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PARASITES *OF THE* EUROPEAN CORN BORER *IN* OHIO

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A project of the magnitude of the European corn borer parasite program, and covering a period of three decades, is the work of many individuals. A number of federal entomologists have contributed in various ways to the work in Ohio, including W. A. Baker, E. W. Beck, W. G. Bradley, S. W. Carter, C. A. Clark and D. W. Jones. W. D. Guthrie made collections for parasite records in Erie and Lucas Counties for several years. Personnel from the Ohio Agricultural Experiment Station who have made contributions to the project include L. L. Huber, E. T. Hibbs and a number of other employees of the institution.

PARASITES OF THE EUROPEAN CORN BORER IN OHIO

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The European corn borer, *Pyrausta nubilalis* (Hbn.), was first discovered in Ohio, in 1921, on Middle Bass Island and along the southern shore of Lake Erie (19). Three years later the first exotic parasites of the borer were released in the state. Additional releases were made annually through 1938 and sporadically from 1940 through 1949. Many of the later releases were for the purpose of disseminating species already established.

The data on colonization through 1940 have been compiled by Baker *et al.*, together with much of the information on parasite recoveries (9). Subsequent releases in Ohio and other states have been reported (10, 11, 13, 15, 4, 7, 6), the recoveries for part of this period summarized (12, 14, 16, 17, 5), and the status of parasites reviewed from time to time (8, 2, 3).

Three species of exotic parasites of the European corn borer, *Lydella grisescens* R.-D., *Horogenes punctorius* (Roman), and *Sympiesis viridula* (Thoms.), are known to be established in Ohio. The history of these species in the state is treated in some detail in this paper. The colonization and recovery of those species introduced without success are summarized briefly, and recoveries of native parasites are reported.

COLLECTIONS FOR DETERMINING THE STATUS OF PARASITES

The status of parasites was determined from collections of overwintering corn borer larvae. Most of the larvae were collected in the fall, but a few collections were made in early spring. Two types of surveys were made depending upon the information desired. Collections

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were made at release sites to detect initial establishment and over extensive areas to ascertain the range of the parasite and the amount of parasitization. The larvae thus collected were held for parasite emergence the following spring.

Lydella grisescens R.–D.

Releases

During the period 1927-35, stock of this larvaevorid from Europe and the Orient was released in 43 Ohio counties, and four counties were colonized with New England stock from 1943 through 1947 (Table 1). Clark and Van Wert Counties were colonized during both the early and recent series of releases. A total of 220,796 individuals have been released in 45 counties (Figure 1).

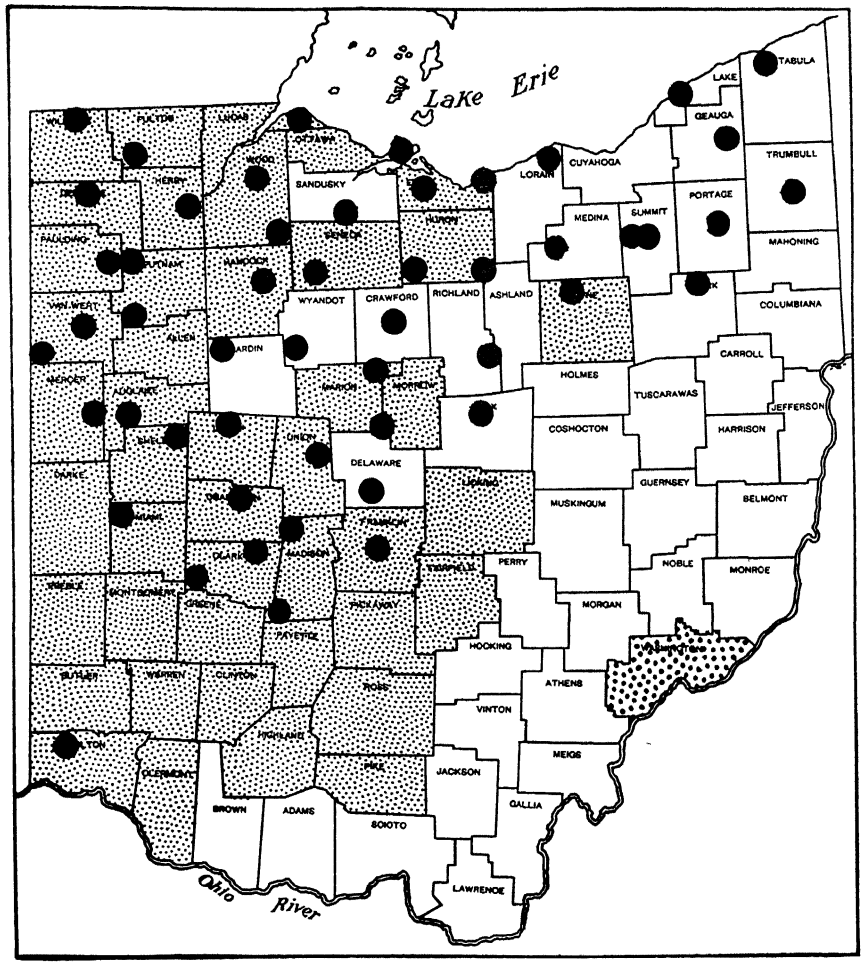
TABLE 1.—Releases of **Lydella grisescens** in Ohio after 1940.

County	Township	Year	Number
Hamilton	Colerain	1943	488
Hamilton	Colerain	1944	493
Hamilton	Colerain	1946	497
Van Wert	Ridge	1945	479
Van Wert	Ridge	1946	497
Clark	Bethel	1947	500
Franklin	Clinton	1947	494
		Total	3,448

Initial Establishment and Maintenance

Sixteen of the counties colonized from 1927 through 1935 were surveyed at least once during, or the year following, colonization. Initial establishment was attained in 11 counties: Erie, Hancock, Hardin, Henry, Huron, Lake, Lucas, Marion, Putnam, Summit and Wood. However, in subsequent surveys of these counties through 1950, the parasite was recovered only in Erie, Lake and Lucas Counties, which border Lake Erie (Table 2). Six additional counties, colonized in 1930, Ashland, Ashtabula, Geauga, Medina, Portage and Trumbull, were surveyed in 1936 without recovery of the parasite. Logan County, colonized in 1934, was surveyed in 1938 and 1939, but no recovery was made here until 1951. Of the remaining 20 counties colonized during 1927-35, five have not been surveyed, two were recolonized, and the remainder surveyed 14 to 20 years after colonization.

Initial establishment and maintenance was apparently attained in at least three of the four counties colonized from 1943 through 1947. The Hamilton County colony is particularly interesting because of the high percentage of parasitization and apparently rapid dissemination



Parasite Recovered

Surveyed After 1947, No Recovery

Colonization Site

Fig. 1.—Colony sites of **L. grisescens,** counties surveyed, and counties in which parasite has been recovered.

from the release site. Releases were from here in 1943, 1944 and 1946 and collections taken from 1944 through 1950. The percent of parasitization in Hamilton County for these seven years was 13.8, 20.2, 61.3, 30.4, 20.7, 11.7 and 38.5, respectively. In Butler County, adjoining the release site on the north, the percent of parasitization from 1948 through 1950 was 21.1, 16.0 and 47.1 (Figures 2, 3, 4). Collections taken in Clermont and Warren Counties, to the east and northeast of the release site, were 2.1 and 9.1 percent parasitized, respectively, in 1949.

Van Wert County was first colonized in 1930-1, but no recovery was made from collections taken in 1931 and 1936. Additional parasites

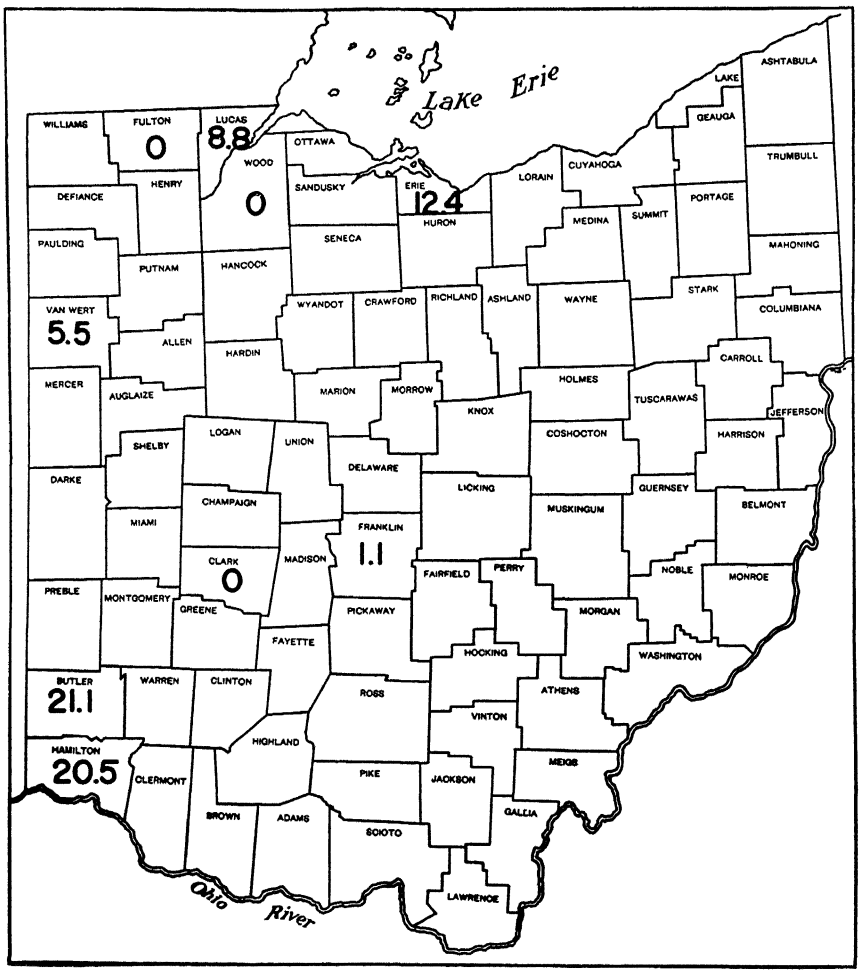


Fig. 2.—Percent of borers parasitized by **L. grisescens** in 1948.

were released in 1945-6. Following these releases, collections were taken from 1945 through 1950 and the parasite recovered each year. The percent of parasitization for these years were 0.5, 2.6, 9.6, 5.5, 18.8 and 25.3.

