MOSQUITOES AND TABANIDS IN SOUTHEAST WISCONSIN[1]

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ABSTRACT. Fourteen species of mosquitoes and 10 species of tabanids were identified in trapping and/or biting collections in the previously uninvestigated southeastern Wisconsin during an exceptionally wet year, 1972. Nine mosquito and 7 tabanid species were new locality records. The most abundant mosquito was *Aedes vexans* (Meigen) with *A. trivittatus* (Coquillett) ranking second. Seasonal frequencies as reflected by trapping and biting collections are compared and discussed in relation to seasonal changes in temperature and rainfall. Information on activity hours, effect of habitats and of method of capture are also provided.

INTRODUCTION

No earlier systematic studies of mosquitoes and tabanids from southeastern Wisconsin have been published. The composition of mosquito and tabanid populations in this ecologically distinct area warranted investigation and comparison with others studied elsewhere in the state. The work reported here is part of a program to study host-ectoparasite systems in southeastern Wisconsin in relation to vector-borne diseases. Findings on mammal host population dynamics, arboviral antibody surveys and fleas and other arthropod ectoparasites are being published elsewhere.

Specific findings include new information on 1) Comparative seasonal abundance of mosquitoes as measured by trapping and biting collections during the exceptionally wet 1972 season. 2) Relative day vs. night activity of certain mosquito species. 3) New locality records of mosquitoes and tabanids.

Other work on adult mosquitoes elsewhere in Wisconsin which the present study complements is summarized as follows: Thompson and Dicke (1965) made some sampling studies with *Aedes vexans* and other *A.* spp. (south central). DeFoliart *et al.* (1967) observed the seasonal succession of bloodsucking Diptera (various locations). Gojmerac and Porter (1969) and Morris and DeFoliart (1969) compared mosquito catches with CDC and CO_2 baited traps (northeast) and between biting and light trap catches (south central), respectively. Porter and Gojmerac (1970 a) surveyed the mosquitoes in a northeastern locality and the same authors (1970 b) reported on the influence of temperature on light trap catches of *A. vexans* in the same locality. Loor and DeFoliart (1970) observed the field biology of *A. triseriatus* (southwest). Wright and DeFoliart (1970) investigated mosquito and woodland vertebrate host associations (central, south central, southwestern).

Wisconsin tabanids were initially surveyed by Roberts and Dicke (1958). New records were added by Morris and DeFoliart (1971).

MATERIALS AND METHODS

THE STUDY AREA. The study area is located in the heavily populated southeastern portion of Wisconsin and consists of cultivated farmlands and deciduous woodlots which often contain suburban or rural homes. The study area encompasses about 75 acres located north of the Pike River and south of County Road A, Kenosha County, and about 4 kilometers (2.5 miles) west of Lake Michigan. The ecological habitats consist of natural undisturbed streamfed deciduous forested areas interspaced with lowland and upland prairies. From south to north, the study area consists of a long strip of southern mesic forest, running west-east, on (north of) the Pike River. The major dominants are sugar maple, basswood, slippery

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elm, red oak, and black willow. The most prevalent ground layer species are *Osmorhiza claytoni, Podophyllum peltatum, Allium tricoccum, Geranium maculatum,* and *Smilacina racemosa.* An adjacent wider stretch of mesic prairie (lowland) to the north is partially replaced with dry mesic prairie (highland) to the east. The main mesic prairie components are big blue stem (turkey-foot), porcupine grass, little blue stem, northern dropseed, and *Passicum leibergri.* The dry mesic prairie has the same composition as above except for the replacement of the latter species with side oats grama. On the northern and western sides of the prairie, an elevated southern dry-mesic forest is located. The major dominants are red and white oak, basswood, sugar maple, and slippery elm. The most prevalent groundlayer species are *Smilacina racemosa, Amphicarpa bracteata, Osmorhiza claytoni,* and *Desmodium glutinosum.*

Considerably more prairies of similar composition and wood lots (wet, dry, and mesic) lie directly south (across the Pike River) and east of the above described area. County Road A runs east-west directly north of it across from which similar habitats as well as farm lands are located. A golf course partially separates the western boundaries of the study area from the larger deciduous forests (Southern mesic) of the Petrifying Springs Park.

