

SEASONAL APPEARANCE OF SELECTED SPECIES
OF NOCTUIDAE IN MICHIGAN

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ABSTRACT

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by Rhodes E. Thompson

Results of a two year survey of Michigan Noctuidae, specifically known agricultural pests, are presented. Blacklight trapping was conducted at East Lansing, Michigan and Galien, Michigan, during 1964 and 1965. Graphs of the occurrence of twelve pest species during these years are included. Where possible, information deduced from these graphs concerning probable overwintering stage, number of broods per year, and peaks of occurrence are discussed. Charts concerning the relative abundance of 159 additional Noctuid species on a monthly basis during the two years are also included. During the study five moths, previously unknown from Michigan, were collected at Galien. These state records, not included in the other data, are also listed with their previous distributional history. Mention is made of possible areas for continued work as a result of this study.

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Rhodes E. Thompson

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INTRODUCTION

Cutworms and armyworms are serious agricultural pests in many areas of the United States. Michigan is occasionally plagued by large populations of certain species, but because of its northern location, few species may be considered serious pests year after year. Despite the importance of the group, there are few published records relating to Michigan pest species. Severe outbreaks have been recorded in Michigan by Slingerland (1895). Pettit (1905, 1910) drew attention to the occurrence of several species on field crops and home gardens, but discusses only the Armyworm, Corn Earworm, and Forage Looper in detail. Forbes, (1904) and Crumb (1929) made occasional mention of severe outbreaks which they were aware of from Michigan, but biological studies conducted on the species as they occur within the state seem to be lacking. For years the "U.S.D.A. Cooperative Economic Insect Report" and more recently the "Weekly Insect Report for Michigan Agriculture" have reported sporadic outbreaks of various pest species throughout the state.

In 1964, work was begun in ten states including Michigan¹ to study the movement of certain Noctuids, specifically Heliothis zea (Boddie), the Corn Earworm, within the region. This study, the first portion of a ten year project, covers a three year survey of Noctuids attracted to light. Its objectives were to check blacklight catches

¹Work sponsored by U.S.D.A. NC-67 Project.

for the time of occurrence of certain pest species. This included the seasonal distribution at each site and also the times of occurrence of peak populations between the southern and central locations--approximately 150 miles apart. Also, it was intended to add to the existing records of the biology of these species in Michigan by interpretation of light trap samples. For example, is a particular species an invasive form or is it capable of overwintering in Michigan? What is the probable overwintering stage for the state? How many broods per year are there in Michigan? Is there any correlation between peak occurrence of a species and cumulative thermal units over the two year period?

A REVIEW OF THE LIGHT TRAP METHOD OF SURVEY

Survey work by means of a blacklight trap is perhaps the most effective and productive single method known for sampling populations of Lepidoptera. Catches of over 2,000 Lepidoptera per night in one trap were not unusual during the study period. This apparent success however, may be biased for there are many possible fallacies and difficulties connected with a light trap study of this sort. C. B. Williams (1939, 1940) has set forth the idea that a light trap catch is proportional to both the size of the population and the activity of the individuals in it. There may be a very large population present around a trap and yet the catch will be negligible because there is no activity due to a number of factors. King (1962) states that, "The catch in any attractant sampling device does not reflect either the population or the weather, but both." A combination of these two statements is essential in analyzing any light trap results.

Possible effects of weather and other environmental factors on the activity of night-flying insects are perhaps paramount in determining the resultant catch. According to Williams, daily fluctuations in catch are the result of differences in activity, while monthly or long term fluctuations are actual population differences. The effect of a single weather factor is very difficult to analyze because of the great amount of interaction. The factors most commonly considered are: temperature, radiation, moisture, wind, atmospheric pressure, and thunderstorm activity. He continues, ". . . maximum temperature is

positively associated with minimum temperature, with the difference between minimum and grass minimum, with sunshine, and with the level of the barometer; but it is negatively associated with relative humidity, day rain, cloud and perhaps wind. Minimum temperature, on the other hand, is positively correlated with night rain, cloud, wind, and barometer."

Intensity and duration of moonlight are also factors which affect catch size (Williams, 1936). This may have been due simply to competition with the trap light source, as he demonstrated a definite reduction in catch when the moon was out. Field workers who have baited for moths have also noticed this effect with greater catches on cloudy nights. In a study similar to this conducted in Maine, higher catches were consistently recorded for cloudy nights (Dirks, 1937). Uvarov (1931) states regarding the effects of light, temperature, humidity, and atmospheric pressure that, "Data show that the daily activities of insects are directly dependent on the daily rhythm of the weather. It appears that most activities are influenced by combinations of several meteorological factors." He was of the opinion that it was not possible to explain these activity fluctuations by a single factor. Cook in 1923 did work in Minnesota on environmental influences that was comparable to a study completed earlier in Montana (Cook, 1921). He found humidity very important in moth flight, more activity occurring when the humidity is near the seasonal mean. The highest emergence of moths was found to occur during times of low humidity in Montana and during high humidity in Minnesota. Flight was affected more by fluctuations in temperature and pressure than in humidity. He felt that further studies along these lines would definitely intensify these

relationships.

Placement of the trap is another factor which has been shown to influence catch. Obviously, a trap placed on a woodlot will not secure an accurate sample of a species which characteristically inhabits fields and vice versa. The distance at which a trap is effective or the distance at which it can be plainly seen, is another factor to be considered. Although the population may be very large over a wide area, there are many areas within this range in which the species will be scarce. A trap placed on a hill with very few obstructions around it will normally produce a much larger catch on any given night than one placed near a building, or in a depression which tends to obstruct the view on one or more sides.

Trap height has also been shown to influence catch size. Williams (1939) consistently obtained a larger catch from a trap 35 feet above ground level as compared to one 3-1/2 feet above ground level. Stanley (1936) concurs and adds that the trap at 35 feet above the ground caught more than a trap on an 18 story building. These are very important considerations to make for placement of the light trap. Obviously comparisons between populations, areas, or traps are difficult if the trap locations are different from one station to the next, yet to attain equality in every detail is almost impossible.

The attractiveness of the light for a particular species is one more factor for consideration in light trap data. Results may be negative for a common species simply because it is not attracted to the trap. A source emitting close to the ultraviolet (3650 angstroms) was found most attractive by Dirks (1937). Gui, Porter, and Prideaux (1942) found that different colors of light (i.e., different wave

lengths) vary in their attractiveness. They found blue light to be the most attractive, followed by white, yellow, and red. More recent studies (Glick and Hollingsworth, 1954) show that blacklight traps, similar to the ones used in this study, are probably the most attractive source. This seems especially true for H. zea which was of special interest in this study. Deay (1965) found that lamps emitting in the middle and near ultraviolet regions attracted more earworm moths than any other lamp type. Similar results were obtained by Belton and Kempster (1963) in Canada. Although the light may be very attractive to many moths, their flight habits or secondary reactions to it may also influence the catch. Robinson (1952) illustrates this possibility in his discussion of congregation, inhibition, and repulsion by light sources. Observations of operating traps show that many moths will come to the vicinity of the trap, but prefer to remain just outside its halo, or to hover above the trap, or light on the ground or on objects around the trap. These moths should also be included in occurrence data, but because they do not end up in the trap, are not considered statistically. Males and females of a given species may possibly be attracted differently to a light source. Williams (1939) found that in almost all species of Noctuidae captured in numbers large enough for analysis, the proportion of males was much greater than of females. Males also commonly emerge earlier in the brood than females. It can readily be seen that the possibility of error in predicting the duration of a brood as shown by nightly sampling is considerable.

METHODS

All sampling was conducted with light traps of two kinds--a motor driven "Spinsect"¹ and a U.S.D.A. omnidirectional blacklight trap (Bull. Ent. Soc. Am., Mar. 1966, pp. 31). The "Spinsect" trap consists of a fan located inside a circular blacklight tube approximately 8 inches in diameter, which is designed to throw the insects attracted to the light into a detachable plastic box for retaining the collection. These were in operation during 1964 from May 1 through September 15 in Galien, Michigan, and from June 20 through September 15 in East Lansing, Michigan. During 1965 both traps were in operation from April 15 through September 15. The traps were examined daily and the collections stored in a refrigerator until identifications and counts could be accurately made. All macrolepidoptera were identified. A small paper sack containing approximately two tablespoons of "Cyanogas G. Fumigant" was placed in the traps as a killing agent every two days. Moths damaged beyond recognition for any reason were not considered in the counts.