Clark County was also colonized during the early series of releases, specifically in 1935, but no collections were made to determine whether or not the parasite became established. Another release was made in 1947 and collections were taken from 1947 through 1951. No recovery was made in 1947 or 1948, but from 1949 through 1951 the collections

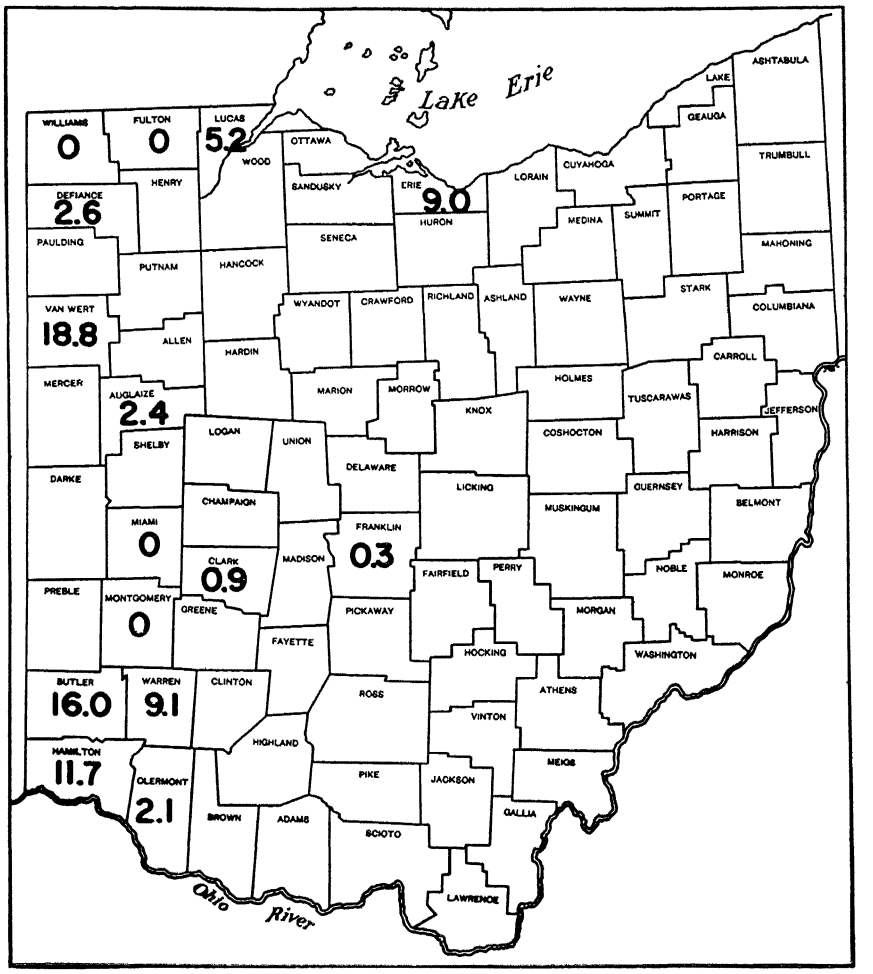


Fig. 3.—Percent of borers parasitized by **L. grisescens** in 1949.

were 0.9, 18.0 and 16.5 percent parasitized. These recoveries may indicate undetected establishment and maintenance, although dissemination from other release sites could also be an explanation.

Franklin County was colonized in 1947 and surveyed from 1947 through 1950. While the parasite did not appear in the 1947 collection, 1.1, 0.3 and 25.7 percent of the subsequent collections were parasitized. The very low amount of parasitization in 1949 and the relatively high amount in 1950 may be a reflection of the borer abundance in the 1949 outbreak and the sharp reduction in the borer population the following year.

Range and Distribution

L. grisescens has been recovered in every county surveyed except Washington, although it has been absent from some collections. It has been recovered in 15 counties where releases were never made and quite probably is present over a more extensive area than here indicated (Figure 1).

While this parasite became initially established at many of the release sites following the 1927-35 colonizations, it appeared to persist only along the area bordering Lake Erie. It was the opinion of many of those associated with the work that this parasite was confined to areas about fresh water marshes (8, 9). In retrospect, it now seems that either this opinion was erroneous, or the parasites released in 1943-7 differed from their predecessors in their ecological requirements, or the borers available for attack in the field were more suitable hosts than those present earlier. The appearance of a second generation of borers in Ohio, Michigan, and Indiana about 1937 (20) was followed by a corresponding change in seasonal history (18), and Arbuthnot presented evidence that the multivoltine borers were a genetically different strain (1). This leads to speculation that any of these conditions may have enabled the parasite to extend its range.

Dispersion

Failure to collect *L. grisescens* following initial establishment in much of the area originally colonized may indicate inadequate sampling rather than the complete absence of the parasite. It is possible, therefore, that the present population of this parasite may have derived primarily from a small, undetected population present for many years following early releases. However, the high amount of parasitization and apparently rapid dissemination immediately following the 1943-7 releases discredit this contention. It seems probable that the present range of this parasite, excepting the Lake Erie area, is the result of dispersion from the 1943-7 colonies.

TABLE 2.—Number of **Lydella grisescens** released by county and year. Years counties surveyed and years parasite recovered.

County	Years Released	Number Released	Years Surveyed	Years Recovered
Ashland	1930	2,089	1936	Not recovered
Ashtabula	1930	2,053	1936	Not recovered
Auglaize	1934	2,097	1949, 1951, 1955	1949, 1951, 1955
Champaign	1934	2,062	1951, 1955	1951, 1955
Clark	1935, 1947	2,491	1947-51, 1955	1949-51, 1955
Crawford	1934	1,489	Not surveyed	----------
Defiance	1934	1,791	1949	1949
Delaware	1935	1,996	Not surveyed	----------
Erie	1927-8, 1930	5,423	1928 55	1928-55
Franklin	1947	494	1947-50, 1952	1948-50, 1952
Fulton	1934	1,795	1948-9, 1955	1955
Geauga	1930	2,047	1936	Not recovered
Hamilton	1943-4, 1946	1,478	1944-50	1944-50
Hancock	1930-2	5,078	1930 4, 1937, 1939, 1955	1932-4, 1955
Hardin	1930	2,056	1931, 1936	1931
Henry	1930-2	19,155	1930-3, 1936, 1939, 1955	1932, 1955
Huron	1930-2	9,271	1930-1, 1936, 1954	1931, 1954
Knox	1935	1,995	Not surveyed	----------
Lake	1928, 1931	7,599	1928-31, 1936	1928-9, 1931
Logan	1934	1,798	1938-9, 1951	1951
Lorain	1935	1,996	Not surveyed	----------
Lucas	1927-9	5,659	1928-53, 1955	1928-51, 1953, 1955
Madison	1935	5,989	1955	1955
Marion	1930	2,048	1931, 1936, 1952	1931, 1952
Medina	1930	2,382	1936	Not recovered
Mercer	1935	1,983	1951, 1955	1951, 1955
Miami	1935	1,992	1949, 1951, 1954-5	1951, 1954-5
Morrow	1935	1,997	1952	1952
Ottawa	1930-1	6,815	1931, 1936, 1955	1955
Paulding	1934	2,389	1950, 1955	1950, 1955
Portage	1930	2,073	1936	Not recovered
Putnam	1930-2	6,435	1931-2, 1934, 1950, 1955	1931-2, 1955
Richland	1930	1,776	1931, 1936	Not recovered
Sandusky	1934	2,795	Not surveyed	----------
Seneca	1930	2,347	1931, 1936, 1955	1955
Shelby	1935	1,992	1950, 1955	1950, 1955
Stark	1935	1,976	Not surveyed	----------
Summit	1930-1	14,414	1930-1, 1936	1930
Trumbull	1930	2,089	1936	Not recovered
Union	1934	2,380	1951	1951
Van Wert	1930-1, 1945-6	5,791	1931, 1936, 1945-50, 1955	1945-50, 1955
Wayne	1935	1,991	1955	1955
Williams	1934	2,196	1949, 1955	1955
Wood	1932-3	62,946	1932-5, 1939, 1948	1932-3
Wyandot	1930	2,088	1930, 1936	Not recovered
Total		220,796		

Following the colonization of *L. grisescens* in Van Wert County in 1945 and 1946, collections were taken on a polar-coordinate scheme from 1947 through 1949 and in alternate townships in 1950. Although the parasite was recovered in some of the peripheral sectors of the polar-coordinate in 1947, the highest amount of parasitization was in the sector where releases were made and in an adjoining sector. The 1948 and 1949 collections indicated a fairly general distribution of the parasite within the sampling area, which was about 14 miles in diameter (Figure 9). The collections taken in alternate townships in Van Wert County,

