16

INVESTIGATIONS ON RECURVARIA PICEALELLA Kft. BERTHIERVILLE, 1943-1951

by

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PRELIMINARY REPORT

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Introduction

From 1943 to 1951 inclusive, with the exception of 1945, 1946 and 1948, larvae and pupae of Recurvaria picealella Kft. were collected in various areas of the Province and reared in the insectary at Berthierville. The principal information gathered during these studies is being summarized in this report.

Methods of Investigation

The method of collecting the insect was simple. In each area visited the foliage of a few spruce trees was carefully searched and all infested twig collected and placed immediately in an individual glass tube and brought to Berthierville for rearing to maturity.

All rearing tubes were examined two or three times a week to follow the development of the insects and notes were taken of larval instars, pupation dates, emergence of adults of the host and parasites, etc.

The number of larvae and pupae collected at each collection date is given in Table 1. Reference to this table will show that the total individuals gathered in different years was as follows: 1943: 55, 1944: 254, 1947: 140, 1949: 1,565, 1950: 2,942, 1951: 1,452; this represents a grand total of 6,408.

Identity and Description

One of the first reference to this species was made by Johannsen in 1893. The information he gave on the habits, seasonal history, and biology applies very well to the insect collected in the Province of Quebec. But, it was not until 1954 that we could obtain a definite identification of the material reared in the course of our studies.

The external morphology of the larva, pupa and adult has been the subject of a Master's thesis presented at Laval University in 1953, by Mr. J.-L. Villeneuve, of the Biological Control Unit. A copy of his thesis is in the library of this laboratory.

In the course of these studies we have measured the head width of 2,831 larvae, with the main purpose of determining the number of instars. Results of these measurements are given in Table 2 and illustrated in Figure 1.

Host and Distribution

As far as we know this insect attacks only the spruce and white spruce seems to be the preferred host throughout Quebec. Out of the 6,408 larvae collected in various regions, on different species of spruce, the distribution was as follows: white spruce 4,880, red spruce 936, black spruce 273, Colorado spruce 235 and Norway spruce 84.

According to Craighead 1950 (p.457) this insect is distributed in the United States from Maine to Colorado. In Quebec it has been found in all areas where collections have been made and in all probability its distribution corresponds to that of its host tree.

No special studies were made to establish the abundance of this insect in various areas and different types of stands. According to our experience, however, it seems to be more abundant and common on trees well exposed to direct sunlight. In April 1948, 87 larvae were collected on a white spruce in the region of Berthierville in a one-half hour search.

There were about 10 to 12 larvae per branch and it was estimated that approximately 15 per cent of the 1947 twigs were attacked.

Life History and Habits

The insect spends the winter in the larval stage inside a needle partially or totally mined the preceding fall, and rarely inside a bud. About 84 per cent are in the penultimate instar and 16 per cent in the ultimate instar, see Table 2.

About the middle of April, the larva emerges from its winter quarters, spins a silk tube, bores a hole at the bottom of a fresh needle and gradually eats its way inside the needle. After having disappeared in the needle, the larva closes the opening with silk and continues to eat the inner portion of this leaf, causing it to appear whitish. When the parenchyma has been completely destroyed, the larva quits the needle, builts a silken tube to reach a second needle that will be eaten in the same manner. The larva can travel from one needle to the next without never being exposed to the exterior. Each larva eats 3 to 5 needles and occasionally one can attack a fresh bud. Usually, the larva sheds its last skin after having eaten its first needle in the spring. The larva reaches its full maturity about the first week in May. The presence of the insect is then easily detected on infested trees because the brown mining needles are kept together by the silk tread produced by the larvae.

The larva transforms into pupa in a silk tube that it spins at the bottom of a group of dried mined needles. The duration of the

pupal period varies necessarily with temperature. It was as indicated in Tables 3 and 4, during the years our studies were conducted.

The dates of emergence of the adults in different years are given in Table 5 and illustrated in Graph 2. As can be seen from the graph the emergence is spread over a long period and the greater number of adults emerge during the last two weeks of June.

The longevity of adults is of approximately 9 days for males and 13 days for females, as per Table 6.

In one cage the eggs were found singly on needles of the preceding year. The eggs are circular in shape and white in colour. The duration of the incubation period was not determined.

On hatching the larva bores a hole directly through the epidermis of the needle and feeds as a miner until cold weather arrives. Each larva can mine one or more needles. Infested needles are recognized by their discolouration and because some frass is excreted through the opening.

