leonard F. Kennedy

The primary object of the rearing facility of this laboratory is to produce sufficient quantities of all phases of the gypsy moth life cycle in support of research projects at this laboratory and several universities and experiment stations in the U. S. and foreign countries. Following is a summary of production and distribution of such material from July 1st to December 31st.

Summary of Production and Distribution
January 1, 1975 - September 1, 1975

Eggs Incubated	Larvae Hatched	Larvae Canned	Pupae Harvested ♂	Pupae Harvested ♀
9,552,000	1,720,185 (14.9%)	792,852 (55.8%)	216,750	137,775 (44.7%)

Mortality:

Virus	Discard	Culls	Cannibalism	Mold	Other
78,273	78,270	227,557	3,288	14,998	1,328

Insect Distribution:

Otis Methods Development:
- Insecticide Screening...2nd Instar Larvae.....54,020
- Lure Bioassay.....Adults.....52,268 ♂
- Repellency Tests.....4th Instar ♂, 5th Instar ♀...2,600 ♂, 2,600 ♀
- Sperm Studies.....Mated ♀.....150
- Mating Studies.....Pupae.....250 ♀, 40 ♂
- Field Studies.....Non-irradiated ♀ Adults.....2600

Field Tests of Disparlure:
- Michigan.....17,296 ♀ Pupae
- Maryland.....16,343 ♀ Pupae, 2,000 ♂ Pupae
- Massachusetts.....4,872 ♀ Pupae, 12,000 ♂ Pupae

P. Barboza, University of Massachusetts.....20 Viable Egg Masses
R. Carde, Cornell University.....101 ♂ Pupae, 85 ♀ Pupae
J. Granet, Connecticut Agricultural Experiment Station...300 ♂ Pupae
H. Hayes, ARS, Beltsville.....43 Viable Egg Masses
C. Hopkins, ARS, Beltsville.....15 Viable Egg Masses
D. Leonard, University of Maine.....3600 ♂ and ♀ Pupae
V. Mastro, Pennsylvania State University.....104 ♂ Pupae, 242 ♀ Pupae
C. McComb, ARS, Beltsville.....100 ♂ Pupae, 55 ♀ Pupae
J. Richerson, Pennsylvania State University.....100 Viable Egg Masses,
.....400 ♂ Pupae, 125 ♀ Pupae
P. Rollinson, Forest Service, Hamden, Connecticut.....100 Viable Egg Masses
M. Winston, Marine Biological Laboratory, Woods Hole.....286 ♂ Pupae

Project Number: GM 5.3.4
Project Title: Effect of the Number of Egg Masses per Storage Container on the Hatchability of Eggs
Report Period: January - June, 1975
Report Type: Interim
Project Leaders: John Allen Tanner and Leonard F. Kennedy

Porthetria dispar eggs refrigerated three or four months are currently being incubated to determine hatch rates. Eggs scheduled for five months refrigeration will commence incubation in July.

Project Number: GM 5.3.5
Project Title: Hatchability of Eggs Produced by Hybridized Wild and Laboratory Reared Gypsy Moths.
Report Period: January - June, 1975
Report Type: Final
Project Leaders: John Allen Tanner and Leonard F. Kennedy

Hybrid matings of laboratory and wild P. dispar increased the total egg hatch rate 13 to 14 percent over that observed with pure laboratory matings (Table 1). Matings with laboratory males tended to produce a higher number of infertile eggs. The number of infertile eggs was reduced slightly by hybridizing the laboratory males with wild females. Matings with laboratory females tended to produce a larger number of dead embryos. Hybridizing the laboratory females with wild males reduced the number of dead embryos and increased the number of eggs laid per female.

Hybridizing laboratory strains with wild strains of P. dispar may increase the total hatch rate of the laboratory strains but it should be noted that the total hatch rate of eggs from the pure laboratory crosses greatly exceeded that rate normally observed in the laboratory culture (GM 5.3.2, July - December 1974 laboratory report). This indicates that presently used rearing practices may be detrimental to laboratory eggs.

Embryo mortality is the major source of reduction in the hatch rate of laboratory reared eggs (GM 5.3.2, July - December 1974 laboratory report). In this experiment a higher number of dead embryos was likewise observed when laboratory females were utilized and this may indicate that eggs produced by laboratory females are morphologically and/or physiologically different from wild eggs.

Before hybridization of laboratory strains and wild strains of P. dispar is undertaken to improve egg hatchability, its effect on the uniformity of larval development and the incidence of virus, two presently used criteria for strain selection, must be ascertained.

Table 1. The effect of cross-mating wild and laboratory reared gypsy moths.

Matings ♂	♀	$\bar{x}$ number of Eggs Laid/♀	Percent Embryonation	Percent Hatch Embryonated Eggs	Percent Hatch Total Eggs
Wild	Wild	425.3	99.7	98.8	98.5
Wild	Lab.	336.9	90.4	89.3	80.7
Lab.	Wild	360.0	82.6	98.3	81.2
Lab.	Lab.	320.2	78.3	85.7	67.1

Project Number: GM 5.3.6
Project Title: Comparison of Different Egg Storage Techniques on the Hatchability of Eggs
Report Period: January - June, 1975
Report Type: Interim
Project Leaders: John Allen Tanner and Leonard F. Kennedy

All egg masses have completed incubation and hatch and are undergoing microscopic examination to determine the number of noneclosed eggs.

Please note: The description of methods (July-December, 1974 laboratory report) erroneously stated that 300 laboratory and 300 field collected egg masses were utilized in this experiment. These numbers should read 150 and the number of egg masses per treatment was 25 instead of 50.

Project Number: GM 5.3.8
Project Title: Effect of Relative Humidity on Hatch Rate
Report Period: January - June, 1975
Report Type: Interim
Project Leaders: John Allen Tanner and Leonard F. Kennedy

Eggs are completing five months refrigeration and are scheduled to be incubated for hatch determinations in July.

Project Number: GM 5.3.9
Project Title: Effect of Chilling Duration on Egg Hatchability
Report Period: January - June, 1975
Report Type: Interim
Project Leader: John Allen Tanner and Leonard F. Kennedy

Preliminary data indicate that laboratory and field eggs stored outdoors may break diapause sooner than eggs stored in the refrigerator.

oject Number: GM 5.3.10
oject Title: Hatch Rates of Laboratory Produced Eggs as Affected by Duration of Refrigeration
port Period: January - June, 1975
port Type: Interim
oject Leaders: John Allen Tanner and Leonard F. Kennedy

gs from broken masses and dehaired masses not treated with Chlorox® or ptan® produced a superficial hatch without cold treatment to break dia-use (Table 1.). This phenomenon has been observed by several authors orbush and Fernald 1896, Maksimov 1958, and Leonard 1968) but attempts develop nondiapausing strains have not been successful (Leonard 1968).

mpared to dehaired eggs, non-dehaired eggs respond more slowly to the apause breaking stimulation of cold temperature, and likewise yield eater hatch (less mortality) with increased exposure to cold temperature. e insulating ability of P. dispar hairs was also demonstrated by Maksi-vic (1958) utilizing field collected eggs. The data indicate that to sure minimum mortality, laboratory eggs should not be dehaired prior to old treatment.

eating dehaired eggs with Chlorox® and Captan® prior to refrigeration de-essed the hatch rate slightly but not significantly.

ble 1. Hatch rate of P. dispar (NJF12) eggs as affected by storage tech-que and length of refrigeration

	Days Refrigerated								
eatment	0	14	28	42	56	70	84	98	112
lf Mass	00.0	00.0	00.0	01.0	03.7	13.8	74.1	84.8	83.0
oken Mass	00.4	00.3	00.5	01.7	07.8	21.0	61.5	87.7	87.1
haired Eggs-Not treated	00.4	00.0	01.8	12.5	22.6	37.8	45.9	43.6	41.0
haired Eggs-Treated	00.0	01.1	01.8	10.5	20.8	32.3	39.1	43.1	38.4

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orbush, E. H., and C. H. Fernald, 1896. The Gypsy Moth Porthetria dispar (L.) Mass Board Agr. Report: 495 pp.

onard, D. E., 1968. Diapause in the Gypsy Moth, J. Eco. Ent., 61(3):596-598

aksimovic, M. 1958. Experimental Research on the Influence of Temperature upon the Development and the Population Dynamics of the Gypsy Moth (Liparis dispar L.)., Posebno Izdanje Bioloskog Instituta Nr Srbije 3:115 pp.