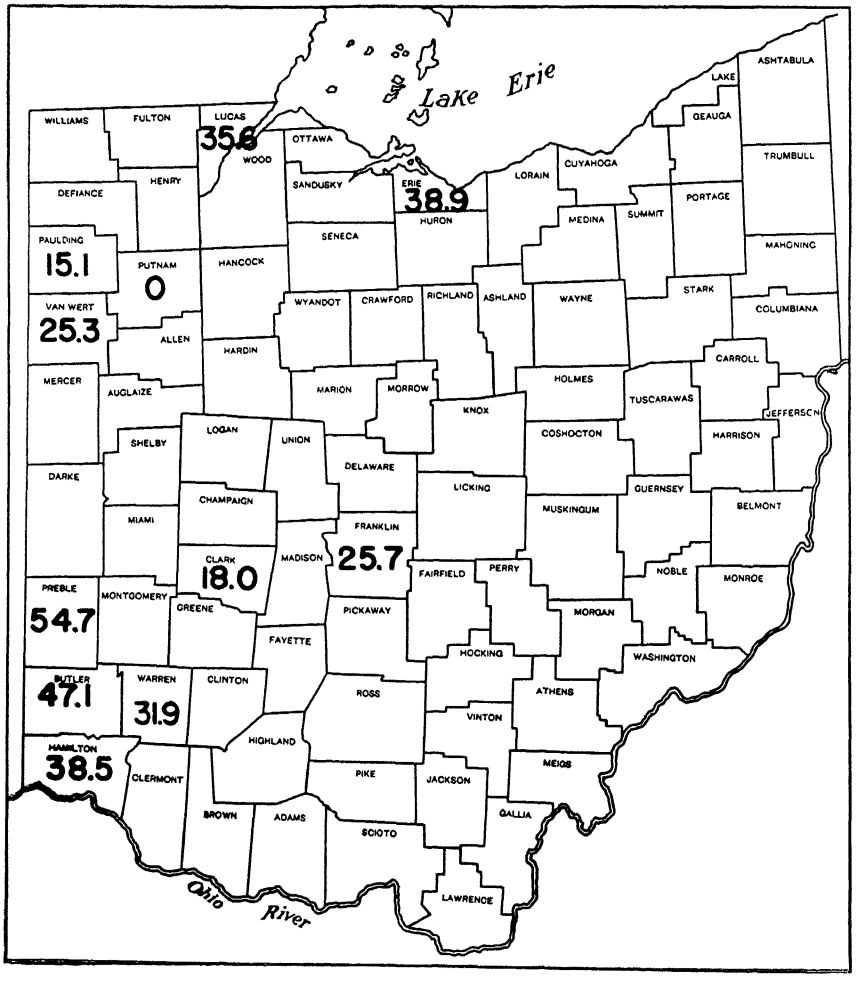


Fig. 4.—Percent of borers parasitized by **L. grisescens** in 1950.

in 1950, were rather uniformly parasitized. There was less parasitization in collections from two townships in Paulding County to the north, and the parasite was not recovered in the single township sampled in Putnam County to the east (Figure 10).

It seems likely that the *L. grisescens* appearing in the collections from Butler, Clermont and Warren Counties, in 1949, were the result of dispersion from the Hamilton County releases of 1943, 1944 and 1946 (Figure 3). This hypothesis is strengthened by the absence of the para-

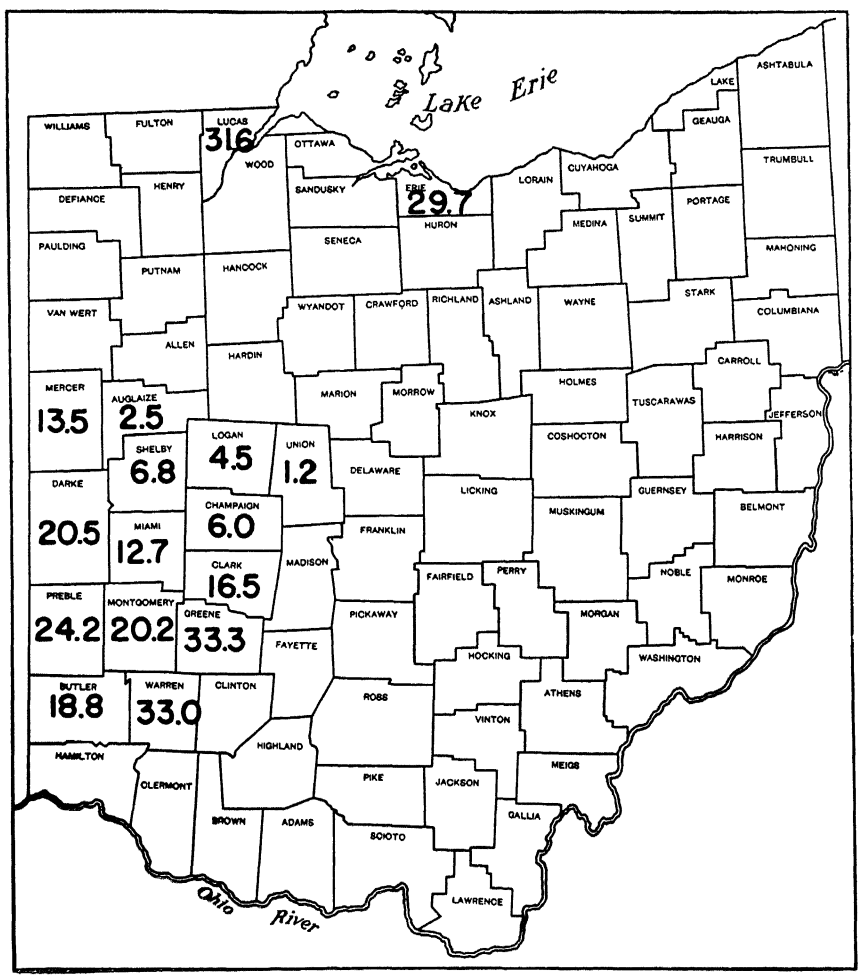


Fig. 5.—Percent of borers parasitized by **L. grisescens** in 1951.

site in Montgomery and Miami Counties and the low amount of parasitization in Greene County that year. The high percentage of parasitization in Preble County the following year is also suggestive of rapid dispersion from the Hamilton County colony (Figure 4), for the closest release site was in Miami County, in 1935, and no recovery was made here in 1949. By 1951 the parasite was so generally distributed in the southwestern counties that any pattern of dispersal was obliterated (Figure 5).

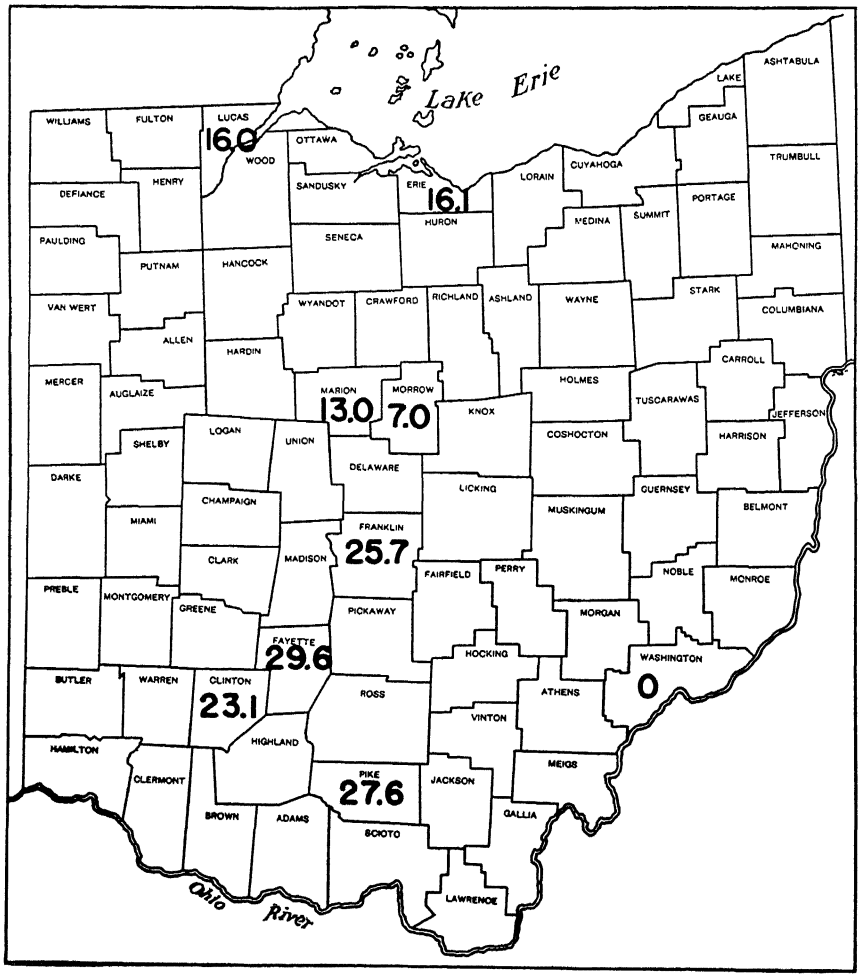


Fig. 6.—Percent of borers parasitized by **L. grisescens** in 1952.

Abundance

L. grisescens is the most important corn borer parasite in Ohio at the present time. In 11 western counties surveyed in 1951 and again in 1955, parasitization averaged 15.9 and 12.7 percent, respectively, in the two years. Parasitization in the Jerusalem Township (Lucas County) study area from 1942 through 1953 averaged 22.3 percent; and in the Perkins Township (Erie County) study area parasitization from 1942 through 1955 averaged 25.0 percent. The fluctuation in parasitization from year to year has been very similar in the two study areas and does not appear to be closely correlated with fall borer populations (Table 3). However, the effect of the 1949 borer outbreak is evident in the low parasitization in 1949 and increased parasitization in 1950. There has not been a marked trend toward increased parasitization over this period, suggesting that the parasite and its host have been in equilibrium in these areas for several years.

TABLE 3.—Parasitization by **L. grisescens** in two study areas.

Year	Percent Parasitization		Fall Borer Population (Borers per 100 Stalks)	
	Jerusalem Twp. Lucas County	Perkins Twp. Erie County	Lucas County	State
1942	24.6	29.5	98	57
1943	32.0	11.7	86	120
1944	23.9	12.5	30	56
1945	8.9	19.4	105	80
1946	11.6	14.7	28	21
1947	33.8	20.4	115	43
1948	10.4	12.4	217	89
1949	6.2	9.0	342	309
1950	35.6	38.9	90	163
1951	31.6	29.7	46	90
1952	16.0	16.1	22	55
1953	33.5	51.5	41	62
1954	----	38.4	107	152
1955	----	46.4	48	124

Horogenes punctorius (Roman)

Releases

Stock from European, Oriental or domestic sources was released yearly from 1927 through 1933 and from 1935 through 1937. Four releases of New England stock have been made since 1940 (Table 4). Altogether, 45,987 individuals have been released in 27 counties (Figure 11).