Parasites

Since R. picealella is a native insect one would expect that during its long period of development some natural enemies would also have developed. This has proven to be the case. Approximately 44 species of parasites have been recovered from material collected in various regions of the Province. All this material has been submitted to the specialists in Ottawa for authoritative identification. The identification

of 4 species has not been received as yet. The list of the material identified is given in Table 7. Reference to this table will show that the parasites are distributed in the following groups:

Hymenoptera:	Chalcididae	7 species
	Braconidae	19 "
	Ichneumonidae	11 "
Diptera		3 "

Table 7 also gives an idea on the relative abundance of the different species in various localities where sampling was done.

The dates of appearance of the different species of parasites are given in Tables 8 and 9.

No serious attempt was made to evaluate the percentage of parasitism caused by these species of parasites. However, records were kept of the number of each species emerging from material collected at Berthierville in various years. Results obtained are given in Table 10. Also in Table 11, figures are given regarding the total parasitism caused by all the species in different years. References to this table will show that the percentage of parasitism did not vary much from year to the other and never exceeded 40.

Notes on the principal species of parasites recovered

Meteorus sp. (no.16) Rare - Endoparasites. Leaves the host larvae at maturity to spin a more or less whitish cocoon on the cast skin of its host; measuring about 1½ lines in length.

Schizactia vitinervis (no.40) Small endoparasite. Larvae attacked become inactive and their colour changes from pink to light yellow. This parasite pupates inside its host larvae which becomes dark brown and twice as big as normal ones.

Cremastus sp. (Zaleptopygus sp.) (no. 24) The larva of this parasite when emerging from the host larva is approximately one quarter of an inch in length, and soon spins a few silk treads around itself. Four days later it turns into a pupa. The pupal period lasts about 12 days.

Chelonus sp. (no. 12) Endoparasite. Cocoon whitish, thin and transparent. One pupa made June 10, 1947 gave rise to an adult on June 26.

Copidosoma nanellae (no.33) A polyembryonic parasite. About 6 to 8 parasites per host larva. When matured each larva of the parasite makes an oval cocoon inside the host larva near the skin.

Bracon gelechiae (no.7) An endoparasite which develops in the abdomen of the larva of its host. Total length of the larva at maturity about 1½ lines. This parasite makes a very thin and transparent silk cocoon. Occasionally two parasites larvae emerge from one host.

Agathis bicolor (no. 13) Endoparasite.

Pimplopterus parvus (no. 29) Matured larva measures about one quarter of an inch in length. Chrysalid naked. Pupation period 8 days.

Recommendations

During the course of this work, a number of items concerning the biology and sampling technique that obviously call for investigation

have become apparent. In most instances full-time studies for one season or more would be needed to adequately investigate them. In some cases, however, at least observations data can be secured while doing regular work.

Following is a list of problems on which studies should be made:

1. Behavior of the adult after emergence: mating, oviposition (time, place, manner, number of eggs laid per female).

2. Duration of incubation period.

3. Number of larval instars. Collection of larvae should be made from June to September to obtain first instars.

4. Natural factors of control, especially predators (birds, ants, insects, etc.), climate.

5. Information on the biology of the principal species of parasites.

6. Total effect of natural factors of control in specific areas.

7. Effect of stand age, vigor and competition on susceptibility to attack.

8. Methods of assessing the population.

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Table 1

R. picealella - Number of Larvae and Pupae Collected at Different Periods in Various Years

		1943	1944	1947	1949	1950	1951
April	1-15				148	17	
	16-30		3	11	428	493	623
May	1-15	13	115	98	739	1,376	310
	16-31	42	136	31	80	161	496
June	1-15				23	86	8
August	15					3	
September						11	15
October	1-15				3	86	
	16-30				115	336	
November	11				26	272	
	30					9	
December	12				3		
January	25					51	
February	20					41	
		55	254	140	1,565	2,942	1,452

Grand total: 6,408

Table 2

R. picealella - Head Width of Larvae Collected in Various Areas, 1949 and 1950

Date of Collection		Measurements in mm.									
		.28	.32	.36	.40	.44	.48	.52	.56	.60	.64
		Penultimate instar						Ultimate instar			
September	18							1			
	23					1					
	29		2	1	4	3					
October	10	4	2	18		5		2			
	5		7	6	12	24	3	16	20	4	
	9		1	3		2	1	3	1		
	13			1		4			1	3	
	16		4	13	19	44	4	3	18	9	
	17	2	16	23	57	110	19	8	25	14	1
	18				1						
	20		2	2	8	20	4	1			
	24				1		1	5	2	1	
	28		4	7	13	21	3				
November	2			4	1	9	1	1			
	8		2	5	2	18	1	1		1	
	9		1	1	2	12		2	1	3	
	10			1		1					
	13		1	6	15	48	7	3	5	1	
	14		2	15	19	79	3	1	4	8	1
	16					4	1	1			
	17	1				3		1			
December	12				1		1	1			
January	17			7	4	10	4				
February	27			1	2	6	3	2	1		
March	22			5	7	16	4				
	23		1	8	20	20	1				
April	4			1		1	3				
	10					1					
	13			2	12	30	3				
Total -		7	45	130	200	492	67	52	78	44	2

Table 2 (Cont.)

