

WINTER, INSECT-LIGHT TRAPPING
AT THE ARCHBOLD BIOLOGICAL STATION, FLORIDA

(Continued from Vol. 45, No. 4.)

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INSECT ACTIVITY DETERMINED BY PERIODIC LIGHT TRAP COLLECTIONS

The following discussion pertains to nightly periods when insects came to lights in the greatest numbers. The time of starting the traps was set, somewhat arbitrarily, at 6 P.M., with the belief that the earliest visitors would not appear before that time. However, when traps were operated from November 10 to 16th between 5:30 and 6 P.M., certain insects, especially the Staphylinidae and Trichopterygidae, were taken in significant numbers. No counts were made of the Trichopterygidae but observations revealed that they came decidedly before 6 P.M., usually within a few minutes and sometimes in enormous numbers striking against the baffles of the trap like buckshot.

TABLE 6.—EARLY VISITORS TO THE LIGHT TRAPS*
NOVEMBER 10-16TH, 1960

Insect	Arriving Between 5:30-6 P.M.	Arriving Between 6-7 P.M.
Aphodiinae	7	40
Carabidae	11	37
Staphylinidae	10139	3207
Pselaphidae	5	13
<i>Caenis diminuta</i>	426	6033
Microtrichoptera	68	3469
Macrotrichoptera	37	1739
<i>Antillocoris pallidus</i>	38	705
Formicidae	13	44

* These are the only insects that came before 7 P.M. on these dates.

Table 7 lists some of the common species and groups of insects by hourly collections. It is very evident that many of the insects had definite hours of flight. The minute mayfly, *Caenis diminuta*, definitely came in greatest numbers during the first or second hour of operation. It is interesting to note that the time of arrival of these insects shifted from the first to the second hour when the light intensity increased at 6 P.M., i.e., when the day lengthened about the end of January (figure 8.) This did not occur in the case of the Staphylinidae or notably with any of the other insects.

TABLE 7.—TOTAL CATCHES OF SOME COMMON INSECTS, NOV. 4, 1959,
TO MARCH 31, 1960.

Insect	6-7 P.M.	7-8 P.M.	8-9 P.M.	9-10 P.M.	10 P.M.- 2 A.M.	2-7 A.M.
ORTHOPTERA						
<i>Nemobius carolinus</i>	332	592	549	338	563	124
EPHEMEROPTERA						
<i>Caenis diminuta</i>	76349	81655	1123	592	19	64
HOMOPTERA						
Cicadellidae	542	615	381	253	554	430
HEMIPTERA						
Miridae	17	70	107	127	445	273
<i>Antillocoris pallidus</i>	2151	2191	196	288	143	224
<i>Trichocorixa louisianae</i>	10067	5055	5566	4434	864	209
PSOCOPTERA						
Psocidae	23	32	69	72	238	281
COLEOPTERA						
Aphodiinae	1376	711	48	738	31	44
Carabidae	999	1036	708	717	1642	440
Pselaphidae	518	665	544	1052	922	174
Staphylinidae	20680	22358	10207	8256	3588	2888
<i>Dyscinetus morator</i>	380	541	187	149	34	12
Dytiscidae	2001	3112	2435	2773	785	335
TRICHOPTERA						
Hydroptilidae	11926	3704	752	447	605	401
Macrotrichoptera	5906	2511	1090	858	1273	795
LEPIDOPTERA						
Noctuidae	49	89	62	112	457	295
Pyalidae	2054	2991	2998	2764	5888	2410
DIPTERA						
Culicidae	705	224	190	161	301	213
HYMENOPTERA						
Formicidae	1228	164	72	49	65	235

Nemobius carolinus came quite consistently throughout the night but was more numerous during the darker hours from 7 P.M. to 2 A.M.

Many species of Cicadellidae were involved but none were attracted in appreciable numbers. They came more freely during the early hours of the evening and those of the morning.

The Miridae were attracted most strongly toward the morning hours. Many species were concerned but few came in large numbers.

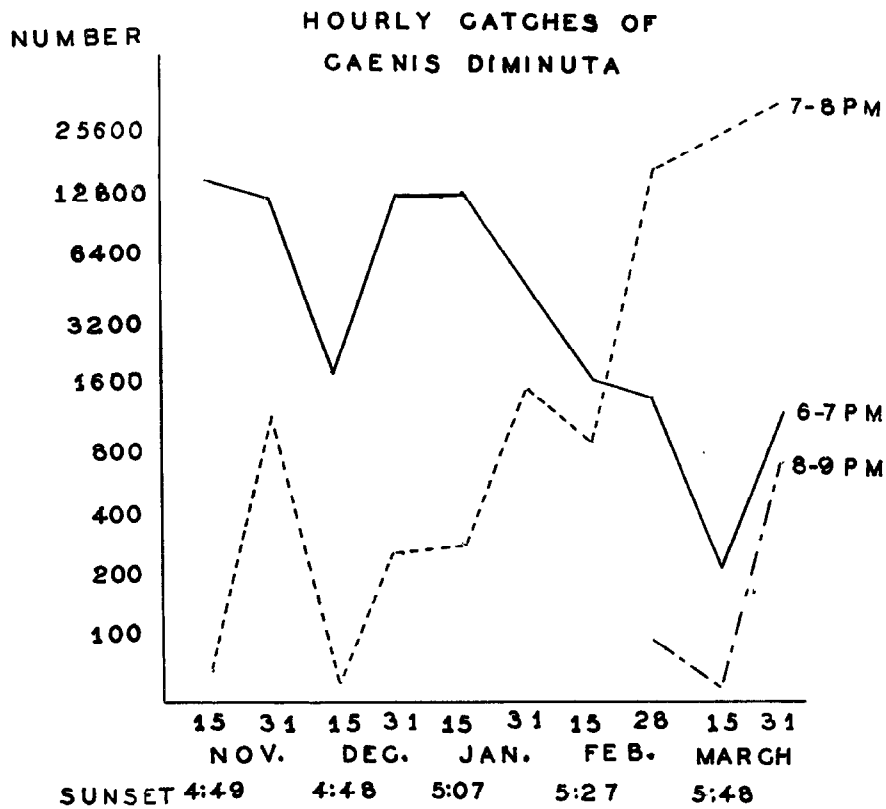


Figure 8. Hourly catches of *Caenis diminuta* correlated with light intensity the first three hours of operation.

The minute lygaeid *Antillocoris pallidus* definitely came in largest number from sunset until about 10 P.M.

The Psocidae, eleven species of which were identified, came chiefly during the morning hours.

A large number of species of Coleoptera were attracted to the light traps. These included 36 species of Carabidae, 10 species of Dytiscidae, 12 species of Aphodiinae, and many species of Staphylinidae and Pselaphidae. In general they came in largest numbers during the early hours of the evening. This was especially true of *Dyscinetus morator* and the Staphylinidae.

The Trichoptera came in largest numbers during the early hours of the evening.

The Lepidoptera were attracted throughout the night but in largest numbers towards midnight. This is a large group involving 65 species of Pyralidae, 147 species of Noctuidae and several smaller groups. Many of the Pyralidae were taken only occasionally. Two species *Paraponyx alionealis* (Wlk.) and *Pachyzancla phaeopteralis* (Gn.) contributed the majority of the records. The numbers of individuals and species of Noctuidae were too small to draw conclusions.

Thirteen species of mosquitoes were most numerous in the early evening and toward dawn.

Nine species of Formicidae came chiefly at dusk and at dawn.