Project Number: 5.3.11
Project Title: Effect on the Hatch Rate of Dehairing P. dispar Egg Masses Prior to Incubation
Project Period: January - June, 1975
Report Type: Preliminary
Project Leaders: John Allen Tanner and Leonard F. Kennedy

In several experiments P. dispar eggs had been incubated with and without dehairing to determine what effect this treatment has on the hatch rate. The following experiment was designed to ascertain this effect and explain a possible source of experimental error.

A 250 ml plastic urine cup containing 50 masses was selected from the culture. Twenty-five masses were numbered and each mass was divided. One half was dehaired and the remaining half left intact. The half masses were placed into individual petrie dishes and incubated (25°C; 75% RH; and 14L:10D). The number of unhatched embryonated and nonembryonated eggs were determined for each group of eggs and the hatch rate of embryonated eggs determined.

Hatch has been completed and the numbers of unhatched embryonated and non-embryonated eggs is currently being determined.

Project Number: GM 5.3.12
Project Title: Hatchability of Gypsy Moth Eggs as Influenced by the Duration of Embryonation Prior to Cold Storage
Report Period: January - June, 1975
Report Type: Final
Project Leaders: John Allen Tanner and Leonard F. Kennedy

Porthetria dispar (L.) eggs are known to complete embryonation prior to entering diapause (Forbush and Fernold, 1896). The duration of time between the laying of the eggs and the commencement of permanent cold weather would likely effect winter egg survival. Laboratory rearing procedures include a 30-40 day embryonation period for eggs prior to refrigeration to break diapause. However, the onset of permanent cold weather occurs in October in the field and eggs laid in July may have up to 12 weeks to complete embryonation. Morphological development evident after three weeks of embryonation does not necessarily imply physiological preparedness for cold treatment and further development after embryonation may be necessary.

Three hundred paired P. dispar pupae were placed, 5 pair per cup, into 455 ml Dixie® cups. The cups were placed into an incubator (25.5°C; 65-75%RH; and 14L:10D photoperiod) and the adults were allowed to emerge and mate.

Newly laid egg masses were removed and placed individually into 230 ml urine cups covered with plastic wrap. The cups were then divided into two equal groups. One group was placed into a cage (44x30x24 mm, covered with 16 mesh screening) in a wooded area. The second group of egg masses was returned to the above described incubator.

Commencing on week following egg laying and at weekly intervals thereafter for 12 weeks, 12 egg masses were removed from each group. Six masses were dehaired and the percent embryonation determined. The remaining six egg masses from each group were placed into a precooling chamber (15.5°C; 65% RH; and 14L:10D photoperiod) for ten days. After precooling, the masses were placed into a refrigerator (4.4°C) for 150 days to break diapause and subsequently incubated for hatch (25°C; 80% RH; and 14L:10D photoperiod) and the percent hatch of embryonated eggs ascertained.

Table . The effect of the duration of the embryonation period on the hatch rate of P. dispar egg masses

	LOCATION OF EMBRYONATION									
	Indoors					Outdoors				
Days Embryonated	% 1/ Embryonation	% 3/ Hatch	% 2/ Embryonation	Days to Hatch Initiation	Days to Complete Hatch	% 1/ Embryonation	% 3/ Hatch	% 2/ Embryonation	Days to Hatch Initiation	Days to Complete Hatch
7	00	00	85	-	-	00	00	46	-	-
14	00	80	97	4-5	12-13	00	52	94	3	7
21	94	70	87	6	13	71	77	95	3-4	10-11
28	85	77	83	8	17	81	70	93	4-5	10-11
35	77	76	93	7	22	64	80	97	5-6	11-12
42	82	93	92	8	19	78	50	86	7	13
49	92	62	96	8	19	84	77	81	7	14
56	79	43	91	8	21	92	77	72	8	21
63	84	15	73	9	18	85	66	62	7	20
70	78	54	78	9	20	83	81	93	6	15
77	95	16	82	9	22	95	70	96	6	20
84	94	47	91	9	21	78	66	97	5	11
Outdoors 4/							67	92	7	20

1/ Percent embryonation of eggs after completion of embryonation period.
2/ Percent embryonation of eggs used to determine hatch rate (after refrigeration)
3/ Percent hatch = $\frac{\text{No. Larvae}}{\text{No. larvae + No. Unhatched Embryonated Eggs}} \times 100$

4/ These masses remained in the field during the winter season

Results and Discussion

P. dispar eggs with 14 days exposure to embryonation conditions and ten days exposure to the precooling temperature were capable of reaching the stage of development necessary to survive refrigeration (Table 1). This is 26 days less than the currently used technique and represents a potential increase in the production of *P. dispar* per unit of time. Embryonating egg masses 14 days would further shorten the life cycle as fewer incubation days are required to initiate and complete hatch compared to longer embryonated masses.

Egg masses embryonated outdoors under fluctuating temperatures require fewer incubation days to commence and complete hatch compared to masses embryonated in the laboratory under constant temperature (Table 1.). However, maximum hatch was obtained with masses embryonated 14 days in the laboratory. Twenty-one days of outdoor embryonation were required to produce the same average maximum hatch. This longer embryonation period maybe the response of the developing embryo to low night temperatures which would tend to reduce the rate of embryo development (Wigglesworth, 1965) and, therefore, increase the amount of time necessary for all the embryos to reach the stage of development necessary to survive refrigeration. Increasing the night temperature may overcome this problem and make it more feasible to use fluctuating temperatures in the laboratory instead of constant temperatures.

Increasing the embryonation period did not greatly affect the hatch rate of the egg masses embryonated outdoors but did reduce the hatch rate of those masses embryonated in the laboratory 49 or more days.

P. dispar eggs are known to cease development at temperatures below 6°C (Mithat Ali, 1933) indicating that those masses not embryonated at the termination of the 7 or 14 day embryonation period completed embryonation during the precooling period (Table 1). This indicates that respiration continues during precooling. The present laboratory precooling technique (50 masses/ plastic covered 250 ml urine cup) may result in the accumulation of CO_2 and asphyxiation of the developing embryos, causing the poor laboratory hatch rate now being obtained.

Reference Cited

Forbush, E. H., and C. H. Fernald, 1896.
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Mithat Ali, 1933
Experimentelle Untersuchungen über den Einfluss von Temperatur und Luftfeuchtigkeit auf die Entwicklung des Schwammspinners, Porthetria dispar L.)., Z. angew. Ent., 20(3):354-381.