R. picealella - Head Width of Larvae Collected in Various Areas, 1949 and 1950

Date of Collection		Measurements in mm.									
		.28	.32	.36	.40	.44	.48	.52	.56	.60	.64
		Penultimate instar						Ultimate instar			
April	14						1	1			
	17							1			
	18				1	12	2	2			
	19				2	16	4	2	5		
	22						1				
	23				9	10	2	1		1	
	24				5	32	5	1			
	25			3	7	55	6				
	27			3	7	7	1				
	28			5	19	112	27	4	2	1	
May	3					1			1		
	4			1	8	42	37	50	14	4	
	5					4	4	3			
	7					1	10	112	67	13	
	8			1	6	50	6	2	1		
	9			1	6	54	17	81	55	34	1
	10				6	51	3	45	24	38	1
	11				1	2	20	64	21	2	
	17					1		12	7	18	2
	18			1		1	1	5	1		
	19				2	26	9	76	48	63	4
	20					6	1	15	16	30	
	24							6	2		1
	26							1	2	2	
	28						1	2	1	1	
	31						1	1	3	3	
June	1						1				
	6										2
Total		0	0	15	79	483	160	487	270	210	11

Summary

	Penultimate instar	Ultimate instar
From Sept. 18 to April 13:	941	176
From April 14 to June 6:	737	978
Grand Total:	1,678	1,154

Table 3

R. picealella - Dates of Pupation

Year	Number of observations	First	50 per cent	Last
1943	8	4/6	5/6	19/6
1944	66	16/5	29/5	30/6
1945	3	13/6	20/6	30/6
1947	11	9/6	12/6	23/6

Table 4

R. picealella - Length of Pupation Period in Days

Year	Number of observations	Mean	Range
1943	8	19.7	16-27
1944	28	16.4	13-18
1945	5	15.4	13-19
1947	9	19.1	17-26

Table 5 (a)

R. picealella - Emergence of Adults in Different Years

Date		1943	1944	1947	1948	1949			1950			1951		
						f.	m.	t.	f.	m.	t.	f.	m.	t.
1		2	3	4	5	6	7	8	9	10	11	12	13	14
June	1											0	2	2
	2											0	2	2
	3						1	1					1	1
	4	1												
	5	1										3	0	3
	6		1				1	1				1	0	1
	7								0	5	5			
	8													
	9								0	1	1			
	10		8				2	2				1	0	1
	11		7				4	4	0	1	1	1	0	1
	12		7			1	4	5	0	4	4	1	5	6
	13					13	67	80	3	13	16	1	9	10
	14		8			46	78	124	7	30	37	3	8	11
	15	1	4			57	55	112	41	70	111	1	4	5
	16					78	71	149	13	16	29			
	17		7			43	30	73	9	20	29	12	21	33
	18	1			2	3	1	4	25	31	56	25	21	46
	19				1	29	16	45	27	26	53	24	8	32
	20	1			1	11	2	13	23	31	54	19	13	32
	21	2			2	8	0	8	34	22	56	9	5	14
	22		1	2	2	5	0	5	25	15	40	4	2	6
	23				13	15	2	17	11	8	19	1	1	2
	24	2	1		28	9	1	10	15	6	21	10	6	16
	25	2		2	42	4	1	5	6	7	13	3	3	6
	26	1	3	1	61	11	1	12	21	11	32	1	1	2
	27		2	6	41	4	4	8	17	13	30	1	1	2
	28			15	39	7	3	10	7	6	13	3	0	3
	29			15	26	5	2	7	6	2	8			
	30	1		8	7	3	0	3	6	0	6			
July	1	1		37	5	4	0	4	2	0	2	1	1	2
	2			10	3				2	1	3	2	1	3
	3			3	3				2	0	2	2	1	3
	4			3	2	1	0	1	5	0	5			
	5	1		1					6	0	6			
	6			19	1	1	1	2	1	1	2			
	7			2					1	3	4	1	0	1
	8			2										
	9			1										
	10													
	11			1		1	0	1						
	12					2	0	2	2	0	2			
	13			1										
	14													
	15													
	16								1	0	1			
Total -		15	49	129	279	361	347	708	318	343	661	130	116	246

