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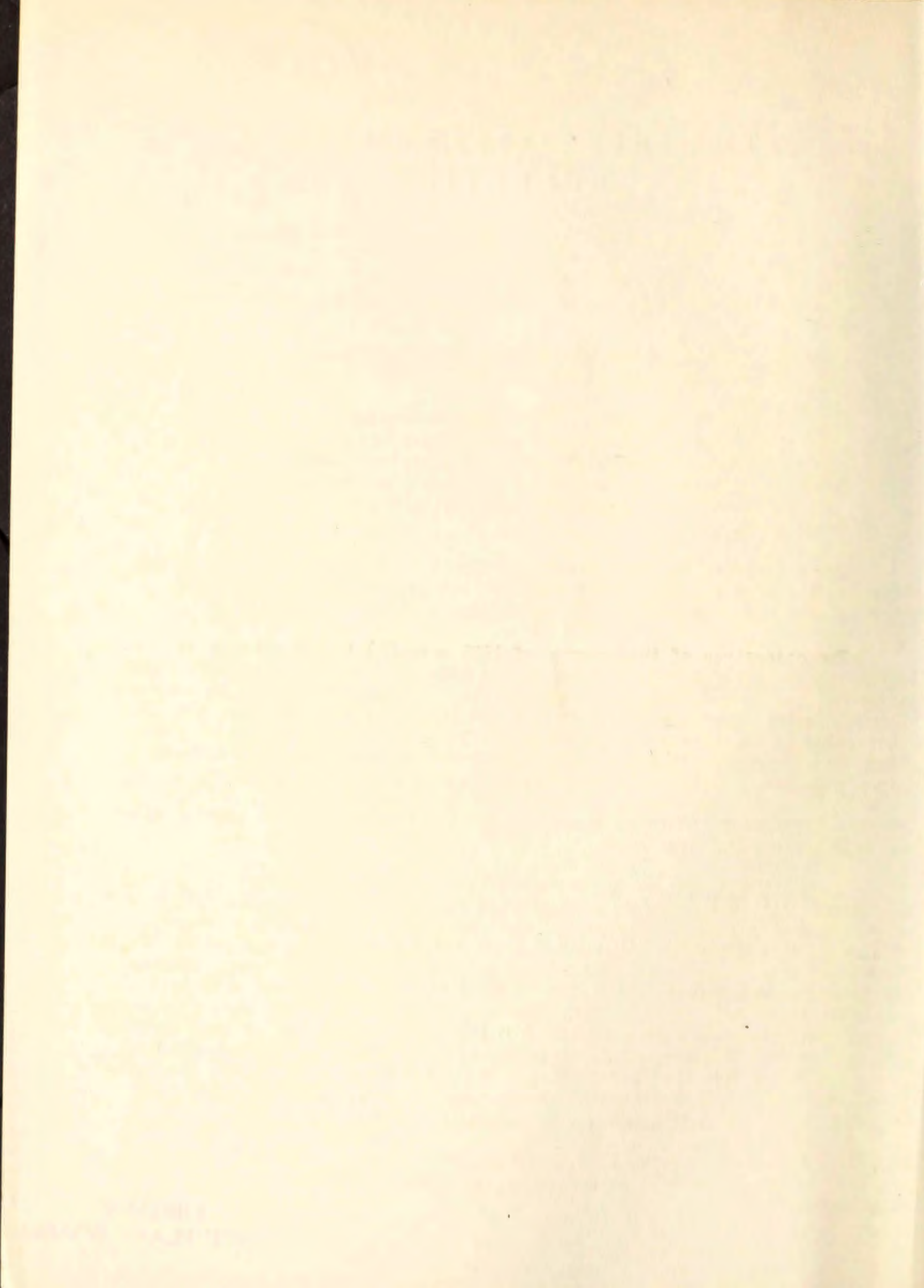
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COLONIZATION OF PARASITES OF THE EUROPEAN
CORN BORER IN THE UNITED STATES in 1936

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The activities in connection with the biological control of the corn borer as discussed in this report were directed from the laboratory for European corn borer research at Toledo, Ohio.