¹Manufactured by Ampsco Corporation, Columbus, Ohio

RESULTS

All data are presented in the form of graphs of occurrence for the two years at each location. All graphs use the $\log (n + 1)$ for the number (Williams, 1939) and accumulative thermal units (Arnold, 1960) for the time of occurrence. The use of the geometric instead of the arithmetic mean by the use of the $\log (n + 1)$ for the number of insects more equally distributes the number of samples above as well as below the mean. Also it is an advantage in graphing results of this sort which may range from zero to 1,000 or more in that the space necessary to graph a thousand or more becomes proportional to that necessary to graph 10 or less, reducing the size of the graph to reasonable limits. Thermal units are used on the graphs in place of dates because of the probability of these being more constant over a prolonged period than calendar dates. A thermal unit by Arnolds' definition is a heat unit similar to a day degree, but with a slight correction unit for lower temperatures. In figuring day degrees a base temperature, usually 50 degrees, is selected and the difference between this base temperature and the average of the maximum and minimum temperatures for the day is the number of day degrees, provided the number is positive. If, as is often the case in the spring, there is a warm day which aids in development of the insect, but a very cool night, no day degrees would be accumulated even though during the warm part of the day heat units were absorbed. With Arnolds' method, units would be added to the cumulative total to account for this midday warmth by

using his thermal unit chart for days with average temperatures below the normal base temperature (in this study 50 degrees).

Graph 1 gives the accumulative thermal units for the two locations by year during the time of operation of the traps. 1964 was slightly warmer throughout the season than 1965, but the slopes of the lines for both years appear identical and there does not seem to be a consistently earlier occurrence of peak populations in 1964 over 1965 as might be expected, since 1964 was warmer.

Of foremost importance in this project is the Corn Earworm, Heliothis zea (Boddie). This pest occurs throughout much of the United States and is given a number of common names that coincide with its varied food habits. In Michigan it is an important pest of corn. In the south up to six generations per year have been recorded (Forbes, 1904). This diminishes towards the North, and in Michigan there is one generation with a partial second brood each year. The species overwinters in the pupal stage in the southern states. Graphs 2 and 3 show the occurrence of H. zea over the past two years. The adult moths occur sparingly (4 or 5 captures being the maximum number) before the middle of August, with the greatest numbers occurring the second week in September. Adults were still being taken at Galien after the first of November. On June 1, 1965, one specimen was taken at Galien, the earliest record known for the state. During the remainder of the month three other specimens were taken by collectors in the southern and central parts of the state: in Berrien County on June 4 and June 28, 1965; in Newaygo County on June 27, 1965; and in Ionia County on July 1, 1965. This poses the question of the possibility of the earworm overwintering in Michigan under favorable

conditions. For years it has been felt that this moth is incapable of overwintering north of a line through Cleveland, Ohio, parallel to the southern border of Michigan. Recently, however, earworm pupae have been shown to overwinter in sheltered locations in Wisconsin (Mangat and Apple, 1965). Assuming that a number of these sheltered pupation sites could occur naturally, it does not seem unreasonable that the overwintering of a small portion of the resident population is also possible in Michigan. Previously the population build-up here has been attributed solely to earworm moths which have migrated into the state. The record taken on June 1 was a bright immaculate specimen, which gave no indication of having flown for an extended period. The data indicate then, that overwintering experiments are desirable. If the findings are coupled with expanded trapping for the state they might well demonstrate a small overwintering population which, together with the invasionary group each spring, combine to produce the big fall population. This of course suggests the possibility of earlier and more severe outbreaks following winters of mild, favorable weather due to an increase in the number of pupae overwintering in the state.

The true armyworm, Pseudaletia unipuncta Haworth, is a pest whose populations often increase into destructive numbers in parts of Michigan. Graphs 4 and 5 show the occurrence of this moth during the study. In June of 1964, a severe outbreak of the armyworm occurred in southwestern Michigan, including the area around Galien. The adults of this population appear in the trap data during late June and early July 1964 (thermal units 1100-1700). There does not appear to be an unusual jump in the East Lansing population for the period, although a late start for that trap in 1964 may be misleading. The first armyworm

adults appear in early May and then seem to remain in a continuous population throughout the rest of the season. Larvae, pupae, and adults are reported to overwinter, with the majority being larvae. From the unusually early build-up (some moths being present in April) the survey indicates that in Michigan sufficient adults overwinter to form the nucleus for the seasonal build-up.

The occurrence of the bristly cutworm, Lacinipolia renigera Stephens, is shown in Graphs 8 and 9. This is a very common moth at blacklight traps throughout the state. It overwinters as a larva and has two broods per year (Forbes, 1878; 1904), which is well authenticated by the data. No reports were received of serious damage by this cutworm during the study.

A common problem genus is the Feltia spp. group of cutworms depicted in Graphs 10 and 11. These were by far the most numerous moth species taken, up to 700 in a trap in one night. These graphs concern three species, Feltia ducens Walker, F. subgothica Haworth, and F. herilis Grote, which were lumped collectively under Feltia spp. because of their apparent similarity in the adult and larval stages. This species complex is single brooded and overwinters in the larval stage (Stanley, 1936). Slingerland (1895) mentions the complex as common but rarely damaging. He does cite one severe outbreak in Michigan during 1890. Despite the large numbers trapped, no reports are known of damage during either year due to the Dingy Cutworm or related species.

Graphs 16 and 17 give the occurrence of the Clover Looper, Caenurgina crassiuscula Haworth, and the Forage Looper, C. erechtea Cramer. Again the adults are very similar and both species are

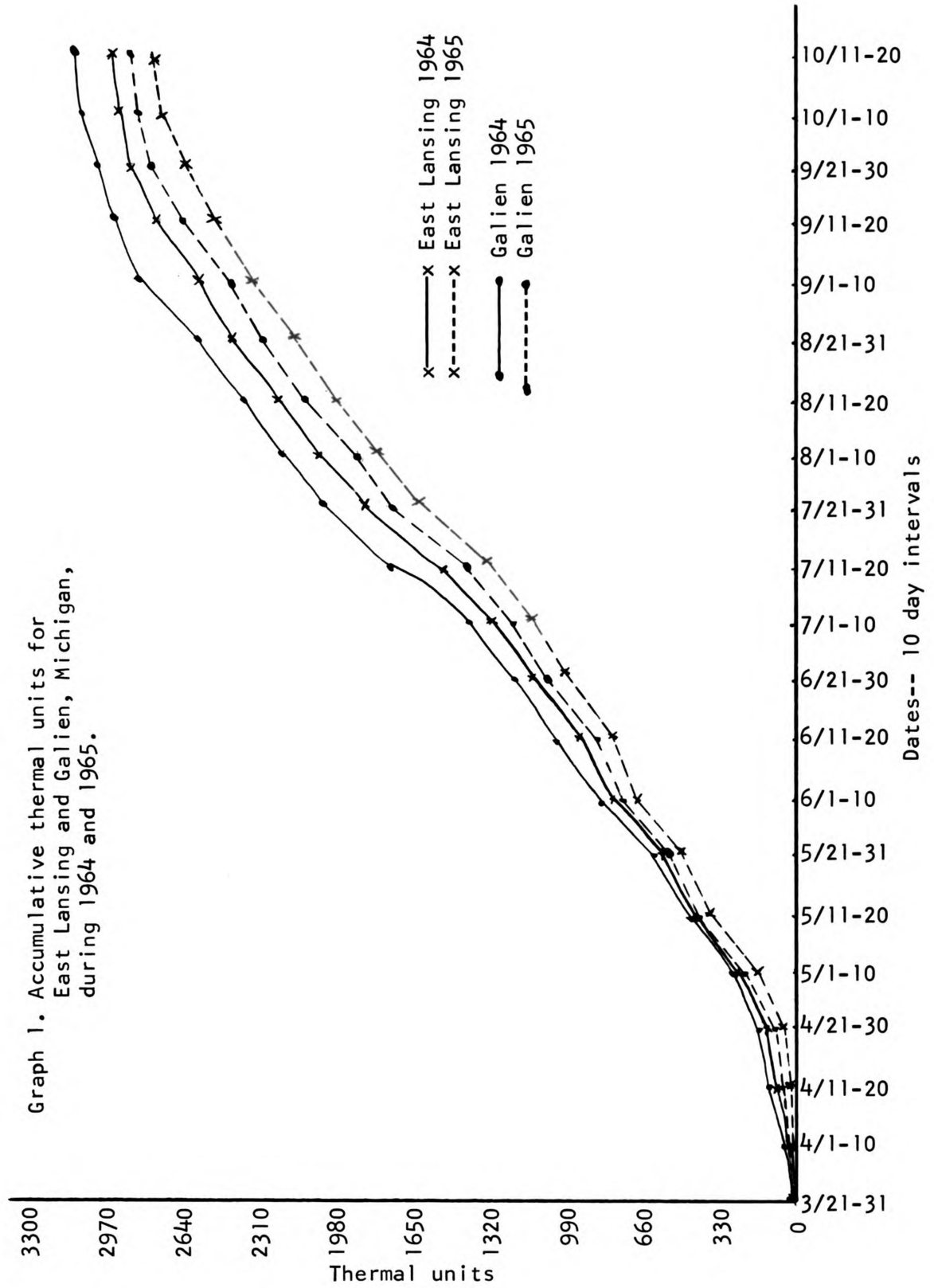
lumped under C. crassiuscula on the graphs. This moth occurs from May to October, but economically during the past two years was not important. Smith (1924) records three broods for the species with an occasional fourth in Kansas. Forbes records three broods for the species with an unexplained break in June. This is borne out by these records including the unexplained dip in June (700-800 thermal units). The first brood was extremely small and dark by comparison with the others.

