

# SOME ASPECTS OF THE DISTRIBUTION OF LARVAL PARASITES OF THE ORIENTAL FRUIT MOTH IN OHIO

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The Ohio Agricultural Experiment Station has carried on investigations with the oriental fruit moth, *Grapholitha molesta* (Busck), since 1925. During this time collections of fruit moth larvae have been made at frequent intervals each year to determine the extent of larval parasitism. The purpose of this paper is to present an interpretation of the data collected over the sixteen-year period from 1932 to 1947.

Neiswander (1936) last published a list of parasites reared from the larvae of the fruit moth in Ohio. The list below includes the 1936 list plus species collected since that time. Only hymenopterous species are included; some of these are possible secondary parasites.

<i>Apanteles aristoteliae</i> Vier.	<i>G. vulgaris</i> Cress. <sup>3</sup>
<i>A. clavatus</i> (Prov.)	<i>Goniozus columbianus</i> Ash.
<i>A. epiontiae</i> Vier.	<i>Hemiteles mellicornis</i> Ash.
<i>Ascogaster quadridentatus</i> Wesm.	<i>Horogenes molestae</i> (Uchida)
<i>Atrometus clavipes</i> (Davis)	<i>H. obliterated</i> (Cress.)
<i>Bassus cinctus</i> (Cress.)	<i>Itoplectis conquisitor</i> (Say)
<i>B. diversus</i> Mues.	<i>Macrocentrus ancylivorus</i> Rowh.
<i>Calliephialtes grapholithae</i> (Cress.)	<i>M. delicatus</i> Cress.
<i>Campoplex tortricidus</i> Cush.	<i>M. instabilis</i> Mues.
<i>C. validus</i> Cress.	<i>M. pallisteri</i> DeGant
<i>Coccygomimus aequalis</i> (Prov.)	<i>Mastrus pilifrons</i> (Prov.)
<i>Cremastus carpocapsae</i> Cush.	<i>Meterorus trachynotus</i> Vier.
<i>C. epagoges</i> Cush.	<i>Microbracon politiventris</i> (Cush.)
<i>C. forbesi</i> Weed	<i>Microgaster ecdytolophae</i> Mues.
<i>C. minor</i> Cush.	<i>Perilampus fulvicornis</i> Ash.
<i>C. tortricidis</i> Cush.	<i>Phaeogenes walshiae walshiae</i> Ash.
<i>Dibrachys boucheanus</i> (Ratz)	<i>Pristomerus ocellatus</i> Cush.
<i>D. cavus</i> (Walk.)	<i>Psychophagus omnivorus</i> (Walk.)
<i>Eubadizon pleuralis</i> Cress.	<i>Scambus hispae</i> (Harris)
<i>Euderus subopaca</i> (Gahan)	<i>S. pterophori</i> (Ash.) <sup>3</sup>
<i>Eupelmus amicus</i> Gir.	<i>Spilochalcis torvina</i> (Cress.)
<i>Gambrus ultimus</i> (Cress.)	<i>Trichomma reticulatum</i> Davis
<i>Gelis tenellus</i> (Say)	<i>Trichogramma minuta</i> Riley
<i>Glypta rufiscutellaris</i> Cress.	

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<sup>3</sup>*Glypta vulgaris* (Townes 1944) and *Scambus pterophori* (Balduf 1929) have not been reared from oriental fruit moth larvae in Ohio but do occur in Ohio and are parasites of the pest elsewhere.

Of this list, seven are of major importance. Their percentage occurrence is listed below.

<i>Macrocentrus ancyliivorus</i> .....	60.0%	of parasites
<i>M. delicatus</i> .....	19.3%	" "
<i>Glypta rufiscutellaris</i> .....	7.5%	" "
<i>Cremastus minor</i> .....	5.8%	" "
<i>Pristomerus ocellatus</i> .....	2.1%	" "
<i>Horogenes obliteratus</i> .....	1.4%	" "
<i>Ascogaster quadridentatus</i> .....	0.3%	" "
Others.....	3.6%	" "

These figures are computed from totals of 81,573 insects reared from collections made in 17 counties and 154 orchards; 39,331 of these insects (48.2%) were parasites.