IDENTIFICATION. The mosquitoes were identified using a visual key based on those of Dickenson (1944), Barr (1958), and Pratt and Stojanovich (1963). The Tabanidae were identified using the keys of Roberts and Dicke (1958).

SITES AND TRAPPING METHODS. Mosquito traps were operated at 3 sites for 48 consecutive hours approximately every 2 weeks between the 4th week of April and the 2nd week of October, 1972. Trap site 1 was located in the southern dry mesic wooded area near an intermittent stream. Trap site 2 was placed in the southern wet mesic area by the Pike river. Trap site 3 was on the edge of the mesic lot and the mesic prairie. Each trap site included one miniature CDC light trap (Sudia and Chamberlain, 1962) and one slightly modified version of the CO_2 (dry ice) baited trap of DeFoliart and Morris (1967). Traps were checked approximately every 12 hours, at dawn and dusk. Mosquitoes and tabanids were individually identified on a homemade chill plate and then deep frozen for future virus isolation attempts. Each CO_2 trap was baited with 1.5-2.0 kilograms of dry ice twice every 24-hour period to provide approximately 300-400 ml of CO_2/minute). The CO_2 release rate was between that of a man and of a large mammal according to Morris and DeFoliart (1969). Biting collections were made using aspirators at sites 1 and 3 during the evening hours and ending by sunset.

WEATHER. Meteorological data were obtained from a U.S. weather station located about 5 kilometers north of the study area in Racine county. The spring and summer of 1972 were relatively cool and unusually wet for southeastern Wisconsin. The temperature was especially low during the first five trapping periods. In May and June no rain fell during trapping weeks. Mean temperatures during June, July, August, and September were 17.3, 20.8, 21.1, and 16.6°C respectively, all below the norms of 19.4, 22.8, 22.4 and 18.2°C. Total precipitation for these 4 months was 226, 161, 168, and 194 mm respectively, as compared with norms of 88, 78, 81, and 77 mm in the same order.

RESULTS AND DISCUSSION

MOSQUITOES. Fourteen species of mosquitoes were identified. These included 9 new locality records for Kenosha County. They are *Anopheles punctipennis, Aedes cinereus, A. communis, A. dorsalis, A. flavescens, A. stimulans, A. triseriatus, A. trivittatus* and *Culiseta inornata* (Table 1).

The composition of the local mosquito populations was highly variable in neighboring ecologically comparable woodlots. For example, *A. stimulans* made up 2.6% of total mosquito catch at county Road E and Highway 31 lot and 30.2% in North Racine. Some species were absent from all but one woodlot, i.e., *A. dorsalis* (Table 2). Specific findings appear below.

Aedes communis (DeGeer) group and *A.*

TABLE 1. Trapping and biting collections of mosquitoes in the Parkside study area during the 1972 season.