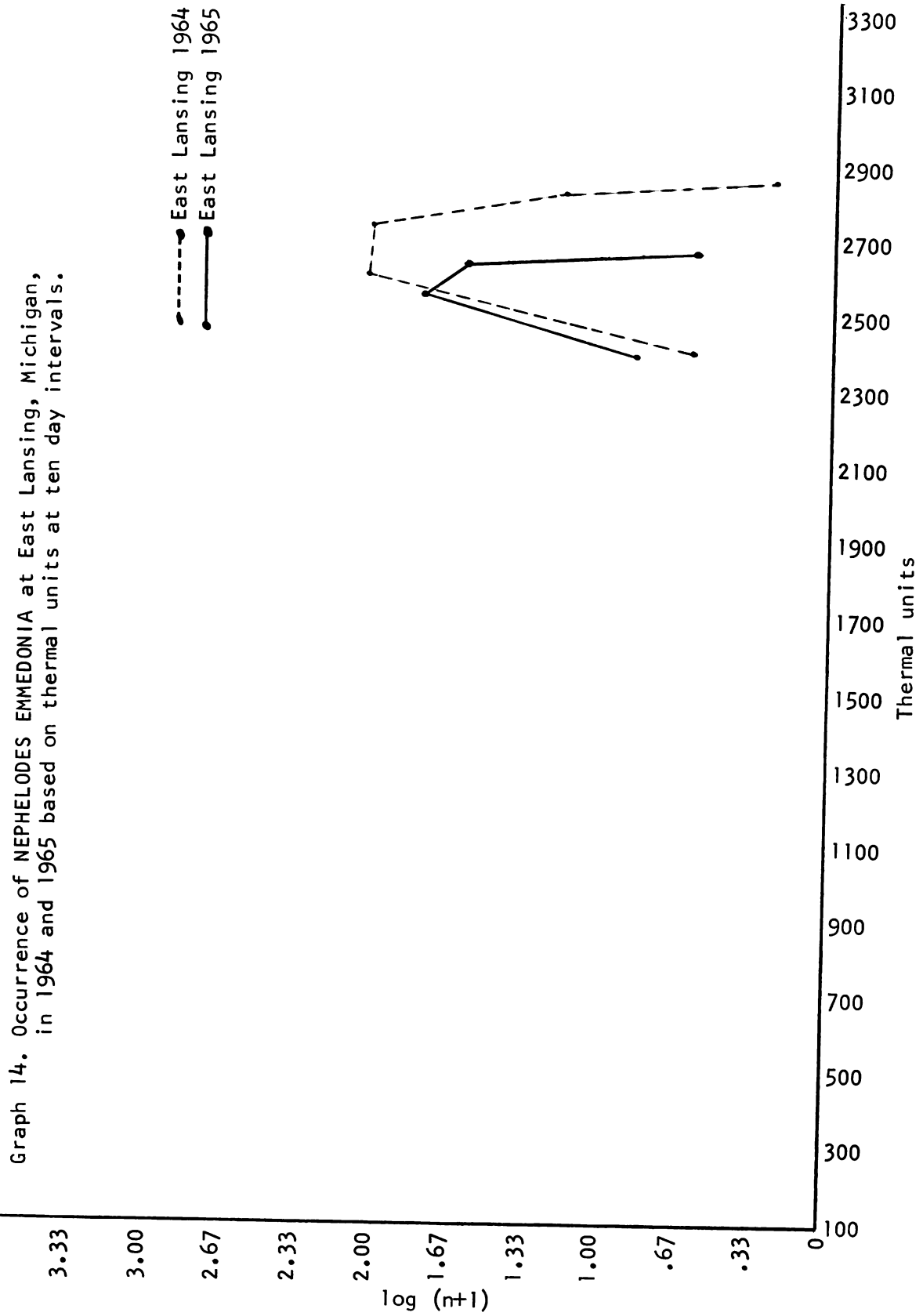
Plathypena scabra Fabricius, the Green Clover Worm, occurred sporadically at Galien, but at East Lansing remained constant, especially in 1964. Reports of damage by this insect were heavier than normal from the bean growing area of the state, in the Saginaw and Bay County areas, in 1964. This infestation may have been indicated by the very high East Lansing catches that summer, but as mentioned earlier, differences in trap location between Galien and East Lansing, or different activity levels in the populations at the two sites may have been responsible. The species overwinters as a pupa or adult (Hill, 1918) and some seasons produces a partial third generation in Michigan.

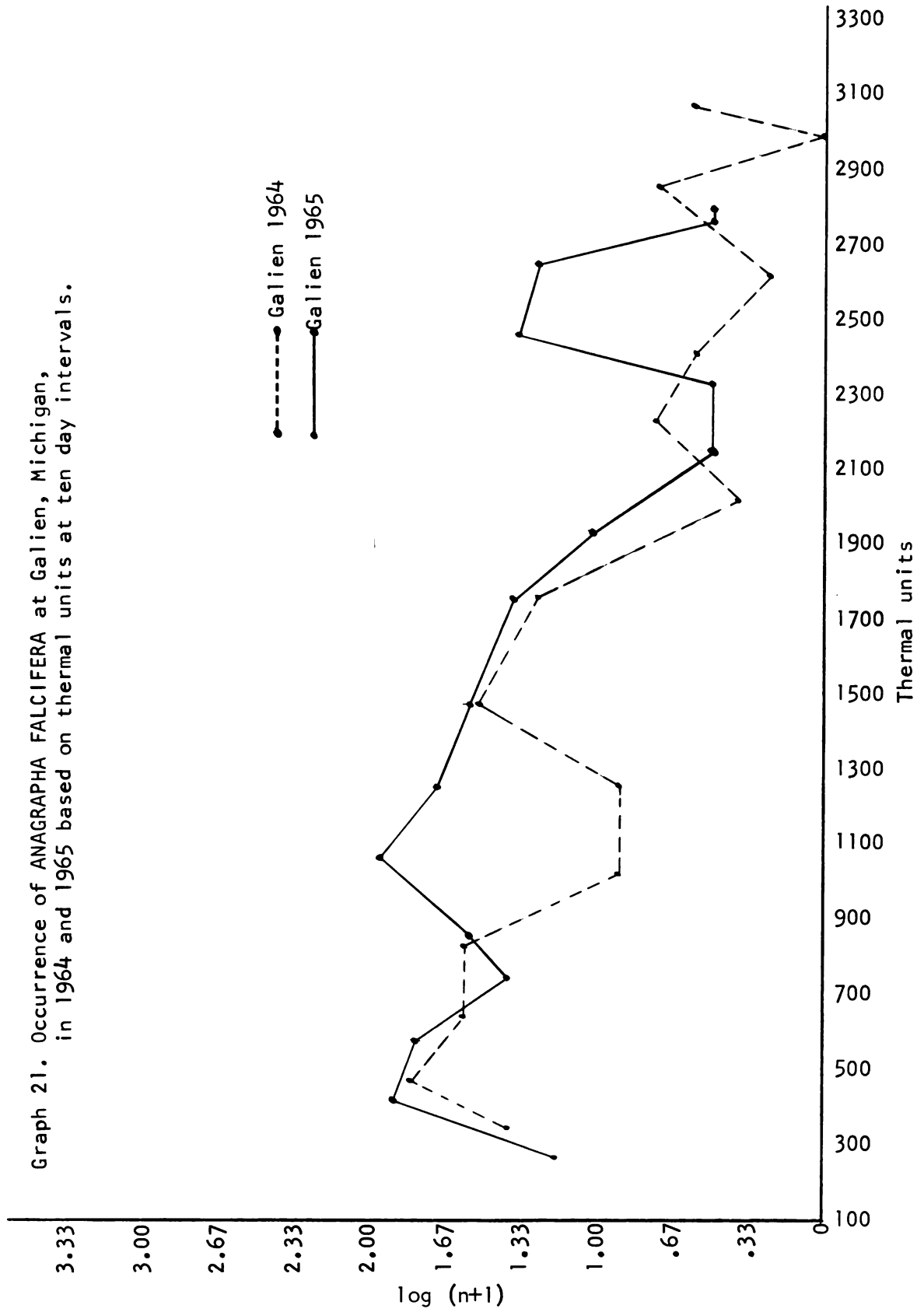
Several of the species are graphed in addition to those discussed above for the purpose of showing seasonal trends in the population. Included in this report are graphs of the occurrence of Amathes c-nigrum Linnaeus (Spotted Cutworm), Anagrapha falcifera Kirby (Celery Looper), Crymodes devastator Brace (Glassy Cutworm), Agrotis ipsilon Linnaeus (Black Cutworm), Nephelodes emmedonia Guenee (Bronzed Cutworm), and Peridroma saucia Hubner (Variegated Cutworm) for the two years of the study. All are known pests at various times in the state, but no