The percent of parasitism through the entire state is of interest; however, the sampling did not take place in such a way that equal numbers were collected from each portion of the state. It will be noted that parasites occurred in different

TABLE I  
PERCENT PARASITIZATION OF ORIENTAL FRUIT MOTH LARVAE BY ALL  
PARASITES BY SECTIONS—1932-1947

YEAR	NORTH	CENTRAL	SOUTH	AVERAGE
1932	47.3	27.6	20.6	31.8
1933	44.8	37.4	67.6	49.9
1934	46.0	43.6	22.9	37.5
1935	80.2	46.7	47.4	58.1
1936	66.3	37.0	30.5	44.6
1937	48.1	44.4	20.7	37.9
1938	73.1	55.4	46.8	58.4
1939	62.6	38.7	42.7	48.0
1940	50.4	42.9	18.3	37.2
1941	52.2	31.3	35.3	39.6
1942	40.4	67.5	32.3	46.7
1943	38.7	54.3	29.7*	40.9*
1944	47.3	44.8	27.0*	39.7*
1945	47.4	31.1	24.4*	34.3*
1946	58.9	37.7	21.7*	39.4*
1947	44.8	37.2	19.1	33.9
Mean.....	53.0	42.4	31.7	42.4

\*These are estimates since no data are available from southern orchards during these years. To obtain these estimated values a straight line has been drawn between the 1942 and 1947 percents of parasitization and indicated values on that line used.

ratios in different sections. For these reasons the calculation of percentages of parasitization from the total number of insects collected does not reveal the true picture. Accordingly, for these investigations, the state has been divided into three portions and the average percent of parasitization of these three sections has been computed for each year. The results are shown in Table 1.

On a state wide basis commercial control of the oriental fruit moth by means of parasites has not been achieved. In isolated areas and on occasional years, control has been satisfactory but the parasite population over the state as a whole remained too low to give good results in spite of large releases of adult parasites.

No trends in percent of parasitization can be noted. Total parasitization has not increased but has remained at a fairly constant level. It will be shown that *M. ancyliivorus* has increased in numbers and therefore has done so at the expense

of other parasites instead of contributing to higher levels of parasitization of the host pest.

Since the two species of *Macrocentrus* are the most important parasites in the state and account for the majority of the parasitized fruit moth larvae, their relative proportions have been computed. Counties in which the ratio of *M. ancylivorus* to *M. delicatus* was high include Sandusky, Summit, Lorain, Ottawa, and Cuyahoga; these are in the northern portion of the state. In the central region a medium ratio was found; counties studied in this region were Knox,

