The
MICHIGAN ENTOMOLOGIST

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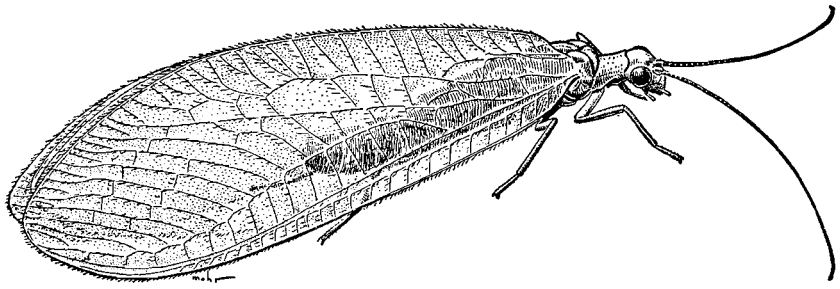

THE MICHIGAN ENTOMOLOGIST

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A lacewing, *Chrysopa* sp. (Neuroptera: Chrysopidae). Drawing by Carl O. Mohr. Printed by courtesy of the Illinois Natural History Survey.

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THE NEUROPTERA – SUBORDER PLANIPENNIA OF WISCONSIN[1] PART I–INTRODUCTION AND CHRYSOPIDAE

Alvin L. Throne
University of Wisconsin-Milwaukee
Milwaukee, Wisconsin 53201[2]

INTRODUCTION

No one to date has published on the Neuroptera of Wisconsin. The only comprehensive report dealing with the group in a neighboring state is the one by Parfin (1952) for Minnesota. I have collected Neuroptera in Wisconsin in a desultory manner from 1922 to 1957 and from then to the present date methodically and much more extensively. I have worked in all 72 countries of the state, some in only a few places but in a number of counties spaced throughout the state, in many places and at many times. With more collecting other species may be found or the distribution of the known species extended but I feel that publication at this time is warranted.

I have examined the collections at the Milwaukee Public Museum, the University of Wisconsin at Madison and several smaller collections in the state. My inquiries concerning Wisconsin specimens in collections outside the state have yielded very meager results.

In my collecting I have kept every neuropteran specimen no matter how damaged it might be and no matter how many duplicates I had. I did this to more accurately get a comparison of the relative abundance of the species and a more accurate figure of the proportion of males and females and of the type of habitat where different species are found.

METHODS

The two commonest methods of collecting insects, sweeping herbaceous vegetation, bushes and the lower branches of trees and attracting them by light were used throughout this work.

The type of habitats swept for specimens included native coniferous forests and woods, pine plantations, native broad-leaved forests and woods, forest and wood edges, apple and cherry orchards, cultivated fields, hay fields, marshes, bogs, swamps, river and stream banks, lake and pond margins, sand dunes, oak openings, wet prairies, dry hill and bluff prairies, limestone and sandstone bluffs, quartsite and granite outcroppings, roadsides and railroad right of ways, and city yards and gardens.

The type of lights used were gasoline lantern, acetylene cap light, auto head lights, 100 and 150 watt incandescent lights, 15 watt BL and BLB blacklight and 400 watt mercury vapor lamp.

Few records are available which show the number and per cent of Neuroptera specimens caught by light as compared to the total catch of all insects. Making such counts is extremely tedious and time consuming and this may account for the scarcity of records.

Shackleford (1960) in reporting on a light trap catch in Oklahoma lists the major orders and families collected but does not mention Neuroptera.

Table 1 shows that Neuroptera constitute a very small part of the total insect catch when light is used. It is to be noted that my count for Neuroptera is considerably higher than those of Frost (1957) and Pfrimmer (1955). This may be due to the different localities but more likely it is due to two other reasons.

First, I have used lights many times and have been able to note various trends. I have observed that the hours from dusk to midnight are the best hours for catching Neuro-

[1]This project was supported in part by the Research Committee of the University of Wisconsin on funds from the Wisconsin Alumni Research Foundation.

[2]Present address: 1358 Meadow Lark Lane, Waukesha, Wisconsin 53186.

Table 1. Number and per cent of Neuroptera caught by light trap.

Reference	No. of insects caught	No. of Neuroptera caught	Neuroptera % of total catch
Frost, 1957	188,135	158	0.084
Pfrimmer, 1955	160,396	4	0.0025
Throne	13,591	69	0.51

ptera. Also I have noted that warm, moonless, relatively calm but dewless nights are best. Therefore when I use lights I carefully select the time that experience has proven to be the most profitable for my purpose. Secondly, I am interested in one group only and thus can more easily pick out the Neuroptera from all others, even the small Hemerobiids and the minute Coniopterygidae which might easily be overlooked by a person not particularly interested in them.

My data given in Table 1 were obtained by collecting during 17.5 hours selected over a period June 11 to July 1, 1961, using a 100 watt incandescent light in a funnel trap, in a small backyard containing grass, flowers and several trees and bushes in Shorewood, Milwaukee County, Wisconsin.

I have not run controlled experiments to determine the efficiency of various types of light but from my observations over many hours of collecting I have come to the conclusion that there is very little difference in the efficiency of the various main types of light source for collecting Neuroptera.

CHRYSOPIDAE Hagen

Three genera are found in Wisconsin; *Meleoma, Chrysopa* and *Eremochrysa.* Bickley and MacLeod (1956:182) have an excellent key for separating these genera.

Genus MELEOMA Fitch

Representatives of this genus are found most abundantly in southwestern United States and Mexico. There are only two species of *Meleoma* in northeastern United States, both of which occur in Wisconsin. In the state they appear to be confined to the northern portion except along Lake Michigan, where, as with a number of northern Wisconsin plants and insects, the range extends sourthward.

Dr. Catherine A. Tauber's (1969) monograph on *Meleoma* is the best and most recent paper on the genus. Keys for the separation of the 22 species found in North America are given on pages 7 to 13.

Table 2. Collecting data of 63 specimens of two species of *Meleoma* collected in Wisconsin.

Species	No. & % of Males	No. & % of Females	No. & % of total caught by light	No. & % of total caught by sweeping
signoretti	8 25%	24 75%	24 75%	8 25%
emuncta	11 38%	20 65%	27 87%	4 13%
Total for both species	19 30%	44 70%	51 81%	12 19%

Fig. 1. The counties of the State of Wisconsin

Table 2 shows that only 19% of the specimens collected were caught by sweeping. This is an indication that the genus in Wisconsin is largely tree inhabiting and not easily reached with a net. Females constituted 70% of the total catch. It is interesting to note that of the 675 specimens of *signoretti* and *emuncta* examined by Tauber, collected in many areas of the United States, Canada and Mexico, 71% were females.

signoretti Fitch. (Fig. 2). July 1 to September 2. This species was described by Fitch (1856:82) from a specimen collected in July near the summit of Mount Antonio, Vermont. It has since been collected, as reported by Tauber (1969) in five provinces of Canada from Quebec and Nova Scotia to British Columbia and in the United States from 15 of the northeastern states from Maine to Wisconsin and south to Virginia and Illinois. Bickley and MacLeod (1956) record it from Minnesota and Tennessee.

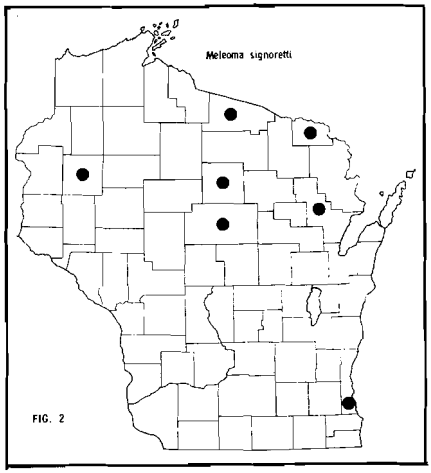


FIG. 2

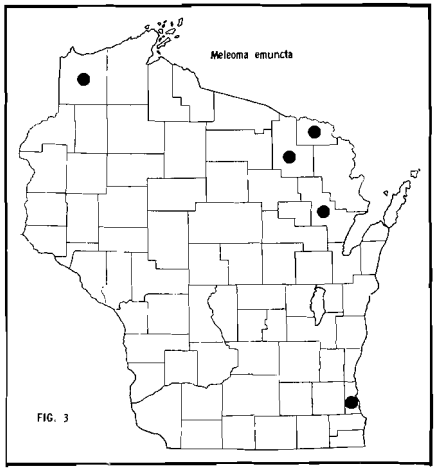


FIG. 3

The Wisconsin specimen recorded by Tauber was collected in Polk County. I have 32 specimens collected in seven counties as indicated in Fig. 2 and three specimens from the Upper Peninsula of Michigan. The male of this species, with its prominent "horn", is a most striking insect when viewed with a dissecting microscope.

emuncta (Fitch). (Fig. 3). July 8 to August 30. This species was described by Fitch (1856) p. 88 as *Chrysopa emuncta.* It is the most widely distributed species of *Meleoma,* recorded by Tauber (1969) from seven provinces of Canada from Quebec and Newfoundland to British Columbia, in the northeastern states from Maine to Wisconsin and southward in the Appalachians to North Carolina, and in the west from Washington to Arizona and Mexico. I have 31 specimens collected in five counties of Wisconsin, two specimens from the Upper and one from the Lower Peninsula of Michigan.

Genus CHRYSOPA Leach

This is by far the best represented genus of the Chrysopidae in Wisconsin. The relationship of the species within the genus is not clear. Smith (1932) breaks the genus into five sections, Bram and Bickley (1963:4) into three groups based on male terminalia, and Dr. Ellis MacLeod (personal communication) speaks of seven groups based on male terminalia, larvae and other characters. Four of the seven groups are represented by Wisconsin species. According to MacLeod's grouping the Wisconsin specimens are as follows:

Perla Group: *nigricornis, oculata, chi, quadripunctata, incompleta* and an undetermined species near *oculata.*

Carnea Group: *carnea, harrisii, rufilabris* and *downesi* if it is found to occur in Wisconsin.

Lineaticornis Group: *lineaticornis.*

Perfecta Group: Undetermined species near *perfecta.*

When Dr. Phillip Adams completes his revision of *Chrysopa* the matter of group or sub-generic relationship will, hopefully, be settled.

It is a rare coincident that the known recognized species of *Chrysopa* in Wisconsin are exactly those found in Maryland and that the key of Bram and Bickley (1963:4) for the *Chrysopa* of Maryland is equally applicable for the Wisconsin species.

Data for specimens of Chrysopa collected in Wisconsin are given in Table 3.

Table 3. Collecting data for 5352 specimens of nine species of *Chrysopa* collected in Wisconsin.

Species	No. & % of Males	No. & % of Females	No. & % of total caught by light	No. & % of total caught by sweeping
nigricornis	93 74%	33 26%	98 78%	28 22%
oculata	920 42%	1273 58%	702 32%	1491 68%
chi	10 37%	17 63%	17 63%	10 37%
quadripunctata	41 51%	39 49%	55 69%	25 31%
incompleta	17 46%	20 54%	0 0%	37 100%
carnea	1267 56%	1004 44%	1429 63%	842 37%
harrisii	61 43%	82 57%	40 28%	103 72%
rufilabris	223 51%	213 49%	293 67%	143 33%
lineaticornis	17 44%	22 56%	16 41%	23 59%
Total for all species	2649 49.5%	2703 50.5%	2650 49.5%	2702 50.5%

nigricornis Burmeister. (Fig. 4). May 27 to October 4. This green lace-wing is widely distributed in the United States. It extends from Maine (Procter, 1927), Massachusetts (Banks, 1903a) and North Carolina (Brimley, 1938) to at least as far west as New Mexico (Banks, 1904), Arizona (Banks, 1903b) and Utah (Knowlton, 1946) and is found in Canada (Smith, 1932). I have collected it in 13 Wisconsin counties and it undoubtedly occurs throughout the state in favorable habitats. It is mainly a tree inhabiting species.