Species	Apr IV	May III	Jun I	Jun III	Jul II	Jul III	Aug II	Aug IV	Sep III	Sep IV	Oct II	Total	(%)
Total mosquitoes trapped in CDC and CO_2 traps (day/night) at indicated month and week													
Anopheles spp.					0/10	0/7	0/26	0/6		0/2	1/1	1/52	(3)
Aedes communis group			1/0		0/43	0/30	0/6	1/7				2/86	(5)
A. stimulans group			1/0	2/0	3/2							6/2	(0)
A. triseriatus		1/1			6/4	1/1						8/6	(1)
A. trivittatus					36/34	38/42	5/15	14/12	1/0	5/12	2/0	101/115	(12)
A. vexans		3/1			64/551	25/98	25/132	74/134	16/0	39/138	54/29	300/1038	(76)
Coquillettidia perturbans						2/0						2/0	(0)
Culex pipiens		0/1		1/0		1/6	0/6	0/22		0/1	3/1	5/37	(2)
Culiseta inornata	2/0	2/7		1/0			0/1					5/8	(1)
Totals	2/0	6/10	2/0	4/0	109/644	67/184	30/186	89/181	17/0	44/153	60/31	430/1389	(100)
Biting (total numbers/numbers per man hour)[1]													
Anopheles spp.						1/0						1/0	(0)
Aedes communis group			6/6		6/12	119/19	13/6		62/21		1/1	207/11	(13)
A. stimulans group		31/62	24/24		22/44	57/9	1/1					135/7	(8.5)
A. triseriatus					9/18	37/6	7/4	3/3	79/26	2/1		137/7	(8.5)
A. trivittatus					6/12	188/30	93/46	16/16	90/30	21/7	9/6	423/23	(27)
A. vexans		1/2	9/9		29/58	211/34	122/61	92/92	128/43	73/24	11/7	676/37	(43)
Totals	0	32/64	39/39	0	72/144	613/98	236/118	111/111	359/120	96/32	21/14	1579/85	(100)

1. *Culex pipiens, Coq. perturbans* and *Culiseta inornata* were not obtained in the biting collection.

cinereus Meigen. Previous identifications of area mosquitoes indicated that the "*A. communis* group" consisted of 80-90% *A. communis* (DeGeer) and 10-20% *A. intrudens* Dyar together with the non-*communis* group mosquito, *A. cinereus* Meigen. Twenty of the 295 caught "*A. communis* group" mosquitoes (Table 1) were *A. cinereus*. These mosquitoes were poorly represented in trap collections but were relatively more abundant in biting collections. They were first obtained during the first week of June, more frequently trapped during late July and persisted in biting collections until the second week of October (Table 1). In 1965, attraction to traps commenced and terminated markedly earlier from mid May to early July according to DeFoliart *et al.* (1967) who did not provide meteorological data for a more specific comparison. In southwestern Wisconsin during 1967 and 1968, a considerably shorter biting season (late June—early September) of *A. communis* group and of other *Aedes* spp. (including *A. stimulans* group, *A. triseriatus, A. trivittatus* and *A. vexans*) was reported by Loor and DeFoliart (1970).

Aedes dorsalis Meigen. This species was only obtained in the woodlot on County Road E and Highway 31 during the July comparative biting collections. This location is about 2.5 kilometers southwest of the Parkside study area.

Aedes stimulans (Walker) group. Previous identifications of area mosquitoes indicated that collections usually consisted of about 90% *A. stimulans* (Walker) and 10% *A. flavescens* (Muller). They were almost exclusively represented in biting collections. Their biting populations appeared to be relatively heavy at the beginning of the season (third week of May) but steadily declined until they became absent after the second week of August (Table 1). In 1965, attraction to traps commenced in mid-May and continued until mid-September (DeFoliart *et al.*, 1967).

Aedes triseriatus (Say). This species is the established vector of the LaCrosse strain of California encephalitis (Pantuwatana, *et al.*, 1972 and Watts *et al.*, 1972) in southwestern Wisconsin. Although its percent distribution in biting collections at Parkside is not appreciably lower than elsewhere in Wisconsin where it is usually active in maintaining a natural cycle of infection, the main natural reservoirs (chipmunks and gray squirrels) were serologically negative for antibodies to this virus and no virus activity was suspected in this area. *A. triseriatus* appeared in the traps as early as the third week of May and its biting activity persisted as late as the end of September. In 1965, *A. triseriatus* was attracted to traps between mid-June and late August (DeFoliart *et al*, 1967).

Aedes trivittatus (Coquillett). This species was commonly found in the traps and was more abundant in biting collections (Table 1). It was first identified in trapping and biting collections as late as the second week of July and persisted until the end of the season. In 1965, it was attracted to traps between mid-June and late September (DeFoliart *et al.*, 1967).

