The Great Lakes Entomologist

Volume 11
Number 1 - Spring 1978 *Number 1 - Spring 1978*

Article 6

April 1978

New Distribution Records for Mosquitoes in Michigan (Diptera: Culicidae)

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NEW DISTRIBUTION RECORDS FOR MOSQUITOES IN MICHIGAN (DIPTERA: CULICIDAE)[1]

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Since the late 1940's very little information has appeared in the literature dealing with the geographical distribution of mosquitoes in Michigan. The earliest attempt at establishing a comprehensive list of species was made by Irwin (1941) who catalogued 43 species by county. A survey by Pederson (1947) resulted in the collection of 48 species and provided the most extensive distribution list of mosquitoes in Michigan. Recent studies by Newson et al. (1975), McGroarty et al. (1976) and Grimstad (1977) have contributed several new distribution and state records.

Prompted by the 1975 St. Louis encephalitis outbreak in Michigan, and a lack of current information on the species of mosquitoes in Isabella County, a survey of mosquitoes was conducted in the Mount Pleasant area.

METHODS

The survey was conducted from 1 June to 22 October, 1976, and 3 March to 29 May, 1977. Adult mosquitoes attracted to human bait during the day and night were collected with a tube aspirator as they attempted to land and bite on an exposed arm or leg. Night-biting mosquitoes were collected for 1 hour starting 15 minutes before sunset at various locations on a weekly basis throughout the survey. Resting adults were sampled from low-lying vegetation during the day with a 38 cm diameter sweep net. New Jersey light traps (25 W incandescent bulbs) were used to sample adult mosquitoes at two locations in Union Township and at one site in Coe Township, Isabella County. The light traps were operated five nights per week from 2 August to 22 October, 1976, and every night from 29 March to 29 May, 1977. Larvae were collected with a fine wire food strainer attached to a 2 m pole for dipping in hard-to-reach areas.

RESULTS

The mosquito species and number of individuals collected by the five sampling methods are listed in Table 1. Specimens of *Culiseta impatiens* (Walker) represent the only distribution record of this species outside Cheboygan County. The genus *Orthopodomyia* previously has been reported only from Berrien (Grimstad, 1977) and Calhoun (Pederson, 1947) counties. *Culex erraticus* (Dyar and Knab) has been collected only in Bay (Newson, 1975) and Van Buren (Pederson, 1947) counties.

Aedes mosquitoes were captured in greatest numbers by using the night-biting collection method while the light traps attracted the largest numbers of *Culex, Culiseta* and *Anopheles*. The sweep net method was more effective for species that aggregated in large numbers in and around low-lying vegetation, but often left the specimen damaged and unidentifiable.

ACKNOWLEDGMENTS

The authors thank H. D. Newson and V. E. Wagner for assistance in the determination of several speices.

[1]Supported by the Central Michigan District Health Department and a Central Michigan University Faculty Research Grant.

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Table 1. Number of female and larval mosquitoes recorded from five collecting methods in the Mount Pleasant area, Isabella County, Michigan. Species which are new records for Isabella County are indicated by *.

Species	Night Biting	Day Biting	Sweep Net	Light Traps	Larvae	Total
Aedes abserratus (Felt & Young) & *A. punctor* (Kirby) complex	2	-	-	-	-	2
**A. aurifer* (Coquillett)	2	-	-	7	-	9
A. canadensis (Theobald)	28	2	-	-	-	30
A. cinereus (Meigen)	1	-	-	5	-	6
**A. dorsalis* (Meigen)	3	-	-	1	-	4
**A. excrucians* (Walker)	1	-	-	2	1	4
A. fitchii (Felt & Young)	99	94	107	20	3	323
A. sticticus (Meigen)	1496	121	39	18	-	1674
A. stimulans (Walker)	118	71	5	109	206	509
**A. trichurus* (Dyar)	-	-	-	-	1	1
A. triseriatus (Say)	-	3	3	1	-	7
A. trivittatus (Coquillett)	328	109	18	38	-	493
A. vexans (Meigen)	249	11	23	687	-	970
**Anopheles earlei* Vargas	1	-	-	73	5	79
A. punctipennis (Say)	13	-	-	110	34	157
A. quadrimaculatus Say	21	-	-	183	56	260
**A. walkeri* Theobald	10	-	-	37	4	51
**Culex erraticus* (Dyar & Knab)	-	-	-	1	-	1
**C. pipiens* Linnaeus	1	-	1	446	377	825
C. restuans Theobald	-	-	-	286	-	286
**C. territans* Walker	-	-	-	103	105	208
**Culiseta impatiens* (Walker)	1	-	-	2	-	3
C. inornata (Williston)	-	-	-	58	2	60
C. morsitans (Theobald)	-	-	-	6	-	6
Mansonia perturbans (Walker)	147	4	5	44	-	200
**Orthopodomyia* sp.	-	-	-	1	-	1
**Psorophora ciliata* (Fabricius)[a]	-	-	-	-	-	1
**Uranotaenia sapphirina* (Osten Sacken)	-	-	-	3	-	3