The objectives of the program of 1936 were (1) the dispersion of Inareolata punctoria Roman, an ichneumonid attacking third-instar corn borer larvae and indigenous both to Europe and the Orient, over as much as possible of the infested territory not previously colonized by this species; and (2) the testing in the more southern range of the borer of two species of parasites, viz, Cremastus flavoorbitalis (Cameron), an ichneumonid of oriental origin attacking fourth-instar larvae, and Microgaster tibialis Nees, a braconid attacking second-instar larvae and indigenous to Europe and the Orient. Previous releases of these two species had resulted in initial establishment but not maintenance.

Parasite material.-- For the first time since the inauguration of the biological control program in 1920, it was deemed feasible to depend upon procuring a supply of the parasites most desired for dispersion purposes, from areas where corn borer parasites were first released in the United States. From these areas, some 14,000 adults of I. punctoria were obtained, thereby permitting an appreciable extension of the total area colonized with this species. Incidental to this work, adults of Lydella stabulans var. grisescens R. Deev. were obtained and were used for colonization in more or less isolated infested areas. A supply of M. tibialis was made available through the Division of Foreign Parasite Introduction. The Entomological Branch of the Canadian Department of Agriculture provided a supply of C. flavoorbitalis from

¹/D. W. Jones, C. A. Clark, E. D. Burgess, N. J. Nerney, and J. S. Mayfield assisted in the release of parasites in the regions of their respective assignments.

the Orient, and a supply of Chelonus annulipes Wesm. bred in the laboratory at Belleville, Ontario. The last-mentioned species was shipped from Canada direct to the point of liberation, but all other material was handled at the Moorestown, N. J., laboratory and shipments were made from that point for distribution. The total releases of corn borer parasites made during 1936 in the United States are summarized by States in table 1. The total releases to December 31, 1936, are given in table 2. The method of selecting colony sites, technique in making releases, colony sizes, etc., were essentially the same in 1936 as in previous years. Information regarding the species released in 1936 follows.

I. punctoria (Ichneumonidae).-- As shown in map 1, a considerable portion of the area infested by the borer was colonized by this species in 1935. Since further extension of this area was the chief objective of the 1936 program, major emphasis was placed on the handling of the host larvae to insure its distribution to field localities under conditions optimum for its establishment, particularly as regards synchronization with the appearance in the field of the preferred stage of its host. The extent of additional distribution of Inareolata during the season is shown on map 1. A total of 14,271 adults were released in 25 colonies. Three of these were at test-colony sites in New Jersey and Virginia, thereby providing an opportunity for observation on the reaction of this species to new environments. Table 3 summarizes the releases of this species in 1936. In most instances satisfactory synchronization of releases of this species with its preferred host stage was achieved. The first adults to emerge from material manipulated to supply adults for the multiple-generation area were released in localities of most advanced borer development and the adults that appeared later were used for colonies located farther north. Under actual conditions experienced during the current season it is probable that a slightly more advanced emergence period would have been desirable. In the one-generation area synchronization of releases with the presence of preferred host stages, as determined by observation at various field stations, was accomplished satisfactorily.

M. tibialis (Braconidae).-- It was desired to test this species in areas characterized by environmental conditions that might be more favorable to its successful establishment than those encountered at points of previous release. Synchronization of releases with the presence of the parasite's preferred host stage (second-instar larvae) was accomplished at all localities. This may be effected with Microgaster by manipulating the cocoons, in which stage the material hibernates and is imported. Observations of host development during the current season indicate when the optimum period will prevail for releases. The cocoons are removed from storage and placed in a developmental environment at the proper time to induce adults to emerge to conform to the host requirements at the various proposed localities of release. Table 4 summarizes the releases of this species.

L. stabulans var. grisescens (Tachinidae).-- A supply of this tachinid, derived both from domestic sources and the Orient, was released at two dispersion points. One colony of 1,965 individuals from the Orient was liberated in Miles Township, Centre County, Pa., on July 10. The second colony was released in Newark Township, Worcester County, Md. This colony, consisting of 5,365 adults from the domestic source, was released in two lots, one of 1,584 on June 8, and one of 3,781 on July 3. Two small lots of domestic adults (one of 215

and one of 595) were released in Woodland Township, Burlington County, N. J., on June 17 and July 18, respectively, supplementing the 1935 releases in that locality.