Typically the antennae are black, at least the basal fourth. Rather recently it has been determined that the antennae of certain specimens are not dark. These have in the past been called *erythrocephala* Banks (1898) and *majuscula* Banks (1906) and have now been reduced to synonymy with *nigricornis* by Bram and Bickley (1963).

oculata Say. (Fig. 5). May 9 to October 16. This species is widely distributed. Hagen (1861) reports it from Nova Scotia, Hudson's Bay, Georgia, Louisiana, Washington and other places. Bickley and MacLeod (1956) say it occurs throughout the Nearctic Region. It and *carnea* are the two most abundant species in Wisconsin. I have specimens from all but seven of the 72 counties in the state.

Specimens of this species have been described under numerous specific and varietal names. Observations and investigations by Bickley (1952), Smith (1922) and Ellis MacLeod (personal communication) show conclusively that these numerous names are not valid and should all be reduced to synonymy.

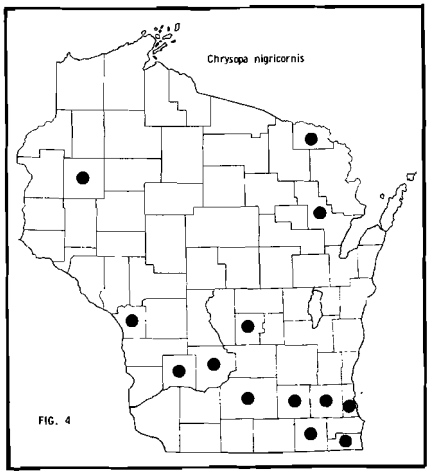


FIG. 4

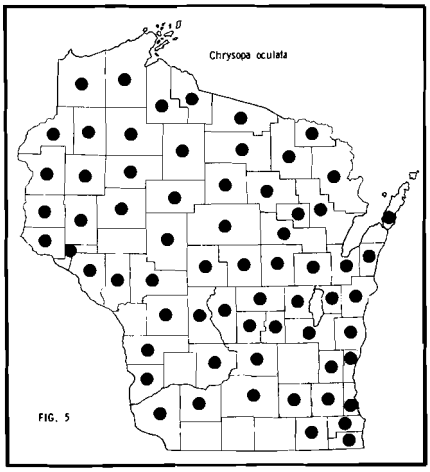


FIG. 5

C. oculata is an open field, roadside and garden inhabiting species and is the one most frequently seen. The adult seasonal distribution, (Fig. 6), is typical of those species overwintering as larvae or prepupa.

chi Fitch. (Fig. 7). June 12 to August 16. This is apparently a northern species. Procter (1927) reports it from Maine, Parfin (1952) from Minnesota, and Bickley and Mac Leod (1956) list it from New Hampshire, New Jersey, Washington, D. C., New York and in Canada from New Brunswick to British Columbia. The species appears to extend southward in the mountains for they also report it from Virginia, Tennessee and California. Banks (1904) records one specimen from New Mexico saying ". . . one specimen from Pecos, June 19th; agrees with eastern specimens throughout."

I have collected *chi* in nine counties but it apparently is not found in southern Wisconsin. *C. chi* appears to be the rarest named species in the state. I have collected only 27 specimens. This species and *lineaticornis* are the two having the shortest period of adult yearly activity in Wisconsin (Fig. 9).

quadripunctata Burmeister. (Fig. 8). May 31 to September 24. Most of the records of *quadripunctata* that I have been able to locate are of specimens collected east of the Rocky Mountains but Knowlton (1946) reports it from Utah and Bickley and Mac Leod (1956) from Vancouver Island. I have 80 Wisconsin specimens from 12 counties. It is primarily a tree and shrub inhabiting species.

The larvae of certain Chrysopids are called "trash-carriers" from their habit of depositing a rather compact pad of aphid skins, plant hairs and other "trash" upon their backs. For details see Smith (1926).

The only true trash-carrier in Wisconsin is *lineaticornis.* However, *quadripunctata* might be termed a partial trash-carrier for, although it does not form a compact pad, it does cover its back loosely with material. It has been claimed that this habit developed as a protection against parasites and predators and this may be true but it seems a little strange that most, if not all, trash-carriers are comparatively rare whereas some of the non-trash-carriers are exceedingly common. At least to the human eye, a mass of aphid skins moving across a leaf or along the bark of a tree, is most conspicuous.

On August 25, 1966 I collected such a larva while sweeping *Quercus.* At 4:45 PM I gave the larva a rose aphid. It seized it with both mandibles, pierced it and starting sucking. As the aphid shrunk in size the larva continued to suck with one mandible and used the other to help move the aphid about so the sucking mandible could get into all the minute cavities of the aphid body. At 4:50 PM it completed sucking and

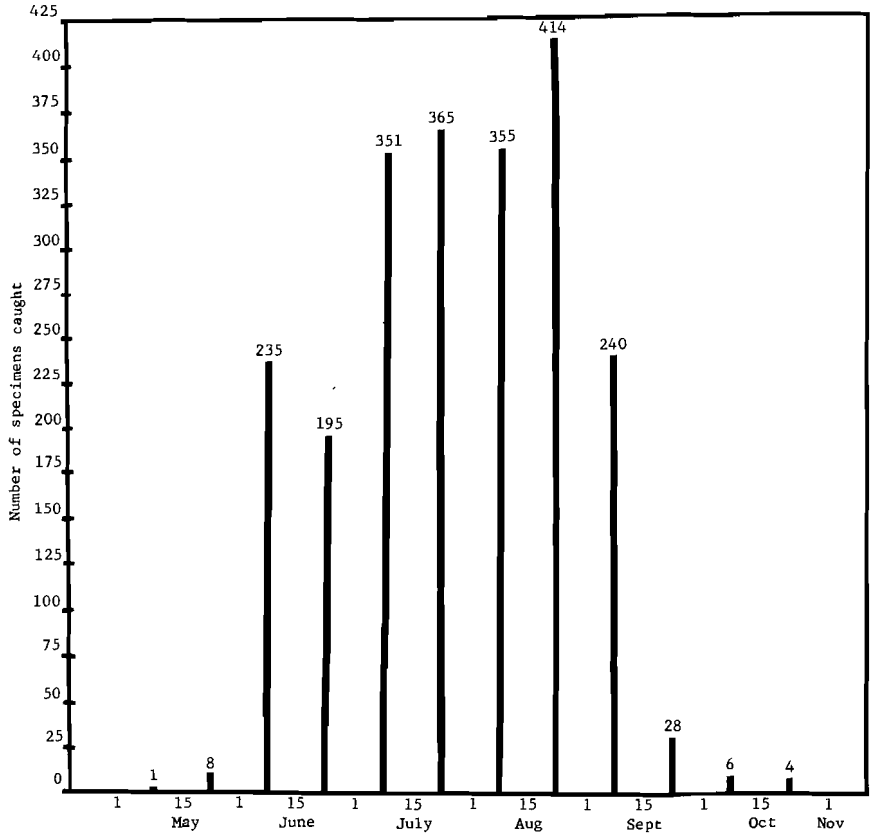
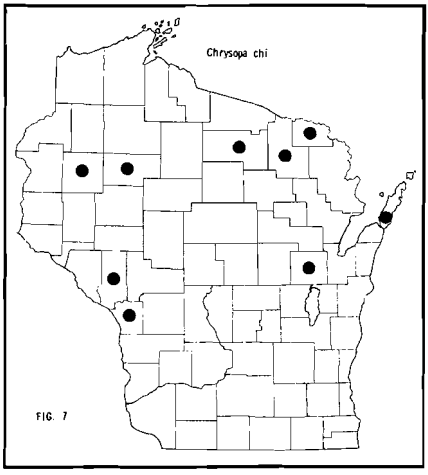
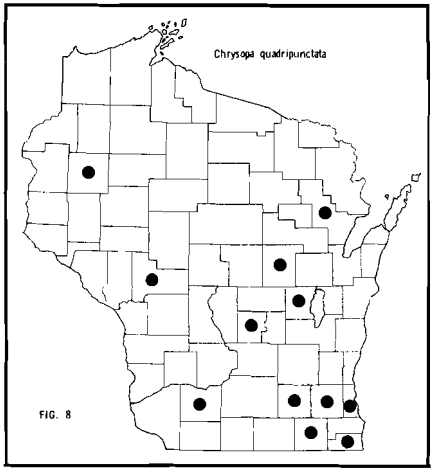


Fig. 6. Seasonal distribution of adult *Chrysopa oculata* Say. Based on 2202 specimens.





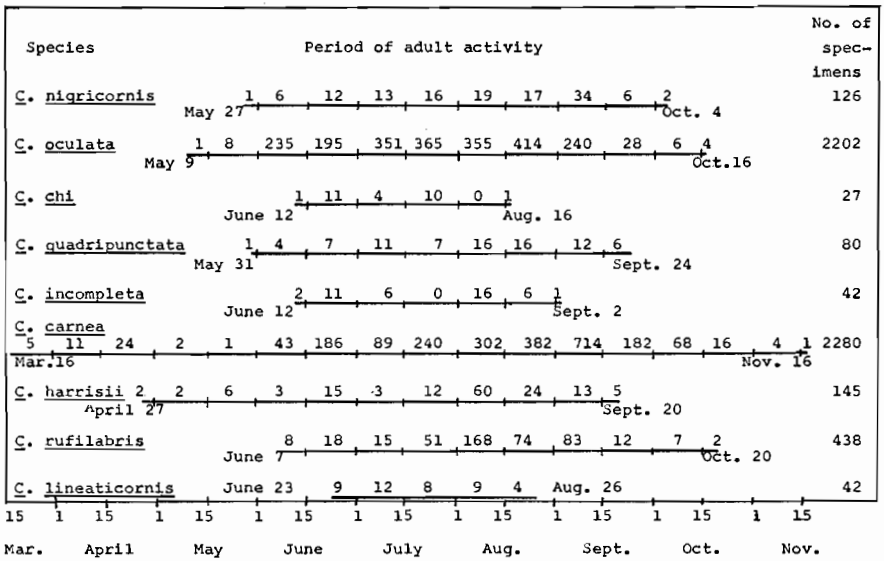


Fig. 9. Period of adult activity of Wisconsin Chrysopids and their relative abundance as indicated by collecting data.

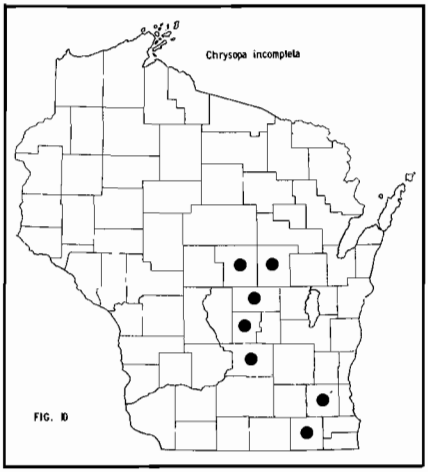
took the empty skin in its mandibles, bent head and thorax up and back and deposited the skin on its back. At 5:05 PM it took another aphid and finished sucking at 5:13 PM. It raised the anterior part of the body up and back as before but this time it also raised the posterior part of the abdomen in order to aid in properly placing the skin.

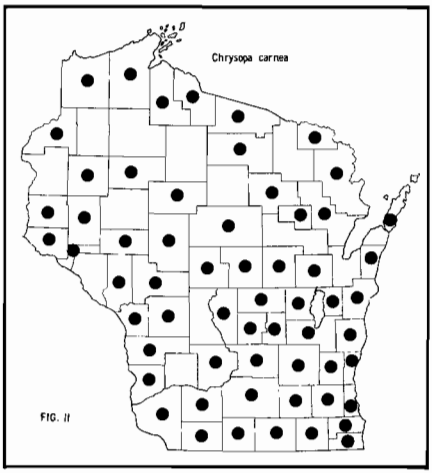
The next morning when I examined it, it was in a corner of a vial between the glass and a rose leaflet and it had taken all the aphid skins off its back and was probing each in turn, apparently trying to extract any juice it had passed up the day before. Could this packet of skins be a reserve cache of food in case a live supply is not found? Or could it serve as a protection against evaporation?

incompleta Banks. (Fig. 10). June 12 to September 2. Bram and Bickley (1963) record this species from Massachusetts, New Jersey, Maryland, Virginia, North Carolina and Georgia. I am indebted to Dr. Phillip A. Adams, California State College at Fullerton for making the determinations of my first specimens collected and of extending the range to include South Carolina and Florida (personal communication).