[a]One adult female from the Central Michigan University insect collection.

https://scholar.valpo.edu/tgle/vol11/iss1/6
DOI: 10.22543/0090-0222.1318

THE NORTHERN GREAT LAKES WHITE, *PIERIS VIRGINIENSIS*, (LEPIDOPTERA: PIERIDAE) IN COMPARISON WITH ITS SOUTHERN APPALACHIAN COUNTERPART

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For many years, the so-called "West Virginia White," *Pieris virginiensis* Edwards, was confused with *P. napi* Linnaeus or treated as a form or subspecies of it. Until recently there was difference of opinion as to whether it should be recognized as a separate species or not. Hovanitz (1962, 1963) regarded the matter as one of personal preference and he placed it with *napi.* Nevertheless, most writers today (e.g., Ehrlich and Ehrlich, 1961; Howe, 1975; Klots, 1951) uphold *virginiensis* as a distinct species. In Michigan we first reported it in the state over twenty years ago (Voss and Wagner, 1956), and we now realize that it occurs over a tremendous area of the northern Great Lakes region. Probably some populations are overlooked because of confusion with other whites, especially *napi,* with which it is sympatric in Michigan, often occurring together in the same woods. In our experience *napi* tends to fly in more open spaces (especially marshy areas), and its flight pattern is bolder and swifter. *Pieris virginiensis* is a butterfly of rich, deciduous forest, and it has a relatively sluggish flight.

It may be that *virginiensis* is more common and widespread in northern Michigan than it is in any other part of its range. Practically any large wooded site in the northern Lower Peninsula and the Upper Peninsula with dominant sugar maple (*Acer saccharum*) and basswood (*Tilia americana*) will yield populations in May or June. Nielsen (1970) reported it in early Spring "before full leaf development." His flight records (Nielsen, pers. comm.) for one county (Emmet) run from 5 May to 19 June. East of Marquette, American beech (*Fagus grandifolia*) is a common dominant associate. In the understory, the larval food plant, the toothwort, *Dentaria diphylla,* is found. In Ontario, *virginiensis* is evidently rare and known mainly from the Niagara Escarpment region (Holmes, 1975). In eastern Canada and eastern United States in general, the butterfly seems to be everywhere very rare and local, and the colonies are mostly widely scattered, mainly in the Appalachian region.

Botanical studies in recent years have taken me to areas along the western side of the Appalachians in eastern Kentucky and western Virginia in the southern part of the range of *virginiensis.* Much to my surprise, the woodland pierid that flies in the spring in this region resembles the summer form of *napi.* The butterflies are slightly larger, and the wings somewhat broader and more rounded. The main differences, however, involve the markings. As shown in Figures 1 and 2, the individuals of *virginiensis* from the southern Appalachians have much reduced dark markings, and indeed some individuals are nearly immaculate. The northern Great Lakes specimens are much more richly marked, the gray scaling conspicuously more extensive, especially on the hind wings below. The following key, based on over 40 specimens of each form, separates the two extremes:

Dorsal dark markings on forewing tip extending 3-6 mm, commonly reaching the juncture of R_3 and R_4, especially in females; markings at forewing base running out 2-4 mm along lower side of discal cell; dorsal surface of hindwings of females usually with more or less gray scaling; ventral surface of hindwings (both sexes) with all veins usually heavily shaded with gray scaling which may become nearly confluent in the cells between the veins. . . NORTHERN GREAT LAKES EXTREME

Dorsal dark markings on forewing tip extending 1-3 mm, not reaching the juncture of R_3 and R_4; markings at a forewing base running out usually only 1-2 mm along lower side of discal cell; dorsal surface of hindwings of females usually without gray scaling; ventral surface of hindwings (both sexes) with veins entirely unmarked to lightly shaded mainly along the lower side of the discal cell, less along the cubital veins, and still less along the radial veins . . . SOUTHERN APPALACHIAN EXTREME