INSECT ACTIVITY AT LIGHT TRAPS DETERMINED BY MONTHLY OBSERVATIONS

Having operated light traps for many years in other areas, a few comparisons might be made. The effective period for trapping most insects in Pennsylvania is approximately 122 nights from May 15 to September 15. In Florida insects were trapped for 148 nights from November 4 to March 31. Of course the effective period in Florida is 365 nights, for insects can be trapped every night of the year with the exception of a few when the temperature drops to or near freezing.

TABLE 8.—NUMBER OF NIGHTS THAT COMMON INSECTS CAME TO LIGHT TRAPS OPERATED FOR 148 NIGHTS FROM NOVEMBER 4, 1959, TO MARCH 31, 1960, IN FLORIDA.

Insect or group	Number of nights insects captured
Nematocera	147
<i>Caenis diminuta</i>	115
Microtrichoptera	112
Noctuidae	111
Pyralidae	109
Macrotrichoptera	103
Culicidae	101
Staphylinidae	97
Miridae	84
Psocidae	84
Cicadellidae	82
Carabidae	79
Corixidae	76
Aphodiinae	75
Dytiscidae	68
Pselaphidae	66
<i>Dyscinetus morator</i>	57
<i>Nemobius carolinus</i>	42
Formicidae	38
Aphidae	35

Table 9 illustrates the winter months when certain common species came to the light traps most frequently. In general, as might be expected, the catches were lightest during December and January. On the other hand some species were collected in considerable numbers during these months. The small cricket, *Nemobius carolinus*, for example, came in the largest numbers during January and February.

The mayfly, *Callibaetis pretiosus* Banks, came more or less consistently throughout the winter although it was more abundant during March. The

minute mayfly, *Caenis diminuta*, was more numerous during the months of November and March.

The carabid, *Agonoderus infuscatus* Dej., was without doubt taken more frequently during February and March.

TABLE 9.—MONTHLY OCCURRENCE OF SOME COMMON INSECTS AT LIGHT TRAPS*

Species	November	December	January	February	March
ORTHOPTERA					
<i>Nemobius carolinus</i>	634	338	943	1690	599
<i>Neoconocephalus triops</i>	19	13	11	23	1
EPHEMEROPTERA					
<i>Callibaetis pretiosus</i>	182	73	105	165	358
<i>Caenis diminuta</i>	42,624	11,044	17,830	24,083	44,079
COLEOPTERA					
<i>Cicindela trifasciata</i>	4	1	0	0	47
<i>Agonoderus infuscatus</i>	10	2	62	233	834
<i>Dyscinetus morator</i>	84	188	288	1057	662
<i>Diplotaxis bidentata</i>	571	107	63	187	606
<i>Anomala nigropicta</i>	0	0	53	268	72
<i>Lytta polita</i>	0	0	58	493	87
<i>Phengodes plumosa</i>	0	0	0	12	49
<i>Philhydrus cinctus</i>	105	30	139	594	802
<i>Tropisternus striolatus</i>	368	10	15	217	1225
LEPIDOPTERA					
<i>Tolype minta</i>	21	37	64	85	34
<i>Halisidota longa</i>	3	7	18	37	13
<i>Urodus parvulus</i>	154	126	168	323	64
HETEROPTERA					
<i>Cyrtomenus mirabilis</i>	94	21	39	403	940
HOMOPTERA					
<i>Tomaspis bicincta</i>	478	10	2	116	14
DIPTERA					
<i>Tabanus lineola</i>	44	1	0	1	62
<i>Pyrgota filiosa</i>	0	1	1	0	89

* Totals for 1958-59 and 1959-60 averaged.

The rather large black scarab, *Dyscinetus morator* (Fab.), was likewise taken more abundantly during February and March. The small *Diplotaxis bidentata* Lec., followed the general pattern, coming more frequently during November and March.

Anomala nigropicta Csy., *Lytta polita* (Say), and *Phengodes plumosa* (Oliv.) were taken chiefly during January, February, and March.

The aquatic beetles, *Philhydrus cinctus* Say and *Tropisternus striolatus* (Lec.), came chiefly during February and March although they were taken to some extent during November.

Urodus parvulus (Hy Edw.) occurred somewhat consistently during the winter although it was more numerous during February.

Tomaspis bicincta Say was noticeably abundant during November.

Tabanus lineola Fab., was one of the few insects that came almost entirely during November and March.

SEASONAL DIFFERENCES IN LIGHT TRAP COLLECTIONS

Further details indicated that some insects were more numerous during one winter than the other. The extreme was noted in the case of the noctuid *Xanthopastis regnatrix* (Grt.). No specimens were taken during the first and second winters; 1958-59 and 1959-60. However, from January 1 to April 1, 1961, they were frequent visitors to the traps. Table 10 illustrates some of these differences.

TABLE 10.—SOME SEASONAL DIFFERENCES IN LIGHT TRAP COLLECTIONS

Species	Number of specimens	
	1958-59	1959-60
ORTHOPTERA		
<i>Nemobius carolinus</i>	4,765	2,787
<i>Neoconocephalus triops</i>	120	14
EPHEMEROPTERA		
<i>Callibaetis pretiosus</i>	890	825
<i>Caenis diminuta</i>	97,298	185,584
HOMOPTERA		
<i>Tomaspis bicincta</i>	971	219
HEMIPTERA		
<i>Cyrtomenus mirabilis</i>	1,099	1,259
COLEOPTERA		
<i>Anomala nigropicta</i>	257	534
<i>Diplotaxis bidentata</i>	1,913	1,061
<i>Dyscinetus morator</i>	3,043	1,299
<i>Aphodiinae</i>	8,764	2,967
<i>Tropisternus striolatus</i>	1,227	2,245
<i>Philhydrus cinctus</i>	1,933	1,258
<i>Neohydrophilus castus</i>	676	1,138
<i>Lytta polita</i>	439	896
LEPIDOPTERA		
<i>Urodus parvulus</i>	1,158	412
<i>Halisidota longa</i>	128	31
<i>Tolyte minta</i>	353	117

The winter of 1962 was exceedingly dry and revealed some unusual conditions. Many of the aquatic groups such as the Odonata, Trichoptera and Ephemeroptera were very scarce or almost entirely absent. The small numbers of *Caenis diminuta*, never exceeding ten specimens on a single night, contrasted with the phenomenal numbers taken the previous winters. On the other hand, the mud-loving beetles, Heteroceridae, were numerous. The Scarabaeidae, especially *Dyscinetus morator*, were noticeable abundant. The total number of these beetles taken during the winters of 1958, 1959, 1960 and 1961 was 4,842. During the winter of 1962 seldom less than 150 specimens and frequently more than 10,000 specimens were taken on a single night. These figures clearly indicate that several winters are necessary to draw correct conclusions concerning the activities of insects about light traps.

A DISCUSSION OF THE INSECTS ATTRACTED TO LIGHT TRAPS IN FLORIDA

Of the 20 extant orders of winged insects generally recognized, all but one have been taken in light traps. There are six entirely wingless orders, not including the Protura, which naturally would not be attracted to light traps. Actually no Plecoptera or Mecoptera were taken in light traps operated in Florida although they have been taken in light traps elsewhere.

ORTHOPTERA: The Orthoptera were relatively rare visitors to light traps in Pennsylvania but were conspicuously present in those operated in Florida. Often as many as 100 small crickets of the genus *Nemobius* came on a single night. *Nemobius carolinus* was most common (Fig. 9), although two other species were involved. The cone-headed grasshopper *Neoconocephalus triops* was also numerous; males and females came in about equal numbers. During 1958-59, 120 specimens were taken but only 14 during 1959-60.