Since I live so far from the known range of *incompleta*, one might assume that my specimens collected in Wisconsin were accidental arrivals but there are some disjunct coastal plain species of plants in Wisconsin and perhaps *incompleta* followed the same route into the state as did the plants. Regardless of how they first reached Wisconsin the species is well established, for I have collected 42 specimens in seven counties in nine of the years from 1957 to 1969, inclusive. All of my specimens were collected in pine plantations by sweeping *Pinus strobus* L., *P. resinosa* Ait. and *Quercus* spp. All of these plantations were in very sandy areas.

carnea Stephens. (Fig. 11). March 16 to November 16. This species has for years been known under the names *plorabunda* Fitch (1856) and *californica* Coquillett (1890). Tjeder (1960) determined that our specimens are identical with the old world *carnea,* which is the most widely distributed chrysopid in the world occurring throughout Europe, north and south Africa and as far east as India and Formosa Killington (1937). Now most of North America must be included in its range. *C. carnea* is the most common species collected in Wisconsin. I have specimens from 60





of the 72 countries and it undoubtedly occurs statewide. It can be found in open fields and gardens, along roads and railroads, open woodlands and to some extent in broad-leaved forests.

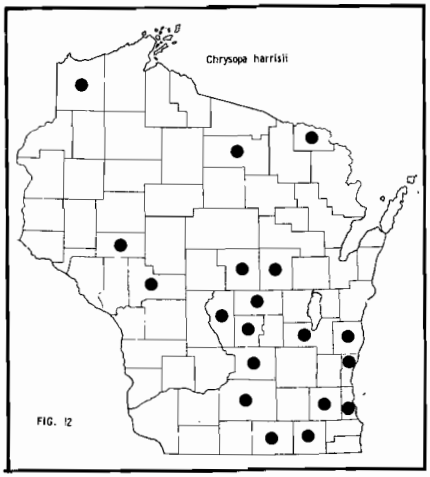
This species overwinters as the adult. This is borne out by the extremely long season of adult activity (Fig. 9) as compared to that of other species in the state. Note that there is a first peak of abundance in the period April 15 to May 1, then a decided dropping off to about June 1 and then an increase to the second peak the first half of September. The peak in April represents the overwintering adults with the generation from eggs starting to appear in June.

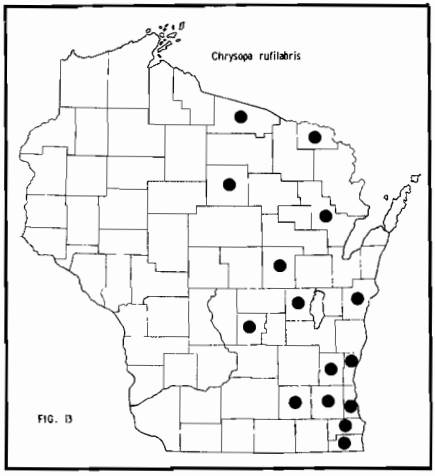
Overwintering adults change color as the days get shorter, becoming pink or pinkish brown. In the spring of the year, when adult diapause is broken with the lengthening day, the green color gradually returns MacLeod (1967), Tauber and Tauber (1969, 1970).

harrisii Fitch. (Fig. 12). April 27 to September 20. This species has been recorded from North Carolina (Brimley, 1938) to Kansas (Smith, 1934), north to Minnesota (Parfin, 1952) and New Hampshire (Banks, 1903a) and many localities in between. Smith (1932) reports it from Ontario to British Columbia and Bickley and MacLeod (1956) record it from Fort Yukon, Alaska. Stroud (1950) records it from White Sands National Monument, New Mexico. This seems an unlikely location for *harrisii* and might upon close examination turn out to be *externa* Hagen which has frequently been confused with *harrisii.*

Chrysopa harrisii seems to be a more northern species found most abundantly on conifers. I have taken the cocoons of this species more commonly than those of any other species. On August 1, 1967 in Waukesha County I collected 28 cocoons in 25 minutes on the needles of *Pinus resinosa* Ait. The yellow or yellowish cocoons are very conspicuous against the dark green needles. I placed each of these cocoons in individual glass vials plugged with cotton. From August 7 to August 14 eight male and eight female *harrisii* emerged. From August 14 to August 26 seven hymenopterous parasites emerged from five cocoons. The remaining cocoons were opened on September 3. Six contained dead *harrisii* larvae and one contained a dead *harrisii* larva and a dead adult hymenopterous parasite. Of the 28 cocoons 16 or approximately 57%, produced living adult *harrisii.*

Smith (1922:1322) in discussing the emergence of the pupa from the cocoon mentions the circular opening in the cocoon and the lid. He raises the question as to whether the larva builds the lid in while spinning the cocoon, the pupal mandibles cut the lid or whether it is torn open by pressure exerted by the pupa. To throw some





light on this question I quote directly from my notes written at the time I opened the cocoons from which nothing had emerged. "I picked the cocoons open with two sharp, thin dissecting needles. In all cases a circular lid easily separated from the cocoon as though a living pupa had emerged. This suggests that it is the larva which is primarily responsible for the ease with which the lid comes off."

rufilabris Burmeister. (Fig. 13). June 7 to October 20. This is a widely distributed species found throughout the United States. It has been recorded from Canada (Bickley and MacLeod, 1956) and from Mexico (Banks, 1901). It is the third most abundant species in Wisconsin. Because of its abundance in the state and its widespread distribution in North America its distribution in Wisconsin is difficult to understand. I have no records of any specimen from the western part of the state. Parfin (1952) records *rufilabris* from only one county in Minnesota. I have collected it in a wide variety of habitats.

On August 14, 1964 I placed a larva of *rufilabris* on a leaf of *Ribes sativum* Syme on which were numerous small green aphids. It immediately caught an aphid in its mandibles and started sucking. I watched it continuously from 12:00 noon until 1:20 PM under a 15 power dissecting scope. In this 80 minute period it caught and completely drained 21 aphids. The average time required to drain an aphid was two minutes, the least one minute and the most slightly over four minutes. Of the 80 minutes, 42 were spent in eating and 38 in resting or searching for aphids. It was apparent that the larva found the aphids by the sense of touch or smell not sight.

On July 22, 1966, having no aphids immediately available, I killed a spider by squeezing the cephalothorax with forceps and put in front of the nearly full grown larva of *rufilabris*. The spider was twice the bulk of the larva which immediately pierced the spider's abdomen. It started to suck the juices at 5:16 PM and by 7:30 PM the spider was greatly shrunken and the larva had finished feeding and had withdrawn its mandibles. Two daya later I put another spider of comparable size with the same *rufilabris* larva at 10:25 AM. It fed continuously until 10:50 AM and then withdrew its mandibles and rested.

This larva fed no more and at 9:00 AM of July 25th started spinning a cocoon which it finished by the next morning. On August 5, 1966 about 8:00 AM the adult emerged.

Frequently, when no other food was available, I have fed *Chrysopa* larvae the larvae of the Goldenrod Ball Gall with success.

lineaticornis Fitch. (Fig. 14). June 23 to August 26. Bickley and MacLeod (1956) record this species from Quebec, New York, Maryland, Virginia, North Carolina, Tennessee

and Michigan and Banks (1903a) records it from Massachusetts and New Hampshire. I have collected six specimens from Edmonson County, Kentucky, two from Baxter County, Arkansas, and 42 from Wisconsin. The latter two states show a westward extension of the former reported range.

C. lineaticornis is largely a tree inhabiting species. It has the shortest period of adult activity of any species of green lace-wing in Wisconsin. It is the only true trash-carrying chrysopid in the state.

Bram and Bickley (1963) have considered *columbiana* Banks as a synonym of *lineaticornis.*

UNDESCRIBED SPECIES OF CHRYSOPA

I am indebeted to Dr. Ellis G. MacLeod for determining that a puzzling specimen of mine belongs to an undescribed species. In a letter dated April 1, 1968 he says, "Specimen #1374B is a female of an undescribed species closely related to *C. oculata.* Both Phil Adams and myself have seen this species from several areas in the east of the U.S. and from as far west as Utah. Your specimen is the first Wisconsin record of which I am aware. This is a particularly interesting little species since it is actually quite common in some localities and has been completely overlooked by all of the workers on the Neuroptera up to now. Although closely similar to *C. oculata* it is consistently different in having large *dark brownish* spots on the clypeus, which are always lacking in *C. oculata* (although, of course, the lateral margins of the clypeus are margined in *C. oculata*). The chromosomes of the new species also differ from those of *C. oculata,* as do the larval stages which I reared a few years ago."

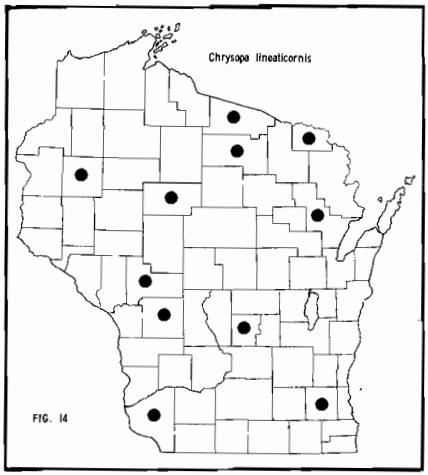
Another series of puzzling specimens that I sent to Dr. MacLeod he determined as specimens of either an undescribed species or of an exotic introduced into the United States. He found it in 1962 in Maryland and later from a number of places in the eastern states. He is investigating the status of this species, which is near *C. perfecta* Banks. I am sure that Dr. MacLeod or Dr. Adams or both in collaboration will soon publish on the status of these species which are new to Wisconsin and to the United States.

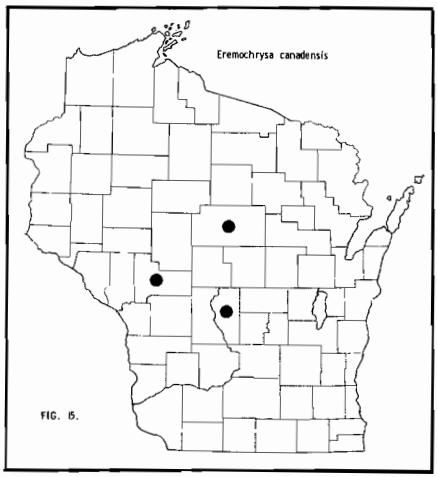
The collection data for my specimen of the undescribed species near *C. oculata* Say are as follows: #1374B female, collected 6-VII-1966 in T16N,R10E,S6 Marquette County, Wisconsin. It was caught while sweeping *Pinus strobus* and *P. resinosa* in a pine plantation in a sandy area.

The collection data for my specimens of the undescribed species near *C. perfecta* Banks are as follows: #429 male, collected 8-VII-1957 in Adams County, Wisconsin; Roche a Cri Roadside Park while sweeping *Quercus* sp. at the base of a moist sandstone bluff. #699 female, collected 28-VII-1958 in Iowa County, Wisconsin; Tower Hill State Park while sweeping vegetation in a hardwoods edge habitat. #1070L female, collected 23-VIII-1959 in T16N,R10E,S6 Marquette Co., Wisconsin; in 100 watt light trap in open vegetated area in a sandy *Pinus strobus, P. resinosa* plantation. #1448E female, collected 23-VI-1967 in Waukasha Co., Wisconsin; Eagle while sweeping *Quercus* spp. and *Pinus* spp. in a sandy pine plantation. #1457B female, collected 12-VII-1967 in Waukesha Co., Wisconsin; North Prairie while sweeping *Quercus* spp. and *Juniperus virginiana* L. All of the above specimens were collected by A. L. Throne.