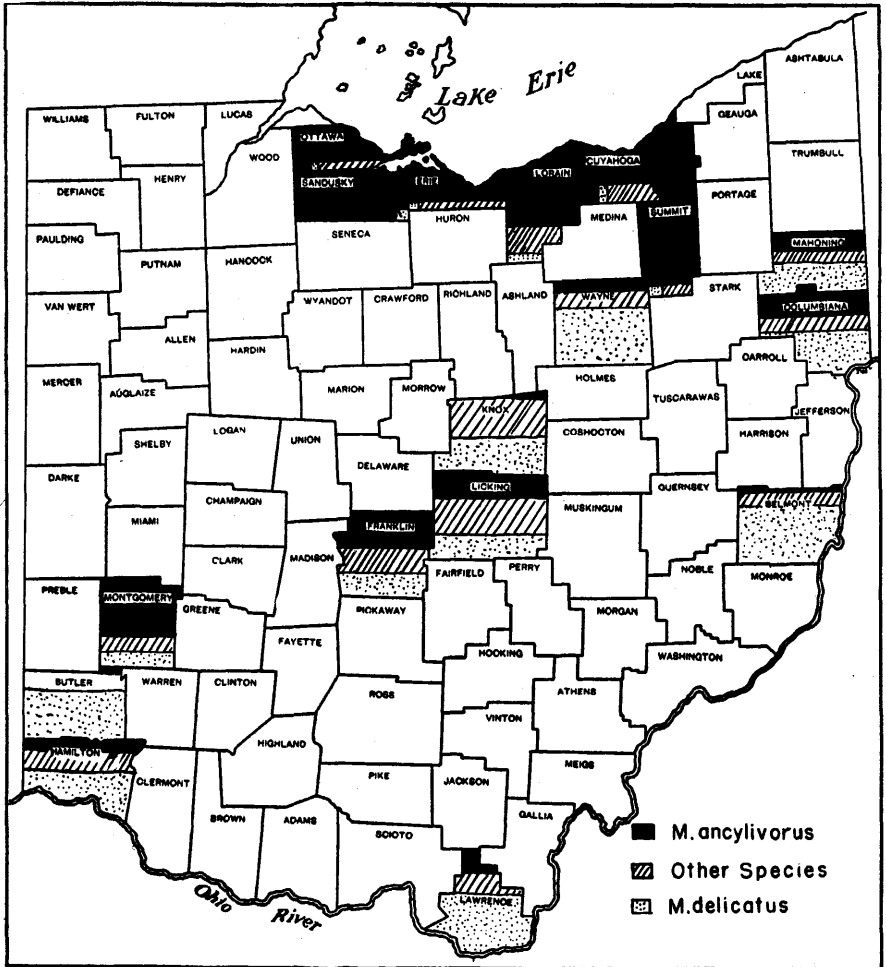


FIG. 1. Relative occurrence of *Macrocentrus* spp. and other parasites of the oriental fruit moth in Ohio. (Percents of county area in black, stippled, and cross-barred, represent the percents of the respective species collected from that county.)

Mahoning, Columbiana, Franklin, Wayne, and Licking. Belmont, Hamilton, Butler, and Lawrence comprise the southern counties in which a low ratio was found. That is, the ratio between the two species was high in the north and decreased to the south. Total parasitization of oriental fruit moth larvae showed the same type distribution.

Of the counties studied one important exception is made. Montgomery County which is geographically located in the southern section is omitted. Here

the occurrence of *M. ancyliivorus* has been predominant, probably because of the presence of extensive plantings of strawberries that supported a large strawberry leaf-roller (*Ancyliis comptana fragariae* (W. & R.)) population and consequently a high *M. ancyliivorus* population.

The nature of the distribution of these two species in the state is shown on the map in Figure 1. Solid black portions show the percent of *M. ancyliivorus*; stippled areas represent the percent of *M. delicatus*; cross-barred areas show the percent of other parasites. Counties without markings are not represented in this report. Inspection of the map will show that in counties in the southern section the predominant species was *M. delicatus*, while in northern counties it was *M. ancyliivorus*. In the central section counties the parasitism was more or less evenly divided between the two species.

TABLE II  
PROPORTIONS OF *M. ancyliivorus* TO *M. delicatus* BY GEOGRAPHICAL  
SECTIONS FOR THE YEARS 1932-1947

	NORTH		CENTRAL		SOUTH	
	M. anc.	M. del.	M. anc.	M. del.	M. anc.	M. del.
1932	96	4	31	69	1	99
1933	82	18	4	96	1	99
1934	89*	11	16	84	1	99
1935	99	1	37	63	1	99
1936	99	1	3	97	8	92
1937	99	1	9	91	0	100
1938	99*	1	22*	78	1	99
1939	96*	4	10*	90	1*	99
1940	97*	3	35*	65	33*	67
1941	99*	1	55*	45	43*	57
1942	95*	5	27*	73	64*	36
1943	94*	6	32*	68		
1944	94*	6	57*	43		
1945	96*	4	67*	33		
1946	99*	1	92*	8		
1947	93*	7	66*	44		
					no record	
					56	44

\*Indicates that releases of more than 400 adult *M. ancyliivorus* were made in the area for the year.

The author attempted several correlations of the relative abundance of the two *Macrocentrus* species with various climatic phenomena. None of the factors investigated presented a pattern that would account for the distribution of the species. Inadequacy of weather data in studies of this type makes any conclusions impossible.

The relative proportion of *M. ancyliivorus* to *M. delicatus* is shown in Table II.

The conclusions from the table are obvious. In the northern section, *M. ancyliivorus* clearly predominated. In the central section, *M. delicatus* predominated for the first nine years and *M. ancyliivorus* has shown the lead in five of the past seven and four of the last four years. Prior to 1942 *M. delicatus* was dominant in the southern regions but *M. ancyliivorus* has shown an increase since 1940 and in the last two years of record (1942 and 1947) has made up more than fifty percent of the total of the two species. It is well known that in cases of multiple parasitism *M. delicatus* usually suffers in competition with *M. ancyliivorus*.

In northern Ohio, Neiswander (1936) has shown that releases of adult *M. ancyliivorus* in Ottawa County established the species and contributed to a high

parasitization of fruit moth populations. The significance of the increase of *M. ancyliivorus* in southern Ohio in the year 1940 has not been determined. It appears, however, that parasite liberations were a contributing factor in the accumulation and perpetuation of the species in the south although there is no statistical correlation between the numbers of *M. ancyliivorus* released and the numbers of this parasite recovered.

It is probable that *M. ancyliivorus* was not indigenous to Ohio. If not, there is the possibility that after 15 years of the presence of the oriental fruit moth the species was yet in the process of becoming established and the release of adults was necessary to achieve success. After establishment it could build up its numbers without additional assistance. The fact that from 1942 to 1947 in the southern section there were no releases, yet the species continued at a high level, lends weight to this argument.