Table 5 (b) Summary

Date of emergence of the adults

	1943	1944	1947	1948	1949	1950	1951
First	4/6	6/6	22/6	18/6	3/6	7/6	1/6
50%	22/6	14/6	1/7	26/6	16/6	19/6	19/6
Last	5/7	27/6	13/7	6/7	12/7	16/7	7/7

Table 6

R. picealella - Longevity of Adults in 1950
(June 12 to 16)

	Female	Male
Minimum	7	2
Maximum	20	19
Mean	13.0	8.9
No. observations	35	51

Table 7 R. picealella - Number of Parasites Recovered in Different Regions

Species	Berthierville	Grand'Mère	Portneuf	St-Gabriel	Rawdon	Lachute	Low	Nominingue	Laprairie	St. Hyacinthe	Sherbrooke	Total
1	2	3	4	5	6	7	8	9	10	11	12	13
Braconidae												
1- Agathis bicolor	8	6	1	4	1	1	1		8	2	35	67
2- " annulipes		1	1	1						2		5
3- " sp.				3		1					1	5
4- Apanteles sp.	34	65	8	14	5	10	3	2	9	5	31	186
5- " fumiferanae	1	2		3								6
6- " aristoteliae	3											3
7- Bracon gelechiae	11	5		3		1		1	1			22
8- " pygmoeus	1			1								2
9- " pini	1					1						2
10- " politiventris						9						9
11- Brachistes sp.		1		1								2
12- Chelonus sp.	10	14	7	4	2	2		1	1	3	9	53
13- Eubadizon sp.	1								1		1	3
14- Hormius sp.		4		1	2	1			1	1	4	14
15- Meteorus trachynotus						1			1			2
16- Meteorus sp.	1			1							1	3
17- Orgilus sp.	3		2	2	1					2	2	12
18- Phaedroctonus sp.	1											1
19- Spathius sp.				1								1
Ichneumonidae												
20- Campoplex validus	1										1	2
21- " temporalis					1							1
22- " sp.	2			1		1	1				1	6
23- " sp. (argyresthiae)											1	1
24- Cremastus sp.(Zaliptopygus)	1	20						1	2			24

Table 7 (Cont.) R. picealella - Number of Parasites Recovered in Different Regions

1	2	3	4	5	6	7	8	9	10	11	12	13
25- Epiurus sp.	1											1
26- Glypta sp.	1											1
27- Horogenes sp.	1											1
28- Lisinota sp. near pleuralis		1										1
29- Pimplopterus parvus	11	3	8	18	2	23	4	2	15	7	26	119
30- Scambus sp.		1										1
Chalcidae												
31- Amblymerus verditer	1	1		4	2	4		2	2	2	3	21
32- " sp.	3	2							1			6
33- Copidosoma nanellae	39	43	7	21	8	17	3	7	4	4	49	202
34- Dicladocerus sp.		1				1					4	6
35- Perilampus sp.		4		6	1				1	1	5	18
36- Sympiesis sp. (stigmaticus)	2										1	3
37- Torymus sp.	2			1		1	2			1	3	10
Diptera												
38- Actia interrupta		2		1		1				3	2	9
39- Leucopsis sp.												
40- Schizactia vitinervis	6			1				1		1	1	10
Sent for Identification												
41- P. 257										1		1
42- P. 261				1								1
43- P. 304A							1					1
44- P. 290				1								1

Table 8 (a)

R. picealella - Emergence of Apanteles sp.

Date	1947	1948	1949	1950
May 10			1	
13			1	
25			3	
26				
27				
28			1	
29			1	
30				
31				
June 1				
2				
3				
4				
5			1	
6				
7				
8				
9				
10				
11			1	
12			1	
13			2	1
14			1	
15			2	1
16			1	
17			3	1
18				3
19			2	1
20			2	5
21			1	
22				
23			2	5
24			2	1
25		1	5	3
26		2	5	
27		2	5	1
28		5	5	1
29		4	3	2
30		5	3	
July 1	2	1		1
2	1	1		
3	1	4	1	1
4	2	1		1
5	2	2		
6	12	1		1
7	2			1
8	4	1		
9	2			
10	9			
11	4	2		
12				
13	10			
14	3			
Total	54	32	55	30

Table 8 (b)