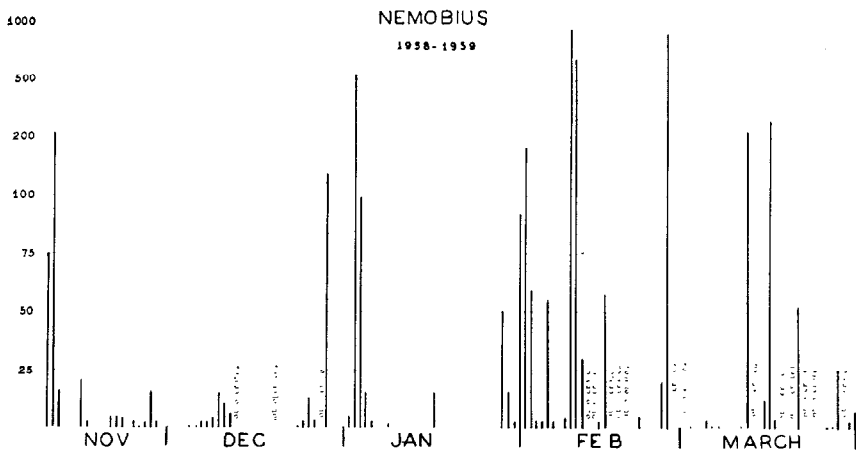


Figure 9. Collections of *Nemobius*, 1958-1959. 95% were *N. carolinus*.

ZORAPTERA: This is the only order with winged forms that has not been recorded from light traps or observed to be attracted to lights.

NEUROPTERA: With the exception of the Hemerobiidae, the Neuroptera were not frequent visitors to the traps. Six species of Hemerobiidae were identified from the material obtained, and many of them were numerous.

The Mantispidae were never common. Twenty-eight specimens were taken during the two winters, and the collections were scattered throughout the winter from November until March. The Chrysopidae, which came to light frequently in some localities, were seldom intercepted in Florida. Only two specimens of Berothidae, *Lomamyia hamata* (Wlk.) were taken. Many of these were seen about lights but apparently they did not readily enter the light traps.

EPHEMEROPTERA: Only two species were taken in light traps. *Callibaetis pretiosus* was an occasional visitor while *Caenis diminuta* was captured in phenomenal numbers. The latter came regularly throughout the winter months, except during very cold periods, and, as indicated elsewhere, came almost entirely during the first or second hour of trap operation (Fig. 8).

PLECOPTERA: Plecoptera have been captured in light traps only when traps were placed close to the source of infestation. Although several species are known to occur in Florida and the traps were close to drainage ditches, none were taken. This may reflect a seasonal condition.

PSOCOPTERA: The Psocidae were conspicuously abundant throughout the winter months. *Psocus leidyi* Aaron, taken on several occasions, is here reported for the first time from the United States. A species of *Caecilius* was collected from light traps in larger numbers than by all previous collectors of Florida Psocidae. Several new species await description.

EMBLIOPTERA: Although three species are known from Florida, only two were taken in light traps, *Oligotoma saundersi* Westw. and *Oligembia vandykei* Ross. They were never numerous; however, 79 specimens were captured during the two winters. Fifty-nine of these came in November; the remainder were taken from December 1 to April.

THYSANOPTERA: Only two specimens of thrips were taken. This is not strange, for many forms are wingless, and they have not been taken commonly in light traps elsewhere. One was *Polyphemothrips tibialis*, H. and W., the other a species of *Hoplandothrips*, probably new.

HOMOPTERA: This is one of the larger groups of insects attracted to light traps. The leafhoppers (Cicadellidae) and the lantern flies (Fulgoroidea) were the most frequent visitors. Approximately 50 species of Cicadellidae were taken but none came in very large numbers. *Balclutha hebe* (Kirk), *Graminella nigrifrons* (Forbes), *Paraphlepsius lippulus* (Ball), *Xestocephala pulicarius* Van D., and *Tylozygus bifidus* (Say) were the most common.

The Aphidae were generally scarce although 11 species were intercepted.

A single species of Cercopidae, *Tomaspis bicincta*, was unusually abundant throughout the winter months. During 1958-59, 971 specimens were taken, while during 1959-60, 219 specimens were taken.

Over 20 species of Fulgoroidea were taken in light traps. Most of them were represented by one or two specimens but a few such as *Flatoides punctatus* Wlk., *Megamelus paleatus* (Van D.), *Oliarus quinquelineatus* Say, and *Epiptera slossonae* (Van D.) were common.

As elsewhere, the Membracidae were taken only when traps were close to the source of infestation. They are not strong fliers and apparently are not freely attracted to light. Two species, *Idioderma virescens* Van D. and *I. varia* Van D., that inhabited nearby live oaks, were taken occasionally.

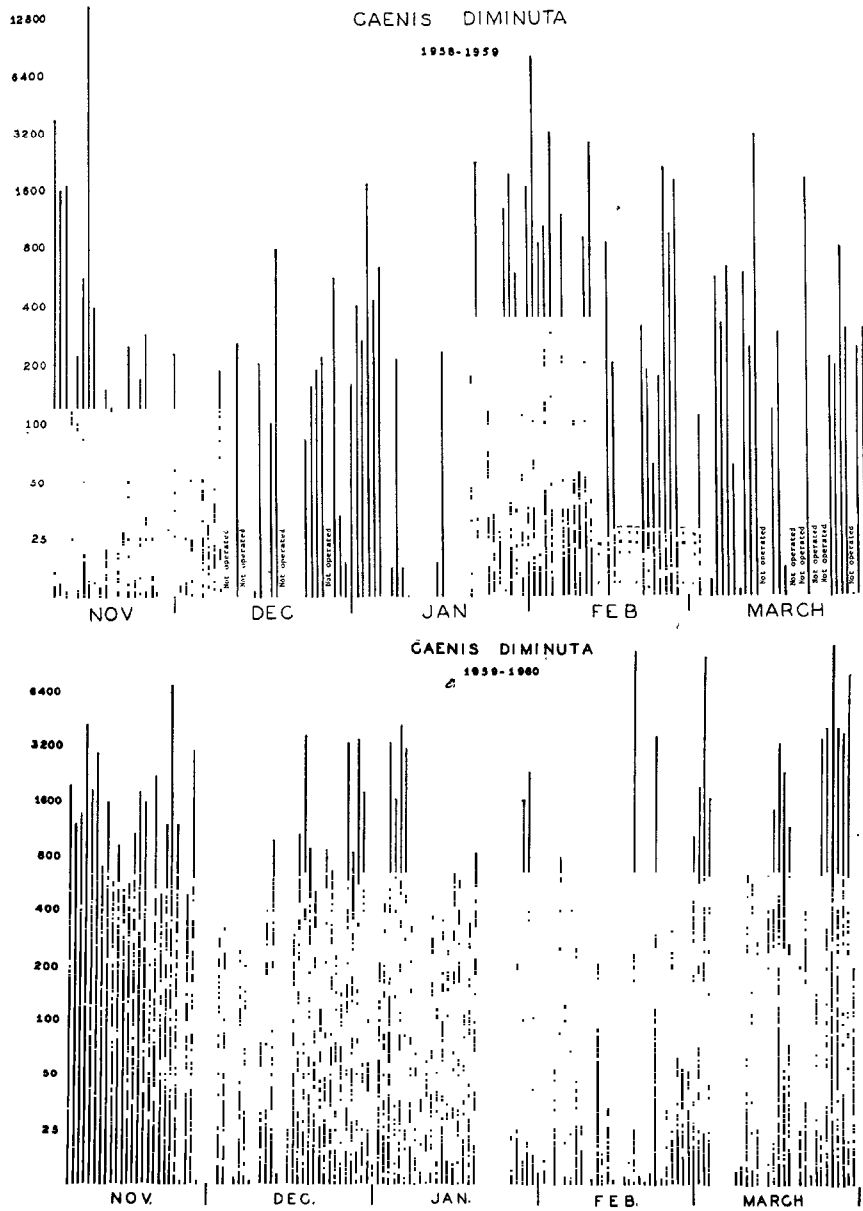


Figure 10. Collections of *Caenis diminuta*; upper graph for 1958-1959, lower for 1959-1960.