1975 Field Evaluation of Candidate Insecticides for Gypsy Moth Control

by

Larry L. Herbaugh, W. H. McLane,
C. R. Stacy, and J. A. Finney

Introduction

Thousands of acres of forest are defoliated yearly by the gypsy moth, *Porthetria dispar* (L.). Because of this, investigations are conducted to evaluate different types of agents and techniques to control this pest. Presently, the most successful of these techniques is the restricted use of insecticides. Before these chemicals can be registered for use they must undergo extensive laboratory and field testing. Field trials reported here were with materials that showed minimal environmental hazard and a high potential for field use (i.e. efficaceous). These data are gathered through a screening program carried out at the USDA, Gypsy Moth Methods Development Laboratory, Otis Air Force Base, Massachusetts (McLane, 1973).

Materials and Methods

Four commercial preparations of test pesticides for gypsy moth control were field tested in 1975. These materials were selected for field testing because of the desirable characteristics demonstrated in laboratory screening. Each treatment was aerially applied to 50 acre plots (replicated 3 times) for evaluation. (See Table I for formulation). Two of the materials were field-tested in 1974. However, one was only on a limited scale and the other needed a follow-up test to substantiate its performance.

CGA-18809, an organophosphate, was field-tested in 1974 on one 50 acre plot and gave excellent foliage protection and larval mortality. Laboratory results demonstrated high activity as both a contact and a stomach poison of laboratory-reared gypsy moth larvae.

TH-6040 (Dimilin) is an insect growth regulator which was field-tested in 1974 and gave outstanding results with regard to larval mortality and egg mass reduction.

S-15126 (Malonoben) is a new class of pesticides belonging to a group called the benzylidene malononitriles. It was selected for field testing because of its performance in laboratory screening.

SAN-197, an organophosphate insecticide, also gave favorable results in laboratory tests.

Sevin-4-oil is a carbamate insecticide currently used extensively for gypsy moth control. It was applied to three 50 acre plots at 1.0 lb ai/40 oz/acre with a 20% kerosene solvent. These plots were used as a standard with which to compare the unregistered test materials.

Nine 50 acre plots were randomly placed throughout the treated areas so that the treated populations could be compared and evaluated against natural, untreated conditions.

Table 1. Details of 1975 formulations field-tested

Material	Application rate/acre	Chemical Concentration	Sticker
CGA-18809			
a.	1 gal/acre	0.125 lb ai/gal	Chevron at 3% Concentration
b.	1 gal/acre	0.50 lb ai/gal	" " " "
TH-6040			
a.	1 gal/acre	0.015 lb ai/gal	Chevron at 3% Concentration
b.	1 gal/acre	0.03 lb ai/gal	None
S-15126(Malonoben)			
a.	1 gal/acre	0.125 lb ai/gal	None
b.	1 gal/acre	0.50 lb ai/gal	None
SAN-197			
a.	1 gal/acre	0.062 lb ai/gal	None
b.	1 gal/acre	0.25 lb ai/gal	None
Sevin-4-Oil	40 oz/acre	1.0 lb ai/gal	20% Kerosene (solvent)

Plot Establishment

An area in Clinton County, Pennsylvania which met the following criteria was selected for establishing study plots: 1) a building population in which there had been no more than 1 year's noticeable defoliation prior to the test year, 2) a readily measureable population within the preferred range of 100 to 900 egg masses per acre, and 3) predominance of preferred host trees (oaks).

Each 50 acre square plot was laid out by establishing an accessible base corner and plotting boundary lines along compass headings. Markers were placed at all four corners for aircraft guidance. These markers were constructed from white canvas bags slipped over folded branches on the ends of long saplings. These saplings, in turn, were raised through the canopy and fastened so that the bags protruded about 10 feet above tree top level. Within each 50 acre plot, 5 subplots (0.1 acre) or sampling units were randomly established. These subplots were representative of the entire plot and werved as sampling points throughout the experiment. Sampling points were similarly established in untreated check areas to measure natural conditions.

Application

The application schedule was designed so that material was to be applied when the majority of the larvae were in the late second instar stage and the oak foliage was 50-75% expanded. However, due to rains and extra warm weather the week prior to spraying, leaf expansion on preferred host plants was about 80%.

Materials were mixed and transfered into the aircraft with conventional equipment (mixing tank, pumps, hoses, measuring devices, and necessary safety equipment). All mixing and spraying equipment was thoroughly cleaned between each treatment to avoid adulteration. Radio communications were maintained between the ground crew and the spray plane with respect to ground conditions of wind velocity and materials dispersement. Application quality and dispersement was checked by placing red Kromekote cards on wire stands in each sampling unit. These were placed just prior to spraying and removed for evaluation immediately after treatment. When possible, cards were used on woods roads to get information at the time of application.

All plots were treated with a Piper Pawnee aircraft equipped with a propeller-driven impeller pump and a conventional spray system (see Table II). The airplane dispersed the material in 75 foot swaths at 100 mph as near to tree top level as possible with a ground wind velocity of less than 5 mph.

Table II. Configuration of spray systems utilized

Material	Orifice	Screen Mesh	psi	Degree to Slipstream
CGA-18809	D8-Hollow cone with 45° swirl plate	25 mesh	40	90
TH-6040(Dimilin)	"	"	40	90
S-15126(Malonoben)	"	"	40	90
SAN-197	"	"	40	90
Sevin-4-Oil	8002	50 mesh	40	90

aluation

ch treatment was evaluated from the standpoint of foliage protection and population reduction.

liage protection was determined from visual estimates of the degree of defoliation in each of the sampling plots at the termination of larval feeding. ese estimates were made in 20% increments and rated low, medium, and high, thin the increment. Estimates were all performed by the same crew so that man judgement would remain constant. For computation purposes, the figures 14, 20,...89, 94, 100, were assigned as low, medium and high percentages.

ch treated plot was measured against its corresponding geographic check and e average of these tabulations gave the percent reduction in defoliation.

pulation reduction was estimated by using a system similar to that described Campbell (1967) in which the beginning larval population is estimated from g mass density and viability data.

ch subplot was intensively surveyed in early spring to determine the number egg masses/acre before treatment. Egg masses were collected adjacent to e sampling plots and were stratified to represent above and below the snowne. These collections were incubated in the laboratory to provide the following data: Number of eggs/mass, number of larvae successfully hatched, and e percent hatch for each egg mass. An estimate of beginning larval population was computed by: (number egg mass/acre)(Number eggs/mass)(percent hatch) = mber of beginning larvae per acre.

e percent reduction in egg mass population was calculated by counting the g masses in each subplot after leaf drop and using the following formula:

$$\frac{\text{Fall egg mass/acre}}{\text{Spring egg mass/acre}} \times 100 = \%\ \text{reduction in egg masses}$$

o determine residual effects on larval mortality, a 3' x 3' white drop cloth s placed under a representative host tree in each of the sampling units. ily readings were made and recorced on each of these until mortality ceased o be significant. This occurred in all cases in 96 hours or less. No drop loths were placed in TH-6040 plots because of its mode of action. The cadaers are similar to those infected with virus and tend to remain attached to e host plant, making dropcloth counts unreliable as indicators of larval morality.

sults and Conclusions

eatment applications began on May 28 and were completed on June 2, 1975, ing a USDA aircraft. During this period of time, 5 different chemicals re sprayed in 25 plots of 50 acres each in central Pennsylvania. During is period rain showers were experienced on the night of May 29 and during e day on May 30. Severe isolated thunderstorms hit the plot area at 3 pm y 31 and rain continued until early afternoon on June 1. Because of the in, no plots were treated on May 30 and Sunday, June 1. No problems or lays were encountered while mixing the materials and no mechanical prob- ms were confronted.