R. picealella - Emergence of Copidosoma nanellae

Date	1947		1949		1950		1951	
	No. adults	No. larvae attacked	No. adults	No. larvae attacked	No. adults	No. larvae attacked	No. adults	No. larvae attacked
June 1								
2								
3	9	2						
4			1	1				
5	7	1						
6	17	2						
7								
8	13	2						
9	18	2						
10	2	1						
11	3	1						
12								
13	10	1						
14								
15								
16			6	2				
17			64	10				
18	5	1						
19								
20					2	1	13	3
21			61	10	16	2		
22			61	12				
23			16	3			7	1
24			12	2			13	2
25							6	1
26			7	2				
27							5	1
28			4	1				
29					14	5		
30								
July 1								
2								
3					16	2		
4								
5							6	1
6					5	2		
Total -	84	13	232	43	53	12	50	9

Table 8 (c)

R. picealella - Emergence of Agathis bicolor

Date	1948	1949			1950		
		F.	M.	T.	F.	M.	T.
June 13							
14			1	1			
15			4	4			
16			1	1			
17		2	3	5			
18							
19		2	1	3			
20		1	2	3			
21			1	1			
22			1	1		1	1
23		2		2			
24		5	1	6		2	2
25		2		2		3	3
26		6	2	8	1		1
27		1	1	2		1	1
28	1	3		3	3		3
29	3		1	1		1	1
30	1	1		1			
July 1	3	1		1			
2	1	1		1			
3							
4							
5	1						
Total -	10	27	19	46	4	8	12

Table 8 (d)

R. picealella - Emergence of Chelonus sp.

Date	1947	1948	1949		
			F.	M.	T.
June 13				2	2
14				1	1
15					
16				1	1
17				2	2
18					
19			1	1	2
20					
21					
22					
23			1	1	2
24			1	1	2
25			1		1
26		1	1		1
27		1			
28		3			
29	1	2			
30		1			
July 1	1				
2					
3					
4					
5					
6	1				
7		1			
8	1				
9					
10	1				
11		1			
12					
13	1				
Total -	6	10	5	9	14

Table 8 (e)

R. picealella - Emergence of Pimplopterus parvus

Date	1948	1949			1950
		F.	M.	T.	
June 14		0	2	2	
15		0	1	1	
16		2	4	6	
17		1	5	6	1
18					2
19		1	4	5	5
20		0	1	1	4
21		1	2	3	6
22					2
23					4
24					0
25	4				2
26	2				1
27		0	1	1	2
28					0
29	1				1
30					
July 1					
2					1
Total -	7	5	20	25	31

Table 9

R. picealella - Emergence Periods of Parasites Recovered

Species	May		June			July	
	11-20	21-31	1-10	11-20	21-30	1-10	11-20
Braconidae							
1- Agathis bicolor				x	x	x	x
2- Agathis annulipes			x	x	x		
4- Apanteles sp.	x	x		x	x	x	x
5- " fumiferanae		x		x		x	
6- " aristoteliae		x	x	x		x	x
7- Bracon gelechiae		x	x	x			
8- " pygmoeus			x				
9- " pini			x				
12- Chelonus sp.	x	x		x	x	x	x
13- Eubadizon sp.			x	x			
14- Hormius sp.				x	x	x	
16- Meteorus sp.			x				
17- Orgilus sp.				x			
18- Phaedroctonus sp.					x	x	
Ichneumonidae							
20- Campoplex validus						x	
22- " sp.				x	x		
24- Cremastus sp. (Zaliptopygus)			x		x	x	x
26- Glypta sp.				x			
27- Horogenes sp.			x				
29- Pimplopterus parvus		x	x				
Chalcidae							
31- Amblymerus verditer		x		x	x		
32- " sp. I	x	x					
33- Copidosoma nanellae				x	x	x	x
34- Dicladocerus sp.			x				
35- Perilampus sp. (probably stygipus)				x	x		x
36- Sympiesis sp. near stigmaticus			x		x		
37- Torymus sp.				x	x		
Diptera							
39- Leucopsis sp.						x	
40- Schizactia vitinervis			x	x	x		