HEMIPTERA: A large number of species of Hemiptera was collected but none in exceptional numbers. *Lethocerus uhleri* (Mont.) and *Benacus griseus* (Say) were conspicuous because of their size. They presented a problem for they resisted killing, thrashed about the cyanide jars and mutilated many of the more delicate specimens.

Four species of Cydnidae, *Cyrtomenus mirabilis* (Perty), *Amnestus pusillus* Uhler, *Pangaesus bilineatus* (Say), and *Aethus indentatis* (Uhler), were generally conspicuous.

Pentatomidae were not common although at times ten or more specimens were taken. *Banasa lenticularis* Uhler, *Nezara viridula* (Linn), *Podisus maculiventris* (Say), and *Euschistus obscurus* (P. de B.) were the conspicuous species. A single specimen of *Amaurochrous magnus* B. and S. is rated as rare.

The Reduviidae were often numerous. These included *Pygolampis pectoralis* (Say), *Rasahus hamatus* (Fab.), *Sirthena carinata* Fab., *Zelus bilobus* Say, and three species of *Pnirontis*. Of the latter *Pnirontis infirma* Sailor and *P. modesta* Banks were most common. *Melanolestes picipes* was also somewhat common.

A single species of Coriscidae, *Leptocoris tipuloides* (De G.), was often abundant.

Some of the Lygaeidae were often numerous. *Cymoninus notabilis* (Dist.), *Orthaea servillei* (Guer.), and *Perigenes constrictus* (Say) were especially outstanding, and the minute *Antillocoris pallidus* (Uhler) was well represented in most of the collections.

Although Miridae are generally attracted to light in considerable numbers, they were not taken in numbers to compare with some of the other insects. This may have been due to the season of the year. *Phytocoris megalopsis* Blatch., was somewhat the exception.

The Corixidae constituted the largest part of the Hemiptera. *Trichocorixa louisiana* was exceedingly abundant. Frequently 200 and sometimes 1000 specimens were taken on a single night (Fig. 11.)

The Notonectidae were also frequently abundant. These included the larger species *Buenoa scimitra* Bare and the minute *Plea striola* Fieber. Several specimens of the macropterous forms of *Buenoa confusa* Truxal., which are rare in collections, were taken.

Several species of Veliidae were taken but *Microvelia albonotata* Champ. was most common.

The Aradidae were not numerous. At most only one or two specimens were taken on a single night.

DERMAPTERA: The earwigs constituted one of the minor groups. Only 27 specimens of the species *Labidura riparia* (Pallas) were taken during the two winters. Twenty two of these came during November.

ISOPTERA: Strangely, these insects were extremely rare in light trap catches in Florida. Normally, termites are strongly attracted to light and are abundant in tropical areas. Only one specimen was taken during November. An interesting emergence of termites was observed indicating that they were on the wing during the winter months.

COLEOPTERA: The beetles constituted one of the outstanding groups of insects attracted to lights. A very large number of species was involved, and some were extremely abundant. This was especially true of the Sta-

phylinae and Trichopterygidae. Often more than 3200 specimens of Staphylinidae were taken on a single night (Fig. 12.) The Trichopterygidae, because of their minute size and abundance, were not counted. Previous reference has been made to the fact that these beetles came at dusk, often before 6 P.M., even when the light intensity was strong at this time. Many specimens were preserved for identification.

The Chrysomelidae were conspicuous by their absence. They were neither abundant in species nor individuals. Not more than one or two specimens were taken on a single night. The most outstanding was *Chrysomela scripta* Fab., which was scarce from 1958-1960 but quite common during 1961. *Rhabdopterus bowditchi* Barber was somewhat common during the entire period.

The Scarabaeidae yielded some unusual records. A medium-sized brown or black species, *Diplotaxis bidentata* Lec., was often numerous. During 1958-59, 1913 specimens were taken while during 1959-60, 1061 specimens were taken. These were more numerous during November, February, and

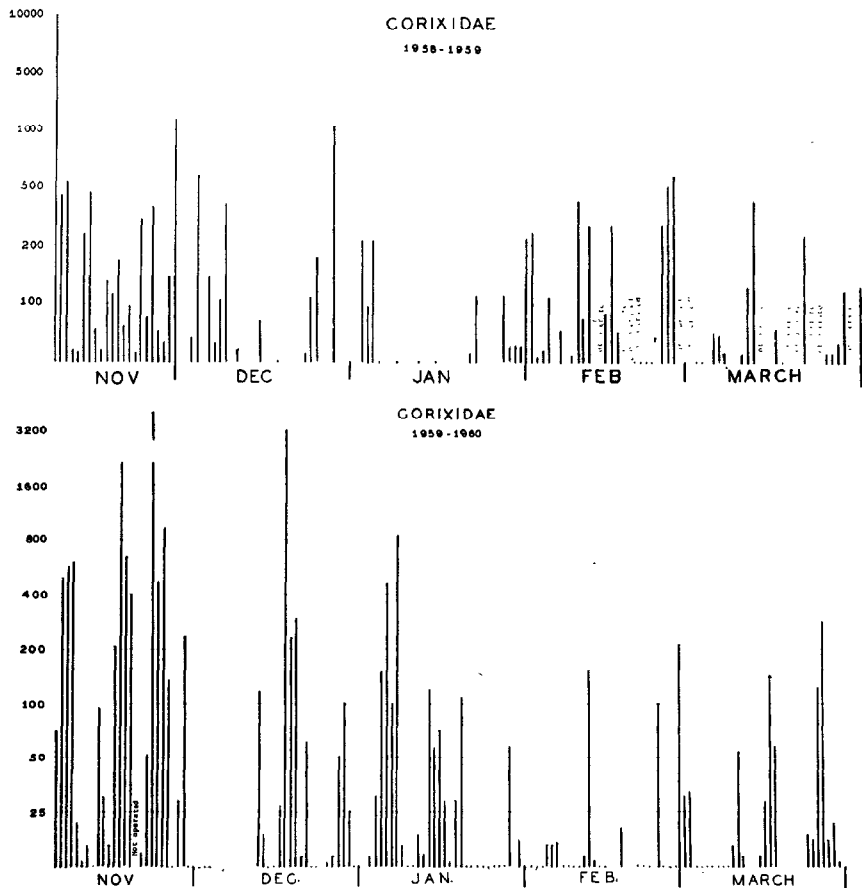


Figure 11. Collections of Corixidae; upper graph for 1958-1959, lower for 1959-1960. Over 95% of those collected were *Trichocorixa louisianae*.

March. A large black species, *Dyscinetus morator* (Fab.), was also numerous and sometimes dominated the collection. During the first winter, 3043 specimens were taken; during the second winter, 1299 specimens were taken. Like most beetles they were more common during November, February, and March. *Anomala nigropicta* Csy. was another somewhat conspicuous species. During the two winters 257 and 534 specimens were taken, respectively. The Aphodiinae, represented by three species of *Aphodius* and eight species of *Ataenius*, were frequently numerous. During 1958-59, 8764 specimens were taken, during 1959-60, 2967 specimens were taken. These came chiefly between 7 and 10 P.M., and were distinctly more common during November and March. A single specimen of *Onthophagus depressus* Har. is the first record of this species from Florida. *Serica errans* Blatch., represented in the U. S. National Museum by a single specimen and considered a rare species, was taken in rather large numbers.