Fig. 7.—Percent of borers parasitized by **L. grisescens** in 1954.

Initial Establishment and Maintenance

Surveys were taken in 13 counties the year of colonization, or the year a series of colonizations terminated, and at least during one of the following two years. An exception is Marion County, which was surveyed the year of colonization (1936) but not again until 1952. Of the 27 counties colonized, four have not been surveyed for the presence of this parasite, and 10 were only recently surveyed, 13 to 20 years after colonization (Table 5).

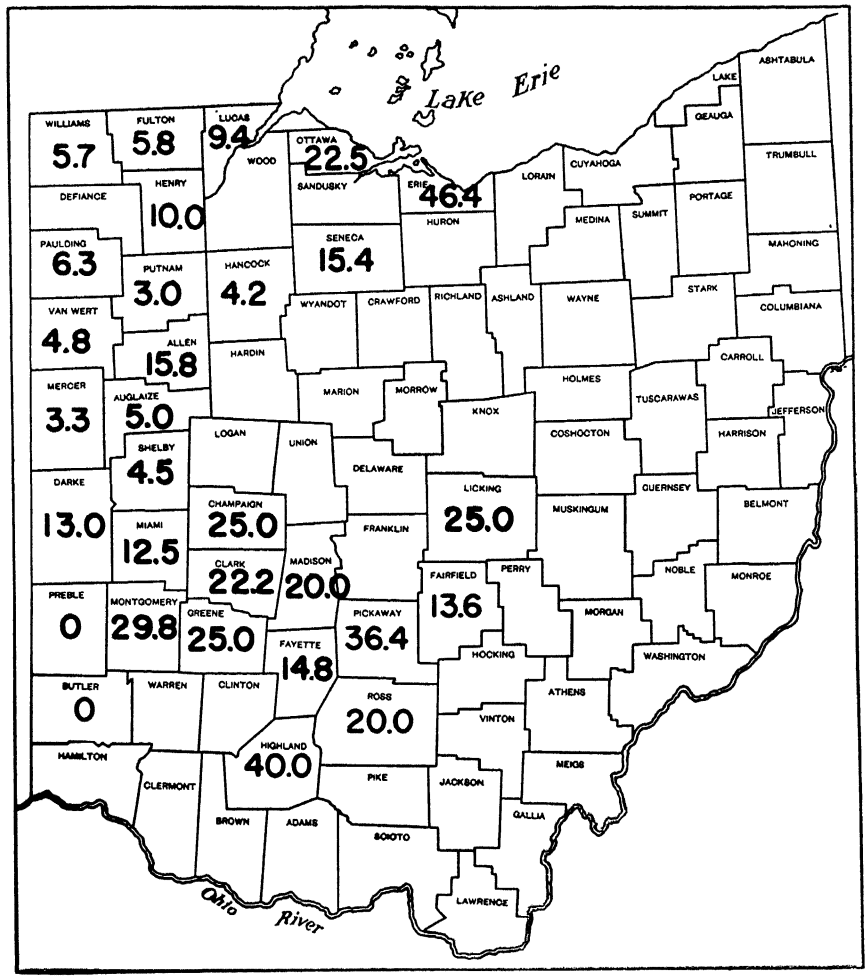


Fig. 8.—Percent of borers parasitized by **L. grisescens** in 1955.

TABLE 4.—Releases of **Horogenes punctorius** in Ohio after 1940.

County	Township	Year	Number
Hamilton	Colerain	1944	486
Hamilton	Colerain	1946	441
Van Wert	Ridge	1946	496
Erie	Perkins	1947	499
		Total	1,922

Initial establishment from colonization prior to 1940 was found in 5 of the 13 counties surveyed. The parasite was recovered in Hancock County in 1932, the year of colonization, but not in surveys in 1933, 1934, 1937 and 1939. In Henry County, colonized in 1930-2, recoveries were made in 1931 and 1932 but not in 1933, 1936 or 1939. Colonies were released in Lucas County from 1927-31 and the parasite recovered from 1930-3. No further recoveries were made here until 1948. The parasite was recovered in Putnam and Wood Counties in 1932 and 1933, respectively, the year of colonization. It did not appear in the 1934 collections from Putnam County or in the 1934, 1935 and 1939 collections from Wood County.

Initial establishment was apparently attained in Van Wert County, and possibly Erie County, from releases in 1946 and 1947, respectively. The parasite was recovered from 1947 through 1950 following the colonization in Van Wert County, and annually in Erie County since 1949. The colonization in Hamilton County was apparently unsuccessful, since no recovery was made in collections taken from 1944 through 1950.

Range and Distribution

The early prospect of *H. punctorius* becoming established in effective numbers was not good. The parasite appeared, in fact, to have vanished even from those localities where initial establishment had been observed. From 1937 through 1947, *H. punctorius* was absent from all collections except those from Van Wert County in 1947, and the parasite had been released here the previous year. However, it reappeared in the 1948 collections from Lucas, Fulton and Wood Counties, where it was last recovered or released 13 to 15 years before (Figure 12). In

1949, the parasite was recovered in Auglaize County, and found parasitizing 18.5 and 12.5 percent, respectively, of the collections from Defiance and Williams Counties (Figure 13). The following year, collections from Paulding and Putnam Counties were heavily parasitized (Figure 14). Subsequent collections have defined the range of this parasite fairly well (Figures 15 to 18). At present, *H. punctorius* appears to be well established in a triangle of northwestern counties, from

TABLE 5.—Number of **Horogenes punctorius** released by county and year. Years counties surveyed and years parasite recovered.

County	Years Released	Number Released	Years Surveyed	Years Recovered
Allen	1936	587	1955	1955
Auglaize	1936	593	1949, 1951, 1955	1951, 1955
Champaign	1936	542	1951, 1955	1951, 1955
Darke	1936	578	1951, 1955	1951, 1955
Defiance	1936	578	1949	1949
Delaware	1936	581	Not surveyed	----------
Erie	1935, 1947	1,087	Annually	1949-55
Fulton	1935	598	1948, 1955	1948-9, 1955
Hamilton	1944, 1946	927	1944-50	Not recovered
Hancock	1932	4,138	1932-4, 1937, 1939, 1955	1932, 1955
Hardin	1936	586	Not surveyed	----------
Henry	1930-2	12,324	1930-3, 1936, 1939, 1955	1931-2, 1955
Huron	1935	586	1935-6, 1954	1954
Logan	1936	588	1936, 1938-9, 1951	1951
Lorain	1936	525	Not surveyed	----------
Lucas	1927-31	5,959	1928-53, 1955	1930-3, 1948-9, 1951, 1953-5
Marion	1936	514	1936, 1952	1936, 1952
Mercer	1935	598	1951, 1955	1951, 1955
Miami	1936	598	1949, 1951, 1954-5	1951, 1954-5
Ottawa	1935	348	1935-6, 1955	1955
Putnam	1932	4,573	1932, 1934, 1950, 1955	1932, 1950, 1955
Sandusky	1937	474	Not surveyed	----------
Seneca	1935	583	1935-6, 1955	1955
Union	1936	565	1951	Not recovered
Van Wert	1935, 1946	1,083	1935-6, 1946-50, 1955	1947-50, 1955
Williams	1937	600	1955	1949, 1955
Wood	1933	5,274	1933-5, 1939, 1948	1933, 1948
Total		45,987		

Preble and Montgomery Counties on the south to Erie and Huron Counties on the east. It is possible this range extends further eastward along Lake Erie, but surveys in southern and eastern counties bordering this triangle have been repeatedly negative.

Dispersion

H. punctorius has been recovered in five counties where no releases were made. Two of these counties, Paulding and Shelby, are within the colonized area and the remaining three counties, Preble, Montgomery

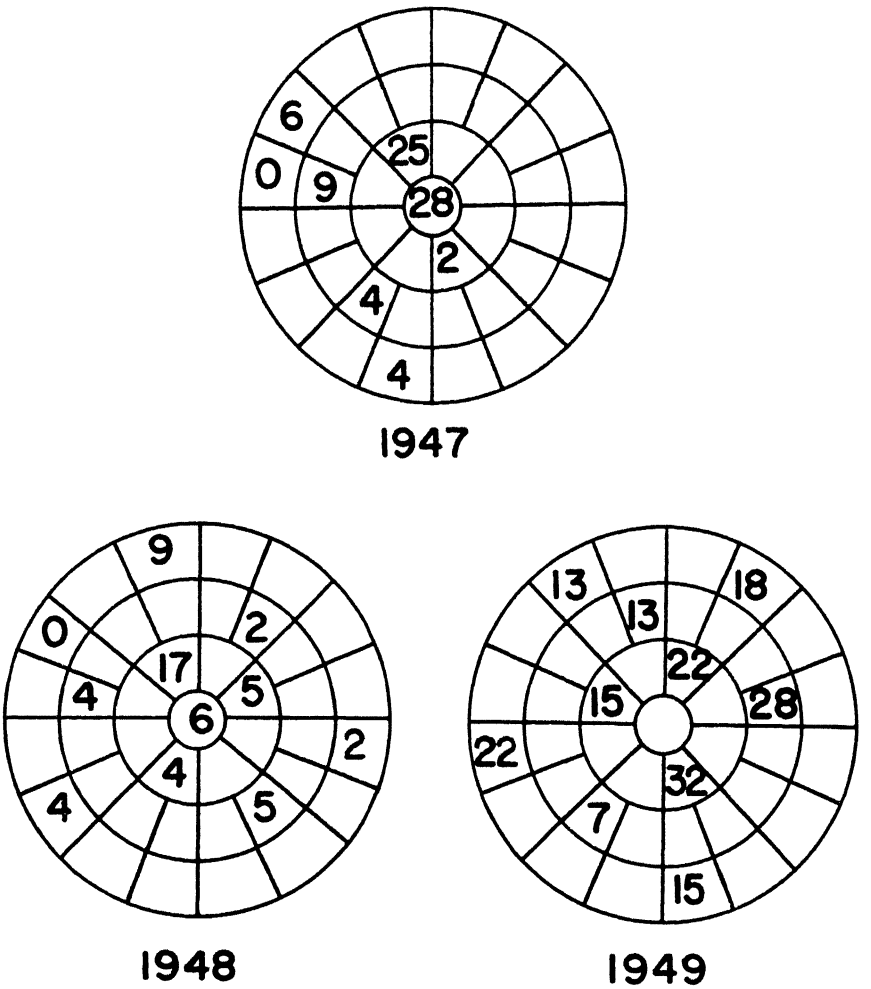


Fig. 9.—Percent of borers parasitized by **L. grisescens** in polar-coordinate area around the Van Wert County releases of 1945 and 1946.