e-treatment densities ranged from 80 to 1940 egg masses per acre. The erage number of eggs per mass per sampling unit was from 145 to 817 with hatching percentage range of 42 to 99. The beginning larval population nged from 17,589 per acre to 610,324 per acre. The egg masses were gen- ally of good size, which would indicate a healthy population. Observations owed that the target insects ranged from 1st to 3rd instar with the major- y being 2nds at the time of treatment. However, due to rains and unsea- nably warm weather the week before spraying, the leaves on host trees were out 80% expanded at treatment time.

valuations of the efficacy of different chemicals tested are imcomplete at is time. Post-season egg mass counts will be performed in November. Data ccumulated to date are given in Table III and Figures I and II. Discussion d conclusions will be presented in the following laboratory report.

ble III. Population Trends (Treatment Average)

eatment	Pre-spray em/A	Avg. No. eggs/mass	% Hatch	Pre-spray Larvae/A	Post-spray em/A	% Change
N-197						
.062 lb ai/gal/A	512	440	82	102,207		
.25 lb ai/gal/A	417	321	78	111,523		
3809						
.125 lb ai/gal/A	348	346	80	94,870		
.50 lb ai/gal/A	517	348	77	145,800		
vin						
1.0 lb ai/40 oz/A	436	344	82	133,420		
040						
.015 lb ai/gal/A	385	414	84	140,549		
.03 lb ai/gal/A	562	385	79	155,002		
-15126						
.125 lb ai/gal/A	484	426	85	179,549		
.50 lb ai/gal/A	355	363	81	93,006		
ecks	383	394	80	119,342		

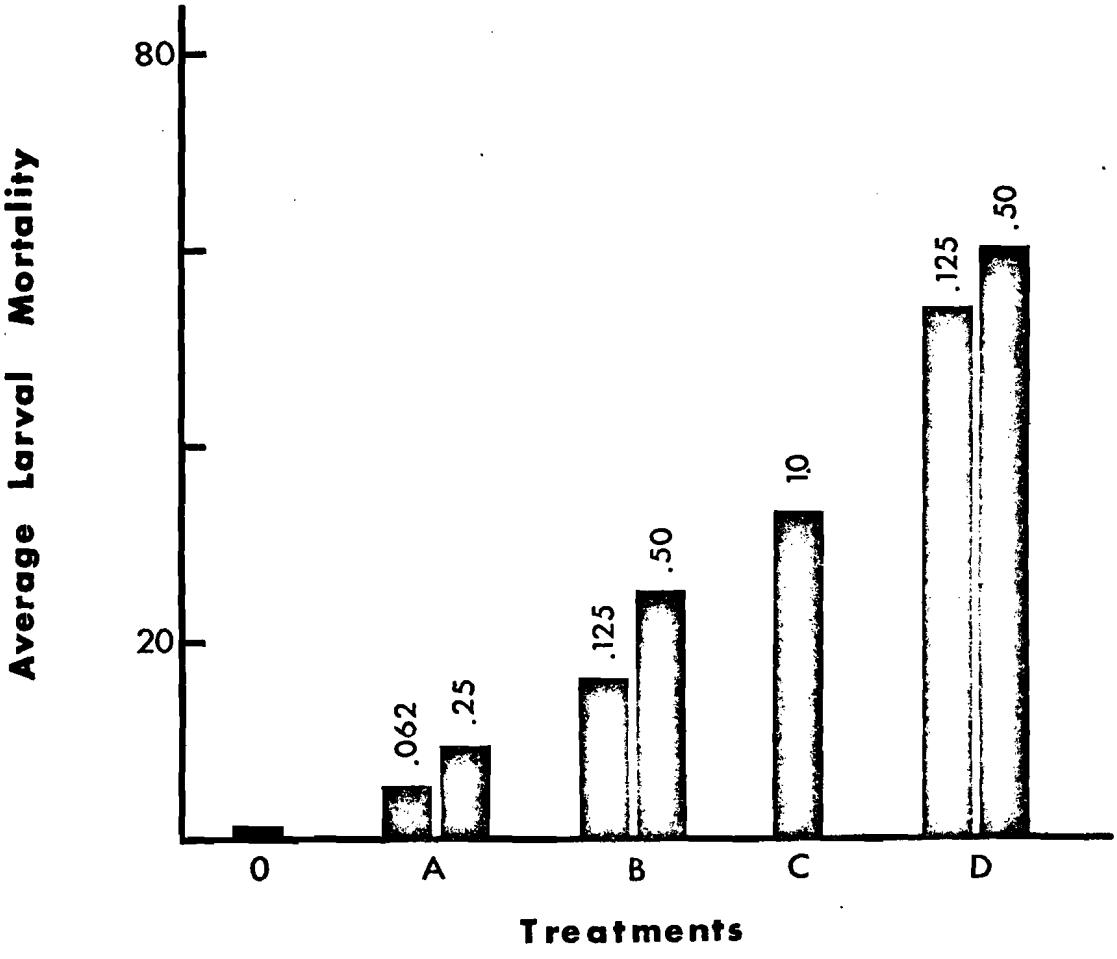

Figure 1. Larval mortality as determined by 3' x 3' dropcloth counts (96 hr. accumulation). No mortality determinations were made for TH-6040. Numbers above each bar denote dosage in lb ai/A.