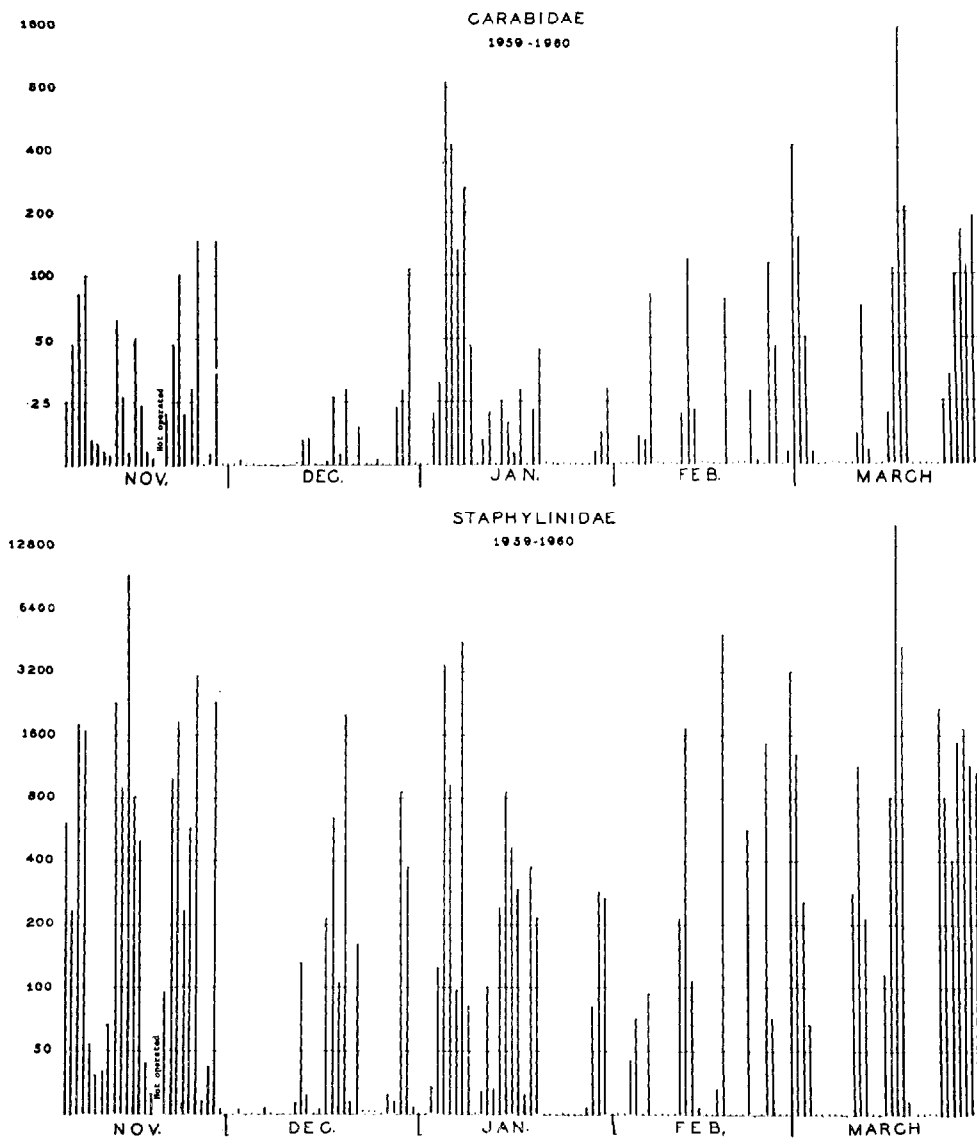


Figure 12. Collections of Carabidae and Staphylinidae for 1959-1960.

Many species of Carabidae were represented. Generally they came in largest numbers during February and March. *Agonoderus infuscatus* Dej. and *Ardistomis viridis* Say were especially conspicuous. During the two winters 9829 specimens of the former and 2182 specimens of the latter came to light traps. It was discovered later that *Anisotarsus agilis* Dej. was common but individual counts were not made.

The aquatic coleoptera, Hydrophilidae, Dytiscidae and Gyrinidae, were common. These species might be expected because of the numerous ditches near the area where the traps were operated. They came in largest numbers between 7 and 10 p.m. and generally during November, February, and March. *Tropisternus striolatus* (Lec.) was especially conspicuous. During the two winters, 3,673 specimens were taken, while in the same period, 3191 specimens of *Philhydrus cinctus* Say were taken. *Neohydrophilus castus* (Say) showed some variation. During 1958-59, 1,676 specimens were collected while during 1959-60 only 1138 specimens were taken. Other Hydrophilidae included *Helocares sallaei* Sharp, *Helobata striata* (Brullé), *Hydrochus callosus* Lec., *Hydrochus simplex* Lec., and *Berosus infuscatus* Lec., all of which were common although no specific records were obtained at the time of the collection and separation. Many species of Dytiscidae came to the traps. Several species of *Celina* were obtained but *Celina slossoni* Mutch. was most common. *Coptotomus interrogatus obscurus* Sharp, *Thermonectes basilaris* (Harris), *Hydaticus bimarginatus* Say, and *Rhantus calidus* (Fab.) were also common. Only one species of Gyrinidae, *Dineutus carolinus* Lec., came to the traps freely.

Although 9 species of Lampyridae were taken, in general they were never common.

The males of *Phengodes plumosa* (Oliv.) were often common. Over 100 were preserved and many were discarded. During the flight period of the males, a search for the wingless females was futile.

Only two species of Meloidae came to the traps. The large brown *Lytta polita* (Say) was noticeably abundant and was taken only during February and March. They often constituted a problem because they were not readily killed in the cyanide jars and crawled about other insects causing much injury. This species gave forth a sweet odor which often scented the whole night's collection and could be detected months after the insects were collected.

The tiger beetles, Cicindelidae, were seldom taken in light traps in Pennsylvania but in Florida they were quite numerous. A single species, *Cicindela trifasciata tortuosa* Lec., was taken on various occasions, chiefly during March. Their presence might be expected because they often feed upon ants, which in turn are common in Florida.

The most abundant specimens of the Elateridae were *Melanotus decumanus* (Er.), *Conoderus falli* Lec., *Lanelater sallei* (Lec.), and *Anchastus fumicollis* Fall.

Sixteen species of Cerambycidae came to the traps but only three, *Amniscus arcuatus arcuatus* (Lec.), *Xylotrechus sagittatus* (Germ.), and *Neacanthocinus obsoletus* (Oliv.) were common.

Two species of scolytids, *Platypus compositus* Say and *Xyleborus affinis* Eich., were frequent visitors.

The Bostrichidae, Lagriidae, and Tenebrionidae were represented by three common species, *Amphicerus bicaudatus* (Say), *Statira gagatina* Melsh, and *Opatrinus notus* Say, respectively.

STREPSIPTERA: The males of a single species *Caenocholax fenyesei* Pierre were taken on several occasions. These insects are minute and difficult to separate from the thousands of other insects. They were especially interesting for males are seldom collected. This species is a new record for Florida. It was known previously only from Mexico, Argentina, and a specimen intercepted in California from Panama.

MECOPTERA: No Mecoptera were taken in light traps at the Archbold Biological Station although several species are known to occur in Florida. Elsewhere they have been attracted only occasionally to light traps.

TRICHOPTERA: The caddis flies, as indicated in the charts, were taken in large numbers. None have thus far been identified, but ample material has been preserved for study. Records for the Microtrichoptera (Hydroptilidae) have been kept separate from those of the Macrotrichoptera (Fig. 13).