Table 10

R. picealella - Number of Parasites Recovered in Different Years - Berthierville

Species	1943	1944	1947	1948	1949	1950	1951	Total
Braconidae								
1- Agathis bicolor (Prov.)	1	1		2	2		2	8
4- Apanteles sp.			22	5	4	3		34
5- " fumiferanae						1		1
6- " aristoteliae		3						3
(Vier.)	5	4		1	1			11
7- Bracon gelechiae (Ashm.)				1				1
8- " pygmaeus (Prov.)						1		1
9- " pini (Mues.)	2	7			2	1		12
12- Chelonus sp.		1						1
13- Eubadizon sp.	1							1
16- Meteorus sp.				2	1			3
17- Orgilus sp.	1							1
18- Phaedroctonus sp.								
Ichneumonidae								
20- Campoplex validus (Cress.)						1		1
22- " sp.							2	2
24- Cremastus sp. (Zaliptopygus)	1							1
25- Epiurus sp.							1	1
26- Glypta sp.		1						1
27- Horogenes sp.				1				1
29- Pimplopterus parvus		1			5	2	3	11
Chalcidae								
31- Amblymerus verditer				1				1
32- " sp.		3						3
33- Copidosoma nanellae	1	16		8	10	2	3	40
36- Sympiesis sp. (near stigmaticus)		2						2
37- Torymus sp.					2			2
Diptera								
40- Schizactia vitinervis	5	1						6
Total -	17	40	22	21	27	11	11	149

Table 11

R. picealella - Percentage of Parasitism in Different Years - Berthierville

Number of Larvae and Pupae	1943	1944	1945	1946	1947	1948	1949	1950	1951
Reared	59	167	13	4	296	456	1380	1088	418
Dead	27	78	8	2	48	36	321	207	49
To adult stage	15	49	5	2	131	286	789	692	273
Parasitized	17	40	0	0	117	134	270	189	96
Percentage parasitism	28.8	23.9	-	-	39.5	29.4	19.6	17.4	23.0