0 = Check A = SAN-197 B = CGA-18809
C = Sevin-4-Oil D = S-15126

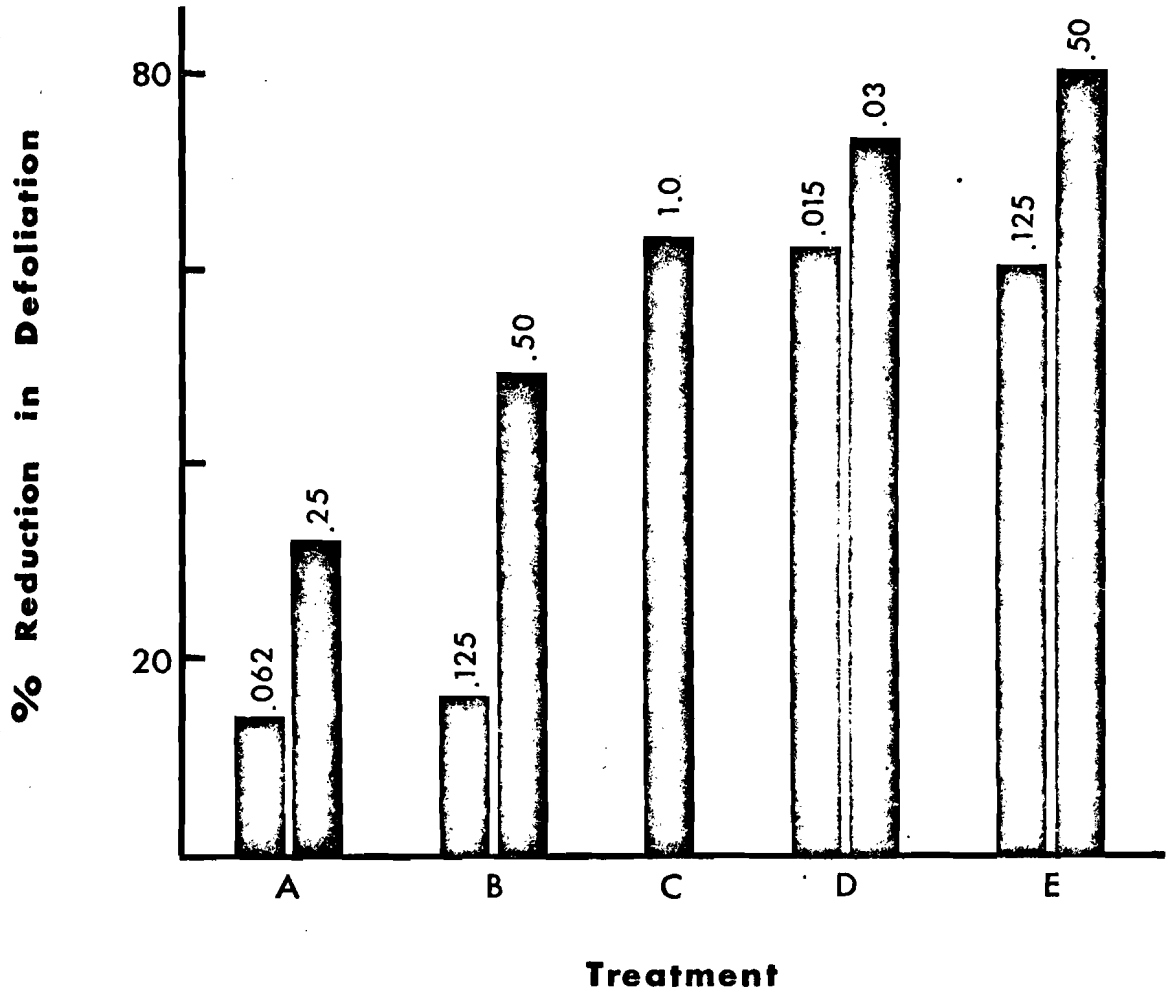

Figure 2. Reduction in defoliation calculated from defoliation in adjacent check plots. Numbers above bars indicate dosage in lb ai/A.

A = SAN-197 B = CGA-18809 C = Sevin-4-Oil
D = TH-6040 E = S-15126

RESEARCH PROPOSAL 75-143 C

APPENDIX 2
Cooperative Agreement
No. 12-16-4-179

Behavior of the Adult Gypsy Moth: Its Use in Quantifying Populations

Principal Investigators:

E. Alan Cameron, Assistant Professor of Entomology
Victor C. Mastro, Research Assistant in Entomology

Performing Organization:

Department of Entomology
106 Patterson Building
The Pennsylvania State University
University Park, Pennsylvania 16802

Date of Submission:

May 28, 1975

Project Leader

Vice-President, Research and Graduate Studies

OBJECTIVE

The objective of this investigation is to develop the application of disparlure in monitoring programs. Two long term goals are established:

a. to develop a baited trap as an accurate indicator of adult population density in both disparlure-treated and untreated areas.

b. to develop a baited trap as an accurate indicator of female mating success in both disparlure-treated and untreated areas.

Towards these ends, a series of short term objectives is established for this proposal:

a. to evaluate the relative attractiveness and efficiency of the standard Johnson traps and the new Delta traps for capturing male moths.

b. to evaluate the extent to which (marked) males are "pulled" into an area containing either natural pheromone or disparlure.

c. to determine the effective zone of a baited trap under different conditions, e.g., population density, male:female ratios, trap density, and environmental conditions.

d. to determine how to maximize trap efficiency with regard to trap density and proximity to female gypsy moths.

e. to determine the accuracy of recapture of released marked males as an indicator of population density in simulated and natural populations.

f. to determine whether the use of baited traps can accurately determine sex ratios existing in the field under different conditions.

PROCEDURES

To assess the effectiveness of the two kinds of traps compared with female moths, virgin females, baited Johnson traps, or baited Delta traps will be placed around the perimeter of plots in treated and untreated areas. The numbers of males caught in each kind of trap will be compared with the number of females mated. An index of trap efficiency (number of males caught/ number of contacts made with the trap) will be developed following procedures used in related 1974 field tests in which observers recorded both the numbers of males caught and the numbers of contacts made.

Within the 0.2 ha plots, virgin females, microencapsulated disparlure, and pheromone-baited traps will be used to measure the movement of male moths "lured" into the pheromone area from distances of up to 1 km. Unbaited sticky panels, suspended 2 or 4 m above the ground, will be placed around the perimeter of each plot. Males will be released from all cardinal directions, and will be color coded to identify their release point. At 24 and 48 h intervals and after 7 days the numbers of males caught on the panels will be recorded.

A circular plot design will be used to determine a trap's "effective zone" under different conditions. Marked wild males will be released in different quadrants and concentric zones within the plot, and a trap will be located in the center. Different densities of males and females, at different sex ratios and under different environmental conditions, and in treated and untreated plots, suitably replicated, will be tested using this design. Plots with only males released will be tested at densities of 4, 16, 32 and 64 males per ha. Females plus males will be tested at the same densities with 1:1, 3:1, 2:1, 1:2 and 1:3 male:female ratios. Wind speed and direction and air temperature will be recorded during all treatments. Simulated populations will be used for accurate control of numbers of insects.

A separate series of tests, using the same plot design, will be conducted to determine how wind speed and direction affect trap catch under light and moderate wind conditions; males will be tested at the densities described above. Differences among treatments and replications will be tested using standard analysis of variance tests.

The data from these tests will provide information on effective trap zone and how it is affected by the variables tested. More specifically, the data will provide basic relationships between trap catch and male moth density under different conditions. If female moth density or proportion affects

rap catch (i.e., females compete with traps), it will also provide information for an index of female density and percentage mating.

To test the possibility of using marked males as an index of population density, a series of tests will be conducted in simulated populations. Both wild unmarked and wild marked males will be released, and the most efficient baited traps (as determined above) will be used as monitors. Daily recapture data will indicate the utility of marked males for population density estimates.

The reliability of baited traps as an index of population densities and percentage mating will be checked in natural populations. Trap density in the test area will depend on preliminary data. Wild females, both free and tethered, will also be placed at random within the test area. Male release and tethered female placement will be carried out at 4 day intervals during the flight period, and traps and females will be monitored daily. Male density, calculated from total trap catches, will be compared with density estimates from marked male recovery. Calculated female density and percent mating will be compared with data collected from tethered females and intensive sub-plot counts of wild females from the forest floor to the tree canopy. As an additional control, male moth catch will be calculated from pupal counts taken in the manner described by Granett (1974) and compared to actual trap catches.

JUSTIFICATION

The most sensitive monitoring tool currently available for detecting gypsy moth mating disruption in disparlure-treated areas is the placement of virgin females in plots and determination of mating success. The use of females as monitoring tools poses problems: collection of field material is time consuming; wild females cannot be standardized; and for large scale

research or control programs, the use of females would be cumbersome at best. In addition, virgin females or other monitoring tools have not been developed to measure adult population densities in treated or untreated areas.

A standardized monitoring tool that could be used to measure adult population densities and mating success would be a valuable tool in research, control, or survey programs. Various gypsy moth traps have been used previously in such programs but only give qualitative data - i.e., no moths caught, or some moths caught. The need to develop a tool to measure and quantify gypsy moth populations for all types of programs is obvious. We propose to assess the accuracy of a baited trap as an indicator of both adult population density and mating success.

Both the leading edge of the current infestation and the most extensive current outbreaks of the gypsy moth are located in Pennsylvania. The research team at The Pennsylvania State University has been active for over four years in both basic and applied research on the gypsy moth, and in particular the use of disparlure. Both the location of the University and the expertise of its personnel are ideally suited to pursue the work outlined. These studies will naturally complement on-going studies into gypsy moth adult behavior.