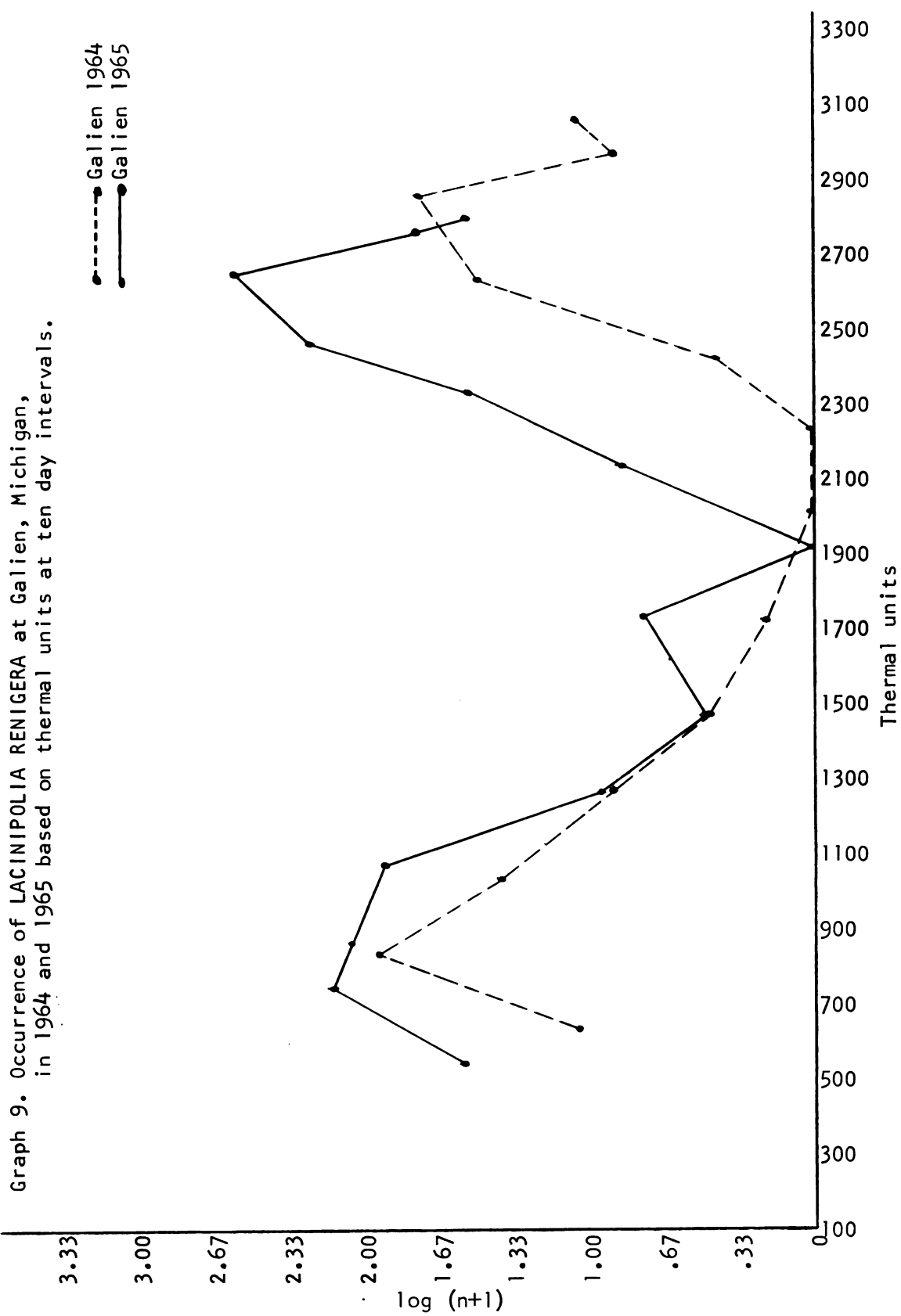
serious outbreaks occurred during the two years of intense trapping. Numbers taken during the trap years were insufficient to attempt any conclusions regarding seasonal history for the state.

Graph 1. Accumulative thermal units for East Lansing and Galien, Michigan, during 1964 and 1965.