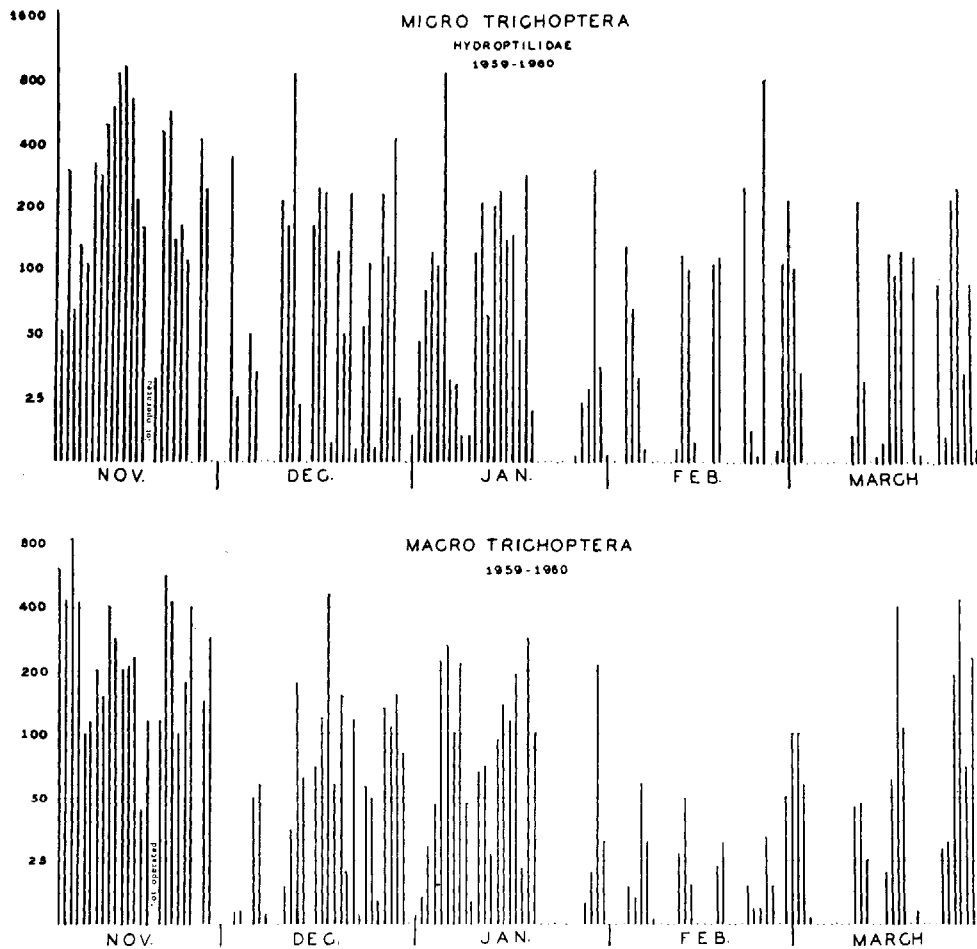


Figure 13. Trichoptera collected during 1959-1960. The Microtrichoptera were represented by two or three species of Hydroptilidae.

LEPIDOPTERA: The moths constituted one of the largest groups taken in light traps. Over 500 species have been isolated and identified. A few skippers and gossamer-winged butterflies were also taken, chiefly during December. It is interesting to note that butterflies have never been taken in light traps in Pennsylvania.

Although 13 species of Sphingidae were attracted, only *Lapara coniferarum* (A. and S.) and *Enyo lugubris* (Linn.) came frequently.

The Saturniidae were not frequent visitors. *Telea polyphemus* (Cram.) and *Callosamia promethea* (Dru.) came occasionally. Only *Automeris io liliith* (S. and Kr.) was numerous.

Of the Citheroniidae, a few *Anisota rubicunda* (Fab.), were taken.

Several species of Amatidae were taken but only *Lymire edwardsii* (Grt.) was common.

Of the Nolidae, only *Nigetia formosalis* Wlk. was common.

The Arctiidae contributed a large number of species. Several species of *Apantesis* were represented; however, *A. plalerata* (Harr.) was most numerous. Males and females came in about equal numbers and both showed considerable variation in color. Over 200 specimens have been preserved for future study.

Holomelina aurantiaca (Hbn.) and *H. laeta* (Guer.) were both numerous.

Halisidota longa (Grt.), a southern species and *Hyphantria cunea* (Dru.), a species widely distributed in the eastern states, were both common.

The Arctiidae *Cyenia insulata* Wlk., *Seirarctia echo* (A. and S.), and *Pagara simplex* Wlk., were also somewhat common.

The Noctuidae were of course numerous. These are typical night-flying moths. They were more numerous than the Pyralidae in species but less numerous in individuals. Most of them appeared each winter but *Xanthopastis regnatrrix* (Grt.) was completely absent during 1958-59 and 1959-60. During 1961 they were very common and were taken in light traps from January 1st to April 15th. Records indicate that they were flying during September and October also.

The following Noctuidae were recorded frequently at light traps: *Agrotis ypsilon* Rott., *Morrisonia mucens sectilana* Strand, *Drasteria graphica* Hbn., *Lepipolys perscripta* Gn., *Euagrotis illapsa* (Wlk.), *Zale metata* Smith, *Zale declarans* (Wlk.), *Cryphia nana* Hbn., *Anicla infecta* Ochs, *Laphygma frugiperda* (A. and S.), *Argyrostromis quadrifilaris* (Hbn.), *Chaetagnathia tremula* (Harv.), *Platysenta apameoides* (Gn.), *Renia fraternalis* Smith, *Tarachidia candefacta* (Hbn.), *Amolita fessa* Grt., *Phytometra rhodarialis* (Wlk.), *Atethmia subusta* Hbn., *Mocis latipes* (Gn.), *Prodenia dolichos* (Fab.), *Prodenia eridania* (Cram.), *Elaphria festivooides* (Gn.), *Elaphria nucicolora* (Gn.), *Acronicta afficta* Grt., *A. lanceolaria* (Grt.), *A. tritona* (Hbn.), *Hormoschista latipalpis* (Wlk.), *Phuphena u-album* (Gn.), and *Eucoptocnemis dapsalis* (Grt.).

Sixteen species of Notodontidae came to the traps but only two were abundant, *Heterocampa astarte* Dbldy. and *Lophodonta angulosa* (A. and S.).

Nearly 50 species of Geometridae were attracted to the light traps and of these five were common—*Semiothisa distribuaria* (Hbn.) *Racheospila gerularia* (Hbn.), *Scelolophia laevitaria* (Hbn.), *Lophosis labeculata* (Hulst), and *Stenotrachelys approximaria* (Hbn.).

Two species of Lasiocampidae were taken commonly, *Artace punctistriga* Wlk. and *Tolype minta* Dyar. During 1958-59, 381 specimens of *Tolype minta* were collected, most of these during February.

Four species of Limacodidae were taken but only *Prolimacodes badia* Hbn., was common.

Of the two species of Megalopygidae, *Lagoa pyxidifera* (A. and S.) was most common.

Many species of Pyralidae came to the light traps. Some of them were very numerous and probably contributed the largest number of any of the Lepidoptera. Three species were especially common, *Pachyzancla phaeopteralis* Gn., *Paraponyx allionealis* (Wlk.), and *Pyrausta tyralis* (Gn.). Other common species were *Synclita oblitalis* (Wlk.), *Anania florella* (Cram.), *Samea eccesialis* (Grt.) *Etiella zinckenella* (Treit), *Nomophila noctuella* (D. and S.), *Tholeria reversalis* (Gn.), *Hymenia fascialis* (Cram.), *Blepharomastix ebulealis* (Gn.), and *Argyria argentana* (Martyn) (Fig. 14).