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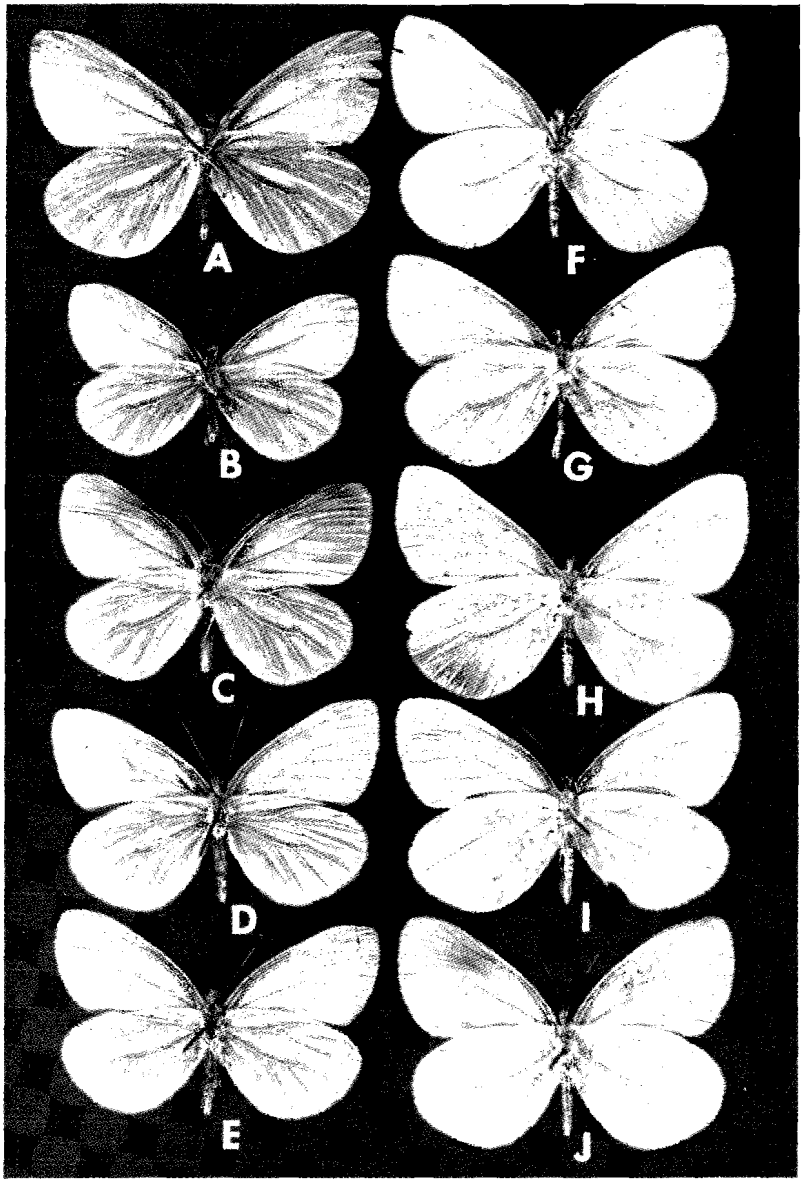

Fig. 1. *Pieris virginiensis* males, undersides. Left-hand column, northern Great Lakes extreme; right-hand column, southern Appalachian extreme. a. MI, Cheboygan Co. (Wagner) b, d, e. MI, Charlevoix Co. (Preston) c, Ontario, Halton Co. (Catling). f-i. VA, Lee Co. (Wagner), j. KY, Owsley Co. (Wagner).

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DOI: 10.22543/0090-0222.1318