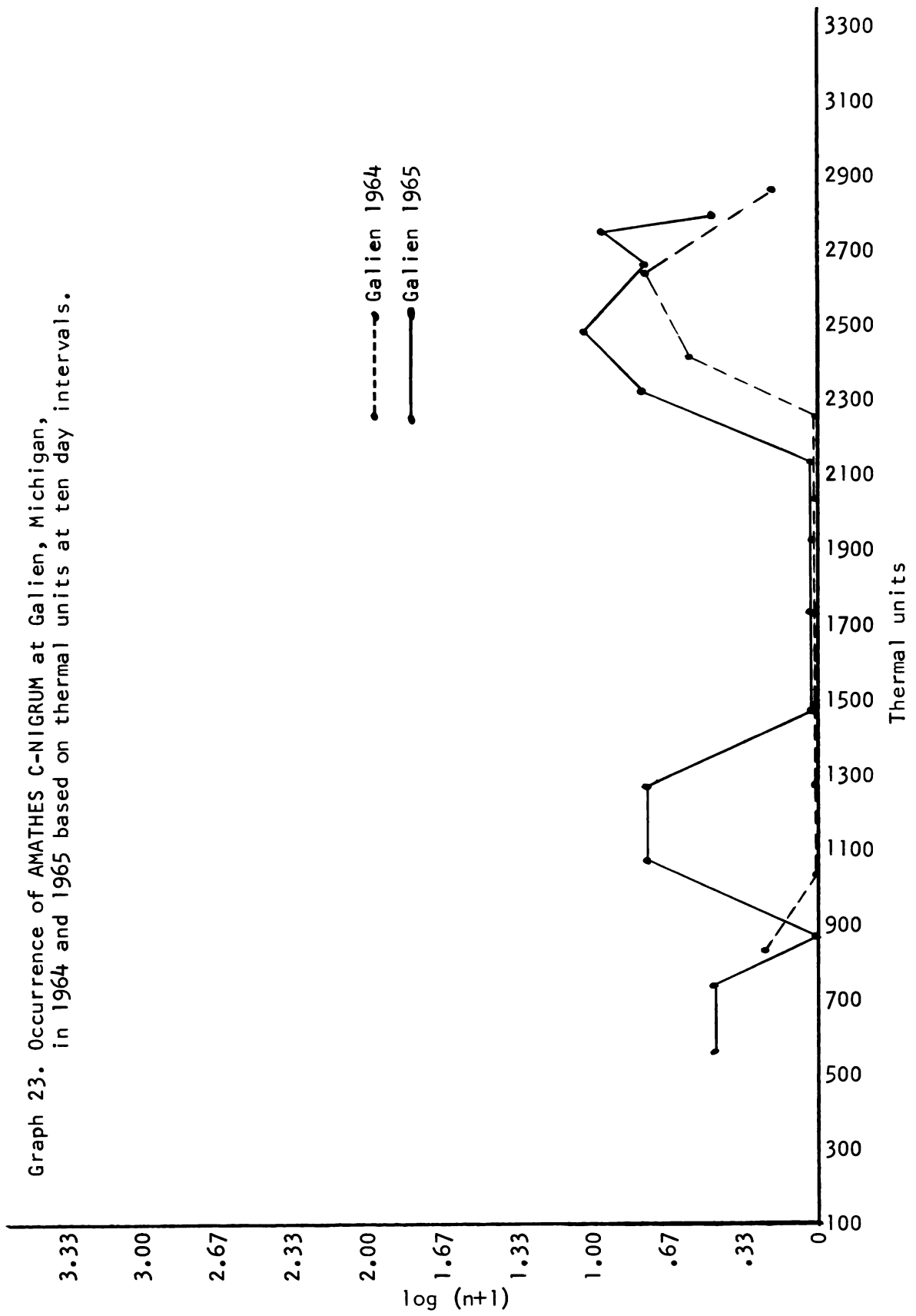




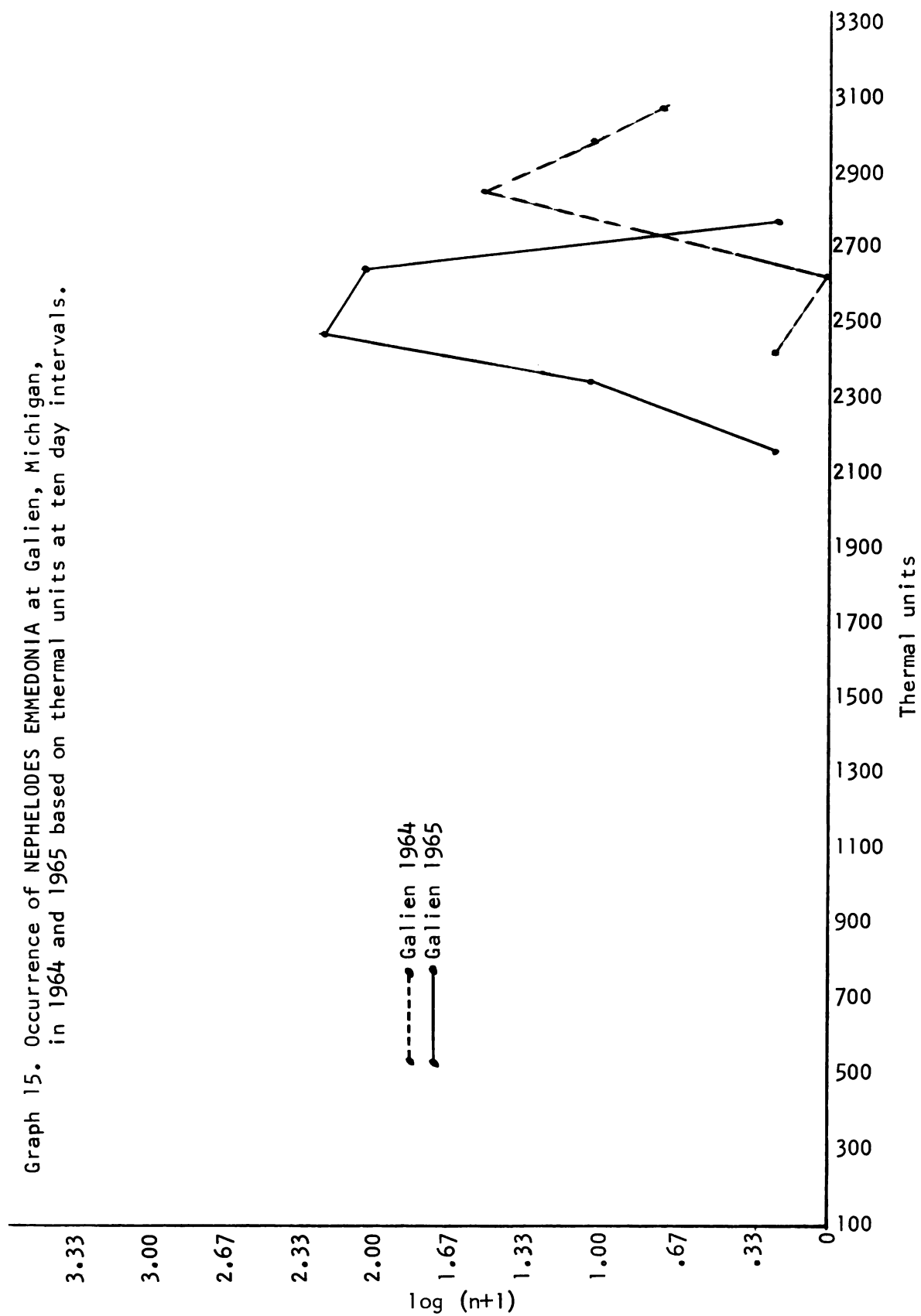


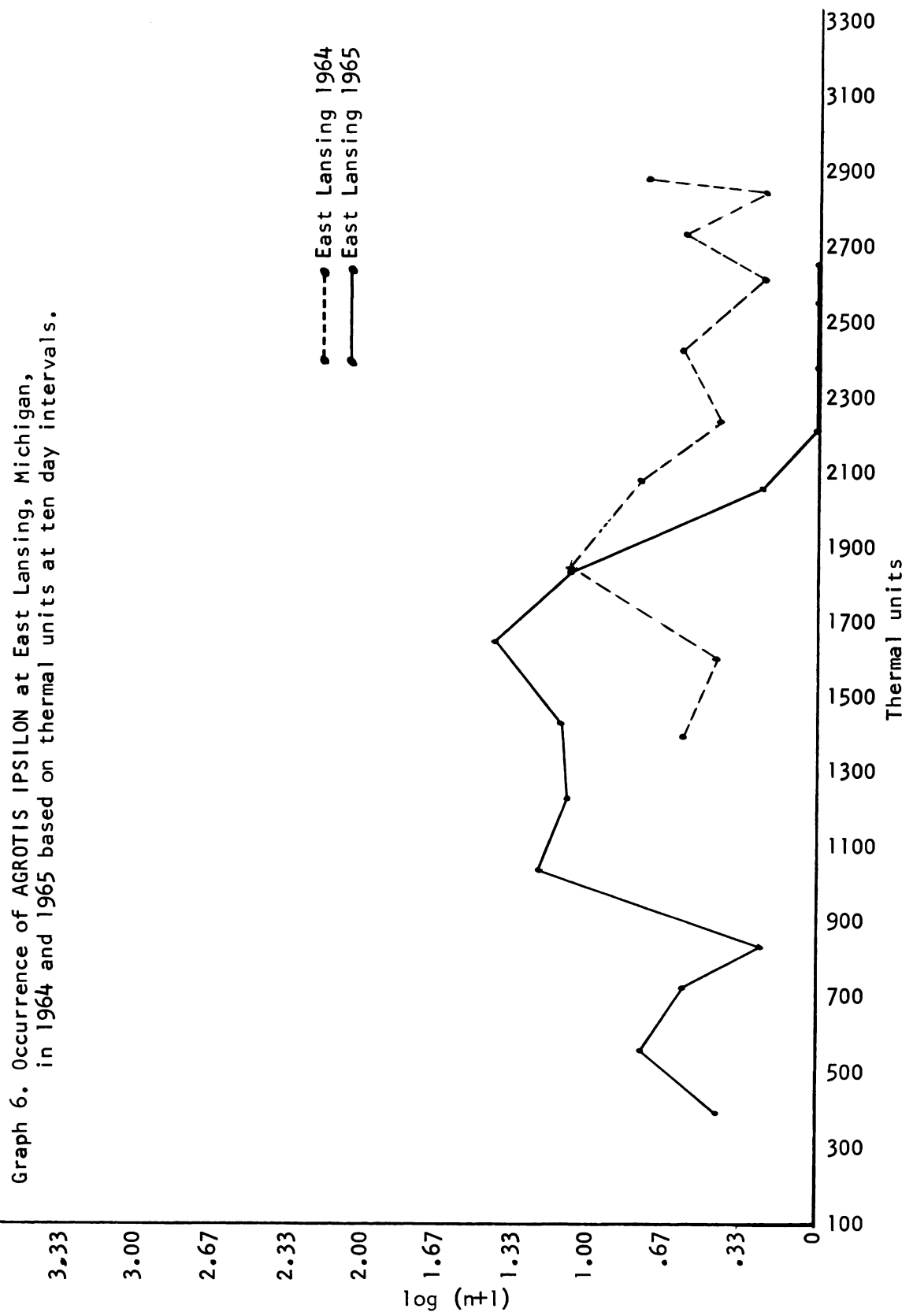


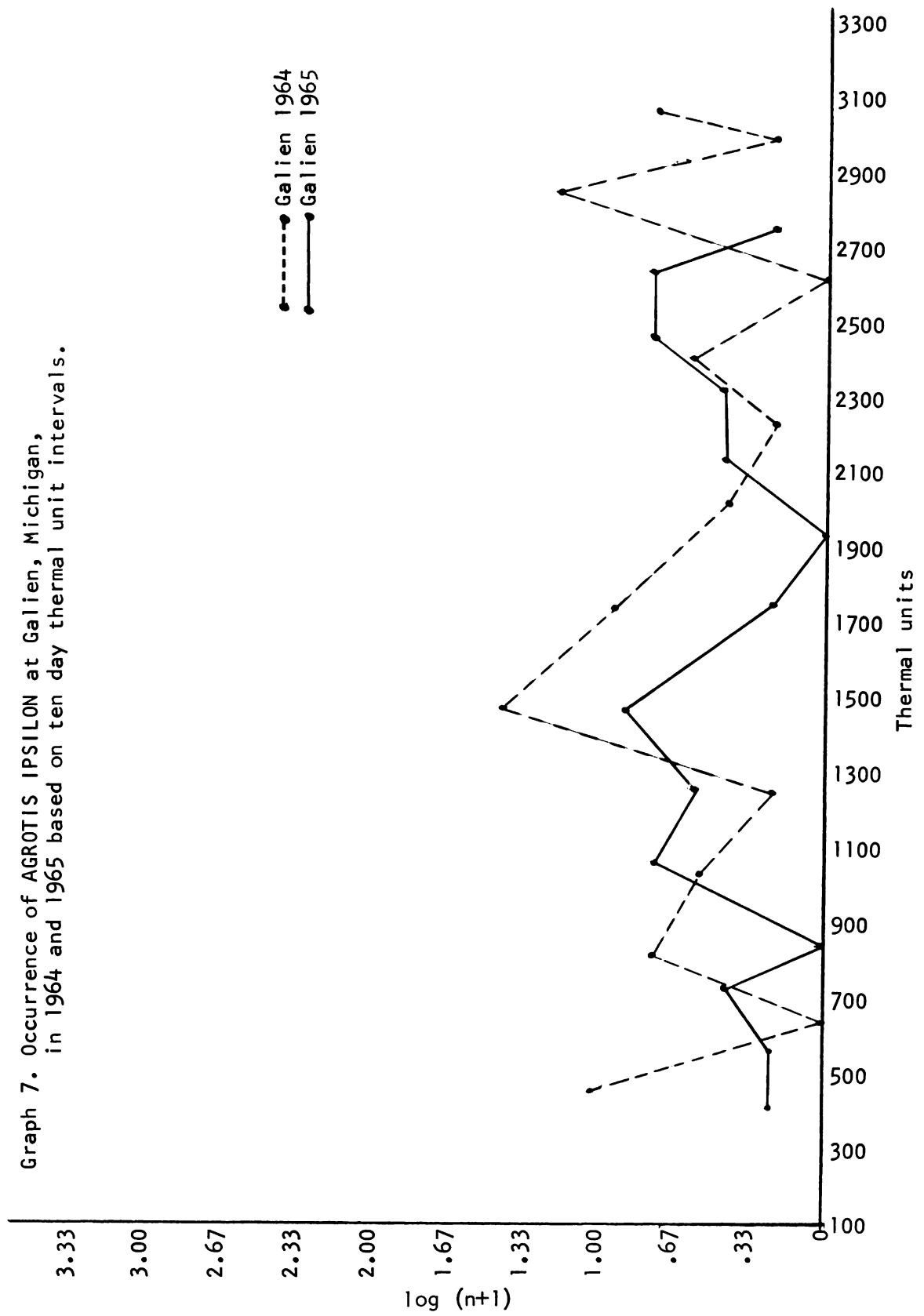
Graph 23. Occurrence of AMATHES C-NIGRUM at Galien, Michigan,
in 1964 and 1965 based on thermal units at ten day intervals.



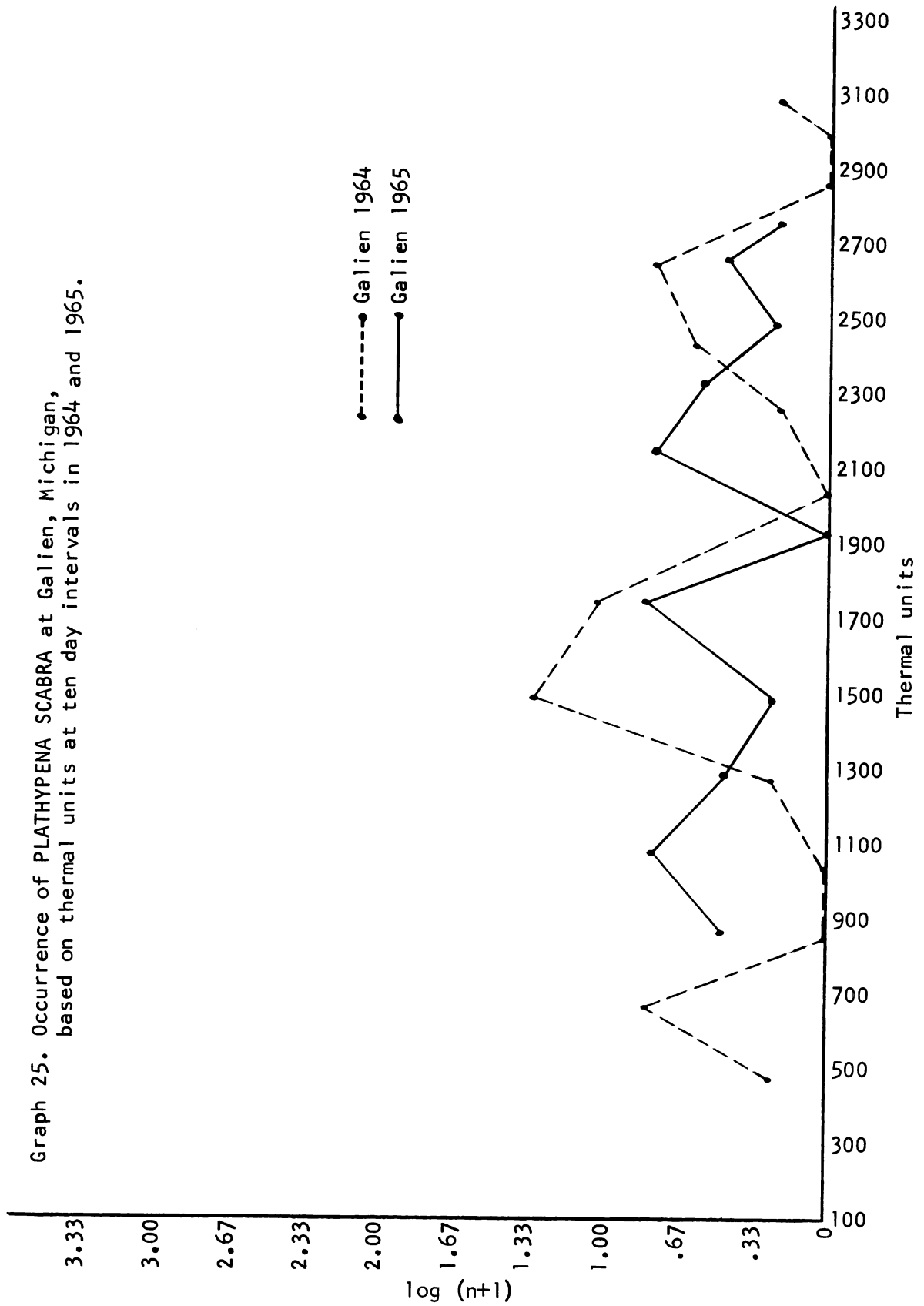
Graph 15. Occurrence of NEPHELODES EMMEDONIA at Galien, Michigan,
in 1964 and 1965 based on thermal units at ten day intervals.







Graph 25. Occurrence of PLATHYPENA SCABRA at Galien, Michigan, based on thermal units at ten day intervals in 1964 and 1965.



ADDITIONAL NOCTUID RECORDS

In addition to the species previously discussed, 159 other species of Noctuidae were taken in the two years of trapping. The Appendix lists the relative abundance of these species. The majority of these species were taken in numbers of less than 10. The numbers are combinations of the Galien and East Lansing traps for each year.

Five species of noctuid moths were taken during the study for the first time in the state. These included:

Bendis detrahens Walker.--Taken at Galien on June 1, 1965. According to Forbes (1954), previously known from southern states, north to the vicinity of Washington, D.C., with stragglers to east New York, Long Island, Pennsylvania and Decatur, Illinois.

Condica cupentia Cramer.--At Galien on September 22, 1965. Forbes reports this species as southern, straggling as far north as Maine and Wisconsin.

Elydna gulnare Strecker.--A male at Galien on June 26, 1965; female at Galien on July 14, 1965. Existing records shown by Forbes from Pennsylvania, Illinois, and Texas.