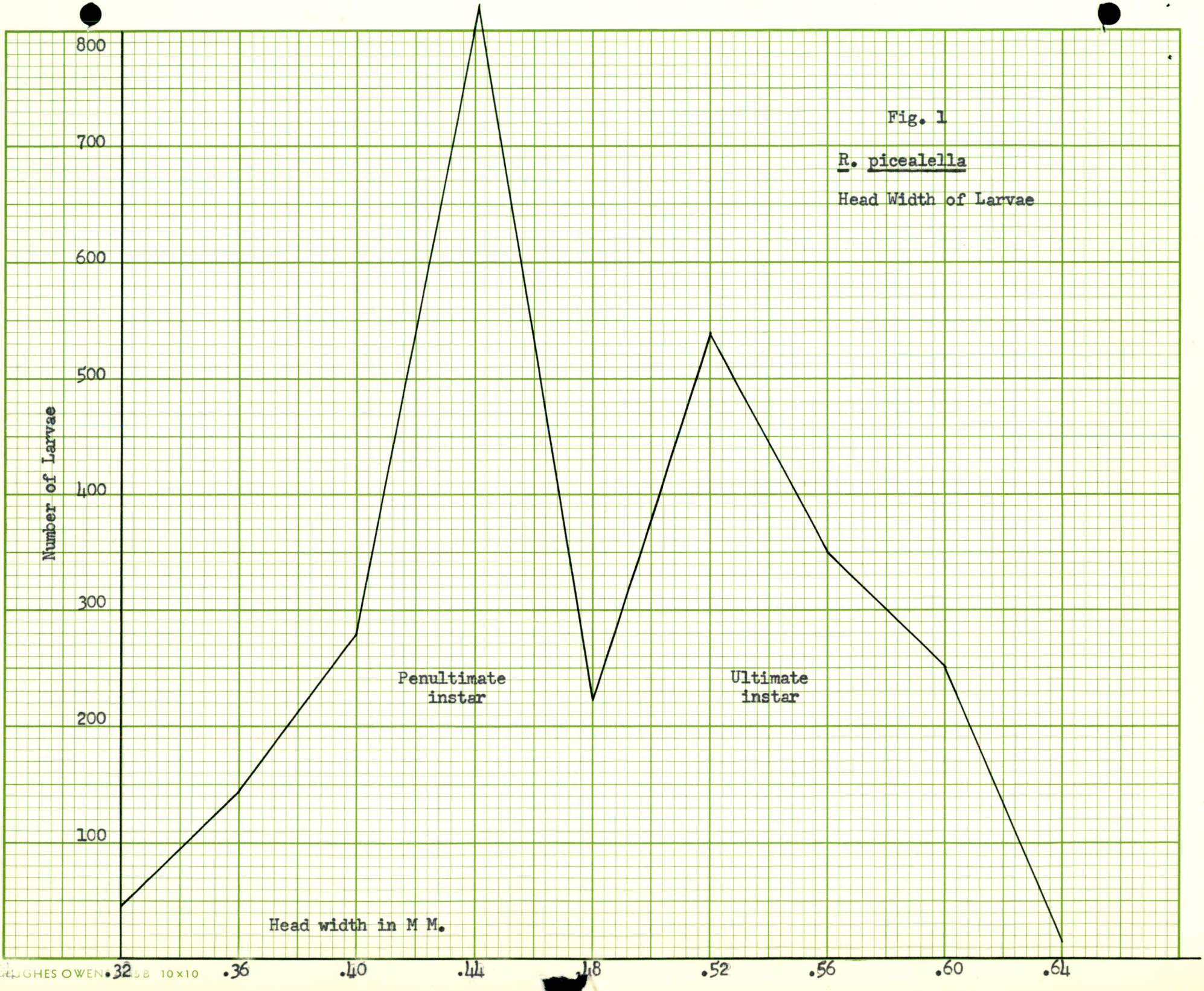


Fig. 1
R. picealella
Head Width of Larvae
Number of Larvae
800
700
600
500
400
300
200
100
Penultimate instar
Ultimate instar
Head width in M M.
.32
.36
.40
.44
.48
.52
.56
.60
.64