TABLE 2: *Aedes* collections from Parkside study area and nearby locations, July, 1972

Aedes spp.	Parkside		Biting data in nearby wood lots		
	Trap. collect.	Biting collect.	E & Hy 31	Pet. Springs Park	North Racine
Aedes communis group	73 (7.5%)	125 (18.3%)	8 (10.2%)	15 (14.3%)	10 (3.2%)
A. dorsalis	0 (0%)	0 (0%)	6 (7.7%)	0 (0%)	0 (0%)
A. stimulans group	5 (0.5%)	79 (11.5%)	2 (2.6%)	6 (5.7%)	95 (30.2%)
A. triseriatus	12 (1.2%)	46 (6.7%)	10 (12.9%)	6 (5.7%)	1 (9.3%)
A. trivittatus	150 (15.3%)	194 (28.4%)	15 (19.2%)	31 (29.5%)	69 (21.9%)
A. vexans	738 (75.5%)	240 (35.1%)	37 (47.4%)	47 (44.8%)	140 (44.4%)
Total	978 (100%)	684 (100%)	78 (100%)	105 (100%)	315 (100%)
Trap or aspiration hrs.	96	3	1	1:30	data not available

Aedes vexans (Meigen). This was the most common species obtained in both trapping and biting collections. It is a well-known pest of man and animals. It was obtained in Parkside in both collections almost throughout the whole season. It is multivoltine and lives about 1-2 weeks or less (Barr, 1958) and appeared to have been continuously emerging until mid-October (Table 1). In 1965, it was attracted to traps between early May and mid-September (DeFoliart *et al.*, 1967).

Anopheles spp. Of the 52 caught specimens, 50 were *A. punctipennis* (Say) and two were *A. walkeri* Theobald. Almost all specimens were obtained in traps between the second week of July and October (Table 1). In 1965, *A. punctipennis* was trapped between end of April and end of August (DeFoliart *et al.*, 1967).

Coquillettidia (Mansonia) perturbans (Walker). Only two specimens were trapped during the third week of July (Table 1).

Culex pipiens Linnaeus. Forty-two specimens were trapped between May and October. None was identified in biting collections (Table 1).

Culiseta inornata (Williston). Thirteen specimens were trapped between April and August. None was identified in biting collections (Table 1).

EFFECT OF METHOD OF CAPTURE. *A. communis* group, *A. stimulans, A. triseriatus* and *A. trivittatus* were more frequently attracted to human bait (biting) than to traps. Higher percentages of the total catches of *A. vexans, Anopheles* spp. and all *C. perturbans, C. pipens* and *C. inornata* were attracted to traps (Table 1). These findings agree with those of Gojmerac and Porter (1969) on *Aedes* spp. in northeastern Wisconsin. This differential attraction to humans, or its absence clearly marks the nuisance mosquito species. Although higher percentages of *A. vexans* are attracted to traps, this species is, however, considered the main nuisance species in southeastern Wisconsin because of its greater numbers. Thompson and Dicke (1965) observed a relative lack of correlation between the numbers of *A. vexans* obtained by light traps and by landing counts. They concluded that "variables affecting these 2 samples were not the same, or were not acting to the same degree, or both."

A comparison between CDC- and CO_2 -trap catches (Table 3) indicates that *A. triseriatus, A. stimulans* group and *C. inornata* were more frequently attracted to CO_2 than to CDC traps. The first two species were also more common in biting than in trapping collections (above). This may indicate a stronger trend of attraction to warm-blooded animals or their exhaled gases than in other species. *A. vexans* did not show any particular preference. The other species were more attracted to CDC traps. These results are not in complete agreement with those of Morris and DeFoliart (1969) near Madison who reported considerably greater attraction of all *Aedes* spp., except *A. triseriatus* to CO_2. The percent of their total mosquito catches attracted to CO_2 (54%) was, however, comparable to our 46%, (Table 3).