HYPOTHETICAL SPECIES

I have never found *Chrysopa downesi* Smith in Wisconsin but I strongly suspect that it occurs in the northern part of the state. It is a species very close to *carnea.* The two species are very difficult to tell apart in pinned specimens; even the male terminalia are of little help. Live specimens are more easily recognized because of the intense dark green coloration of *downesi* as contrasted to the much lighter green of *carnea. C. downesi* appears to be always associated with coniferous trees, whereas *carnea* seldom is. Overwintering *carnea* change color as preciously mentioned but *downesi* never change color.





Genus **EREMOCHRYSA** Banks

Most of the species of this genus are found in southwestern United States. It is the rarest genus of Chrysopidae in Wisconsin, there being but one species and that seldom found. The best keys for separating the species of *Eremochrysa* are those in Banks (1950:52-53, 59-60).

canadensis Banks. (Fig. 15). July 8 to July 26. The type locality for this species is Go Home Bay, Lake Huron, Ontario (Banks, 1911). It has also been recorded from Maine, New Hampshire and Massachusetts (Bickley and MacLeod 1956). I find no other localities listed for this species. No specimen of this genus has ever been recorded from Wisconsin so this report extends the known range considerably to the west. I have taken 23 specimens of *canadensis* from three counties and consider this species rare enough to give the collecting data.

Adams County, Roche a Cri Roadside Park about one-half mile north of Friendship on State Highway 13. On July 8, 1957 I caught four males and thirteen females. All were at rest in the shade on a bare, vertical, moist sandstone bluff. Some were caught with forceps and others with a net after they flew when disturbed. Twelve were captured about 3:30 PM and five about 7:30 PM. About 8:00 AM, July 9, 1957, I took three more males and one female at the same place.

Marathon County, Rib Hill State Park near Wausau. During the evening of July 9, 1957 I caught one female at the summit of Rib Hill on the bare quartsite outcrop. It was attracted by the light of a gasoline lantern.

Jackson County, Castle Mounds Roadside Park just south of Black River Falls. During the evening of July 26, 1957 one female was attracted to a gasoline lantern at the base of a bare sandstone bluff.

I have collected at the latter two locales several times and at Roche a Cri many times since 1957 looking for *canadensis* without finding another specimen. I suspect the species may still be found in the state but to get rare specimens one must collect at the right spot at the right time and often the right spot and time are very restricted in extent.

Banks (1950) on pages 60 and 64 suggests the similarity of *E. canadensis* and *E. hageni* Banks. On page 66 he lists as *candensis* the specimen which Procter caught in Maine and called *hageni* (Procter, 1927). Also Dr. Ellis G. MacLeod suggested to me (personal communication) that *canadensis* appears to be a synonym of *hageni.* Perhaps on further study this will prove to be true.

ACKNOWLEDGEMENTS

I wish to thank the persons, too numerous to mention individually, who contributed one or more specimens to my collection. Two persons who gave me many specimens, Dr. Ronald L. Giese of Purdue University and Mr. Daniel L. Dettwiler of Milwaukee, deserve special thanks.

Others who deserve special thanks are Mr. Kenneth MacArthur and Mr. James Lawton, Milwaukee Public Museum for allowing me to examine the Neuroptera specimens under their care and for the use of the Department facilities; to Dr. R. D. Shenefelt, University of Wisconsin for granting me permission to examine the specimens in the University collection; to Dr. Philip Whitford, University of Wisconsin-Milwaukee and Mr. Paul Hoffmann, Wales, Wisconsin for allowing me to set up light traps on their natural habitats in Marquette and Waukesha Counties respectively; to Mr. Paul Matthiae, Resident Manager, University of Wisconsin-Milwaukee Field Station, Ozaukee County for assisting in my light trap collecting at that excellent native area; to Dr. Catherine A. Tauber, Cornell University for checking the identification of all of my *Meleoma* specimens; and lastly to Dr. Ellis G. MacLeod, University of Illinois and Dr. Phillip A. Adams, California State College at Fullerton for their help in determining some of my specimens and for giving me advice.

LITERATURE CITED

Banks, Nathan. 1898. Descriptions of new North American Neuropteroid Insects. Trans. Am. Entomol. Soc. 25:199-218.

———. 1901. A list of Neuropteroid Insects from Mexico. Trans. Am. Entomol. Soc. 27:361-371.

———. 1903a. A revision of the Nearctic Chrysopidae. Trans. Am. Entomol. Soc. 29:137-162.

———. 1903b. Neuropteroid Insects from Arizona. Proc. Entomol. Soc. Wash. 5:237-245.

———. 1904. Neuropteroid Insects from New Mexico. Trans. Am. Entomol. Soc. 30:97-110.

———. 1906. Three new species of Neuroptera. Psyche. 13:98-100.

———. 1911. Descriptions of new species of North American Neuropteroid Insects. Trans. Am. Entomol. Soc. 37:339-340.

———. 1950. Notes and descriptions of western Chrysopidae. Psyche. 57:45-67.

Bickley, William E. 1952. Inheritance of some varietal characters in *Chrysopa oculata* Say. Psyche. 59:41-46.

——— and Ellis G. MacLeod. 1956. A synopsis of the Nearctic Chrysopidae with a key to the genera. Proc. Entomol. Soc. Wash. 58:177-202.

Bram, Ralph A. and William E. Bickley. 1963. The green lacewings of the Genus *Chrysopa* in Maryland. Maryland Agr. Exp. Sta. Bull. A-124:1-18.

Brimley, C. S. 1938. The insects of North Carolina. Raleigh, N. C. (Neuroptera 28-32).

Coquillett, D. W. 1890. Report of the California State Board of Horticulture.

Fitch, Asa. 1856. First and second reports on the noxious, beneficial and other insects of the State of New York. Albany. 1-336.

Frost, S. W. 1957. Pennsylvania insect light trap. J. Econ. Entomol. 50:287-293.

Hagen, Hermann. 1861. Synopsis of the Neuroptera of North America. Smithsonian Misc. Coll., Washington, D. C. 187-240.

Killington, Frederick J. 1937. A monograph of the British Neuroptera. Ray Soc. London. 2:1-306.

Knowlton, G. F. 1946. Neuroptera in light trap. Bull. Brooklyn Entomol. Soc. 41:19.

MacLeod, Ellis G. 1967. Experimental induction and elimination of adult diapause and autumnal coloration in *Chrysopa carnea*. J. Insect Physiol. 13:1343-1349.

Parfin, Sophy I. 1952. The Megaloptera and Neuroptera of Minnesota. Am. Midland Naturalist. 47:421-434.

Pfrimmer, Theodore R. 1955. Response of insects to three sources of Black Light. J. Econ. Entomol. 48:619.

Procter, William. 1927. Biological survey of the Mount Desert Region, Maine. Part I. The insect fauna. Wister Inst. Phila.

Shackleford, Martha W. 1960. Insect swarms coming to light traps. Southwwestern Naturalist 5:221-224.

Smith, Roger C. 1922. The biology of the Chrysopidae. Cornell Univ. Agr. Exp. Sta., Memoir 58:1287-1372.

———. 1926. The trash-carrying of certain lace wing larvae. Scient. Mon. 23:265-267.

———. 1932. The Chrysopidae of Canada. Ann. Entomol. Soc. Am. 25:579-601.

———. 1934. Notes on the Neuroptera and Mecoptera of Kansas, with keys for the identification of the species. J. Kansas Entomol. Soc. 7:120-145.

Stroud, Clyde. 1950. A survey of the insects of the White Sands National Monument, New Mexico. Am. Midland Naturalist. 44:659-677.

Tauber, Catherine A. 1969. Taxonomy and biology of the lacewing genus *Meleoma*. Univ. Calif. Publ. Entomol. 58:1-94.

Tauber, Maurice J. and Catherine A. Tauber. 1969. Diapause in *Chrysopa carnea*. II. Effect of photoperiod on reproductively active adults. Can. Entomol. 101:364-370.

———. 1970. Photoperiodic induction and termination of diapause in an insect: response to changing day lengths. Science. 167:170.

Tjeder, Bo. 1960. Neuroptera from Newfoundland, Miquelon and Labrador. Opusc. Entomol. 25:146-149.

THE NEUROPTERA – SUBORDER PLANIPENNIA OF WISCONSIN PART II – HEMEROBIIDAE, POLYSTOECHOTIDAE AND SISYRIDAE

Alvin L. Throne
University of Wisconsin
Milwaukee, Wisconsin 53201[1]

Family HEMEROBIIDAE

This family is represented in the Wisconsin fauna by five genera: *Hemerobius, Micromus, Sympherobius, Psectra* and *Kimminsia,* with the possibility that *Wesmaelius* and *Boriomyia* may be found with more extensive collecting. Carpenter (1940) has keys for separating the genera and species. I have collected 904 specimens in Wisconsin representing 14 species and have examined 139 other Wisconsin specimens from the collections of the University of Wisconsin, Madison; the Public Museum, Milwaukee: and Carroll College, Waukesha.

I sexed 1012 specimens of which 384 (38%) were males and 628 (62%) were females. Of 1043 specimens, 290 (28%) were caught by light traps and 753 (72%) by sweeping. Of 603 specimens for which I have the data, 466 (77%) were swept from coniferous trees and 137 (23%) from broad-leaved trees or shrubs.

Judged from collecting data, some species, as *Hemerobius stigma,* have a long period of adult activity, indicating several generations per year and hibernation as adults. In other species, as *H. conjunctus, Micromus angulatus, M. montanus, Sympherobius occidentalis, Psectra diptera, Kimminsia disjuncta,* and *K. pretiosa,* the period of adult activity appears to be short, indicating but one generation a season. However, in all these latter cases only a few specimens of each species were collected, so the validity of generalizations may be doubtful.

Specimens of all 14 species in Wisconsin were collected between June 1 and September 30. Specimens of only four species were collected before June 1 and of only five after September 30. This suggests that the best time to collect Hemerobiidae in Wisconsin in numbers is June to September inclusive.

Genus HEMEROBIUS Linnaeus

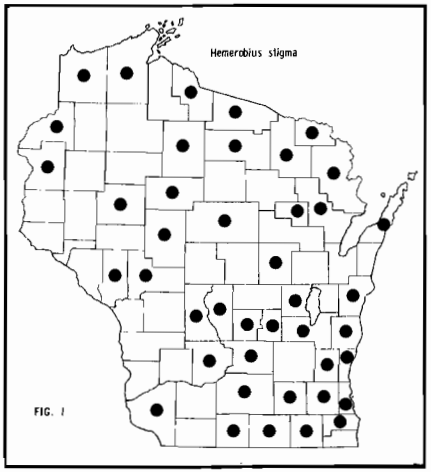
stigma Stephens. (Fig. 1). March 17 to November 26. This is the most abundant species of Hemerobiidae in Wisconsin. Carpenter (1940), recording it as *H. stigmaterus* Fitch, lists it as being the most widely distributed species of Nearctic *Hemerobius,* occurring from Labrador to British Columbia and across the entire United States. It is not common in the plains. Killington (1937) reports it as widely distributed in Europe.

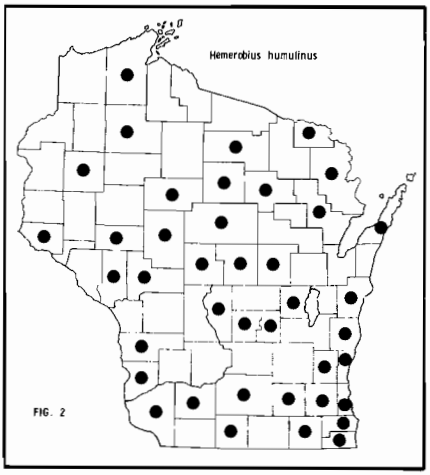
This species was called *Hemerobius stigmaterus* Fitch in North America until Tjeder (1960) synonymized it with the European *H. stigma.* This has been recognized by most workers as being valid but Nakahara (1965) believes there are differences in the aedeagus which seem important and he suggests that dissection and study of a large number of specimens are necessary before the synonymy is definitely established.

I have examined 368 specimens which were collected in 42 of the 72 Wisconsin counties, showing a state-wide distribution.