1949

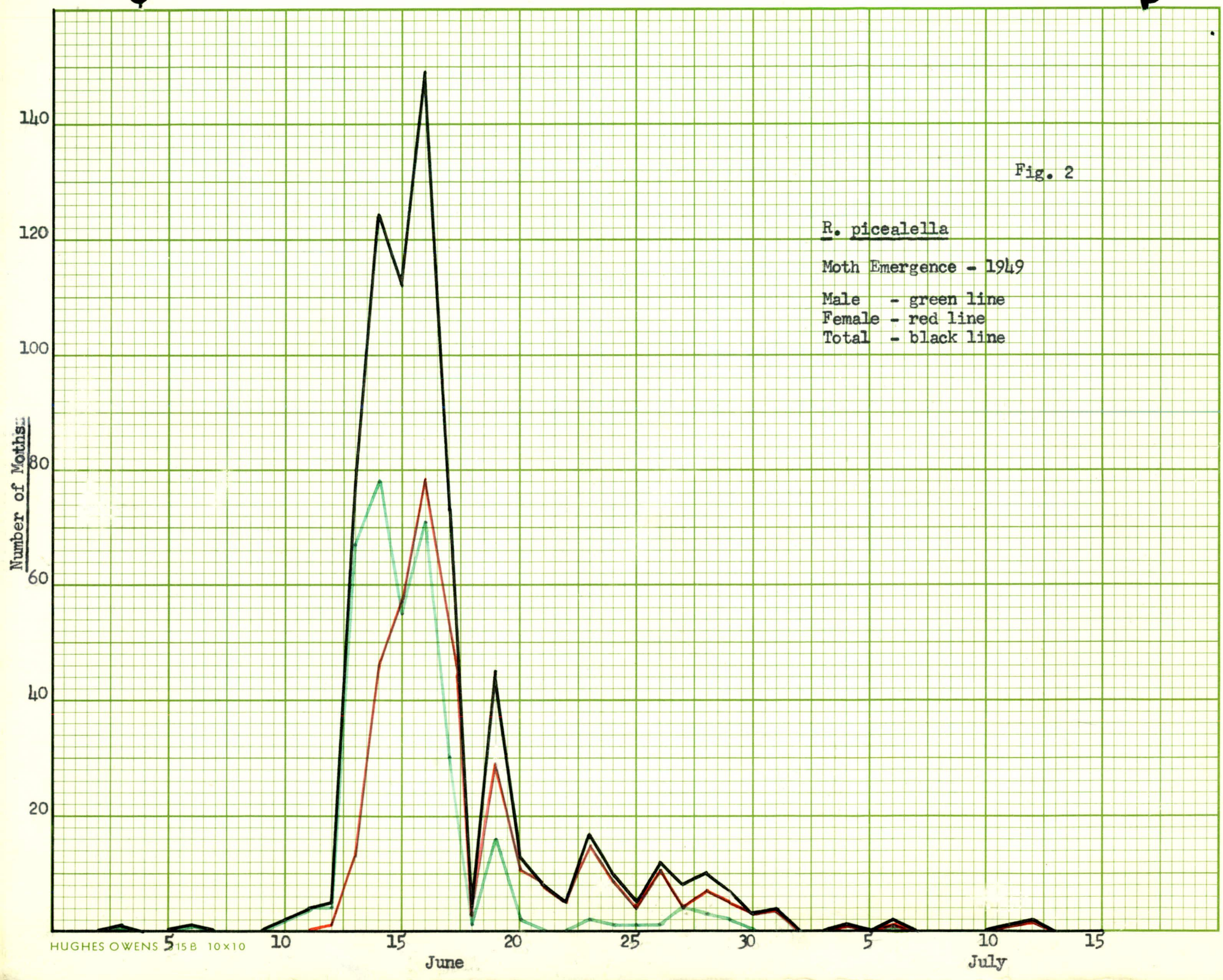


Fig. 2

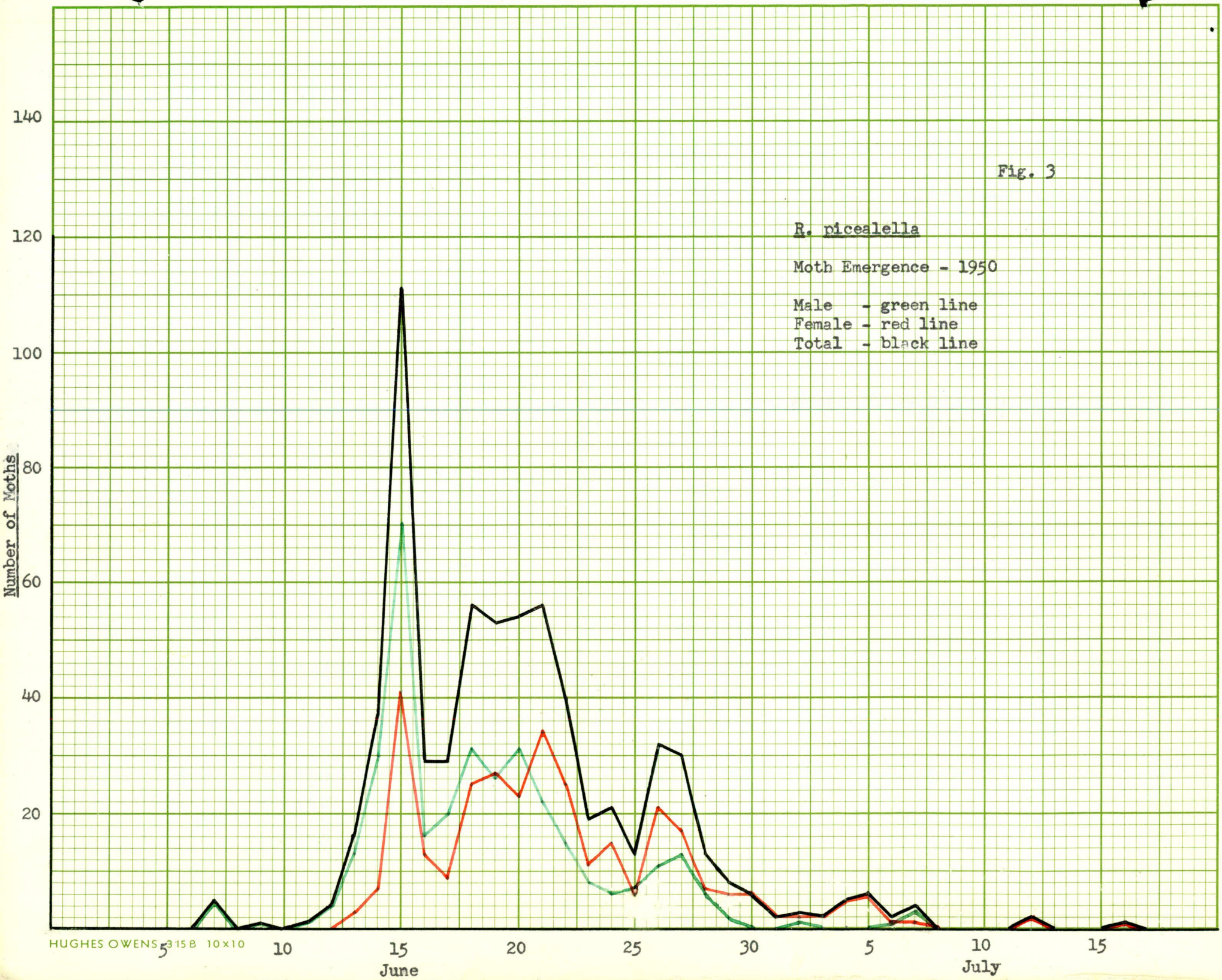
R. picealella

Moth Emergence - 1949

Male - green line
Female - red line
Total - black line

1950

Fig. 3


R. picealella
Moth Emergence - 1950
Male - green line
Female - red line
Total - black line
Number of Moths
140
120
100
80
60
40
20
5
10
15
20
25
30
5
10
15
June
July
HUGHES OWENS 315B 10x10

1951

Fig. 4

R. picealella

Moth Emergence - 1951

Male - green line
Female - red line
Total - black line