and Clark, immediately border the colonized area (Figure 11). The amount of parasitization by *H. punctorius* has been rather low in the collections from the latter counties. These circumstances, and the history of the species in Ohio, suggest that the parasite was generally established by early releases, but dispersed at a relatively slow rate. The evidence regarding dispersion rate from the 1946 release in Ridge Township, Van Wert County, is inconclusive. Collections were taken here from 1947 through 1949 on a polar-coordinate scheme. The parasite appeared to have reached the periphery of the sample area, about 14 miles in diameter, even in the year following the release (Figure 19). In 1950, an

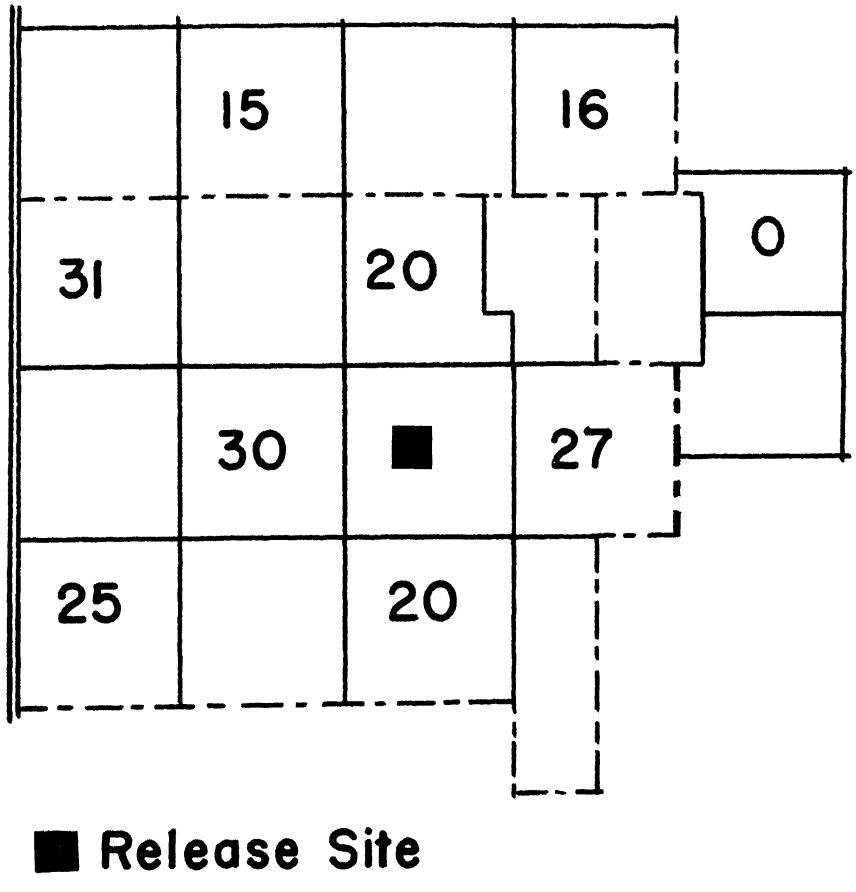


Fig. 10.—Percent borers parasitized by **L. grisescens,** in 1950, in area around the Van Wert County releases of 1945 and 1946.

alternate township scheme was used in collecting in Van Wert County and part of Paulding and Putnam Counties (Figure 20). The parasite was recovered in all samples but was most abundant to the north of the release site. In view of the amount of parasitization in Williams and Defiance Counties the previous year (Figure 11), the 1950 recoveries can not be interpreted with confidence with regard to dispersion rate.

Abundance

It is questionable whether or not *H. punctorius* has reached equilibrium with its host and other parasites. A good measure of abundance from year to year is not available, since the only localities that have been continuously surveyed are the study areas in Perkins Township, Erie County, and Jerusalem Township, Lucas County. Neither locality appears to be favorable for *H. punctorius,* for the maximum amount of parasitization has not exceeded 4.3 percent. An average of all collections for each year would be very biased, since many were made on the fringe of the parasite's range, or outside its range. However, it is perhaps indicative that in nine counties where collections were made in 1951 and 1955 (excluding Erie and Lucas) and where the parasite was recovered in either survey, the amount of parasitization increased in seven counties and the average parasitization more than doubled.

Sympiesis viridula (Thoms.)

Releases

Colonies of this eulophid from Italy were released yearly from 1931 through 1934. An additional release of 1,986 individuals from Canada was made in 1947 in Perkins Township, Erie County. A total of 103,634 individuals have been colonized in seven counties to date (Table 6).

TABLE 6.—Number of **Sympiesis viridula** released by county and year. Years counties surveyed and years parasite recovered.

County	Years Released	Number Released	Years Surveyed	Years Recovered
Erie	1931-2, 1947	6,162	1928-55	1939-40, 1942-9, 1951-5
Hancock	1932	6,643	1930-4, 1937, 1939, 1955	Not recovered
Henry	1931-2	23,148	1930-3, 1936, 1939, 1955	1931, 1939
Huron	1932	2,232	1930-1, 1936, 1954	Not recovered
Lucas	1931-2	12,567	1928-53, 1955	1938-44, 1946, 1948-53
Putnam	1932	5,862	1931-2, 1934, 1950, 1955	Not recovered
Wood	1932-4	47,020	1932-5, 1939, 1948	1932, 1939
Total		103,634		

Initial Establishment and Maintenance

The frequency of initial establishment following colonization of *S. viridula* is difficult to determine, since this parasite apparently disperses rapidly from release sites. However, recoveries were made following colonization in Henry County in 1931 and in Wood County in 1932. The first indication that this parasite was on a maintenance basis was the recoveries in Lucas and Ottawa Counties in 1938. Lucas County was last colonized in 1932 and the most recent release had been in neighboring Wood County in 1934. Ottawa County was never colonized, but releases were made across Sandusky Bay from the recovery site, in Erie County, in 1931 and 1932.

Range, Abundance and Dispersion

Field observations in 1939 and 1940 disclosed the presence of *S. viridula* in ten counties: Allen, Auglaize, Erie, Hardin, Henry, Logan, Lucas, Sandusky, Seneca and Wood (9). That this species disperses quite readily is indicated by the records from Auglaize and Logan Counties, a considerable distance from the closest release site (Figure 21). Through 1955, the parasite had been taken in 21 counties, from Lucas to Pike and from Van Wert to Wayne.

Although occasionally as many as 10 percent of the larvae in a collection have been parasitized by this species, *S. viridula* is usually absent from collections or found parasitizing less than 5 percent of the borers. In Jerusalem Township, Lucas County, and Perkins Township, Erie County, where quantitative records are available over a period of 12 and 14 years, respectively, the amount of parasitization by this species has not exceeded 6.3 percent and has usually been less than 1 percent.

PARASITES NOT ESTABLISHED IN OHIO

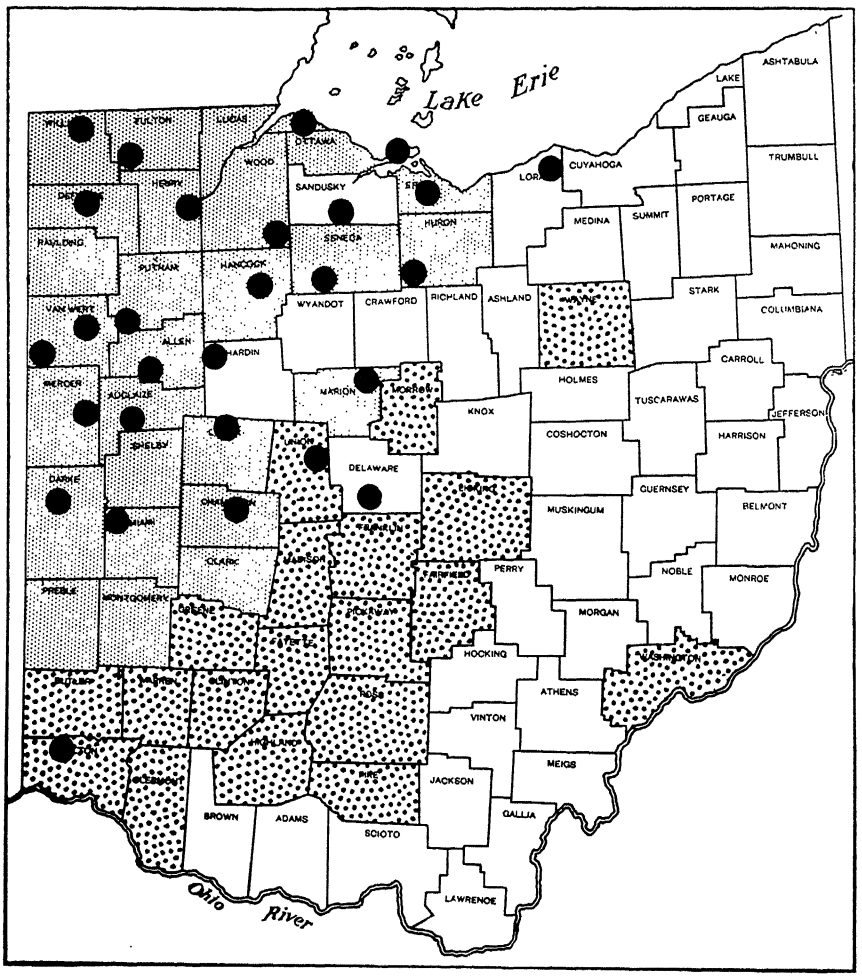
Fifteen species of European corn borer parasites introduced into Ohio did not become permanently established. Most of these parasites were colonized intensively for several years during the period 1924 through 1933. The details of colonization efforts through 1940 have been compiled by Baker *et al.* and need only be summarized here (9). Further attempts to establish *Macrocentrus gifuensis* Ashm. after this date are herein reported.