Killington (1937) remarks that, *"Hemerobius stigma* is exclusively associated with conifers". I have recorded the type of plants upon which 280 of my specimens were caught. Two hundred forty-two (86%) were swept from coniferous trees, about equally from *Pinus strobus* L., *P. resinosa* Ait., and *Juniperus virginiana* L., but 38 (14%) were collected from broad-leaved trees and shrubs, mainly *Quercus* spp. but also *Salix* spp., *Ostrya virginiana* (Mill.) K. Koch, *Hamamelis virginiana* L., and *Pyrus malus* L.

[1]Present address: 1358 Meadow Lark Lane, Waukesha, Wisconsin 53186.





humulinus Linnaeus. (Fig. 2). April 20 to November 2. This species is apparently holarctic. Killington (1937) states that *humulinus* occurs in Europe from Spain to the Arctic Circle and as far east as Siberia. According to Carpenter (1940) it is common from Newfoundland to Manitoba and less common to British Columbia; and common in the United States from the Atlantic to about the 100th meridian and north of the 35th parallel, but rare elsewhere. Nakahara (1965) lists it from Alaska.

I have collected 276 and examined 77 others totalling 353 specimens from 40 countries distributed throughout Wisconsin.

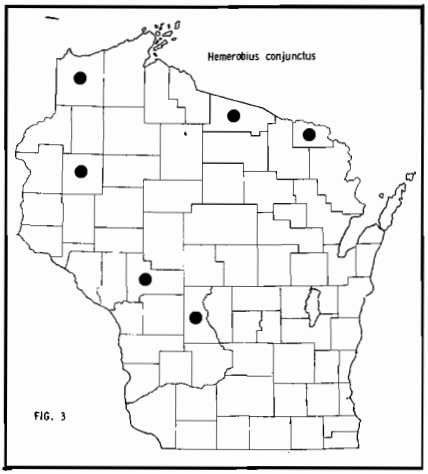
Killington (1937) states that it occurs abundantly in deciduous woods but that it is rarely taken from conifers. One hundred fourteen (59%) of 194 of the specimens I examined were collected on conifers, about equally on *Pinus strobus, P. resinosa* and *Juniperus virginiana* and two specimens from *Thuja occidentialis* L. and only 80 (41%) on broad-leaved trees and shrubs, mainly *Quercus* spp. and *Pyrus malus* L. but some on *Alnus rugosa* (Du Roi) Spreng., *Acer saccharinum* L., *Carpinus caroliniana* Walt. and *Rubus* sp. Smith (1923) records it from spiraea, elm and alfalfa.

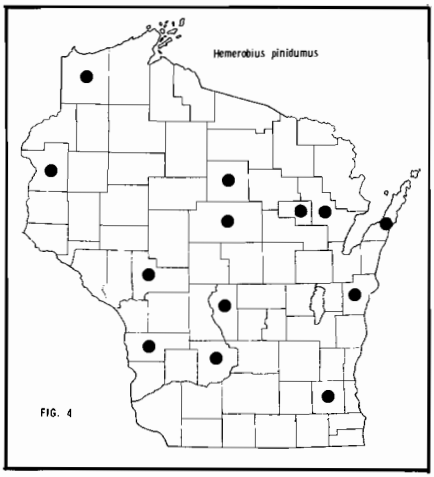
Several of my specimens are very dark winged. Concerning one such specimen of mine which Dr. Ellis G. MacLeod of the University of Illinois examined, he wrote in a letter to me April 1, 1968, "Specimen #655 I will identify as *Hemerobius humulinus* (as you note); however, I am rather suspicious that these dark-winged specimens which we attribute to this species may actually represent the species *H. perelegans* Stephens." The latter is a palaearctic species.

Later I sent three similar specimens to Dr. Oliver S. Flint of the Smithsonian Institution. I quote from his letter of March 15, 1971: "The 3 specimens of *Hemerobius* are one of the things that I would lump into *humulinus* L. However, Dr. MacLeod is quite likely correct that they may be *perelegans* Steph. Before we can make any definite statement on this point it will be necessary to study the complex in detail to determine if we have one or more species, what names are to be applied to which, etc. If I were you I would stay with the determination of Dr. MacLeod on these." Thus it appears we may have another species of *Hemerobius* to add to our known list. I hope that Dr. MacLeod will find time to study this problem in detail.

conjunctus Fitch. (Fig. 3). June 23 to August 23. This is the rarest species of *Hemerobius* in Wisconsin. Carpenter (1940) lists this species under the name *H. conjunctus* var. *conjunctus* Fitch. However, for reasons given under *H. pinidumus,* I believe it should be given specific rank as originally applied by Fitch in 1856.

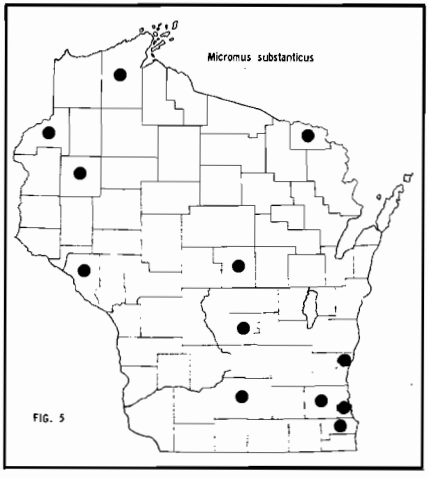
Carpenter (1940) records it from Newfoundland to British Columbia, Maine, New Hampshire, Vermont, and in the mountains of North Carolina, Tennessee, Montana,

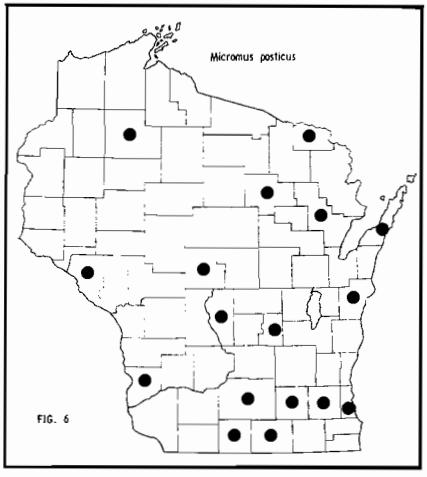




Wyoming, Colorado, and New Mexico; Nakahara (1965) from Alaska, Yukon, Oregon, Washington, California, Idaho, Utah, and South Dakota; Parfin (1952) from Minnesota; and Orman and Jacques (1949) from Iowa. I have collected nine specimens from six widely spaced counties of Wisconsin.

pinidumus Fitch. (Fig. 4). June 6 to August 26. This species was named and described by Fitch (1856). Carpenter (1940) reduced it to varietal status, *H. conjunctus* var. *pinidumus* Fitch, and it has retained the varietal name. Because of the great differences between *pinidumus* and *conjunctus* I believe the varietal status should be questioned and I have here retained Fitch's original designation. In support of this contention I quote from a letter I received from Dr. Ellis G. MacLeod dated August 7, 1968, in which he says, "With respect to the so-called variety *pinidumus* Fitch, I believe I mentioned to you that I have studied this species rather closely and am convinced that it is perfectly distinct from *Hemerobius conjunctus* and should be accorded full species status. There are consistent differences in the maculation and shape of the forewing, in the size of the insects, and in the pigmentation pattern of





the larva. If you like, why don't you cite it as *H. pinidumus* Fitch in your list and cite my unpublished studies for your authority for the statement."

Carpenter (1940) records this species as having been collected in Quebec, British Columbia, Maine, New Hampshire, Massachusetts, New York, Minnesota, Colorado and from Douglas County, Wisconsin. It is not abundant in Wisconsin but is apparently distributed throughout the state. Fitch aptly called it the Pine-bush Lace-wing. All 42 of my specimens were collected on *Pinus strobus* and *P. resinosa.*

Genus **MICROMUS** Rambur

subanticus Walker. (Fig. 5). May 12 to October 11. This and *M. posticus* are the two most abundant and widely distributed species of *Micromus* in Wisconsin. Carpenter (1940) records *subanticus* as occurring in the United States south of latitude 37°, from Florida to California. North of this area it occurs less abundantly from the Atlantic to longitude 97°. He mentions specifically only Massachusetts and New York. He records no specimens from Canada. Smith (1934) records it from Kansas; Froeschner (1947) from Missouri; Orman and Jacques (1949) from Iowa; and Parfin (1952) from Minnesota. I have 122 specimens from Wisconsin. The fact that only six out of 122 specimens were collected by sweeping and all the rest by attraction to lights suggests that *M. subanticus* is a tree-inhabiting species.

posticus Walker. (Fig. 6). April 3 to November 16. This species is common from Massachusetts to Minnesota and south to Florida and Texas Carpenter (1940). He records it in Canada from Ontario. He also lists it from Nebraska, Kansas, Colorado, North Dakota, and Arizona. Nakahara (1965) records it from Washington.

There are several generations a year in Wisconsin and the early and late collecting dates may indicate that some adults overwinter. Fifty-five percent of the 31 specimens for which I have data, were collected on *Pinus strobus, P. resinosa,* and *Juniperus virginiana* and 45% on broad-leaved trees, mainly *Quercus* spp. but also *Pyrus malus* and *Populus tremuloides* Michx.

angulatus Stephens. (Fig. 7). July 9 to July 17. This is a Holarctic species widely distributed in Europe and Asia Killington (1936), and throughout Canada and in the United States from Maine to Minnesota and in South Dakota and Colorado Carpenter (1940). It is rare in Wisconsin being recorded by Carpenter from Douglas and Shawano Counties and I have only three specimens from Florence and Marathon Counties. Mine were collected in July and those reported by Carpenter in August.

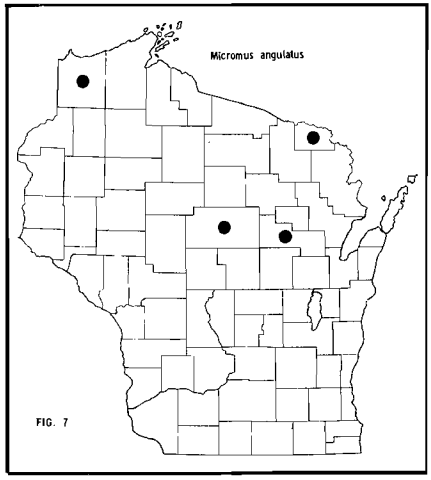


FIG. 7

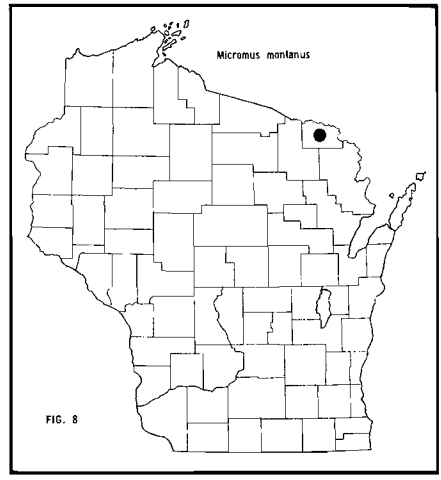


FIG. 8

montanus Hagen. (Fig. 8). June 25 to August 11. This is the largest of the Nearctic species of *Micromus* and the rarest in Wisconsin. Only three specimens have been collected, all from Florence County in three different years. Carpenter (1940) states that it apparently ranges across Canada and the northern United States from Maine to Washington with the exception of the plains region of both countries. Its range extends southward only at high elevations. All of my specimens were obtained with a light trap.

Genus **SYMPHEROBIUS** Banks

barberi Banks. (Fig. 9). August 9 to September 20. According to Carpenter (1940) this is the commonest species of the genus, ranging from Florida to California with northernmost localities in Oregon and Pennsylvania. Nakahara (1965) lists it from Utah and Froeschner (1947) says it is common in Missouri. Parfin (1952) lists one specimen from Ramsey County, Minnesota and remarks, "The possibility of artificial introduction from outside the state should not be disregarded." I have collected 31 specimens in two southern counties in two different years and believe that this indicates that *barberi* is an indigenous species in Wisconsin and most likely in Minnesota also. One of my specimens was attracted by light and 30 were collected by sweeping *Juniperus virginiana.* Wisconsin is apparently on the northern border of the range of this species.

amiculus Fitch. (Fig. 10). June 7 to October 11. This is a species of eastern North America. Carpenter (1940) reports it from many localities from the Atlantic to about the 100th meridian in the United States and southern Canada. Although I have more Wisconsin specimens of *barberi* than of *amiculus* the latter is more widely distributed in the state. Smith (1923) has taken it on oak and apple, Froeschner (1947) on *Juniperus virginiana,* and 50% of my specimens were swept from *J. virginiana* and 50% were taken in a light trap.