The conclusion that *M. ancyliivorus* is increasing in relation to *M. delicatus* may be made from the above data. It now becomes desirable to investigate the relation of *M. ancyliivorus* to the oriental fruit moth population. Table 3 shows this relationship.

TABLE III  
PERCENT OF FRUIT MOTH LARVAE PARASITIZED BY *Macrocentrus ancyliivorus*

	NORTH	CENTRAL	SOUTH
1932.....	18.0	1.6	1.0
1933.....	17.4	1.3	0.0
1934.....	26.3	6.7	1.0
1935.....	73.9	13.3	0.0
1936.....	58.7	1.0	2.2
1937.....	44.1	3.0	0.0
1938.....	53.4	8.4	1.0
1939.....	46.9	3.3	1.0
1940.....	39.0	14.9	5.7
1941.....	33.0	15.9	14.0
1942.....	24.7	15.7	14.4
1943.....	30.1	16.1	
1944.....	34.8	24.8	no record
1945.....	41.3	16.7	
1946.....	50.5	30.4	
1947.....	40.4	23.6	10.3
Average.....	39.5	12.3	4.2
Slope*.....	+ .32	+ 1.66	+ 1.58

\*Indicates the slope of a straight line fitted through the points and indicates the rise in percent per year.

The slopes of the three lines cannot be demonstrated to be statistically significant for the entire group of years. In the south and central sections, however, since 1940 the rise has been sharp, indicating that *M. ancyliivorus* is parasitizing a larger percentage of larvae than in the past.

Since *M. ancyliivorus* is parasitizing a larger number of larvae it might be concluded that it is bringing about better control of the oriental fruit moth. However, in view of the fact that the percent of parasitism is not increasing in any section of the state and *M. ancyliivorus* is competing with *M. delicatus*, it must be maintained that *M. ancyliivorus* is increasing at the expense of other parasites and not at the expense of the fruit moth. The desirability of this condition is open to question.

## SUMMARY

*Macrocentrus ancyliivorus*, *M. delicatus*, *Glypta rufiscutellaris*, and *Cremastus minor* are the most important parasites of the oriental fruit moth in Ohio. The first two species accounted for 60.0 and 19.3 percent, respectively, of the larval parasitization of the fruit moth over a 16 year period. (1932-1947). The average percent of fruit moth larvae parasitized by all parasites during this period was 42.4%. Percent of parasitization showed no upward trend over the period.

The state is divided roughly into three geographical sections on the basis of relative occurrence of *M. ancyliivorus* and *M. delicatus*. The former is high in the northern section with the proportion decreasing from the north to the south. The percent of total parasitism exhibits the same relationship; high parasitization occurs in the north and decreases from north to south. The proportion of *M. ancyliivorus* to other parasites is very high in the northern section and has been on the increase in the central and southern sections since 1940. Releases of adult *M. ancyliivorus* are probably partially responsible for this increase. The percent of larvae parasitized by *M. ancyliivorus* is also increasing slowly in the northern area; more rapidly in the central and southern sections. *M. ancyliivorus* is achieving its increase at the expense of other parasites rather than contributing to the increased destruction of the host insect.

## LITERATURE CITED

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## WILDLIFE FACTS

The National Wildlife Federation estimates that the yield of commercial fish can be increased by over forty per cent in a few years through the use of conservation practices.

Approximately one hundred and thirty different species of fish are captured commercially in waters adjacent to the United States and Alaska, reports the National Wildlife Federation.

Gigantic lizards, says the National Wildlife Federation, were the motives for many of the legends of winged dragons and griffins; consequently, their modern descendants are the subject of superstition and fear.

The heaviest flying bird in America, says the National Wildlife Federation, is the trumpeter swan with a maximum weight of forty pounds.

Sixty-six species of birds are enemies of the cotton boll weevil, reports the National Wildlife Federation. Among these are the Bobwhite Quail, Red-headed Woodpecker, Bluejay, and the Oriole.

Twenty-four birds help control the chinch bug, reports the National Wildlife Federation, an insect pest that does great damage to wheat. Among these birds are the Meadowlark, the Flicker, and the House Wren.

The National Wildlife Federation requests you not to pick or dig wild flowers unless they are abundant.

To birds must go the credit for being a vital factor in checking the hoards of injurious insects, weed seeds, and small rodents, reports the National Wildlife Federation. Without birds, agriculture would be next to impossible.