Schinia thoreaui Grote and Robinson.--At Galien on August 22, 1965. Previously recorded by Forbes from New York to Alabama, west to Illinois, Kansas and Arizona.

Spragueia onagrus Guenee.--At Galien on July 2, 16, 21, 1964; August 6, 1964; September 4, 5, 6, 1964. None taken in 1965. Generally southern distribution, rarely reaching as far north as Illinois.

All of the above records were taken at Galien. Galien, being in the extreme southern part of the state, appears an ideal location for picking up extensions of distribution for species which have previously been known only from areas further south or west.

DISCUSSION

These data as presented are not meant to be a comparison between locations because of the obvious differences between sites. Of prime importance in locating the traps was ease of servicing and the availability of electricity. In order to satisfy these requirements, the East Lansing trap was placed in the bee yard at the Michigan State University apiary. The trap, a "Spinsect" type was located on a mowed section of lawn next to a small woodlot and overlooking pastureland on one side during both years. The Galien trap during 1964, a "Spinsect" type, was placed on top of a one story building in an open field located about a mile east of town on Highway M-60. During both years this open location at Galien produced much larger and more varied catches than the East Lansing trap. During 1965 a U.S.D.A. omnidirectional trap, placed on the ground was used at Galien instead of the "Spinsect". This reduces the possibility of comparing 1964 and 1965 catches at the Galien location because of possible differences in trap efficiency.