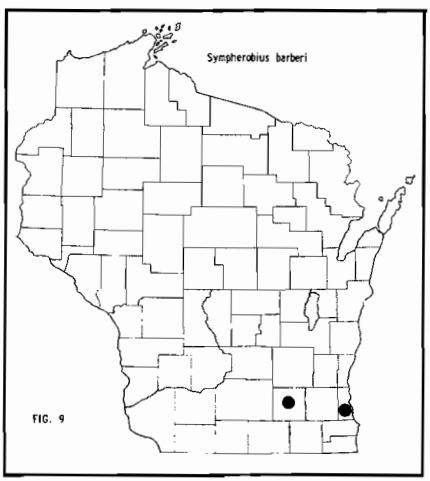


FIG. 9

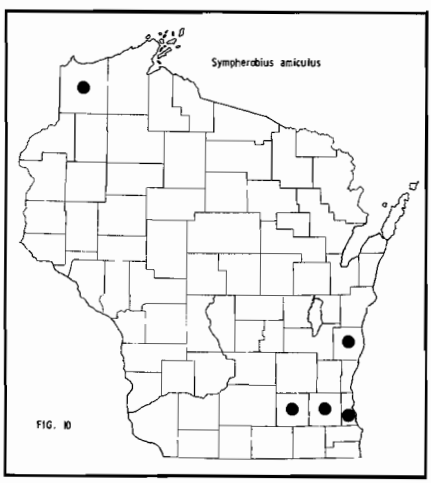
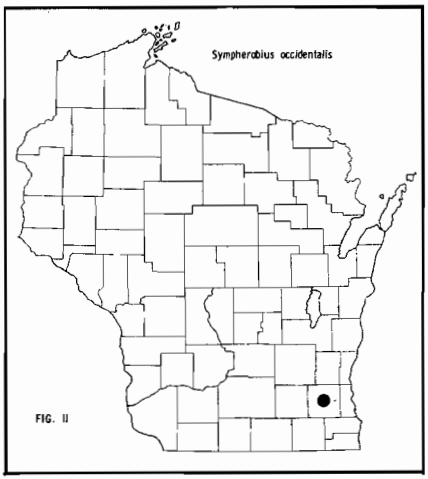
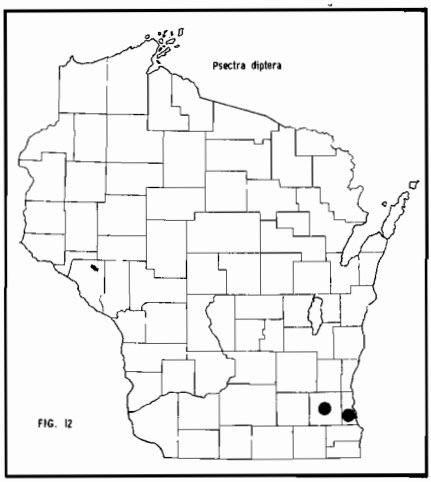


FIG. 10

occidentalis Fitch. (Fig. 11). June 23. This is a rare species being listed by Carpenter (1940) from Illinois, Kansas, Arkansas, District of Columbia, and Texas. Froeschner (1947) lists one specimen from Missouri collected on elm. It is the rarest species of Hemerobiidae in Wisconsin. I have collected but one specimen in the state and one in Baxter County, Arkansas, both taken on *Quercus.* Both are males and my identifications have been confirmed by Dr. Ellis G. MacLeod.





Genus **PSECTRA** Hagen

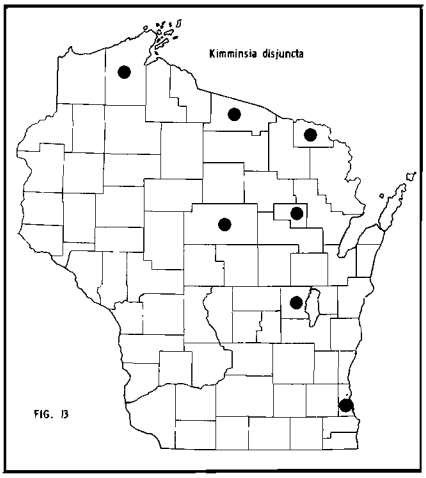
diptera Burmeister. (Fig. 12). August 2 to August 30. This species is widespread in Europe and Asia Killington (1936). It is found in northeastern United States as far west as Michigan and south to Virginia and West Virginia Carpenter (1940). Fitch (1856) records it as *Hemerobius delicatulus* Fitch from Illinois. Banks (1905) lists it from New York and New Hampshire, Parfin (1952) from Minnesota, MacLeod (1960) from Maryland and Connecticut, and Throne (1961) from Wisconsin.

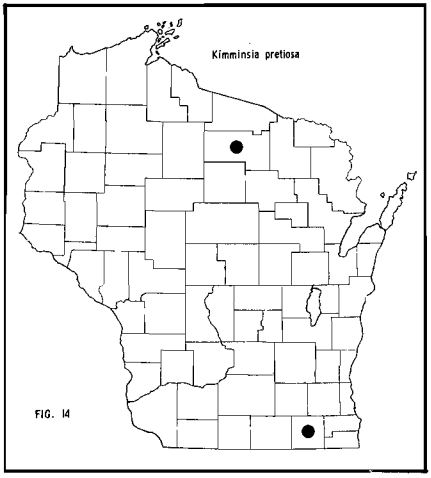
Carpenter, Killington and MacLeod who have each made studies of the occurrence and distribution of *Psectra diptera* all agree that it is exceedingly rare. MacLeod (1960) records two specimens attracted to light. This is the only reference I can find to this method of collecting the species. I have taken 13 specimens in Wisconsin in five different years, all taken in a light trap about three feet above the ground. All my specimens are macropterous.

Genus **KIMMINSIA** Killington

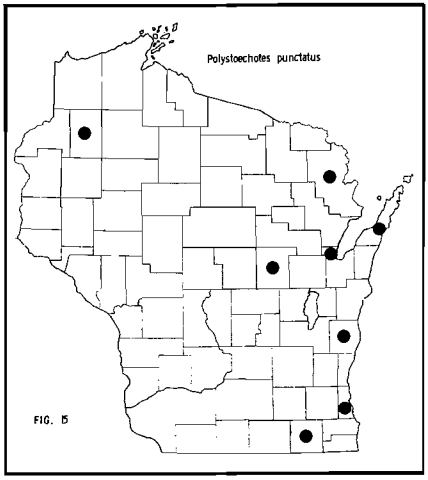
disjuncta Banks. (Fig. 13). August 23 to September 20. This is a northern species found in Alaska, Canada, and in the northern tier of states with southward extensions in the mountains (Carpenter, 1940 and Parfin, 1956). It is one of the rarer species of Hemerobiidae in Wisconsin. Carpenter (1940) records one specimen from Marathon County and I have six specimens from the state. The seven specimens were collected from seven different counties indicating wide distribution in the state.

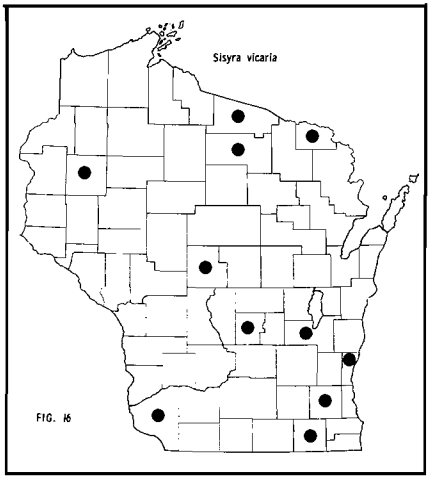
pretiosa Banks. (Fig. 14). August 9 to August 24. This species is listed by Carpenter (1940) as uncommon. He cites specimens from Colorado, Arizona, Oregon, and Nebraska. Nakahara (1965) cites specimens from Utah. There is a specimen in the Milwaukee Public Museum labeled *Boriomyia pretiosa* Banks collected by Dr. S. Graenicher at Two Rivers, Manitowoc County, Wisconsin on 14 May, 1911. The specimen is so badly damaged as to make verification of the identification impossible. I collected two specimens in Wisconsin, both females. One, #539, was examined by Dr. Ellis G. MacLeod and he said (personal communication), "It is close to *pretiosa* and may be that". The other, #1555D, was examined by Dr. Oliver S. Flint and in a letter to me dated March 15, 1971 he says, "The specimen matches perfectly our examples of *Kimminsia pretiosa* (Bks.) and I would agree completely with your determination".





My two specimens and Dr. Graenicher's probable specimen are from three widely separated areas in Wisconsin with nearly 60 years separating the first and last collecting dates. This indicates that the species is most likely native to the state even though collected considerably east of its previously reported range. Both of my specimens were collected on *Pinus resinosa.*





Family **POLYSTOECHOTIDAE**

Genus **POLYSTOECHOTES** Burmeister

punctatus Fabricius. (Fig. 15). August 5 to August 27. This species is widespread in western United States as reported by Carpenter (1940), but not so common in the eastern states. He reports it as common in British Columbia, Alberta, Ontario, and Quebec. It is rare or absent in the prairie states. There are seven Wisconsin specimens

in the Public Museum, Milwaukee and seven in the collection of the University of Wisconsin, Madison. All 14 specimens were collected before 1920. The only Wisconsin specimens I know of collected after 1920 are the three I have, two of which were collected in 1938 and one in 1948. All of my specimens were attracted by light. It must be very rare in Wisconsin, for so large and attractive an insect is not easily overlooked. It appears that *punctatus* is less common now that it formerly was in Wisconsin.

Family SISYRIDAE

The adults of this family are known as spongilla-flies. Their larvae are the only truly aquatic larvae of the Neuroptera-Planipennia and feed upon fresh-water sponges. The excellent work of Parfin and Gurney (1956) contains keys for the separation of the genera and species. Specimens may be attracted by light or collected from vegetation bordering lakes, ponds, and streams wherever fresh-water sponges are found.

Genus SISYRA Burmeister

vicaria Walker. (Fig. 16). June 9 to August 18. This is the most common Nearctic species of Sisyra and is reported in Canada from Nova Scotia to British Columbia and in the United States from Maine to Florida in the east to Washington and Arizona, although it is less common in the western part of the country (Parfin and Gurney, 1956). I have 69 specimens from eleven widely distributed counties in Wisconsin.

fuscata Fabricius. (Fig. 17). June 7 to August 29. This species is widely distributed in Europe Killington (1936). Parfin and Gurney (1956) record it from Alaska, British Columbia, Ontario, Quebec, Maine, Massachusetts, Michigan, Minnesota, New York, and Washburn and Jefferson Counties in Wisconsin. I have 59 specimens from nine other counties in the state.