LITERATURE AND CURRENT RESEARCH

Baited traps of various designs have been tested at different heights on trees and distances from the base of trees to determine the best trap location and the most effective design (Granett 1974; Hall et al. 1975; Holbrook 1964; Holbrook et al. 1960). Recently, Beroza et al. (1974) have described a new wick which should contribute to improvement and standardization of baiting in gypsy moth traps. It is generally agreed that traps should be placed below ca 2 m in height and on a vertical surface to maximize moth catch. Holbrook et al. (1960) attempted to determine a trap's effective range in simulated

male populations. They found that range was dependent on wind direction, and generally decreased over distance with little effect over 1/3 mi. Female-trap or trap-trap interaction were not taken into consideration.

Granett (1974) showed a highly significant correlation between trap catches and pupal populations in natural infestations. This study suggested that trap catches might also be used effectively to determine adult moth density. Granett also showed a high correlation between male "mating potential" and trap catch, indicating that a correlation between trap catch and the percentage of females mated in a population should exist.

Traps used in survey and detection programs have been able to detect the presence of male moths in areas where egg masses could not be located. If trap catch could be used as an accurate index of population density and/or mating success, we would have an invaluable tool for research, survey and detection, and control programs. No efforts are known to be underway to evaluate traps as evaluators of natural populations.

FACILITIES AND EQUIPMENT

Penn State University is located within easy commuting distance of both healthy natural populations of the gypsy moth at many different densities, and appropriate oak type forest where natural populations are currently below detection levels. Consequently, full laboratory space and backup facilities at the University are available on a daily basis, and substantial economies can be realized compared to providing temporary on-site food and lodging for project personnel. We have experienced excellent Cooperation for Pennsylvania Department of Environmental Resources District Foresters and others while conducting previous experiments on State lands, and this cooperation and these lands continue to be made available.

Pertinent specialized equipment and facilities on hand or under development include a portable videocamera, recorder, and monitor, various items of field equipment (specifically including safety equipment such as snake leggings, safety belts, hard hats, etc., for a full field crew) to conduct the required tests, and a laboratory bioassay room in a building uncontaminated by disparlure.

RESEARCH TIMETABLE

The research outlined will be conducted primarily during the 1975 summer field season, with data analyses and manuscript preparation continuing through the year. Funds are requested to cover the period July 1, 1975 to June 30, 1976.

PERSONNEL SUPPORT

Dr. E. Alan Cameron, Assistant Professor of Entomology, Department of Entomology, The Pennsylvania State University. Other current research involvements include gypsy moth adult behavior studies, bionomic and other studies in hemlock looper and oak leafroller, and acquisition of efficacy data for various insecticides on these forest pests.

Mr. Victor C. Mastro, Research Assistant, Department of Entomology, The Pennsylvania State University. Time commitment will be 50% to 31 March 1976, 100% 1 April - 30 June 1976.

Technical Service - One person full time

Hourly Wage - Six persons full time during the summer field season; 2 - 3 persons on a part-time basis during other times of the year.

Resumes are appended (Appendicies A and B) for each of the two scientists named.

INSTITUTIONAL UNITS INVOLVED

Agricultural Experiment Station of The Pennsylvania State University
U.S.D.A. - Animal and Plant Health Inspection Service
U.S.D.A. - Agricultural Research Service
Department of Environmental Resources, Commonwealth of Pennsylvania (lands)

RESEARCH IMPACTS

Direct Users of Research Results: A wide variety of users, working with federal, state, university and private agencies, would be expected to utilize results of these studies. Among the planned accomplishments of the expanded gypsy moth project are the demonstration of the use of disparlure for containment, suppression and possible elimination of gypsy moth populations. Both research personnel and applications organizations will have a better means of evaluating experiments and operations in sparse populations. Currently, such an ability is one of the major drawbacks to adequate assessment of activities in such populations.

Potential Beneficiaries of the Research: If the objectives of this proposal are achieved, potential beneficiaries of the work would include temporary and permanent residents of states in which gypsy moth populations are currently sparse or unknown but threatening. Data they might gather using standard detection traps would provide a better basis for evaluation of hazard by state and federal plant protection and quarantine officials, and enhance the likelihood that adequate and proper remedial action is taken.

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Behavior of the Adult Gypsy Moth: Its Use in Quantifying Populations.

(An Ammendment to APHIS Cooperative Agreement No. 12-16-4-179)

Principal Investigators:

E. Alan Cameron, Associate Professor of Entomology

Jim V. Richerson, Research Associate in Entomology

Victor C. Mastro, Research Assistant in Entomology

Performing Organization:

Department of Entomology

106 Patterson Building

The Pennsylvania State University

University Park, Pennsylvania 16802

OBJECTIVE

To compare the effectiveness of disparlure, manufactured in two different years and in two different formulations, for disruption of gypsy moth chemical communication.

PROCEDURES

Each of the following formulations of microencapsulated disparlure will be applied, by APHIS personnel, to one 16 ha test area:

1. 1974 disparlure, formulated as in 1974 (UCAR latex sticker).
2. 1974 disparlure, formulated as in 1974 but substituting Rhoplex B-15 as the sticker.
3. 1975 disparlure, as preformulated (Rhoplex B-15 sticker).
4. 1975 disparlure, formulated as in 1975 but with Rhoplex B-15 replaced by UCAR latex as the sticker.

A suitable additional 16 ha test area will be used as an untreated control.

Three 0.2 ha circular subplots (= replicates) will be established in each 16 ha block. In each subplot, 4 virgin female moths, collected from natural populations as pupae and being 1-3 days old, will be tethered equidistant from each other and near the subplot perimeter; 4 delta traps, baited with 1975 Hercon dispensers, will be placed equidistant from pairs of females on the subplot perimeter. One hundred male moths (or as near that number as possible), collected from natural infestations as either pupae or adults, will be released in the centre of each subplot. On test days, the same number of replicates will be run in each treatment and in the control area simultaneously. At one-half hour after male moth release, the numbers of attempted matings and delta trap catch will be recorded; 24 hours following moth release, additional trap catch will be recorded and all females and any eggs present will be

collected. Fertility assessments, using the technique of examining the bursa copulatrix of females for presence of sperm, supplemented by egg mass examination, will be performed.

An attempt will be made to locate a suitable natural infestation area as a test site for a "new formulation" which will consist of disparlure in an as yet unidentified liquid carrier. This test will be monitored only by placement of baited delta traps, and trap catch will be compared with trap catch in a similar untreated natural infestation.

JUSTIFICATION

Microencapsulated disparlure was applied to test areas in central Pennsylvania on June 29 and 30, 1975. In addition to the "1975 formulation", which was completely formulated by NCR, used Rhoplex B-15 as the sticker, and contained disparlure synthesized in 1975, one plot was treated with disparlure encapsulated and slurried in 1974 and to which UCAR latex sticker was added just prior to application. Following application, questions were raised concerning the effectiveness of Rhoplex B-15 as a sticker, and bioassay data comparing the 1974 and 1975 disparlure suggested that the 1975 disparlure was not as effective as the year old material. (See letters of July 2, 1975, E. Alan Cameron to J. R. Plimmer, and July 29, 1975, Jim V. Richerson to C. P. Schwalbe for summaries of orally communicated information.) Since the "1975 formulation" is being so widely used this season, it becomes mandatory that there be data available upon which comparisons to 1974 test results can be made.

Two important variables have been identified: the year of formulation of disparlure (and chemical differences, such as cis/trans ratios, which may exist between each year's production), and the sticker used in the spray formulation. The test proposed herein will evaluate the four possible combinations of these two variables.