During 1965 both a "Spinsect" and a U.S.D.A. omnidirectional trap were placed in an open field at the Rose Lake Wildlife Experiment Station, ten miles northeast of East Lansing, with the intention of comparing the two types of traps. During the first three weeks of trapping, counts of the moths taken in each trap were kept, but it soon became apparent that for sheer numbers, the U.S.D.A. omnidirectional type was best. Deay (1965) found that traps equipped with fans were

definitely superior to gravity types, so once again the idea of trap location may be interfering. It should perhaps be noted that the catch of midges was consistently higher in the "Spinsect" trap. Further study using the two traps might result in positive preference by certain groups for one trap or the other, but no conclusion is possible from these data at present.

The August and September catches were consistently larger each year than those of any other month. The Agrotis spp. and Graphiphora spp. comprised the majority of the daily catches during these months.

These data, being taken strictly for survey purposes, are not suitable for analysis of the effect of the environmental factors discussed in the Introduction. In addition, the two year duration of the study is too short a period to attempt any conclusions regarding the apparent effect of these factors due to the difficulty of establishing a reliable mean for comparison. Trapping is to be continued however, at one of these locations and in another three years enough information of the proper type will have been gathered to allow analysis of the activity of many of these important species.

CONCLUSION

Complying with plans for a ten-year project, data from a preliminary survey of Noctuidae occurring in the state has been presented in the form of graphs of occurrence of several known pest species. These data are presented as an aid to the study of the biology of these species by measuring, within the limitations mentioned, the numbers of any species active at any particular locality or date. Of particular interest has been the dates of appearance and relative lengths and size of broods, as well as preliminary records for changes in populations from Galien to East Lansing during 1964 and 1965. In view of the variation in trapping stations and the lack of specific measurements of associated environmental conditions, nothing outside of the survey data has been attempted. A discussion of some of the inherent problems has been included as a foundation for the next phase of the project.

The work shows the need for greatly expanded blacklight survey within the state. The need for biological information on these species within the state such as overwintering experiments with the Corn Earworm is pointed out. Other possibilities suggested by this project include work on species preference for different traps and or wavelengths of light; the affects of trap location on catch and further information on the problem of environmental factors influencing activity.

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APPENDIX

RELATIVE ABUNDANCE OF NOCTUIDAE TAKEN AT LIGHT TRAPS
IN SOUTHERN MICHIGAN

x = present 1-10
 xx = present 11-30
 xxx = present--more than 30

Name	Year	Month					
		April	May	June	July	August	September
Noctuidae							
<u>Abagrotis placida</u> Grote	1964				x		xx
	1965				x	x	xx
<u>Abrostola urentis</u> Guenee	1964				xx	x	x
	1965		x	x	x	x	x
<u>Achatodes zaea</u> Harris	1964						
	1965				x		
<u>Acontia aprica</u> (Hubner)	1964						
	1965						x
<u>Acronycta</u> spp.	1964		xx	x	x	x	
	1965		xx	x	x		
<u>Agroperina dubitans</u> Walker	1964				x	xxx	x
	1965					x	
<u>Agroperina helva</u> Grote	1964				x	xx	x
	1965					xx	xx
<u>Agrotis gladiaris</u> Morrison	1964					x	xxx
	1965						xxx
<u>Agrotis venerabilis</u> Walker	1964						xxx
	1965				xx		xxx

<u>Name</u>	<u>Year</u>	<u>April</u>	<u>May</u>	<u>June</u>	<u>Month</u>		
					<u>July</u>	<u>August</u>	<u>September</u>
<u>Agrotis vetusta</u> Walker	1964						xx
	1965						xxx
<u>Agrotis volubilis</u> Harris	1964		x				
	1965		xx				
<u>Amphipyra pyramidoides</u> Guenee	1964				x		xx
	1965						xx
<u>Amyna octo</u> Guenee	1964						
	1965						x
<u>Anaplectoides prasina</u> McDunnough	1964					x	
	1965						
<u>Anathix puta</u> Grote & Robinson	1964						x
	1965						x
<u>Anepia capsularis</u> Guenee	1964						
	1965		x				
<u>Anomogyna elimata</u> Guenee	1964						
	1965					x	
<u>Anorthodes tarda</u> Guenee	1964						
	1965		xx	x		x	x
<u>Apamea americana</u> Speyer	1964			x	xxx	xxx	x
	1965			x	xxx	xxx	x
<u>Apamea velata</u> Walker	1964				x		
	1965						

Name	Year	April	May	June	Month		August	September
					July	August		
<u>Argyrostroma anilis</u> Drury	1964				x			
	1965				x	x		
<u>Autographa ampla</u> (Walker)	1964							
	1965					x		
<u>Autographa biloba</u> (Stephens)	1964		xx	x	x	x		
	1965		x	x	xx			
<u>Autographa contexta</u> Grote	1964							
	1965			x	x		x	
<u>Autographa oo</u> (Cramer)	1964							
	1965						xxx	
<u>Autographa ou</u> Guenee	1964							x
	1965							
<u>Autographa oxygramma</u> Geyer	1964							
	1965						x	
<u>Autographa precatioris</u> Guenee	1964		x	x	xx	x	x	
	1965		xx	xx	xxx	xx	xxx	
<u>Baileya australis</u> Grote	1964							
	1965		x			x	x	
<u>Baileya dormitans</u> (Guenee)	1964							
	1965			x				
<u>Balsa malana</u> Fitch	1964							
	1965			x				

<u>Name</u>	<u>Year</u>	<u>Month</u>				
		April	May	June	July	August September
<u>Bellura gortynoides</u> Walker	1964					
	1965			x		
<u>Bomolocha</u> spp.	1964				x	
	1965					
<u>Canaptylochila americalis</u> Guenee	1964					
	1965			x		
<u>Catocala</u> spp.	1964				x	x
	1965				x	xxx
<u>Celiptera frustulum</u> Guenee	1964					
	1965					x
<u>Ceramica picta</u> (Harris)	1964		xx	xx		x
	1965		x	x		x
<u>Cerastis tenebrifera</u> (Walker)	1964					
	1965		x			
<u>Chamyris cerintha</u> (Treitschke)	1964					
	1965			x		
<u>Choephora fungorum</u> Grote & Robinson	1964					
	1965					x
<u>Chytonix palliatricula</u> (Guenee)	1964					
	1965			x		
<u>Chytonix sensilis</u> (Grote)	1964					
	1965				x	

<u>Name</u>	<u>Year</u>	<u>April</u>	<u>May</u>	<u>June</u>	<u>Month</u> <u>July</u>	<u>August</u>	<u>September</u>
<u>Colocasia propinquilinea</u> (Grote)	1964 1965			x			
<u>Cosmia canescens</u> Behr	1964 1965				x		
<u>Crambodes talidiformis</u> Guenee	1964 1965		x			x	
<u>Cryptocala acadiensis</u> (Bethune)	1964 1965					x	
<u>Cuculia asteroides</u> Guenee	1964 1965		x			x	
<u>Cuculia convexipennis</u> Grote & Robinson	1964 1965					x	
<u>Delta ramosula</u> (Guenee)	1964 1965		x		x	x	xx
<u>Dipterygia scabriuscula</u> (Linnaeus)	1964 1965			x		x	
<u>Elaphria grata</u> Hubner	1964 1965				x	x	
<u>Epiglaea apiata</u> Grote	1964 1965						x
<u>Erastria bellicula</u> Hubner	1964 1965			x			

Name	Year	April	May	June	Month		
					July	August	September
<u>Erastria carneola</u> Guenee	1964		x	x	xx	xx	x
	1965		x	x		xx	x
<u>Euagrotis lubricans</u> (Guenee)	1964						
	1965				x		
<u>Euherrichia monetifera</u> (Guenee)	1964						
	1965			x			
<u>Eupsilia devia</u> (Grote)	1964						
	1965	x					
<u>Eupsilia tristigmata</u> (Grote)	1964						
	1965	x					
<u>Eupsilia vinulenta</u> (Grote)	1964						
	1965		x				
<u>Euthisanotia grata</u> Fabricius	1964				x		
	1965				x	x	
<u>Euxoa declarata</u> Walker	1964						
	1965				x		
<u>Euxoa detera</u> Walker	1964						
	1965			x			
<u>Euxoa messoria</u> Harris	1964		x	x	xxx	x	xxx
	1965				x	xx	xx
<u>Euxoa redimicula</u> Morrison	1964				x		
	1965				x	xx	x

<u>Name</u>	<u>Year</u>	<u>April</u>	<u>May</u>	<u>June</u>	<u>Month</u> <u>July</u>	<u>August</u>	<u>September</u>
<u>Euxoa tessellata</u> (Harris)	1964 1965			x	x		
<u>Euxoa velleripennis</u> (Grote)	1964 1965					xx xxx	xxx xxx
<u>Feltia geniculata</u> Grote & Robinson	1964 1965						x
<u>Galgula partita</u> Guenee	1964 1965		x xx	x xx	xx	xxx x	x x
<u>Graphiphora badinodis</u> Grote	1964 1965						xx xxx
<u>Graphiphora bicarnea</u> Guenee	1964 1965					xxx xxx	xx xxx
<u>Graphiphora collaris</u> Grote & Robinson	1964 1965					x	x
<u>Graphiphora normaniana</u> (Grote)	1964 1965					x xx	xx xx
<u>Graphiphora smithi</u> Snell	1964 1965			x	x x	xxx xx	xxx xxx
<u>Graphiphora treatii</u> (Grote)	1964 1965					x	
<u>Harpaglaea sericea</u> (Morrison)	1964 1965						x