C. annulipes (Braconidae).-- Through cooperation with the Entomological Branch of the Canadian Department of Agriculture it was possible to release three lots of this species at one colony site in Lee Township, Accomac County, Va. These releases consisted of individuals bred in the laboratory at Belleville, Ontario, and were made on July 31, August 7, and August 19. A total of 2,105 adults were released in lots of 873, 1,008, and 224, respectively, on the above dates. It is known that host eggs, the stage utilized by this species for oviposition, were present in the field during the period of release.

Conclusions.-- Except in Virginia and western and central Ohio, where the weather was abnormally hot and dry, the season in general appeared favorable to the successful colonization of corn borer parasites. The completion of the current season's colonization activities has demonstrated that Inareolata punctoria, one of the most promising of the imported parasites of the corn borer, may be obtained in satisfactory numbers more economically from well-established colony sites in the United States than from foreign sources.

Table 1.--Summary of releases of imported parasites in 1936

State	C. annulipes	L. griseus	I. punctoria	C. flavoorbitalis	M. tibialis	Total
	Number	Number	Number	Number	Number	Number
Connecticut..	--	--	--	--	1,994	1,994
Indiana.....	--	--	599	--	--	599
Maryland.....	--	5,365	--	--	--	5,365
Massachusetts	--	--	1,679	--	--	1,679
Michigan.....	--	--	1,606	--	--	1,606
New Jersey...	--	810	585	599	1,809	3,803
New York.....	--	--	1,779	--	--	1,779
Ohio.....	--	--	6,835	--	--	6,835
Pennsylvania.	--	1,965	--	--	--	1,965
Virginia.....	2,105	--	1,188	2,371	3,199	8,863
Total..	2,105	8,140	14,271	2,970	7,002	34,488

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Table 2.---Total releases of imported parasites in the United States to December 31, 1936

State	Apanteles sp. Oriental	Apanteles thompsoni Lyle European	Bracon atricornis (Smith)*	Campoplex multicinctus Grav.	Campoplex pyraustae Smith	Chelonus annulipes	Cremastus flavoorbitalis	Eulimneria alka Ell. & Sacht.*	Eulophus viridulus Thoms.	Exeristes roborator Fab.	Inareolata punctoria**	Lydella stabulans var. grisescens**
Conn..	---	21,268	12	---	---	2,227	1,483	1,057	17,200	---	6,882	32,736
Ill....	---	---	---	---	---	---	---	---	---	2,302	---	---
Ind....	---	5,700	---	---	---	2,259	---	5,161	6,671	22,905	6,588	25,335
Maine..	---	---	---	---	---	---	---	---	---	---	---	1,927
Md.....	---	---	---	---	---	---	---	---	---	---	---	5,365
Mass...	388	69,144	127	1,129	1,697	9,204	6,762	28,526	84,786	54,957	30,363	92,087
Mich...	---	34,837	---	---	---	6,363	---	24,075	44,037	86,607	8,764	123,524
N. H...	---	---	---	---	---	---	---	---	---	---	---	5,569
N. J...	---	---	---	---	---	---	---	---	---	---	---	7,271
N. Y...	3	51,106	---	61	16	4,783	1,192	9,279	55,755	40,050	1,150	122,153
Ohio...	---	52,505	---	357	38	19,167	1,109	36,398	101,648	87,826	42,991	219,820
Pa.....	---	5,774	---	---	---	---	---	550	7,446	20,119	707	11,588
R. I...	---	11,756	211	123	47	7,552	1,014	4,636	---	---	14,572	35,293
Vt.....	---	---	---	---	---	---	---	---	---	---	---	9,813
Va.....	---	---	---	---	---	2,105	2,971	---	---	---	1,188	3,956
Total.	391	25090	350	1,670	1,798	53,660	19,676	109,682	317,543	314,766	129,750	696,437

* European and oriental material
** European, oriental, and domestic material

Table 2 (con't.) --- Total releases of imported parasites in the United States to December 31, 1936