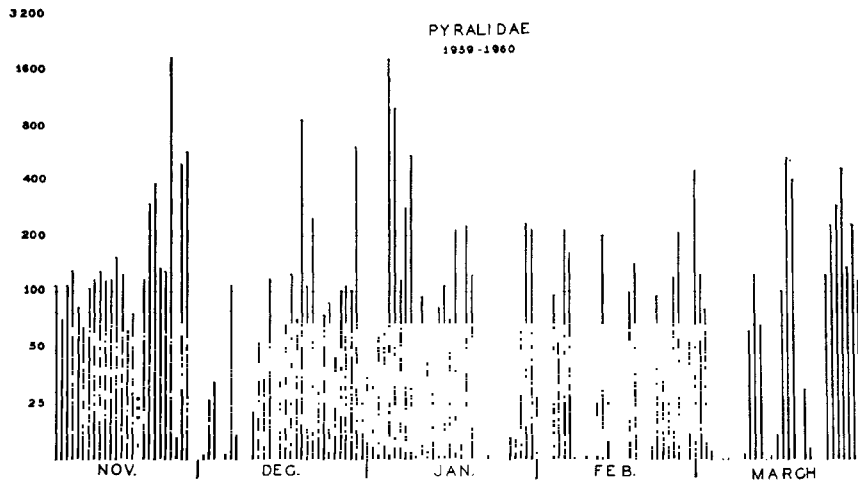


Figure 14. Collections of Pyralidae made during the winter months of 1959-1960.

Of the 15 species of Phycitidae, three were common: *Dioryctria amatella* (Hulst), *D. clarioralis* Wlk., and *Adelphia petrella* (Zell.).

Twenty species of Olethreutidae were taken but only three were common: *Rhyacionia buoliana* Schiff., *R. rigidana* Fern., and *Thiodia dorsiotomana* Kft.

Two Tortricidae were common, *Platynota rostrana* (Wlk.) and a new species of *Argyrotaenia*.

A gelechiid, *Aroga coloradensis* (Busck), a cossid, *Givira francesca* (Dyar), and a stenomid, *Stenoma vestalis* (Zell.), were noticeably abundant.

The hyponomeutid, *Urodus parvulus*, visited the traps quite regularly and provided sufficient data to plot curves. The favorite food of the larvae of this species, bay tree, *Persea*, orange, oaks and others grew only a few feet from the light traps (Fig. 15).

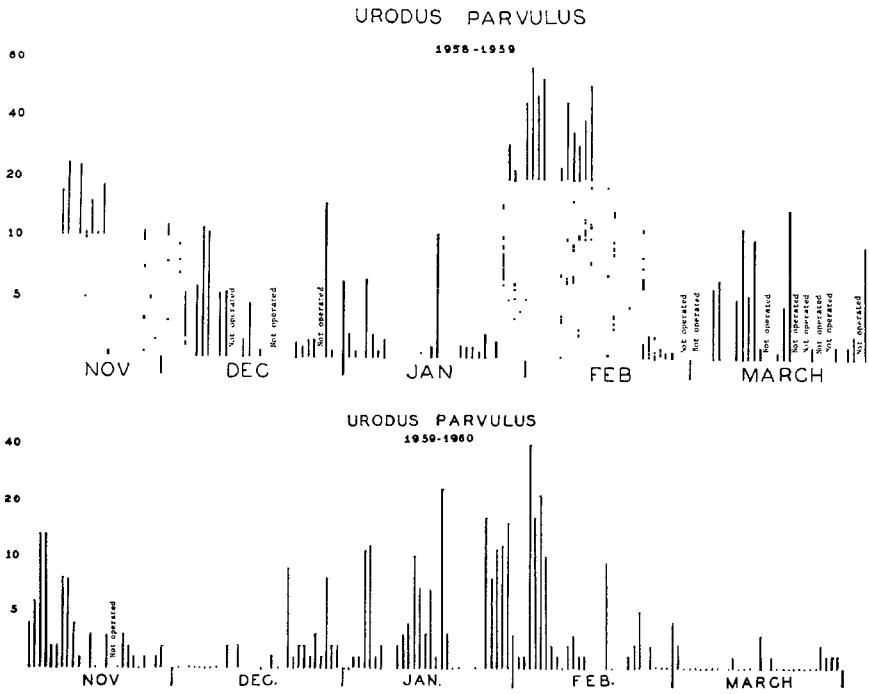


Figure 15. Collections of *Urodus parvulus* made during the winter months of 1958-1959 and 1959-1960.

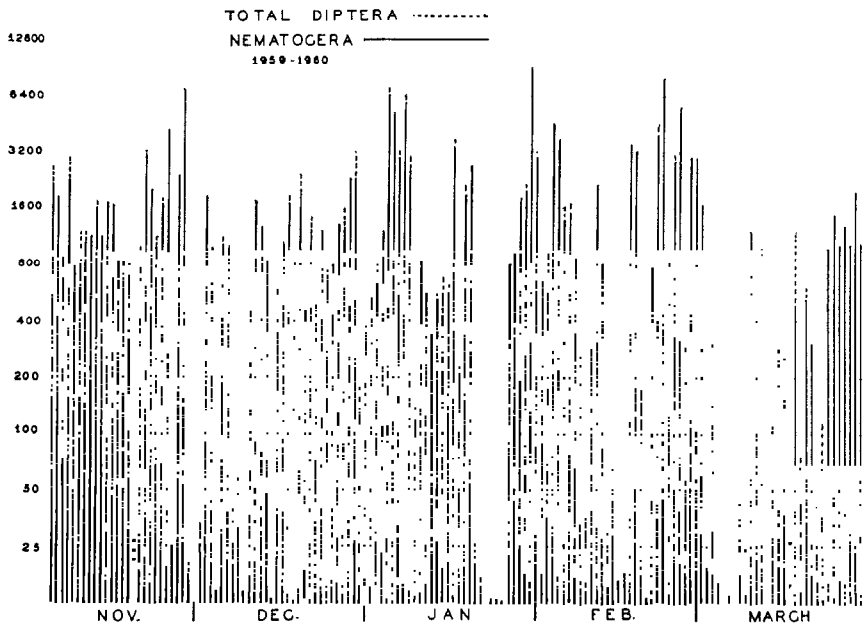


Figure 16. Total number of Diptera as compared with the Nematocera collected in 1959-60. A very large percentage of the Nematocera were *Culicoides*.

Four species of Psychidae were taken; two of these were common visitors, *Platoeceticus nigrita* (B. and McD.) and *P. gloveri* (Pack.).

DIPTERA: The Nematocera, including the Tipulidae, Psychodidae, Tendipedidae, Culicidae, Ceratopogonidae, Mycetophilidae, Cecidomyiidae, Bibionidae and Simuliidae, were far more numerous than the Brachycera and Cyclorrhapha (Fig. 16).

Two species of Tendipedidae (Chironomidae), *Tendipes crassicaudatus* (Mall.) and *T. decorus* (Johns.), were especially conspicuous (Fig. 17).

Eleven species of Ceratopogonidae were taken in light traps. Several of the genus *Atrichopogon* are still unidentified. They contributed the largest proportion of the catches. *Forcipomyia fuliginosa* (Meig.), generally rated an uncommon species, was noticeably abundant.

The Tipulidae were never very numerous. Of the eleven species, four were somewhat common, *Limonia distans* (O. S.), *L. rostrata* (Say), *Tipula osceola* Alex., and *Pseudolimnophila luteipennis* (O. S.). A new species, *Limonia frosti* has been described by C. P. Alexander.