There is some unpublished evidence that disparlure is not as susceptible to chemical breakdown as a result of "weathering" as had been previously believed. If disparlure, applied only in a fluid carrier to increase spray volume, is effective in disrupting adult moth chemical communication, substantial economies may be realized if the more expensive encapsulation and formulation processes can be avoided. The test proposed is admittedly less than elegant, and proposes to do no more than permit a cursory look at some arbitrarily selected formulation. If successful, this test could accelerate development of a new formulation for subsequent years.

FACILITIES AND EQUIPMENT, RESEARCH TIMETABLE, PERSONNEL SUPPORT

With the exception of the involvement of Dr. Jim V. Richerson, Research Associate, Department of Entomology, The Pennsylvania State University, and approximately 25 additional man-weeks of hourly wage labor (6 persons for 4 weeks each), details of these sections are as in Cooperative Agreement No. 12-16-4-179.

APPENDIX 3
Cooperative Agreement
No. 12-16-4-167

Application Submitted to

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE

Chemical Residue Analysis in Ecosystems Sprayed in Communication Disruption Experiments with Disparlure

Submitted by: L. B. Hendry
Assistant Professor
Department of Chemistry
152 Davey Laboratory
Phone: 814-865-8912

The Pennsylvania State University
University Park, Pennsylvania 16802

Duration: One Year

L. B. Hendry
Principal Investigator

J. A. Dixon
Head, Department of Chemistry

R. G. Cummingham
Vice President for Research and
Graduate Studies
814-865-6331

Chemical Residue Analysis in Ecosystems Sprayed in Communication Disruption Experiments with Disparlure

L. B. Hendry
Department of Chemistry
The Pennsylvania State University
University Park, Pennsylvania 16802

Objectives:

To determine the quantities of disparlure in aquatic and terrestrial ecosystems sprayed in communication disruption experiments by the USDA.

Specific Tasks to be Performed:

In order to provide information on evaporation rates of disparlure in forested areas, quantities of disparlure in streams and ponds, and the amounts of disparlure in various locations in a sprayed area over a 32-week period, the following will be conducted:

1) water samples will be collected in four areas: a) control stream, b) treated stream, c) control pond, d) treated pond and analyzed by gas chromatography-mass spectrometry,
2) fish will be analyzed for disparlure and other possible metabolic products,
3) foliage samples will be collected at the top, middle and base of trees and analyzed for the presence of disparlure in: a) 2 controls (infested and noninfested areas), b) 3 blocks sprayed at 8 g/acre, c) 4 sample sets in a block sprayed at a concentration of ca.15 g/acre,
4) air will be passed through porapak to determine the amounts of disparlure evaporating in the field in: a) control (no gypsy moths), b) gypsy moth infested area, c) gypsy moth infested area treated with disparlure,

5) preliminary experiments will be conducted in the laboratory to optimize procedures for 1 and 4.

Reports:

Informal reports will be forthcoming every three months with a final report at the end of the year.

Equipment and Facilities:

The specific pieces of equipment required for this project are:
(1) a highly sensitive computerized electron impact gas chromatograph-mass spectrometer with mass fragmentography programs and capillary column capabilities and
(2) a highly sensitive computerized chemical ionization gas chromatograph-mass spectrometer with mass fragmentography programs and capillary column capabilities.

Both of these requirements are met by Finnigan 3200 Electron Impact and Finnigan 3300 Chemical Ionization Gas Chromatograph-Mass Spectrometers with associated Finnigan 6000 Computer Data System which are under Dr. Hendry's supervision. The cost of these systems and computer programs is ca.$180,000. Both instruments can detect less than 10^{-11}g of most organic compounds and are equipped to handle extremely small quantities of pheromones. An extensive pheromone data library is stored in the computer for fast identification of pheromone samples. A Mod Comp II Computer with 64 K core is also available in the chemistry department.

In addition to the above spectrometers, Dr. Hendry directs eleven laboratories containing 4000 sq. ft. of space, physically located in Pond,

Whitmore, Chandlee and Davey Laboratories. Incubators, growth chambers, insect rearing facilities, centrifuges, gas chromatographs, electrophoresis chambers, fraction collectors and all types of radiochemical equipment are available. The laboratories are well equipped with micro U.V., micro infrared, NMR (A-60, HA 100, Fourier transform), and mass spectrometers (MS 902, high resolution capability).

BIOGRAPHICAL SKETCH

Name and Title

Lawrence Benes Hendry
Assistant Professor
Department of Chemistry

Date and Place of Birth

March 6, 1945, New York City, New York

Education

Lafayette College, Easton, Pa., B.S. 1966, Chemistry
Cornell University, Ithaca, N. Y. Ph.D. 1970, Organic Chemistry

Honors

Sigma Xi; NIH Traineeship, 1968-69; Dean's List; PRF Undergraduate Fellow; Honors in Chemistry.

Major Research Interests

1. Behavior Mediating Chemicals
2. Chemical Communication in Insects
3. Exploratory Synthetic Chemistry

Professional Experience

Assistant Professor 1973 - , The Pennsylvania State University, Department of Chemistry.

Instructor, 1971-1973, The Pennsylvania State University, Department of Chemistry

Assistant Professor, 1970-1971, Cornell University, Ithaca, New York, Department of Chemistry.

Teaching Assistant in Organic Chemistry, 1966-1968, Cornell University, Ithaca, N. Y., Department of Chemistry.

Research Chemist in Drug Products, 1965-1966, Lederle Laboratories, Pearl River, New York

Research Chemist in Paper Products, 1964, St. Regis Paper Company, West Nyack, New York

Doctoral Thesis Contents

I. Synthesis of an Allenic Sesquiterpenoid
II. The Oral Secretion of the Pine Saw Fly Larvae (*Neodiprion sertifer*)

PUBLICATION LIST
L. B. Hendry

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4. The Deconjugation of Isophorone," J. Meinwald and L. Hendry, J. Org. Chem., 36, 1446 (1971).

5. "Light, Temperature and Geotactic Responses of a Mushroom-Infesting Phorid Fly Megaselia bovista (Diptera:Phoridae)", J. E. Girard, R. Snetsinger, and L. B. Hendry, Melsheimer Entomological Series, No. 10, 1-7 (1972).

6. "Evidence of a Sex Pheromone in the Oak Leaf Roller, Archips semiferanus (Lepidoptera:Tortricidae): Laboratory and Field Bioassays", L. B. Hendry, L. Roman and R. O. Mumma, Environmental Entomology, 2, (No. 6) 1024-1028 (1973).

7. "Kairomone Mediated Host-finding Behavior in the Parasitic Wasp Orgilus lepidus", L. B. Hendry, P. D. Greany, and R. J. Gill, Entomologia Experimentalis et. Applicata, 16, 471-477 (1973).

8. "Sex Pheromone in a Mushroom-Infesting Sciarid, Lycoriella mali", J. Girard L. B. Hendry, and R. Snetsinger, The Mushroom Journal, 13, 29-31 (1973).

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12. "Sex Attractant Trapping Techniques for the Oak Leaf Roller (Archips semiferanus Walker)", L. Hendry, L. Capello and R. O. Mumma, Melsheimer Series, No. 16, 1-9 (1974).

13. "Cis-10-tetradecenyl Acetate. An Attractant Component in the Sex Pheromone of the Oak Leaf Roller Moth (Archips semiferanus Walker)", L. B. Hendry, J. Jugovich, L. Roman, M. E. Anderson, & R. O. Mumma, Experientia, 30, 886-887 (1974).

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17. "Evidence of the Origin of Insect Sex Pheromones :Presence in Food Plants", L. B. Hendry, J. K. Wichmann, D. M. Hindenlang, R. O. Mumma and M. E. Anderson, Science, 188, 59-63 (1975).