ACTIVITY HOURS. Data in table 1 show that *A. communis* group, *A. vexans, C. pipiens* and *Anopheles* spp. were more active at night. Other species, i.e., *A. trivittatus* appeared equally abundant day and night. This pattern partially corresponded with the activity hours of the natural hosts on which the respective mosquito species feed most readily. See Barr (1958) and Wright and DeFoliart (1970) for examples.

EFFECT OF HABITATS. *A. triseriatus* and *A. vexans* were collected more readily in wood edge than in wooded areas. The same distribution pattern was less markedly shown by *Anopheles* spp. and *C. pipiens. A. trivittatus* showed no preference while *A. communis* group and *A. stimulans* group were more frequently caught in the woods (Table 4). Thompson and Dicke (1965) observed that *A. vexans* fed far more actively in prairie and meadow than in wooded situations. The opposite trend was observed for *A. stimulans* group by the same authors. Our test results on *A. trivittatus* are, however, not in agreement. It is here suggested that such distributional patterns are correlated initially with breeding and emerging sites and subse-

TABLE 3. A comparison of mosquito trap preference.

Species	mosquitoes collected in CDC traps No.	%	CO_2 traps No.	%	Total No.	%	% caught CO_2 traps
Anopheles spp.	43	4	10	1	53	3	19
Aedes communis group	82	8	6	1	88	5	7
A. stimulans group	1	0	7	1	8	0	88
A. triseriatus	3	0	11	1	14	1	79
A. trivittatus	155	16	61	7	216	12	28
A. vexans	653	68	730	87	1383	76	53
Coquillettidia perturbans	2	0	0	0	2	0	0
Culex pipiens	37	4	5	1	42	2	12
Culiseta inornata	3	0	10	1	13	1	77
Totals	979	100	840	100	1819	100	46

quently with the habitats frequently encountered by the hosts on which they readily feed.

SEASONAL DISTRIBUTION. The pattern shown in figure 1 is for all mosquito species obtained, with *A. vexans* making up 76% and 43% of the trapping and biting catches, respectively (Table 1). Variations in overall seasonal frequency thus depended on those of *A. vexans* to a great extent.

Attraction to traps commenced in late April but biting activity first occurred in the 3rd week of May. This was apparently influenced by the April rains. The little trapping success and the absence of biting catches in late June corresponds with unusually low minimum temperatures (Fig. 1). The subsequent emerging populations peaked during the second week of July following heavy rains during mid-June and corresponding with increasing temperatures. Porter and Gojmerac (1970 b) observed

TABLE 4. A comparison of mosquito habitat preference.

Species	mosquitoes collected in Wood edge No.	%	Woods No.	%	Total No.	%	% preference for wood edge[1]
Anopheles spp.	21	3	32	3	53	3	57
Aedes communis group	22	3	66	7	88	5	40
A. stimulans group	2	0	6	1	8	0	40
A. triseriatus	6	1	6	1	12	1	67
A. trivittatus	70	9	146	14	216	12	49
A. vexans	656	83	723	72	1379	77	64
Coquillettidia perturbans	0	0	2	0	2	0	0
Culex pipiens	17	2	24	2	41	2	59
Culiseta inornata	0	0	2	0	2	0	0
Totals	794	100	1007	100	1801	100	61

1. Since twice as many traps were located in the woods, the number of mosquitoes collected in the woods was divided by 2 to compute preference for trap location.