Likewise mosquitoes were generally not abundant. They were most common during November, February, and March but seldom exceeded 25 to 30 a night. On a few nights during November and March 100 speci-

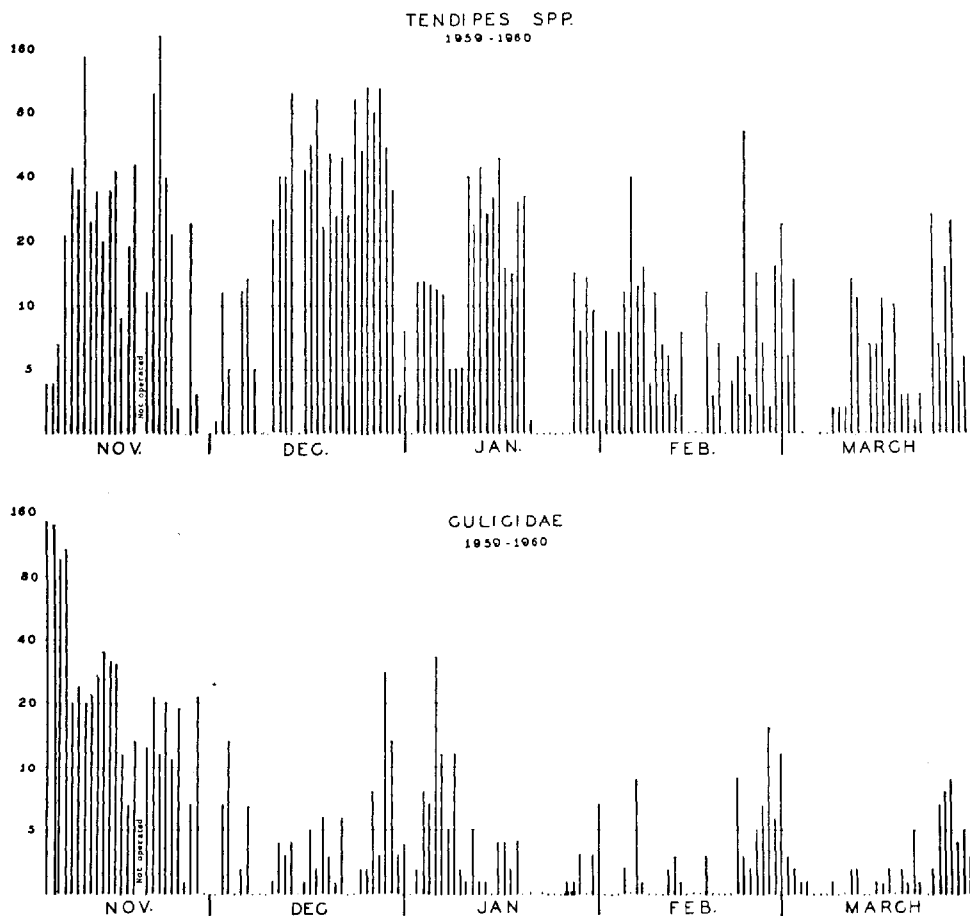


Figure 17. Collections of *Tendipes* and Culicidae made during the winter months of 1959-1960. Over 90% of the various *Tendipes* species were *T. crassicaudatus*.

mens were taken. *Culex nigripalpus* Theob., *Anopheles crucians* Wied., *Mansonia perturbans* Wlk., and *Urotaenia lowii* Theob. predominated (Fig. 17).

The higher Diptera, Brachycera and Cyclorrhapha were not taken in large numbers. Some of the smaller flies of the families Agromyzidae, Drosophilidae, Ephydriidae, Chloropidae, Otitidae, and Ephydriidae were occasional visitors to the traps. One of the Chloropidae, *Hippelates pusio* Loew was noticeably abundant. The Ephydriidae, *Paralimna punctipennis* (Weid.) and *P. decipiens* Loew, were also abundant. One specimen of *Zeros Calverti* Cress., a species considered rare in Florida, was taken during 1961. Two Otitidae, *Euxesta notata* (Wied.) and *E. basalis* (Wlk.), occurred quite frequently.

The Pyrgotidae, represented by *Pyrgota filiosa* Will., were often somewhat numerous.

Two Tabanidae were conspicuous in the collections, *Tabanus lineola* Fab., and *Chlorotabanus crepuscularis* (Beq.). *Tabanus lineola* was the most seasonal of the insects taken and came almost entirely during November and March. Males were more common than females. This had been noted for light-trap catches elsewhere. It is an excellent method of obtaining the somewhat elusive males. Of 82 specimens trapped during a short period in November, 53 were males. *C. crepuscularis* came in large numbers only during March. Dr. L. L. Pechuman states that the males of *Tabanus*

TABLE 11.—NUMBER OF SPECIES TAKEN IN LIGHT TRAPS AT THE ARCHBOLD BIOLOGICAL STATION, WINTERS OF 1958, 1959, 1960, AND 1961.

Order	Number of species
Orthoptera	14
Neuroptera	21
Isoptera	1
Ephemeroptera	2
Odonata	11
Psocoptera	25
Thysanoptera	3
Embiopoda	2
Homoptera	94
Hemiptera	115
Dermoptera	1
Coleoptera	337
Strepsiptera	1
Trichoptera	unidentified
Lepidoptera	509
Diptera	227
Hymenoptera	61
Total	1424

nigripes Wied and *T. rufocrater* Wlk. are rarely collected. These were taken in light traps.

ODONATA: During the winters that the traps were operated, 23 specimens of Odonata in 11 species were taken. The majority appeared in March; however, specimens were also taken during November, early December, and late February. They were usually trapped on warm nights when the insect catch was large or relatively large. Of these, one came between 6 and 7 P.M., two between 7 and 8 P.M., two between 8 and 9 P.M., two between 9 and 10 P.M., five between 10 P.M. and 2 A.M., and one close to 7 A.M. This is contrary to the early belief that they came chiefly at dusk.

HYMENOPTERA: With the exception of the Formicidae and a few parasitic wasps, the Hymenoptera were not strongly attracted to light traps. This is generally true of the Hymenoptera. *Xyela pini* Rohwer was taken occasionally. The larvae of this species develops in the staminate cones of pines which, of course, were numerous in the vicinity.

CONCLUSIONS

Insects responded freely to light traps operated at The Archbold Biological Station during the winter months from November 4th to March 31st. The recovery of over 1000 species, some in enormous numbers, indicated that insect light trapping was profitable for study of abundance. The Lepidoptera and the Coleoptera contributed the largest number of species. The Hemiptera, Homoptera, Diptera and Psocoptera were also conspicuous visitors to the traps.

Information was obtained on the periods of the winter and intervals of the night when certain species or groups of species were most active.

The catches of many species were large and continuous during the winter except when the temperatures dropped close to freezing. Collections were very satisfactory when the temperatures were above 60° F. but below this temperature they were somewhat reduced. When the temperatures dropped below 50° F., numbers of many insects, especially the Lepidoptera and Coleoptera, were noticeably reduced. Midges (Nematocera) were captured in considerable numbers even below 40°. In Florida, slightly higher temperatures were required to trap the same groups of insects attracted further north at lower temperatures.

Light drizzling rains affected the catches but little. At higher temperatures, foggy, drizzling rains actually increased the collections. Heavy rains seldom prevented the operation of the traps but reduced the catches considerably. Strong winds reduced the collections noticeably.

The discovery of several new species and many new records for Florida and the United States added much to these studies.

ACKNOWLEDGMENTS

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This work would have been futile without the help of many who willingly identified the tremendous amount of material gathered in the light traps. A list of the specialists who cooperated will accompany an annotated list of insects taken at light traps at The Archbold Biological Station to be published separately.