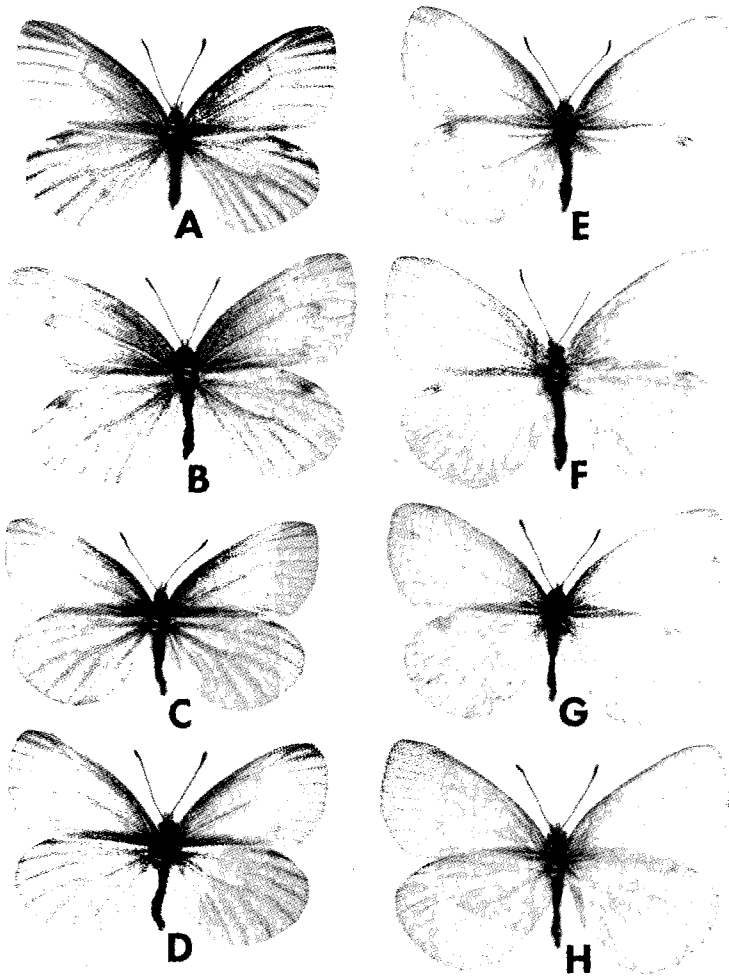

Fig. 2. *Pieris virginiensis* females, dorsal view. Left-hand column, northern Great Lakes extreme; right-hand column, southern Appalachian extreme. a, c, d, MI, Charlevoix Co. (Wagner and Preston). b, MI, Cheboygan Co. (Wagner). e, g, VA, Lee Co. (Wagner). f, h, KY, Owsley Co. (Wagner).

DISCUSSION

Because the northern Great Lakes representative of *virginiensis* can be readily distinguished from the southern Appalachian does not mean that they are necessarily discrete taxonomic entities worthy of nomenclatural designation. The point is that there are well known differences along a north-south gradient in many pierid (and other butterfly) species. These trends include increasing size southward, and decrease in the extent of markings on the ventral surfaces of the secondaries. Part of the "northern look" in pierids involves a change from practically unmarked hindwings to heavily suffused hindwings below. In the case of *virginiensis* we are very likely dealing with a clinal series from the smoky northern Michigan type to the nearly immaculate southern type. All degrees of intermediates should be found in the areas between, such as southern New York, Pennsylvania, Maryland. The presence of numerous intergradient, clinal forms prevents the logical delimitation of true geographical subspecies.

It is pertinent to this study that Arthur Shapiro (1971) experimentally produced forms of *virginiensis* even more immaculate than those from Virginia and Kentucky illustrated here. Normally *virginiensis* is univoltine, unlike *napi* in eastern North America which is bivoltine. The single brood of *virginiensis* appears only in spring, but Shapiro succeeded in producing a second brood artificially by using photoperiod control (continuous light and 80°F temperature) of larval development, so that they failed to go into their normal diapause and simply pupated and eclosed as adults the same season. These individuals had no trace of darkened areas and were indistinguishable from summer phenotypes of eastern U.S. *napi*. Comparison of his illustrations of the experimentally produced forms (op. cit., Fig. 1) and mine of the southern Appalachian region (this paper, Fig. 1) show how similar they are. It seems unlikely, however, that the differences between northern and southern counterparts of *virginiensis* can be accounted for by photoperiod alone. The photoperiod during larval development of the northern is actually longer than the southern, the reverse of what we might expect from Shapiro's experiment. The northern Great Lakes flight period is mainly in May, and the larval development occurs presumably during June; the southern Appalachian flight period is mainly in April, and the larval development occurs during May, a month earlier. On the basis of latitude and season, the daily light regime of the northern larvae may be as much as two hours longer than the southern (cf. Leopold, 1964, Fig. 13-9).

Subspecies can be easily erected for perhaps the majority of nonmigratory species with broad north-south ranges, if only the extreme ends of the variation pattern are considered. In the present case, it is tempting to designate the northern Great Lakes and the southern Appalachian forms as subspecies. However, unless a definite stepwise boundary or gap can be established, such action would be untenable[2] from a biological standpoint.

ACKNOWLEDGMENTS

I wish to thank David J. Bay, Thomas J. Carlson, Paul M. Catling, Loran D. Gibson, Robert A. Preston, and Florence S. Wagner for help in various ways. Special appreciation goes to Mogens C. Nielsen, not only for his aid in the present project, but for his broad encouragement of the study of lepidopterology in general in the Upper Great Lakes region.

[2]A questionable example of naming "new subspecies" in eastern North America is that of *Lethe appalachia leeuwi* Gatrelle and Arbogast (1974). They state that "The northern population of *L. appalachia* ranging from Massachusetts and Maryland westward to Wisconsin and Illinois were found to be sufficiently distinct from southern nominate *appalachia* populations to warrant a subspecific name." Nevertheless, the specimens they examined of "nominate *appalachia*" came from only South Carolina, Georgia, Florida, and Mississippi. They examined no specimens from North Carolina, Tennessee, Kentucky, southern Ohio, Virginia, and West Virginia, where the critical intergradient forms would be expected to occur.

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