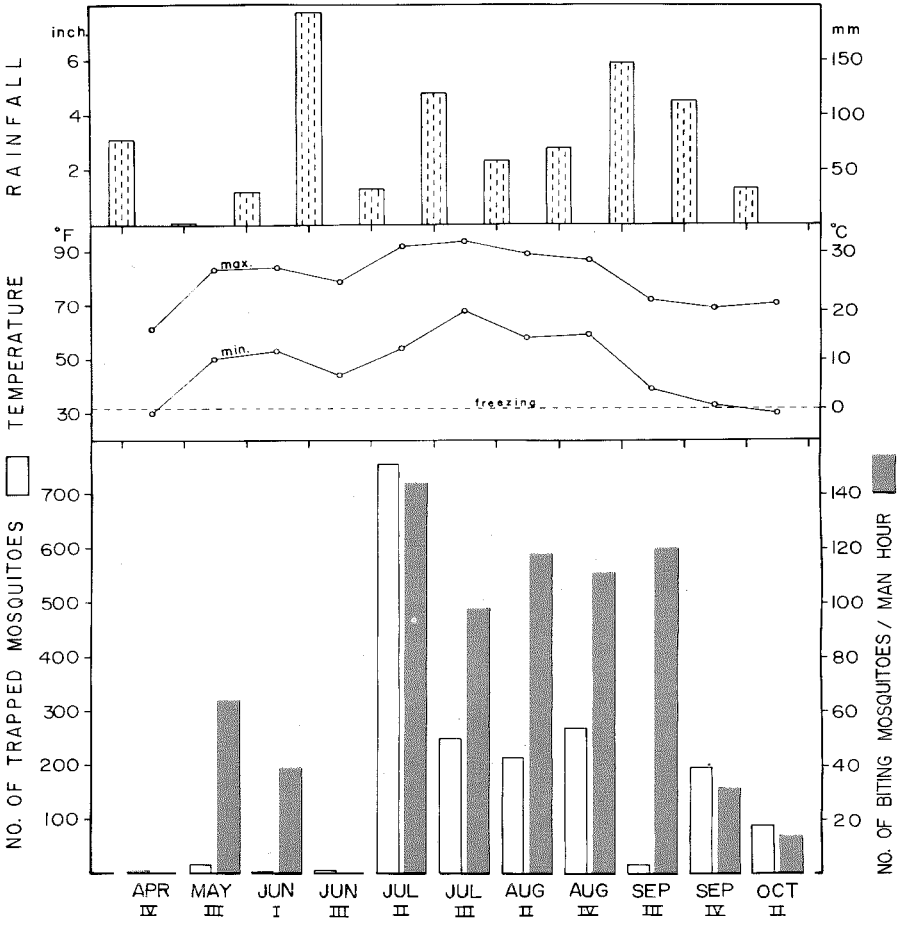

FIGURE 1. Seasonal frequency of Parkside trapping (using CDC and CO_2 traps) and biting collections of mosquitoes compared with seasonal changes in temperature and rainfall during 1972. Maximum and minimum temperatures are those of four days ending with the end of each two day collecting period. Amounts of rainfall indicated are those falling during a two week period preceding and including each collecting period. Roman numerals indicate the quarter or the week of the corresponding month.

that "Above 62°F a rise of one degree F increased light trap catches by 1.2 times." Mosquito indices continued moderately high through the third week of September with the continuous presence of rain water and moderate temperatures. The end of the season's decline started during late September primarily influenced by near and below freezing minimum temperatures.

TABANIDS. One hundred and eight tabinids belonging to 10 species were trapped. *Chrysops inda* Sacken (30), *Chrysops callida* Sacken (18), *Hybomitra lasiophthalma* (Macquart) (24), and *Tabanus lineola scutellaris* Walker (19) accounted for 93% of all tabanids collected. Others were *Chrysops aestuans* Wulp (8), *Chrysops celeris* Sacken (3), *Chrysops frigida* Sacken (3), *Chrysops montana* Sacken (1), *Tabanus quinquevittatus* Wiedmann (1) and *Tabanus trimaculatus* Beauvois (1). Of these, seven tabanids represent new locality records. They are *C. aestuans, C. callida, C. celeris, C. frigida, H. lasiophthalma, T. l. scutellaris* and *T. trimaculatus.*

It is interesting to note that most of these species (above) were reported in CO_2 traps in central, south central and southwestern Wisconsin from late May or early June until mid- or late August, 1965 (DeFoliart *et al.*, 1967). In Parkside, they ceased entering the traps after early June.

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