State	Macrocentrus gifuensis Ashm.*	Meteorus nigricolis Thoms.	Microbracon brevicornis Wesm.	Microgaster tibialis*	Nemorilla floralis Fall.	Phaeogenes nigridens Wesm.*	Phorocera erecta Coq.	Zenillia mitis Meig.	Zenillia roseanae B. B.	Total
Conn...	8,036	--	--	7,101	533	1,620	193	178	7,754	108,280
Ill....	--	--	3,635	--	--	--	--	--	--	5,937
Ind....	4,416	--	107,109	8,985	--	--	--	8	8,526	203,663
Maine..	--	--	--	--	--	--	--	--	--	1,927
Md.....	--	--	--	--	--	--	--	--	--	5,365
Mass....	70,621	--	1,084,590	84,689	371	21,885	--	514	64,802	1,706,642
Mich....	40,790	--	534,334	81,747	--	3,933	--	395	17,896	1,007,302
N. H....	--	--	--	--	--	--	--	--	--	5,569
N. J....	--	--	--	1,809	--	--	--	--	--	11,422
N. Y....	37,057	--	349,294	34,752	--	569	4	463	29,743	752,742
Ohio....	132,241	--	587,583	138,585	843	8,306	499	1,664	32,334	1,467,950
Pa.....	9,006	--	128,211	6,842	--	347	--	20	3,800	186,964
R. I....	33,214	8	--	19,740	--	12,037	--	188	9,305	157,142
Vt.....	--	--	--	--	--	--	--	--	--	9,813
Va.....	--	--	--	3,199	--	--	--	--	--	13,419
Total..	335,381	8	2,794,756	387,449	1,747	48,697	696	3,430	174,160	5,644,137

* Includes adults from European and oriental sources

Table 3.-- Summary of Inareolata punctoria releases in 1936

State	Township	County	Parasites liberated	Period of release (dates inclusive)
			<u>Number</u>	
Indiana	Lafayette	Allen	599	July 21
Massachusetts...	Agawam	Hampden	522	July 8
	Charlton	Worcester	597	July 6
	Hadley	Hampshire	560	July 14
Total	--	--	1,679	July 6 - 14
Michigan.....	Harrison	Macomb	599	July 25
	Koylton	Tuscola	598	July 28
	Lexington	Sanilac	409	Aug. 6
Total.....	--	--	1,606	July 25 - Aug. 6
New Jersey.....	Atlantic*	Monmouth	585	July 2
New York.....	Hamlin	Monroe	588	July 21
	Ontario	Wayne	598	July 21
	Scriba	Oswego	593	July 21
Total.....	--	--	1,779	July 21
Ohio.....	Avon	Lorain	525	July 14
	Brown	Darke	578	July 16
	Claiborne	Union	565	July 17
	Liberty	Delaware	581	July 17
	Liberty	Hardin	586	July 23
	Newberry	Miami	598	July 23
	Richland	Logan	588	July 29
	Salem	Champaign	542	July 23
	Scott	Marion	514	July 17
	Shawnee	Allen	587	July 16
	Washington	Auglaize	593	July 16
	Washington	Defiance	578	July 21
Total.....	--	--	6,835	July 14 - 29
Virginia.....	Lee*	Accomac	595	July 1
	Franktown*	Northampton	593	July 1
Total.....	--	--	1,188	July 1
Grand total.	--	--	14,271	July 1 - Aug. 6

* Test colonies.

Table 4.--Summary of *Micrograster tibialis* releases in 1936

State	Township	County	Parasites liberated	Period of release (Dates inclusive)
			<u>Number</u>	
Connecticut...	E. Hartford	Hartford	1,994	June 22
New Jersey...	Atlantic	Monmouth	1,809	June 23
Virginia	Lee	Accomac	2,093	June 4
	Franktown	Northampton	1,106	June 6
Total	--	--	3,199	June 4-6
Grand total.	--	--	7,002	June 4-23

C. flavoorbitalis (Ichneumonidae).-- In order to test this species further in areas having winters less rigorous than those characteristic of colony sites where parasites have failed to become established, colonies were released in Virginia and New Jersey. Table 5 presents the data in regard to releases of this species.

Table 5.--Summary of *Cremastus flavoorbitalis* releases in 1936

State	Township	County	Parasites liberated	Period of release (Dates inclusive)
			<u>Number</u>	
New Jersey...	Berkeley	Ocean	599	July 8
Virginia.....	Lee	Accomac	1,191	July 8-11
	Franktown	Northampton	1,180	July 8-13
Total....	--	--	2,371	July 8-13
Grand total.	--	--	2,970	July 8-13

Available information indicates that the release in New Jersey coincided nicely with the presence of the parasite's preferred host stage. The exact extent of synchronization in Virginia is not known, although some individuals of the preferred host stage were present.