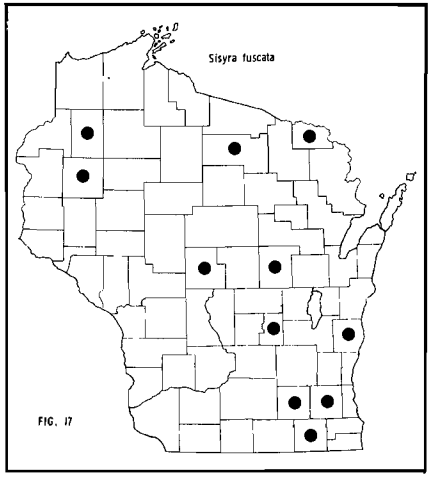


FIG. 17

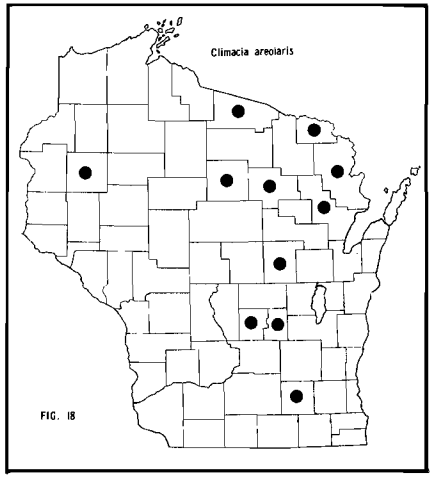


FIG. 18

Genus CLIMACIA McLachlan

areolaris Hagen. (Fig. 18). June 27 to August 19. This species is found from Maine to Florida and westward to about the 100th meridian (Parfin and Gurney, 1956). They also record it from Ontario and Quebec, and from Vilas and Jefferson Counties, Wisconsin. There is one specimen collected in Lincoln County in the collection of the University of Wisconsin, Madison. I have 34 specimens from eight other counties in the state.

ACKNOWLEDGMENTS

In addition to the persons listed in Part I of this paper I wish to thank Mr. Lutz J. Bayer of the University of Wisconsin, Madison for allowing me to examine numerous specimens under his care and Dr. Oliver F. Flint, Jr. of the Smithsonian Institution for verifying my identifications of certain specimens.

LITERATURE CITED

Banks, Nathan. 1905. A revision of the Nearctic Hemerobiidae. Trans. Am. Entomol. Soc. 32:21-51.

Carpenter, F. M. 1940. A revision of the Nearctic Hemerobiidae, Berothidae, Sisyridae, Polystoechotidae and Dilaridae. Proc. Am. Acad. Arts and Sci. 74:193-280.

Fitch, Asa. 1856. First and second reports on the noxious, beneficial and other insects of the state of New York. Albany. 1-336.

Froeschner, Richard C. 1947. Notes and keys to the Neuroptera of Missouri. Ann. Entomol. Soc. Am. 40:123-136.

Killington, Frederick J. 1936 Vol. I, 1937 Vol. II. A monograph of the British Neuroptera. London.

MacLeod, Ellis G. 1960. Sexual differences in the proportion of two-winged and four-winged individuals of *Psectra diptera* (Burmeister), together with five new records. Entomol. News 71:231-236.

Nakahara, Waro. 1965. Contributions to the knowledge of the Hemerobiidae of western North America (Neuroptera). Proc. U.S. Nat. Mus. 116:205-222.

Orman, D. and H. E. Jacques. 1949. A preliminary list of Hemerobiidae known to occur in Iowa. Proc. Iowa Acad. Sci. 56:377.

Parfin, Sophy I. 1952. The Megaloptera and Neuroptera of Minnesota. Am. Midland Naturalist 47:421-434.

————. 1956. Taxonomic notes on *Kimminsia*. Proc. Entomol. Soc. Washington. 58:203-209.

———— and Ashley B. Gurney. 1956. The Spongillaflies, with special reference to those of the Western Hemisphere (Sisyridae, Neuroptera). Proc. U. S. Nat. Mus. 105:421-529.

Smith, Roger C. 1923. The life histories and stages of some Hemerobiids and allied species. Ann. Entomol. Soc. Am. 16:129-151.

————. 1934. Notes on the Neuroptera and Mecoptera of Kansas. J. Kansas Entomol. Soc. 7:120-145.

Throne, Alvin L. 1961. *Psectra diptera* (Burmeister) in Wisconsin. Entomol. News. 72:193-194.

Tjeder, Bo. 1960. Neuroptera from Newfoundland, Miquelon and Labrador. Opuscula Entomol. 25:146-149.

EVALUATION OF THREE ALDRIN APPLICATION METHODS FOR WHITE GRUB, *PHYLLOPHAGA* SPP., CONTROL (COLEOPTERA: SCARABAEIDAE)[1]

Richard F. Fowler and Louis F. Wilson[2]

White grubs, the larvae of May beetles (*Phyllophaga* spp.), feed on the roots of newly planted red pine (*Pinus resinosa* Ait.) seedlings in the Lake States region. A 1/2 or 1% solution of aldrin insecticide is recommended to control these grubs (Shenefelt and Benjamin 1955; Speers and Schmiege 1961). Treatments of white grubs in Michigan using a 1% solution dispersed from the planting machine (standard method) have given erratic control and therefore reevaluation appeared necessary. We decided to retest the standard application method and to test two new methods.

METHODS

Five plantable areas with high white grub populations were selected for the tests in the Hiawatha National Forest in Upper Michigan. These areas were machine-planted in the spring of 1967. Planting stock was run-of-the-nursery red pine 3-0 seedlings and 2-1 transplants.

A randomized complete block design replicated 5 times in each test planting was used to evaluate the aldrin treatments. Each of the four treatments in a block involved 15 trees in 6 adjacent rows. The treatments were as follows:

Treatment 1 – aldrin solution applied with a dispenser attached to the planting machine, the standard method of application
Treatment 2 – Aldrin solution applied with a backpack pump and wand designed for the purpose
Treatment 3 – granular aldrin applied with a dispenser attached to the planting machine
Treatment 4 – check plots (no aldrin application)

In Treatment 1, the dispenser used is a modification of the one described by Shenefelt *et al.* (1954, 1955). It consists of a pressurized tank for the insecticide, a system of hoses containing a foot- or knee-operated valve, and a nozzle located at the planting shoe. The soil immediately around the tree is sprayed with insecticide as the tree is placed in the ground and before trench closing.

In Treatment 2, aldrin solution was applied with a backpack pump fitted with a long rod for insertion into the ground. Three nozzle holes dispensed the insecticide into the soil near the tree roots.

In Treatment 3, aldrin granules were applied with a dispenser consisting of a non-pressurized hopper and system of tubes with a value. Two tubes with flattened ends terminated in the vicinity of the shoe, depositing the granules continuously in two 18-inch bands, one on each side of the seedling.

[1]This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife–if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

[2]Members of the U.S. Department of Agriculture Forest Service: Entomologist, Northeastern Area, State and Private Forestry, St. Paul, Minnesota 55101; and Principal Insect Ecologist, North Central Forest Experiment Station, headquartered at the East Lansing Research Unit, in cooperation with Michigan State University, East Lansing, Michigan 48823.

The standard liquid application is a 0.5 to 1.0% solution of technical aldrin in water at a dosage of about 8.5 ml per seedling. Our aldrin concentrations varied from 0.3 to 1.2% and dosage rates from 8.8 to 11.3 ml per seedling. A summary is presented in Table 1 where all the dosages are converted to show the amount of aldrin appplied if a 1% solution had been used.

Table 1. Dosage rate of aldrin applied per seedling per plantation, based on 1% solutions and 20% granulars.

Test plantation	Liquid		Granular
	Machine	Backpack	
	mls	mls	gms
1, 2, 3	13.7	10.6	9.3
4	5.8	4.6	9.3
5	5.8	3.7	9.3

Mortality, root damage, and height growth of the planted red pine indicated the effectiveness of the aldrin treatments. All dead trees in each plot were dug and root scored in the fall of 1967, the spring of 1968 , and the fall of 1968 – 4, 12, and 16 months after planting. Also eight to ten living trees per plot were randomly selected, dug, and root scored in the fall of 1967 and again in the fall of 1968.

The root damage was visually scored as follows:

1 – no grub injury
2 – 1-33% of fibrous roots destroyed by grubs
3 – 34-66% of fibrous roots destroyed by grubs
4 – 67-99% of fibrous roots destroyed by grubs; also includes some seedlings completely stripped of fibrous roots but which had grown some new root tips
5 – 100% of fibrous roots destroyed or tap root severed above all fibrous roots

A Damage Index (DI), which is the average root score damage per treatment plot, was used to compare treatment and check plots. A DI of 1.00 indicates there was no damage in a treatment; a DI of 5.00 indicates maximum damage.

Terminal shoot growth was measured on all living seedlings in the fall of 1967 and 1968 in four of the test plantings as an indicator of sublethal grub injury.

RESULTS

The three aldrin treatments gave comparable protection to the seedlings from white grubs after two growing seasons (Table 2). White grubs killed less than 3% and damaged

Table 2. Mortality and damage by white grubs to red pine seedlings in aldrin test plots two growing seasons after planting.

Treatment	Percentage red pine seedlings			Damage index
	Killed by all causes	Killed by grubs	Damaged by grubs	
1. Aldrin liquid (machine)	6.8	2.8	35.3	1.97
2. Aldrin liquid (backpack)	4.7	1.4	36.2	1.78
3. Aldrin granules (machine)	6.4	1.8	32.4	1.71
4. Check (no aldrin)	14.5	10.4	57.3	3.03

no more than 36% of the seedlings in all three treatments. However, they killed over 10% of the unprotected (check) seedlings, and damaged 57% more. Significantly more damage occurred to the check seedlings ($P > .01$). The degree of larval feeding on the living seedlings (Damage Indices) was about the same for all aldrin treatments but considerably more for the checks. Damage Indices of about 2.00 and 3.00 signify average grub populations of 0.2 and 1.0 grubs per cubic foot respectively (Fowler and Wilson 1971).

Significant differences in height growth between the living treated and living check trees were found after two growing seasons in all but one planting ($P > .05$). Average 2-year leader lengths for all seedlings combined were 3.8, 3.8, and 3.7 inches for aldrin treated trees and 3.3 inches for the check trees.

CONCLUSIONS

The backpack method of dispensing aldrin solution and the machine-dispensing of granular aldrin were not significantly better than the standard method.

Damage from white grubs in all three control treatments was significantly less than in the untreated check seedlings.

Since some of the damaged seedlings are likely to die by the third year, a practical estimate of mortality would be to assume death of score 4 and 5 seedlings (67 to 100% of roots destroyed by grubs) plus mortality due to other causes. Under this assumption, a maximum of 13% of the aldrin-treated seedlings would die by the third season, compared to a maximum of 38% of untreated seedlings.

If one accepts up to 15% seedling mortality by the start of the third growing season and gambles on some—but probably little—additional mortality later, than the three aldrin treatments and mean dosages tested in this study are adequate suppression techniques.

LITERATURE CITED

Fowler, R. F. and L. F. Wilson. 1971. White grub populations related to damaged red pine seedlings in Michigan and Wisconsin plantations. Mich. Entomol. 4:23-28.

Shenefelt, R. D. and D. M. Benjamin. 1955. Insects of Wisconsin forests. Univ. Wis. Agr. Entomol. Serv., Exp. Sta. and Wis. Cons. Dep. Circ. 500, 47 p.

————, H. R. Liebig and R. C. Dosen. 1954. Protecting machine transplanted trees from white grubs. Univ. Wis. Forest Res. Note 17, 3 p.

————. 1955. Protecting machine transplanted trees from white grubs. Tree Planters' Notes 20:14-17.

Speers, C. F. and D. C. Schmiege. 1961. White grubs in forest tree nurseries and plantations. USDA Forest Serv., Forest Pest Leafl. 63, 4 p.

GYNANDROMORPHISM IN THE ODONATA

Leonora K. Gloyd

Museum of Zoology, University of Michigan, Ann Arbor, Michigan 48104

In the Odonata, gynandromorphism has been rarely observed or mentioned in the literature. In 1929, Ris reported that only three cases were known to him. Two were in the Calopterygidae, and one in the Libellulidae. Since then gynandromorphic specimens have been recorded for one species of Aeshnidae and five more for the Libellulidae. For the latter family, I can add another record which is the first for the subfamily Corduliinae and the second for North America.

A list of the species and specimens in which gynandromorphism has been noted and the nature and extent of the modification of sexual characteristics may be summarized as follows:

Calopteryx splendens (Harrison). According to Ris (1929:100) the specimen figured, briefly described and determined by Westwood (1874:189 & Pl. 35, Fig. 12) as *C. virgo,* is a chiefly feminine *C. splendens* having a mosaic type of anomaly of the wings. The specimen was taken in France and is in the McLachlan Collection. This may be the same specimen exhibited by McLachlan at the November 6, 1865 meeting of the Entomological Society of London (1866:125) as "a partially andromorphous female of the dragon-fly Calepteryx splendens" taken in France by M. Fallou. Both accounts give the left front wing as of the color of the male and only blotches or dashes of color on the right front wing.