Apanteles thompsoni Lyle

This gregarious, thelyotokus braconid from northern France was colonized each year from 1925 through 1933. A total of 52,505 individuals were released in nine counties, but no recoveries were made. Colonization efforts in other states were also failures.

Aplomya mitis (Meig.)

Colonies of this larvaevorid from France were released each year from 1930 through 1933. Releases totaling 1,659 individuals were made in Henry, Lucas and Wood Counties. The species was not recovered.



Parasite Recovered

Surveyed After 1947, No Recovery

Colonization Site

Fig. 11.—Colony sites of **H. punctorius,** counties surveyed, and counties in which the parasite has been recovered.

Campoplex alkae (Ell. & Sacht)

Another European importation, this ichneumonid was colonized each year from 1926 through 1933. Releases in six counties totaled 36,398 individuals. Some initial establishment was demonstrated by the recovery of a few specimens, in 1929 and 1930, at the colonization site in Lucas County, but no further recoveries were obtained.

Fig. 12.—Percent of borers parasitized by **H. punctorius** in 1948.

Campoplex multicinctus Grav. and ***C. pyraustae*** Smith

These two species were incidental imports from France, and both were colonized in Lucas County in 1930. Three hundred fifty seven individuals of *C. multicinctus* and 38 of C. *pyraustae* were released. Neither species was recovered.

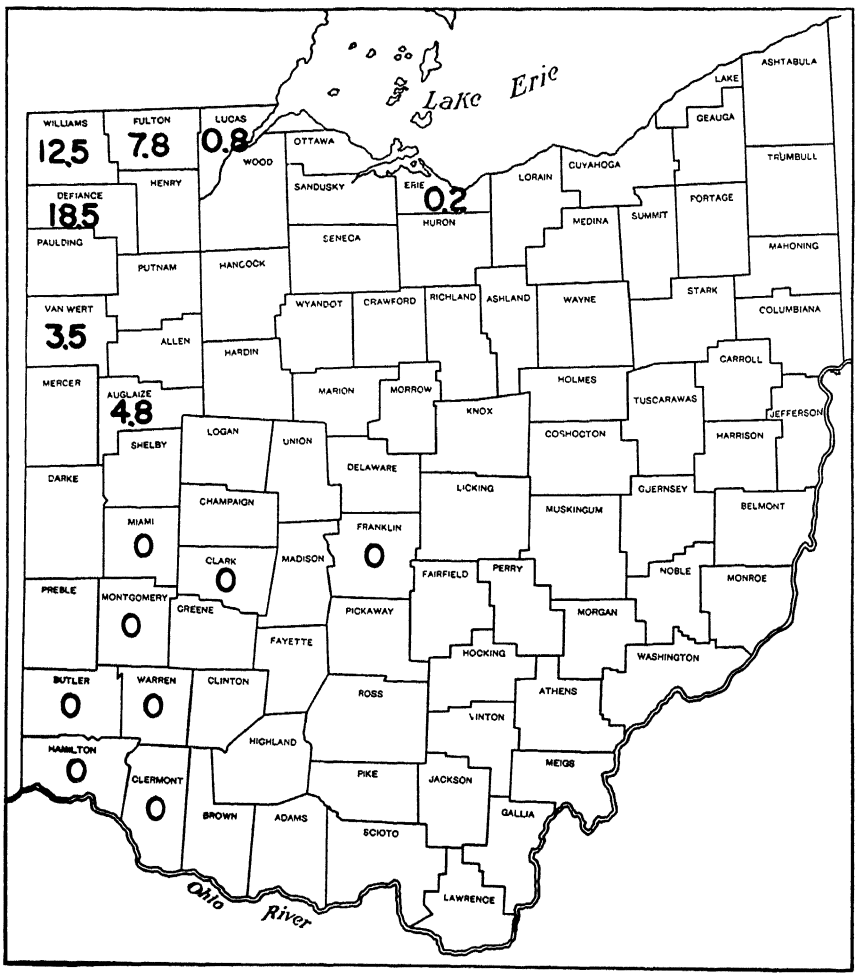


Fig. 13.—Percent of borers parasitized by **H. punctorius** in 1949.

Chelonus annulipes Wesm.

Colonies of this braconid from Italy were released from 1930 through 1934. After the appearance of a second generation of the borer, additional releases of laboratory reared parasites were made in 1938 and 1940. In all, 22,952 individuals were released in 15 northwestern counties.

A few individuals were recovered each year through 1934 in Jerusalem Township, Lucas County, following colonization there in 1930. The species persisted for a decade in Adams Township, of the same

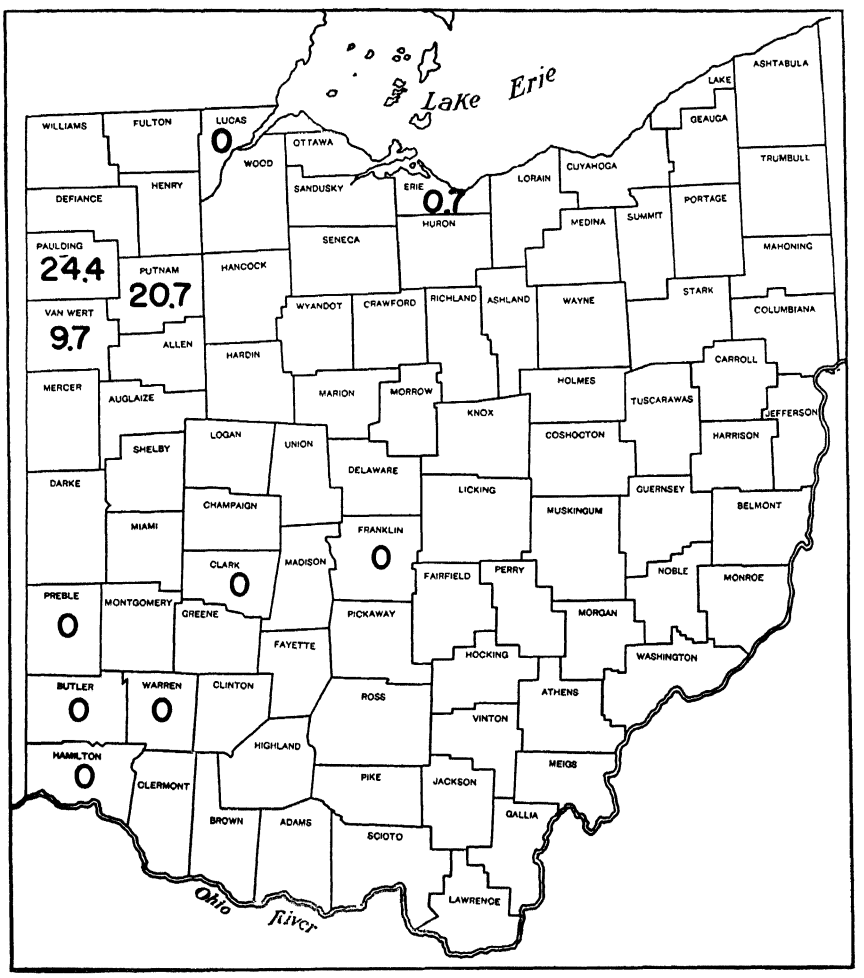


Fig. 14.—Percent of borers parasitized by **H. punctorius** in 1950.

county, following colonization in 1938. Recoveries were made here in 1938, 1939, 1945 and 1948. The amount of parasitization was quite small and no specimens have been taken for the past eight years in Ohio.

This species has been successfully established in restricted areas in New England (3).

Exeristes roborator (F.)

This ichneumonid was successfully reared from European stock, and all releases in Ohio were from the Arlington, Massachusetts, and Monroe, Michigan, laboratories. Colonies totaling 87,826 individuals were

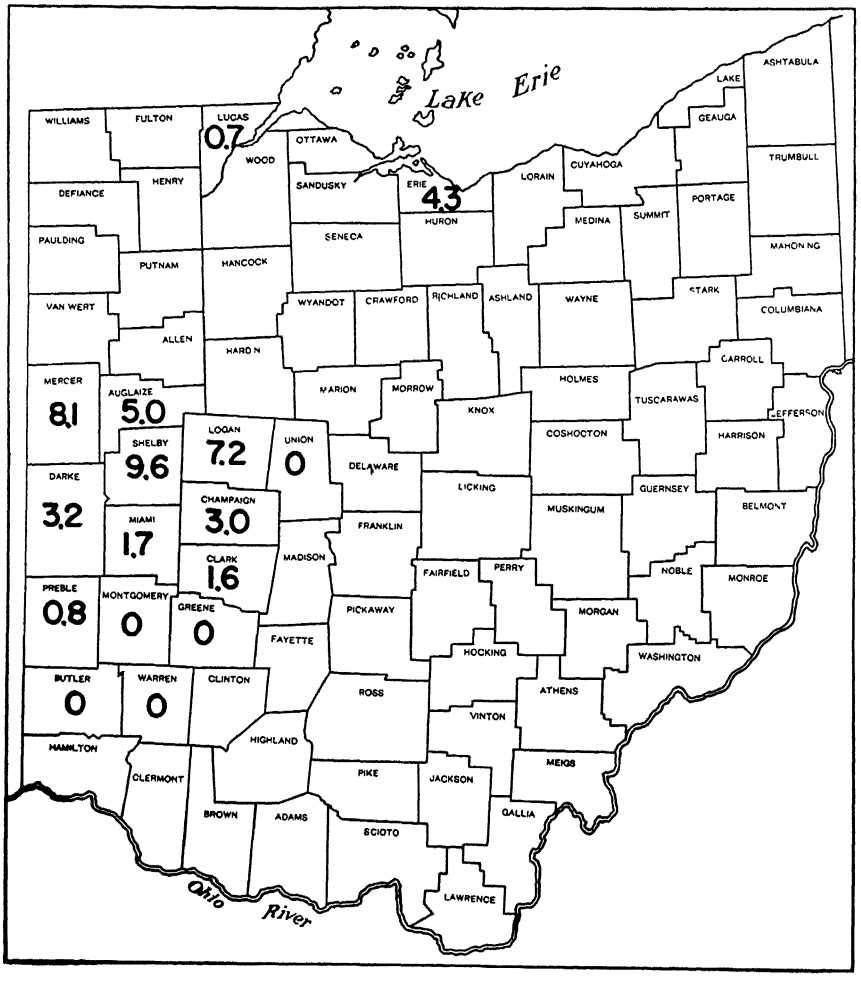


Fig. 15.—Percent of borers parasitized by **H. punctorius** in 1951.

released in 11 northern counties over the period 1924 through 1931. The parasite was recovered only where releases were made the previous fall.