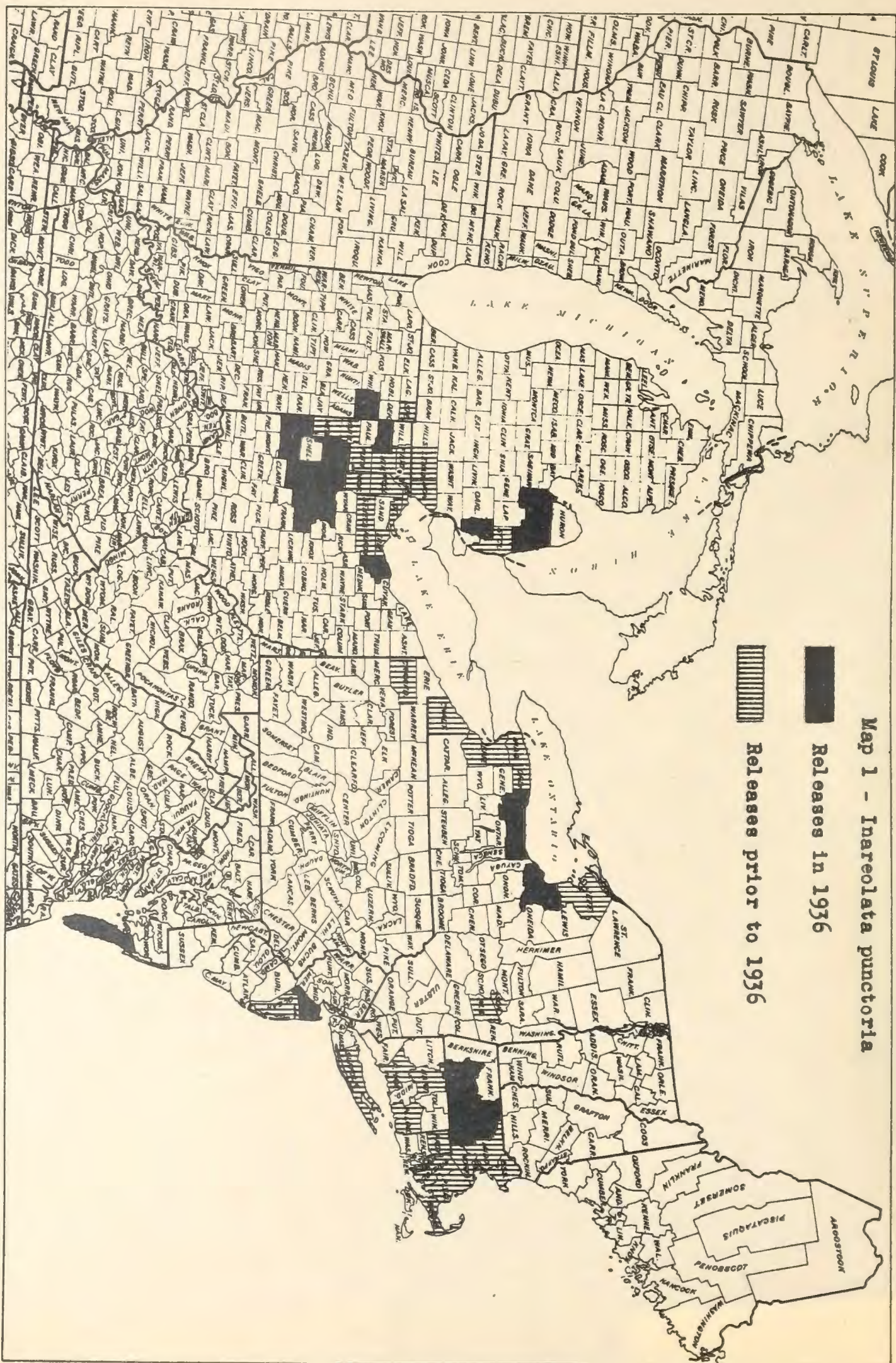
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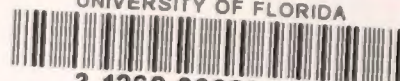
Map 1 - Inareolata punctoria

Releases in 1936

Releases prior to 1936



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