Calopteryx virgo (Linné). A predominately female specimen, collected by Dr. Ris in Switzerland has been described in detail and figured by him (1929:97-100). The departure from female characteristics is most conspicuous in the coloration of the wings. The left front wing is like that of the male, the right hind wing is largely so, and both lack the pterostigma characteristic of females. The color pattern of head and prothorax is mostly like that of the male, but on the pterothorax the pattern is in keeping with the corresponding colored wings, described as a mosaic arrangement of the characters of both sexes.

Rhyothemis phyllis snelleni Selys. Ris (1919:1222 and 1929:101-102, Fig. 3) described a specimen from North Celebes, collected in 1913 by Dr. L. Martin, that was typically female except for the superior appendages which were many times longer and much more robust than normal, and in length exceeded those of a male but were unlike them in shape.

Aeshna juncea (Linné). Harrison (1939:286) reported a specimen of this species taken in Scotland as a gynandrous example but did not describe it.

Plathemis lydia (Drury). Klots (1943:142) described and figured a predominately male specimen, collected in 1934 in Westchester Co., New York. The right front wing had the color pattern of a female, and abdominal segment 2 lacked a right hamule.

Crocothemis servilia (Drury). Yakota & Asahina (1953:167-169, Figs. 1-5) described a specimen, collected in 1952 in Japan, having the red coloration of a normal male on the right side and the brownish color of a female on the left. Structures characteristic of the male are normal on the right side but underdeveloped or rudimentary on the left. The left superior abdominal appendage is like that of a female, but the inferior appendage is fully developed and symmetrical.

Orthetrum brachiale (Beauvois). Pinhey (1958:116) recorded a specimen collected by Dr. P. Corbet in Northern Tanganyika, August 26, 1956 that is primarily a female. Markings, coloration, and abdominal segments 3-7 and 9-10 are typically female. Abdominal segment 2 has a well-developed left posterior lobe similar to that of the male, and on segment 8 the foliations are narrow on the right side and on the left only developed on the distal half of the segment.

Deielia phaon Selys. Eda (1960:264-266, Figs. 1-3) collected a heterocromatic female on June 10, 1960 in Tokyo, Japan. The left side of the thorax and left legs have the color of a male. The abdomen, aside from vestigial and imperfectly formed accessory genitalia on segments 2-3, is similar to a normal female and contained mature eggs.

Lyriothemis pachygastra Selys. I have not seen the article by Yamamoto (1968) in which he records a gynandromorphic specimen of this species.

Somatochlora filosa (Hagen). On August 25, 1932, in Liberty Co., Florida, a member of the Williamson-Ditzler Expedition collected a female with indications of male characteristics as follows: On abdominal segment 2, lateral lobes are present but not as large as in a normal male, and on the sternal plate there is a curved paired process suggestive of vestigial hamules; segment 3 has a narrowing or constriction of the segment intermediate between that of the normal male and female; the superior appendages are also intermediate in shape and slightly shorter than normal; and the wings lack any tinge of color. The legs have no tibial keels but the femora are as long as those in the male; the ovipositor has a greater upward curve than in a normal female; the distal margin of segment 10 dorsally is like that of a female; and the epiproct has no suggestion of any prolongation to form an inferior appendage.

Of the eight specimens for which data was available for this paper, six are predominately female, one is about half and half, and one is predominately male. There seems to be no consistent pattern or uniformity in degree of gynandromorphism.

In the genus *Calopteryx*, sex of an individual is usually easily determined by the coloration of the wings and the presence or absence of pterostigmas. If a specimen has one or two wings colored like those of one sex and the others like the opposite sex, it is regarded as a gynandromorph. This raises a question of why a specimen with all four wings like the male and a body of a female is not regarded as a gynandromorph. In the same paragraph of McLachlan's description of the andromorphous *C. splendens* (1866:125) is the following: "De Selys Longchamps mentioned the capture, in Prussia, by Dr. Hagen, of the female C. splendens the wings of which were entirely coloured as in the male." An example of the same type is described by Shiffer (1969:138-141) for two females of *Perithemis tenera* (Say) with amber wings characteristic of males. Are these merely homeochromatic females? Or, if body color and pattern is like that of a male in an otherwise normal female, as frequently occurs in several species of *Ischnura* and perhaps less often in some other zygopteran genera, is this a form of gynandromorphism?

LITERATURE CITED

Eda, Shigea. 1960. On a gynandromorphic specimen of *Deielia phaon* Selys. Kontyû, Tokyo 28:264-266.

Harrison, J. W. Heslop. 1939. A gynandrous example of the dragonfly *Aeshna juncea* L. from Raasay. Entomol. 72:286.

Klots, Elsie Broughton. 1943. A dragonfly gynandromorph. Bull. Brooklyn Entomol. Soc. 38:142.

McLachlan, Robert. 1866. [A partially andromorphous female of the dragon-fly Calepteryx splendens.] Jour. Proc. Entomol. Soc. London for 1865:81-174, with the Trans., 3rd ser., vol. 2, 1864-1866.

Pinhey, E. C. G. 1958. Records of dragonflies from the Zambezi and Rhodesia; a revision of genus *Platycypha;* a gynandromorph dragonfly from Uganda. S. Rhodesia Natl. Mus. Occ. Papers 3(22B):97-116.

Ris, F. 1919. Collections Zoologiques du Baron Edm. de Selys Longchamps, Facs. XVI, Pt. 2, Libellulen 9, p. 1043-1278. Brussels.

Ris, F. 1929. Gynandromorphism in Odonata. Mittel. Schweiz. Entomol. Gesells. 14(3):97-102.

Shiffer, C. N. 1969. Homeochromatic females in the dragonfly *Perithemis tenera.* Proc. Penn. Acad. Sci., 42 (1968):138-141.

Westwood, J. O. 1874. Thesaurus Entomologicus Oxoniensis; or illustrations of new, rare, and interesting insects, for the most part continued in the collections presented to the University of Oxford by F. W. Hope. Pp. xxiv, 205: 40 pls. (col.). 4° Oxford.

Yamamoto, Y. 1968. A note on a gynandromorphic specimen of the dragonfly, *Lyriothemis pachygastra* Selys. New Entomol. 17(2):1-5.

Yokota, Eizaburo, and Syoziro Asahina. 1953. On a gynandromorph of *Crocothemis servillia* Drury (Odon., Libellulidae). The Entomol. 86:167-169.

PHORESY BY PSEUDOSCORPIONS

Sigurd Nelson, Jr.
Department of Zoology
Michigan State University
East Lansing, Michigan 48823

Phoretic behavior involving a non-parasitic association of a larger animal by a smaller animal resulting in transportation is well documented in some pseudoscorpions. Muchmore (1971) summarized the records of pseudoscorpion phoresy in Central and North America as presented by Beier and as published since 1948. Both Beier and Muchmore categorized six different relationships of pseudoscorpions with larger animals, as follows: 1) species found attached to the appendages of other arthropods, 2) species found settled on the bodies of larger insects, 3) species found in the nests of social insects, 4) species found in birds' nests, 5) species found in the nests of small mammals or on such mammals, and 6) species found in human habitations. While the first two categories represent direct evidence of phoresy, the last four represent indirect evidence at best. Such evidence may point to phoresy even though the pseudoscorpion is not collected attached to a carrier. Included herein are further records of such direct and indirect evidence. The indirect evidence presented is confined to those situations where phoresy is the most reasonable explanation for the presence of pseudoscorpions. All records, except one from Pennsylvania, are from Michigan.

Fenstermacher (1959) in an unpublished thesis reported "a group" of *Lamprochernes oblongus* (Say) under the elytra of elaterid beetles, *Alaus oculatus* (Linnaeus), from Ingham County. The beetles were collected on 15 April, 1948, by R. L. Fisher who, through personal communication, indicated the beetles were actually collected in Washtenaw County. The above possibly represents the fourth separate record of *L. oblongus* on *A. oculatus*. Muchmore (1971) summarized the other records.

A male *Dinocheirus pallidus* (Banks) was found attached to the thoracic region of the noctuid moth *Caenurgia crassiuscula* Haworth. The moth was collected by J. Donahue on 9 August, 1965 in Somerset County Pennsylvania. Treat (1956) also reported the occurrence of two pseudoscorpions on noctuid moths. The pseudoscorpions represented undescribed male species of *Apocheiridium* according to C. C. Hoff. Muchmore (1971) reported four individuals of *Apocheiridium*, obtained from A. E. Treat on two different species of noctuid moths, *Acronycta morula* G. and R., and *Catocala neogama* A. and S..

Female *Hesperochernes ewingi* (Hoff), *H. lymphatus* (Hoff) and *Dinocheirus pallidus* were collected in Saginaw County in aerial net traps erected to capture flying insects. The collections were made by J. Truchan on three separate dates during 1968. When collected, the pseudoscorpions were not attached to insects.

A male *Dactylochelifer copiosus* Hoff was collected by J. Donahue in Ingham County, atop an automobile hood, at a black light on 28 April, 1970. The black light was used to attract flying insects. Similarly, Muchmore (1971) discussed the occurrence of pseudoscorpions in light traps and concluded the pseudoscorpions entered the light traps attached to some unknown flying insects.

Two female *Hesperochernes tamiae* Beier were collected in Ingham County by G. Klee on 11 October, 1967 in a pittrap set in an oak-hickory forest floor. The pseudoscorpions may have entered phoretically.

A female *Apocheiridium stannardi* Hoff and five nymphs of *Lamprochernes oblongus* were collected by S. Nelson, Jr. in Shiawassee County in nest boxes of the wood duck *Aix sponsa* (Linnaeus). The boxes, attached to dead trees in a flooded area, were completely surrounded by ice when collected on 18 February, 1970, but during more seasonal periods would have been surrounded by water. However, man may have introduced nesting materials containing pseudoscorpions, therefore, discounting phoresy. If phoresy occurred, the nymphs of *L. oblongus* likely did not enter the nest boxes phoretically but were the progeny of a pregnant female which more logically did.

ACKNOWLEDGMENTS

I am grateful to the Society of the Sigma Xi for a Grant-in-Aid of Research in 1968 to study pseudoscorpions.

LITERATURE CITED

Fenstermacher, J. D. 1959. Survey of the pseudoscorpions of Michigan. M.S. Thesis. Michigan State University. 43 pp.

Muchmore, W. B. 1971. Phoresy by North and Central American Pseudoscorpions. Proc. Rochester Acad. Sci. 12:79-97.

Treat, A. E. 1956. A pseudoscorpion on moths. Lepidopterists' News. 10:87-89.

INFORMATION FOR AUTHORS

Papers dealing with any aspect of entomology will be considered for publication in *The Michigan Entomologist.* Appropriate subjects are those of interest to amateur and professional entomologists in the North Central States and Canada, as well as general papers and revisions directed to a larger audience while retaining an interest to readers in our geographical area.

Manuscripts must be typed, double-spaced, with wide margins on white 8½" X 11" or equivalent size paper, and submitted in *duplicate.* Footnotes, legends, and captions for illustrations should be typed on separate sheets of paper. Titles should be concise, identifying the order and family discussed. The author of each species mentioned must be given fully at least once in the text. A common name for each species or group should be given at least once when such a name exists. The format of references should follow that used in recent issues. Photographs should be glossy and 8" X 10" size. Drawings, charts, graphs, and maps must be scaled to permit proper reduction without loss of detail. Contributors should follow the recommendations of the *Style Manual for Biological Journals,* available from the American Institute of Biological Sciences, 3900 Wisconsin Avenue, N.W., Washington, D.C. 20016.

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Authors will receive page proof, together with an order blank for reprints.

All manuscripts for *The Michigan Entomologist* should be sent to the Editor, Irving J. Cantrall, Museum of Zoology, The University of Michigan, Ann Arbor, Michigan 48104, USA. Other correspondence should be directed to the Executive Secretary (see inside front cover).