Macrocentrus gifuensis Ashm.

Early releases of this braconid were from European and Oriental importations. Colonies were released yearly from 1927 through 1933 and one release was made in 1940. Through 1940, a total of 3,537 individuals were colonized in six counties. Additional releases from domestic sources were made from 1943 through 1949 and these are listed in Table 7.

TABLE 7.—Releases of **Macrocentrus gifuensis** in Ohio after 1940.

County	Township	Year	Number
Hamilton	Colerain	1943	1,889
Hamilton	Colerain	1944	4,120
Hamilton	Colerain	1946	3,062
Van Wert	Ridge	1946	1,846
Clark	Bethel	1947	495
Erie	Perkins	1947	1,958
Franklin	Clinton	1947	1,898
Van Wert	Ridge	1947	1,905
Erie	Perkins	1949	26,449
		Total	43,622

Although the parasite was successfully established in Massachusetts, only two recoveries were made in Ohio following early releases. These were in Erie and Wood Counties, in 1928 and 1932, respectively, and both were made the year of colonization. The parasite was recovered twice following the later series of colonizations. The first recovery was in Ridge Township, Van Wert County, in 1947. A colony of 1,846 individuals was released here in 1946. The second recovery was in Perkins Township, Erie County, in 1949, the same year a colony of 26,449 individuals was released. The species has not been taken in Ohio since that date.

Bracon brevicornis Wesm.

The colonies of this braconid released in Ohio were laboratory reared from European stock. Releases were made each year from 1924 through 1931 in one or more northern counties. Although intensively colonized—587,583 individuals were released—no recoveries were made.

Microgaster tibialis (Nees)

Colonization of this European braconid was undertaken yearly from 1925 through 1933, a total of 138,585 individuals being released in eight northern counties. The parasite was recovered only in localities currently colonized.

Nemorilla sp.

A small number, 843 individuals, of a larvaevorid species were imported from the Orient and released in Webster Township, Wood County, in 1932. Baker *et al.* state the species imported under the name

Fig. 16.—Percent of borers parasitized by **H. punctorius** in 1952.

N. floralis (Fallen) is morphologically and biologically indistinguishable from the indigenous *N. maculosa* (Meig.) (9). No parasite conforming to the description of these species has been reared from the European corn borer in Ohio.

Phaeogenes nigridens Wesm.

This ichneumonid was colonized in Henry, Lucas and Wood Counties during the period 1927 through 1933. All of the 8,306 parasites released were from European sources except 13 individuals released in Wood County in 1933. No recovery was made in Ohio.

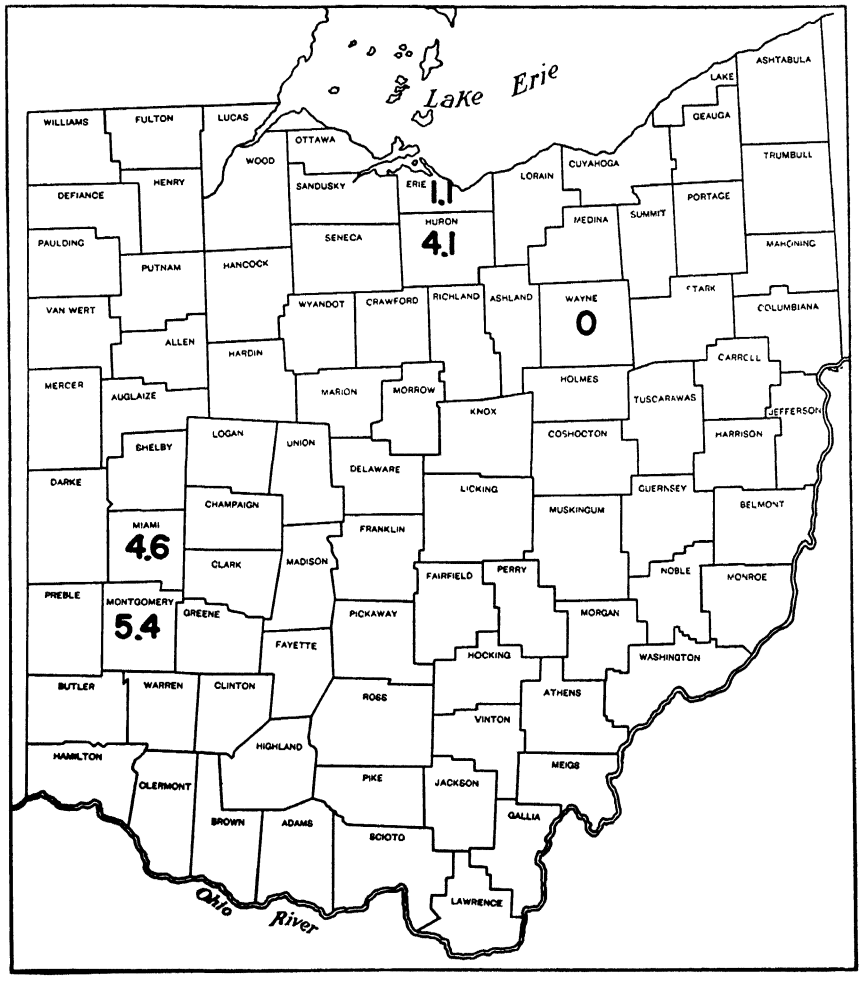


Fig. 17.—Percent of borers parasitized by **H. punctorius** in 1954.

Pseudoperichaeta spp.

A single colony, comprising 499 individuals, of a larvaevorid imported from the Orient under the name *P. erecta* (Coq.) was released in Webster Township, Wood County, in 1932. Parasites from Europe imported under the name *P. roseanae* (B. & B.) were released from 1927 through 1933. A total of 32,334 individuals from European sources were released in seven counties. According to Baker *et al.*, the parasites

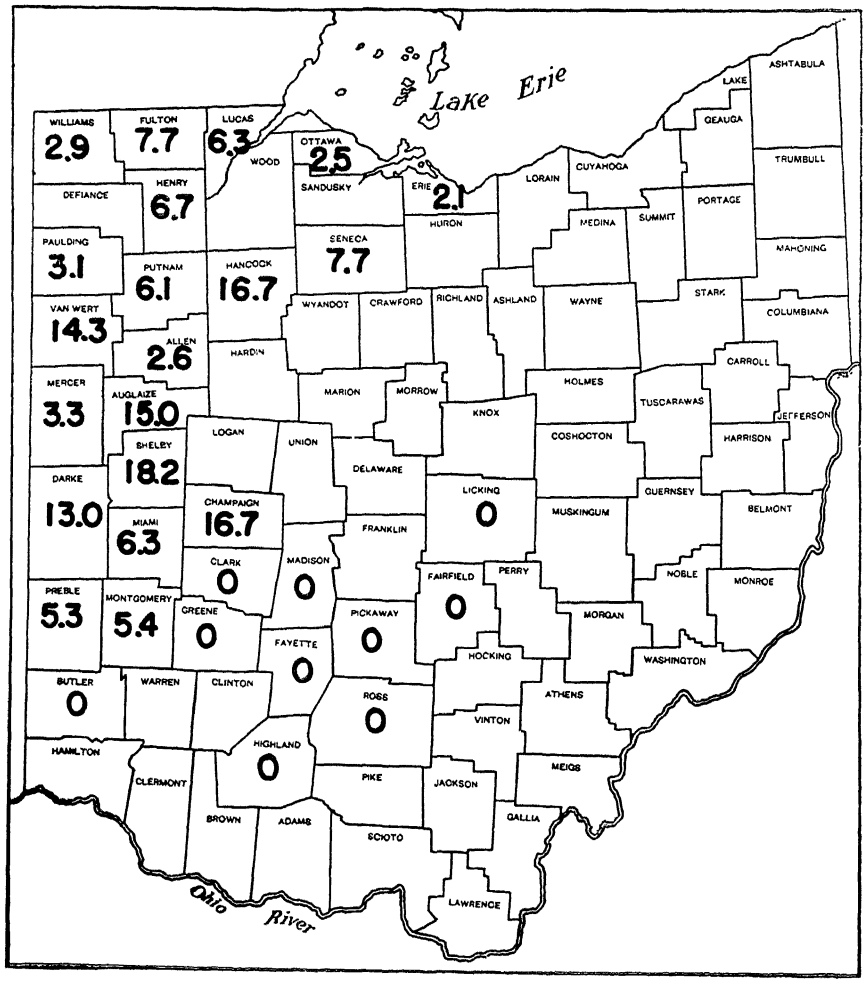


Fig. 18.—Percent of borers parasitized by **H. punctorius** in 1955.

from Europe and from the Orient were indistinguishable morphologically, and both *P. erecta* and *P. roseanae* have been reported as indigenous (9). In any event, no parasite of this genus has been reared from the European corn borer in Ohio.