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19. "Insect Sex Pheromones - Identification by Mass Fragmentography", L. B. Hendry and D. M. Hindenlang, Finnigan Spectra, 5 (1), 1-3 February (1975).

20. "A Sex Pheromone in the Potato Tuberworm Moth, Phthorimaea operculella (Zeller): Biological Assay and Chemial Investigation", D. M. Hindenlang, J. R. McLaughlin, and L. B. Hendry, J. Chem. Ecol., in press.

21. "Plants" The Origin of Chemical Signals in Insect Host - Parasite Relationships", L. B. Hendry, J. Wichmann, D. M. Hindenlang and K. Weaver, submitted for publication (1975).

22. "A Macrocyclic Lactone Isolated from the Sexual Excitant Component of the Oak Leaf Roller Pheromone Complex", L. B. Hendry, S. H. Korzeniowski, J. Jugovich and D. M. Hindenlang, in preparation (1975).

23. "A Sex Pheromone in the Parasitic Wasp Itoplectis conquisitor (Hymenoptera:Ichneumonidae)", D. Robacker, K. Weaver, and L. B. Hendry, submitted for publication (1975).

24. "A Sex Attractant in the Mushroom Fly, Lycoriellia mali Fitch: Identification and Possible Origin", L. B. Hendry, J. Kostelc, R. Snetsinger and J. Girard, in preparation (1975).

L. B. Hendry

Submitted papers

Group Addressed	Date	Title of Paper
Entomological Society of America New York City	Nov. 73	Biological Parameters of the Adult Oak-Leaf Roller, *Archips semiferanus* Walker (Lepidoptera:Tortricidae), and Pupal Parasites.
Entomological Society of America New York City	Nov. 73	Sex Pheromones of the Oak Leaf Roller *Archips semiferanus* Walker (Lepidoptera:Tortricidae): Laboratory Bioassay and Field Tests
Entomological Society of America New York City	Nov. 73	Sex Pheromones of Oak Leaf Roller *Archips semiferanus* Walker (Lepidoptera:Tortricidae) Preliminary Isolation and Characterization
Entomological Society of America New York City	Nov. 73	Sex Pheromone of the Mushroom Fly *Lycoriella mali* (Fitch): Isolation an Biological Assay.
ACS National Meeting at Atlantic City	Sept. 1974	A Complex Chemical Communication System - The Sex Pheromones of the Oak Leaf Roller
Entomological Society of America Hershey	Sept. 1974	The Oak Leaf Roller Sex Pheromone Complex - Identification of Active Principles by Novel Spectroscopic Methods.
Entomological Society of America	Sept. 1974	Responese of Oak Leaf Roller Males to Synthetic Attractant Chemicals: Field Trapping and Electroantennograms
Entomological Society of America	Sept. 1974	Sex Pheromone of the Potato Tuberworm Moth, *Phthorimaea operculella* (Lepidoptera:Gelechiidae): Biological Assay and Chemical Investigations

L. B. Hendry

Submitted papers "continued

Group Addressed	Date	Title of Paper
Entomological Society of America Hershey	Sept 1974	Kairomone mediated host-finding behavior in the parasitic wasp, *Orgilus lepidus* Muesebeck (Hymenoptera:Braconidae)
Entomological Society of America Hershey	Sept 1974	A Sex Pheromone in *Itoplectis conquisitor* (Hymenoptera:Ichneumonidae): Biological Assay and Isolation
ACS National Meeting - Chicago	Aug. 1975	Insect Host-Parasite Chemical Signals (Kairomones): Isolation from Plants
ACS National Meeting - Chicago	Aug. 1975	The Origin of the Cabbage Looper Sex Attractant: Plants or De Novo Biosynthes
ACS National Meeting - Chicago	Aug. 1975	Plants: The Origin of Sexual Messengers in the Oak Leaf Roller Moth?
ACS National Meeting - Chicago	Aug. 1975	Macrocyclic Lactones in the Sexual Excitant Component of the Oak Leaf Roller Pheromone Complex: Identification, Synthesis and Computer Modeling.
ACS National Meeting - Chicago	Aug. 1975	A Mushroom Fly Sex Attractant Isolation, Identification, and Possible Origin.

Invited Lectures

Group Addressed	Date	Title of Talk
East Stroudsburg State College	Dec. 1971	"Chemical Communication"
Penna. Entomological Society Symposium	Sept. 1972	"Isolation and Identificat of Insect Sex Pheromones"
Dept. of Environmental Resources Meeting, Harrisburg Legislators and Foresters	Mar. 1972	"The Oak Leaf Roller - Pheromone Control"
Earth Week Symposium (Citizens for Ecological Action)	Apr. 1972	"Natural Alternatives to Pesticides"
Sigma Xi Lecture at Wilkes College	Nov. 1973	"Sex and Communication Among Insects"
Pest Control Operators Conference	Nov. 1973	"Control of Agricultural Insects with Chemical Communicants"
Albright College	April 1973	"Insect Chemical Communication"
Pennsylvania Forest Pest & Disease Conference	Feb. 1974	"The Oak Leaf Roller - Control by Sex Attractants"
Eastern Forest Insect Pest Conference	April 1974	"The Sex Attractant of the Oak Leaf Roller"
Soil Conservation Society of America	May 1974	"Natural Chemical Alternatives for Insect Control"
International Union of Pure & Applied Chemistry -- Natural Products Symposium Ottowa, Canada	June 1974	"Mass Fragmentography Aided Identification of the Oak Leaf Roller Sex Pheromone Complex"
Grove City College	Nov. 1974	"Insect Chemical Communication - You Are What You Eat.
ACS - Southwestern Regional Meeting - Symposium on New and Interesting Biological Active Natural Products - Houston, Texas	Dec. 1974	"Insect Chemical Messengers"
Allegheny College	Jan. 1975	"Insect Chemical Messengers"
Lebanon Valley College	Jan. 1975	"Insect Chemical Messengers"

Invited Lectures "continued"

Group Addressed	Date	Title of Talk
ACS--Susquehanna Valley Section	Feb. 1975	"Chemical Communication Among Insects"
American Cyanamid Colloquium Series	Feb. 1975	"Chemical Messengers Involving Insects and Plants"
Lafayette College	Mar. 1975	"Insect Chemical Messenger Systems: You Are What You Eat"
Penna. Forest Insect and Disease Conference	Feb. 1975	"Oak Trees, Oak Leaf Rollers and Sex"
Dept. of Plant Physiology PSU	Feb. 1975	"Chemical Messengers in Insect and Plants
Biological Research Society	Mar. 1975	"Insect Chemical Messengers: You are What You Eat?"
Ethology of Host Selection by Entomophagous Insects - Workshop Tifton, Ga.	Mar. 1975	Informal Discussion "Plant derived Insect Kairomones"
Stony Brook SUNY	Apr. 1975	"Chemical Messengers in Insects and Plants"
Zoecon Corporation	Apr. 1975	"Plant-Insect Chemical Interactions"
Forest Insect Work Conference Hampden, Conn.	Apr. 1975	"Insect Chemical Messengers of Plant Origin"
Gordon Conference	Jul. 1975	"Insect Chemical Messengers and their usefulness in Agriculture"
Symposium - Recent Advances in Phytochemistry - Tampa, Fla.	Aug. 1975	"Chemical Signals in Insect-Plant relationships.
Central Research-DUPONT	May 1975	"The Origin of Insect Chemical Messengers: Plants.
Entomological Society of America Philadelphia	Oct. 1975	"The Evolution of Plants and Insects"