<u>Name</u>	<u>Year</u>	<u>April</u>	<u>May</u>	<u>June</u>	<u>Month</u> <u>July</u>	<u>August</u>	<u>September</u>
<u>Heliothis paradoxa</u> (Grote)	1964 1965				x	x	
<u>Heliothis phloxiphaga</u> Grote & Robinson	1964 1965		x x	x x	x	x	
<u>Heliothis virescens</u> Fabricius	1964 1965				x		
<u>Helotropha reniformis</u> (Grote)	1964 1965					x	x
<u>Homoglaea hircina</u> Morrison	1964 1965	x					
<u>Hydroecia stramentosa</u> Guenee	1964 1965						x
<u>Hypena humuli</u> (Harris)	1964 1965				x		
<u>Hyppa xylinoides</u> (Guenee)	1964 1965		x				
<u>Lacinipolia implicata</u> McDunnough	1964 1965						x
<u>Lacinipolia meditata</u> (Grote)	1964 1965		x			xx	xx
<u>Laphygma frugiperda</u> Abbot & Smith	1964					x	x

Name	Year	April	May	June	Month		
					July	August	September
<u>Lemmeria digitalis</u> (Grote)	1964 1965						x
<u>Leucania</u> spp.	1964 1965		xx xxx	xx xxx	xxx x	xxx xxx	x xxx
<u>Leuconycta diphteroides</u> Guenee	1964 1965		x	x		x	
<u>Lithophane antennata</u> (Walker)	1964 1965						x
<u>Lithophane cinerosa</u> (Grote)	1964 1965						x
<u>Macronoctua onusta</u> Grote	1964 1965						x
<u>Metaxaglaea inulta</u> Grote	1964 1965				x		
<u>Morrisonia confusa</u> (Hubner)	1964 1965		x				
<u>Neorastria apicosa</u> (Haworth)	1964 1965					x	
<u>Ochropleura plecta</u> (Linnaeus)	1964 1965		x	x	x	x	x x
<u>Ogdoconta cinereola</u> (Guenee)	1964 1965		x			x	

<u>Name</u>	<u>Year</u>	<u>April</u>	<u>May</u>	<u>June</u>	<u>Month</u>		
					<u>July</u>	<u>August</u>	<u>September</u>
<u>Oligia fractilinea</u> Grote	1964				xx	xx	
	1965				x	x	x
<u>Oligia mactata</u> (Guenee)	1964						
	1965					x	
<u>Oligia modica</u> (Guenee)	1964						
	1965						x
<u>Orthodes crenulata</u> (Butler)	1964		x				
	1965			xx	x	xxx	xx
<u>Orthodes cynica</u> Guenee	1964						
	1965			x			
<u>Orthodes furfurata</u> (Grote)	1964						
	1965					x	
<u>Orthodes vecors</u> Guenee	1964						
	1965				x		
<u>Orthosia hibisci</u> Guenee	1964						
	1965	xx	x				
<u>Orthosia revicta</u> Morrison	1964						
	1965	x	x				
<u>Paectes oculatrix</u> (Guenee)	1964						
	1965			x	x		
<u>Paleoplusia venusta</u> Walker	1964						
	1965						x

<u>Name</u>	<u>Year</u>	<u>April</u>	<u>May</u>	<u>June</u>	<u>Month</u>		
					<u>July</u>	<u>August</u>	<u>September</u>
<u>Palthis angulalis</u> Hubner	1964 1965				x		
<u>Panapoda rufimargo</u> Hubner	1964 1965				x		
<u>Papaipema</u> spp.	1964 1965				x	x xxx	xx xxx
<u>Phlogophora periculosa</u> Guenee	1964 1965					x	
<u>Phoberia atomaris</u> Hubner	1964 1965		x				
<u>Plagiomimicus pityochromus</u> Grote	1964 1965				x	x	
<u>Platysenta videns</u> (Guenee)	1964 1965		x x			x	xx
<u>Plusia aerea</u> Hubner	1964 1965			x x	x x	x x	x x
<u>Plusia aereodes</u> Grote	1964 1965				x		
<u>Plusia balluca</u> Geyer	1964 1965				x x		x
<u>Plusiodonta compressipalpus</u> Guenee	1964 1965				x		

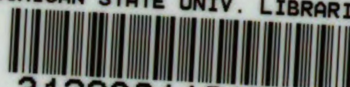
<u>Name</u>	<u>Year</u>	<u>April</u>	<u>May</u>	<u>June</u>	<u>Month</u>		
					<u>July</u>	<u>August</u>	<u>September</u>
<u>Polia adjuncta</u> Boissduval	1964		x		x		
	1965	x	xx	x	x	xx	x
<u>Polia distincta</u> (Hubner)	1964						
	1965		x				
<u>Polia grandis</u> Boissduval	1964			x			
	1965						
<u>Polia latex</u> Guenee	1964			x			
	1965						
<u>Polia legitima</u> (Grote)	1964			x	x	xx	
	1965				x	xx	
<u>Polia subjuncta</u> Grote & Robinson	1964		x	x		x	
	1965		xx	xx	x	xx	x
<u>Prodenia ornithogalli</u> Guenee	1964		x	x	xx	xxx	x
	1965			x	x	x	xx
<u>Protolampra brunneicollis</u> (Grote)	1964			x	xx	xx	xx
	1965			x	xx	xxx	xxx
<u>Proxenus miranda</u> Grote	1964						
	1965				x		
<u>Psaphida electilis</u> Morrison	1964						
	1965	x					
<u>Psaphida grotei</u> (Morrison)	1964						
	1965	x					

<u>Name</u>	<u>Year</u>	April	May	June	<u>Month</u>		
					July	August	September
<u>Psaphida resumens</u> Walker	1964 1965	x					
<u>Pyreferra indirecta</u> (Walker)	1964 1965						x
<u>Pyrrhia umbra</u> Hufnagel	1964 1965		x	x	x	x	
<u>Raphia frater</u> Grote	1964 1965		x	x			
<u>Rhodophora florida</u> Guenee	1964 1965				x	x	
<u>Rusina bicolorago</u> (Guenee)	1964 1965			x	x	x	xx x
<u>Schinia arcigera</u> Guenee	1964 1965				x	x	x x
<u>Schinia lynx</u> (Guenee)	1964 1965				x	x	
<u>Schinia marginata</u> (Haworth)	1964 1965					x	x
<u>Schinia trifascia</u> Hubner	1964 1965					x	x
<u>Scotogramma trifolii</u> Rottenburg	1964 1965		x	x	x	xxx	x xxx

<u>Name</u>	<u>Year</u>	<u>April</u>	<u>May</u>	<u>June</u>	<u>Month</u>		<u>August</u>	<u>September</u>
					<u>July</u>	<u>August</u>		
<u>Septis alia</u> (Guenee)	1964							
	1965			x				
<u>Septis arctica</u> Boisduval	1964			x	x			
	1965			x				
<u>Septis cariosa</u> (Guenee)	1964							
	1965			x				
<u>Septis indocilis</u> Grote	1964							
	1965				x			
<u>Septis lignicolora</u> (Guenee)	1964							
	1965				x			
<u>Septis plutonia</u> (Grote)	1964							
	1965				x			
<u>Sideridus rosea</u> Harris	1964							x
	1965		x	x				
<u>Simyra henrici</u> Grote	1964			x	xx	x	x	x
	1965		x	x	x	xx	xx	
<u>Spaelotis clandestina</u> (Harris)	1964			x	x	x	x	x
	1965			x	x	x	x	
<u>Strenoloma lunilinea</u> (Grote)	1964							
	1965				x			
<u>Tarachidia candefacta</u> Hubner	1964		xx	xxx	xxx	xxx	xxx	xxx
	1965		xx	x		xx	xx	xx

<u>Name</u>	<u>Year</u>	<u>April</u>	<u>May</u>	<u>June</u>	<u>Month</u> <u>July</u>	<u>August</u>	<u>September</u>
<u>Trachea delicata</u> (Grote)	1964					x	
	1965						
<u>Trichoplusia</u> ni Hubner	1964		x		x	x	x
	1965					x	x
<u>Tricolita signata</u> Walker	1964						
	1965					x	x
<u>Ulolonche culea</u> Guenee	1964						
	1965			x			
<u>Xanthorhoe lacustrata</u> (Guenee)	1964						
	1965				x		
<u>Xylomiges dolosa</u> Grote	1964						
	1965		x				
<u>Zale spp.</u>	1964						
	1965			x			

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