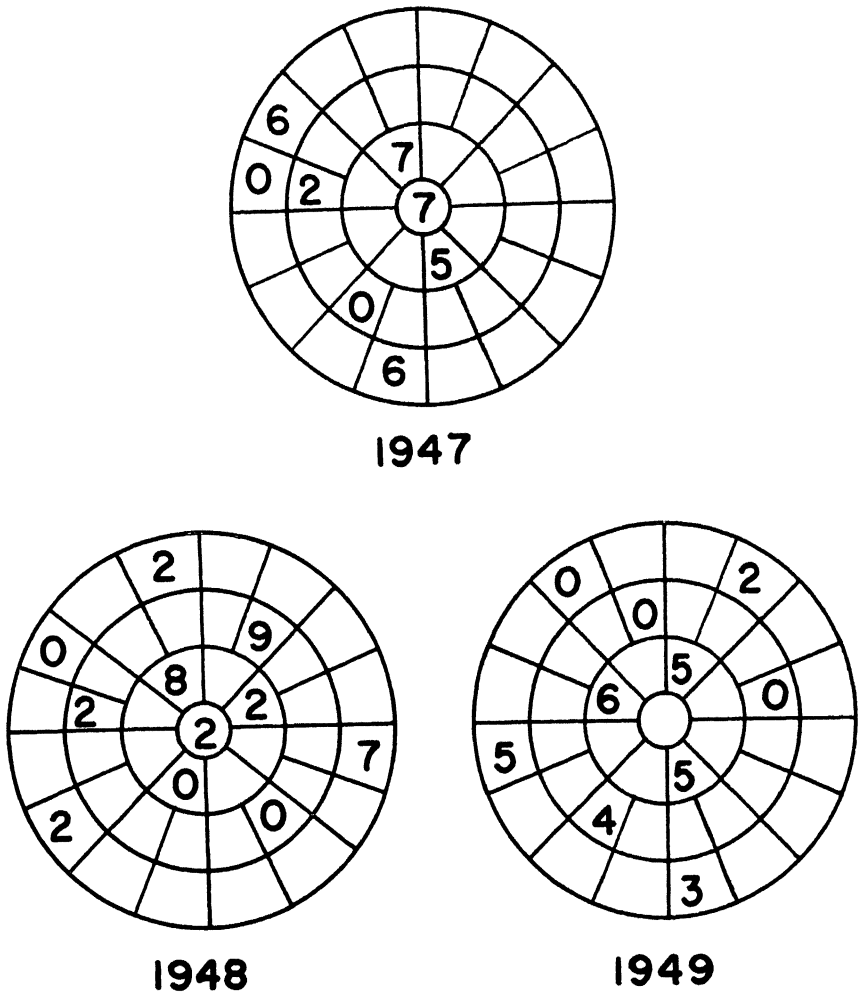


Fig. 19.—Percent of borers parasitized by **H. punctorius** in polar-coordinate area around the Van Wert County release of 1946.

Zaleptopygus flavo-orbitalis (Cam.)

Colonies of this ichneumonid from Japan, totaling 5,145 individuals, were released in Henry and Lucas Counties in 1932. No recoveries were made.

NATIVE PARASITES

Five species of native parasites have been reared from the European corn borer in Ohio. The number of borers attacked has been trivial. The county, percentage of sample parasitized, and year follow for each species.

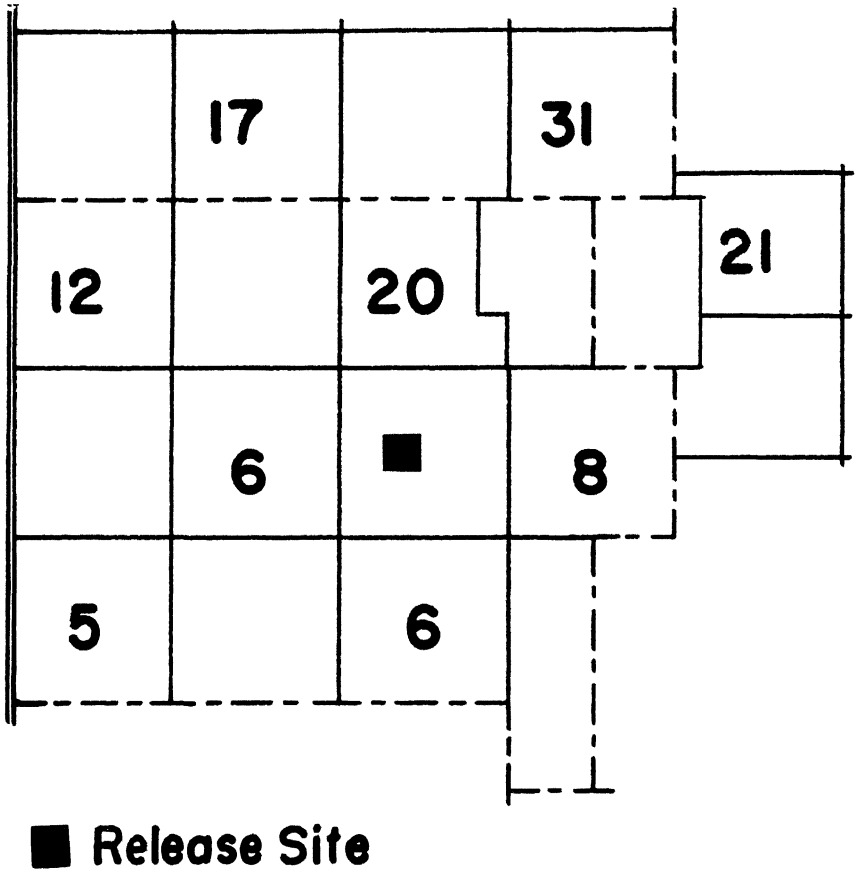


Fig. 20.—Percent of borers parasitized by **H. punctorius,** in 1950, in area around the Van Wert County release of 1946.

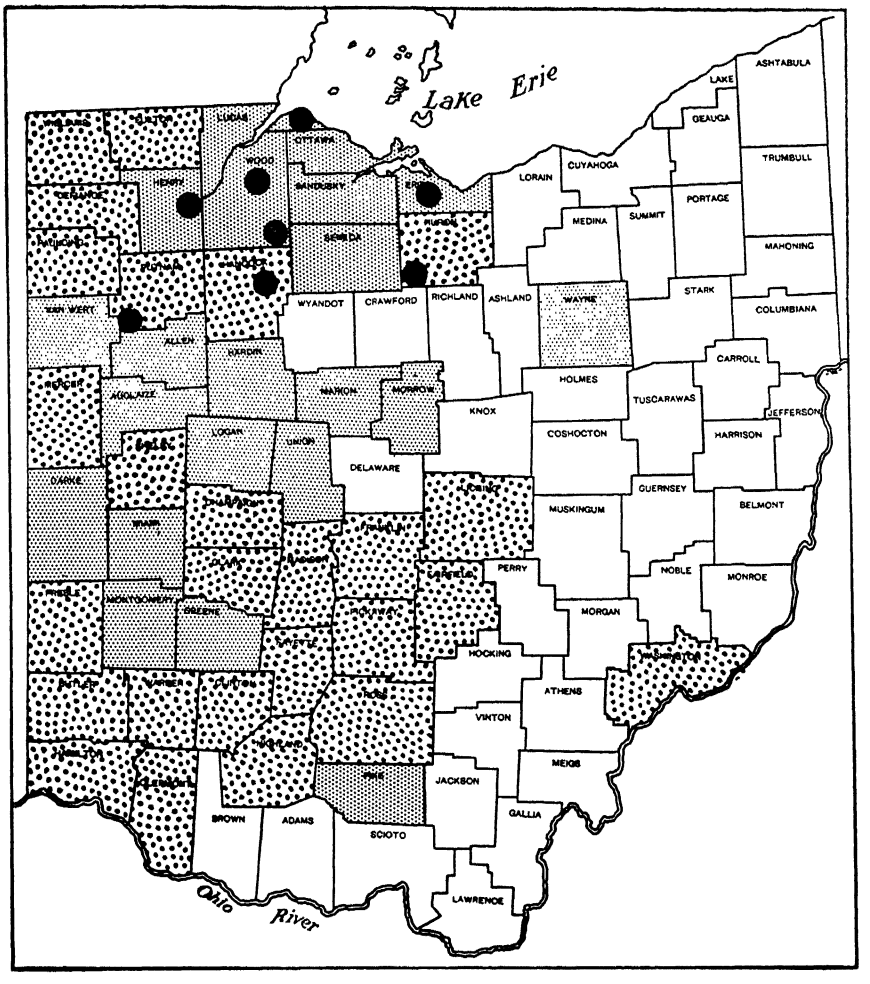


Fig. 21.—Colony sites of **S. viridula**, counties surveyed, and counties in which parasite has been recovered.

Aplomya caesar (Ald.)—Hamilton, 0.2, 1947

Agathis agilis (Cress.)—Lucas, 1.8, 1949

Lixaphaga sp.[5]—Washington, —, 1950

Pyraustomyia penitalis (Coq.)—Hamilton, 0.2, 1947; Butler, 2.2 and 12.0, 1948; Butler, 2.0, 1949; Hamilton, 4.5, 1949; Erie, 0.4, 1951

A single specimen of *Brachymeria ovata* (Say)[6] emerged from a pupa collected in Miami County in 1954.

SUMMARY

Exotic parasites of the European corn borer were first colonized in Ohio in 1924, three years after the borer was discovered in the state. Additional releases were made annually through 1936 and intermittently through 1949. Eighteen species of European corn borer parasites have been released in the state, three of which are apparently established on a permanent basis. These are *Lydella grisescens* R.-D., *Horogenes punctorius* (Roman), and *Sympiesis viridula* (Thoms.). *L. grisescens* is the most important species numerically, although *H. punctorius* may dominate in localized areas. A few specimens of *S. viridula* appear infrequently in collections of borer larvae. Both *L. grisescens* and *S. viridula* appear to be generally distributed, while *H. punctorius* has been taken only in the northwestern and central-western counties.

Chelonus annulipes Wesm. persisted for a period of 10 years in the vicinity of one colony site but has not been recovered since 1948.

Five species of native parasites have been reared from European corn borer larvae. None of these occur in sufficient numbers to be of importance.

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[5]Determined by H. J. Reinhard.

[6]Determined by B. D. Burks.

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