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INSECT COMPOSITION OF THE MOSQUITO MAGNET PRO® MOSQUITO TRAP IN NORTHEASTERN OHIO

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ABSTRACT

The trap composition of 6 Mosquito Magnet Pro® mosquito traps from northeastern Ohio is given by insect order, dipteran family, and mosquito species. A total of 395 mosquitoes (Culicidae), 20,984 biting midges (Ceratopogonidae), 196 black flies (Simuliidae), and 318 stable flies (Muscidae: *Stomoxys* sp.) was captured. Non-biting fly abundance accounts for 49.6% of the total catch. Large variation occurred among dates and traps.

INTRODUCTION

The Mosquito Magnet® line of mosquito traps is marketed to provide control of biting flies. Patent pending counterflow geometry technology is used to suck flying insects into a chamber from an area close to but not interfering with emitted attractants (Kline 1999). The Mosquito Magnet Pro® is advertised to be effective in an area of 1 acre (0.4 ha) with heat, moisture and carbon dioxide produced via propane combustion. Octenol (1-octen-3-ol) packs are also used as an attractant. The manufacturer (American Biophysics Corporation, East Greenwich, Rhode Island) claims in their website (www.mosquitomagnet.com) that only blood seeking insects are attracted to the traps and when used properly, will decrease the population of mosquitoes within 4 to 6 weeks. Previous studies with this device and a prototype report its superiority to CDC-type traps for attracting and collecting mosquitoes (Kline 1999, Mboera et al. 2000a, Burkett et al. 2001).

Studies of various mosquito (Diptera: Culicidae) traps have shown that a certain composition and concentration of attractants can increase the number of mosquitoes captured for some species but decrease captures of other mosquito species. Reeves (1953) found species preferences based on carbon dioxide level. Rueda et al. (2001) showed octenol and light to be important attractants for some species but not for others. In Germany, octenol combined with carbon dioxide did not attract significantly more mosquitoes than carbon dioxide without octenol (Becker et al. 1995). This is in contrast to the synergistic effect found in Takken and Kline (1989), Kline et al. (1990) and Kline et al. (1991).

Octenol has generally not been useful in capturing *Culex* species. Kline et al. (1991) found *Culex* (*Melanoconion*) spp. were significantly more abundant in traps without octenol while *Culex nigripalpus* Theobald was more abundant at the low octenol level compared to the high level or its absence. Burkett et al. (2001) found octenol-baited traps contained significantly fewer *Culex pipiens* L. Likewise, octenol significantly increased the capture of all mosquito species except *Culex* spp. and *Wyeomyia mitchellii* Theobald (Takken and Kline 1989). Afrotropical *C. quinquefasciatus* Say was shown by Mboera et al. (2000b) to be captured in similar numbers using octenol-baited traps and unbaited traps. The addition of octenol to carbon dioxide increased the catch but not significantly.

The objective of this study is to document the results of trapping during one summer in urban areas of northeastern Ohio, U.S.A. We give the mosquito

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and other biting fly abundances encountered, as well as numbers of non-target (i.e., non-biting) insects obtained and changes in abundance of taxa over time.

MATERIALS AND METHODS

Six Mosquito Magnet Pro® traps were run continuously from 14 May to 20 August, 2002 on wastewater treatment sites owned by the Northeast Ohio Regional Sewer District. The traps used carbon dioxide produced by propane combustion and octenol as attractants. Traps #1 and #2 were placed on the east side of Cleveland; trap #3 was placed on the west side of Cleveland; and traps #4-6 were located south of Cleveland in Cuyahoga Heights. Sites in Cleveland are located near Lake Erie and those in Cuyahoga Heights are in a valley. All sites are surrounded by urban areas where there were no mosquito abatement efforts during the study period. Traps were sometimes placed at slightly different areas in the same location. The traps were serviced five times according to the manufacturer's instructions, and specimens were brought to the lab where they were frozen, identified, and counted. Random subsamples (6.25 – 50%) were occasionally used for non-mosquito content identification when counts were greater than 150 individuals. Taxa were arbitrarily categorized as rare (<1% of total catch), uncommon (1-2%), common (3-10%), or abundant (>10%).

A one-way analysis of variance (ANOVA) or a Kruskal-Wallis ANOVA on ranks was used where appropriate to test the hypothesis that differences occurred among traps and among collection dates for each taxon of biting fly (Ceratopogonidae, Culicidae, Simuliidae, *Stomoxys* (Muscidae)) and for non-targets. Tukey's post-hoc test was used to detect significant differences among traps and dates. SigmaStat version 2.03 (SPSS 1992-1997) was used in these analyses.

RESULTS

A total of 43,464 insect specimens was collected. A list of the non-dipteran insect orders or families, dipteran families, and mosquito species is given in Table 1. Mosquitoes were rare, totaling 395 specimens, or 0.67 mosquitoes per day per trap. All undetermined Diptera were non-biting flies and remain unidentified due to their poor condition. Likewise, the undetermined *Aedes*/ *Ochlerotatus* and *Culex* specimens were damaged so that key characters were indiscernible. Most *Culex* were either *C. pipiens* or *C. restuans* Theobald. *Culex, Aedes*/ *Ochlerotatus,* and *Anopheles* were collected at similar densities (Table 1).

The abundance by date and by trap for the most frequently encountered taxa (>0.50% of total) is shown in Tables 2 and 3 respectively. Although mosquito counts generally increased through time, they were not significantly different from each other (F = 1.13, df=4,12, P = 0.37). The abundance of mosquitoes was significantly higher in trap #6 compared to trap #1 (H = 17.79, df = 6, P < 0.01). The abundance of Ceratopogonidae (biting midges) was significantly higher in trap #5 versus traps #2 and #3 and higher in trap #6 versus trap #2 (H = 19.90, df = 4, P < 0.001). *Stomoxys* sp., although categorized as rare, were taken frequently in early June (Fig. 1).

The proportion of mosquitoes remained low throughout the season (Fig. 1) with the largest proportion collected occurring on 20 August with 6.2% of the total. Ceratopogonidae were common throughout the year, being especially prevalent in July (Fig. 1). Mosquitoes were a minor component in all traps (Fig. 2). Non-targets dominated all trap catches except #5 and #6 where Ceratopogonidae were also numerous (Fig. 2).

Non-targets (i.e., non-biting insects) totaled 21,572, or 49.6% of all specimens obtained. The abundance of non-targets exhibited a significant increase from the first to the second collecting date (6 June to 24 June; H = 14.32, df = 4, P < 0.01). Chironomidae (non-biting midges) and Psychodidae (moth and drain

Table 1. Taxa and number of specimens collected (R = <1%, U = 1-2%, C = 3-10%, A = >10%).

Taxon	# of specimens	percent	abundance
Agromyzidae	4	0.00	R
Aleyrodidae	6	0.014	R
Anthomyiidae	3	0.007	R
Aphididae	161	0.370	R
Caenidae	1	0.002	R
Calliphoridae	14	0.032	R
Cecidomyiidae	2093	4.815	C
Ceratopogonidae	20984	48.279	A
Chironomidae	12173	28.007	A
Chloropidae	11	0.025	R
Chrysopidae	14	0.032	R
Cicadellidae	393	0.904	R
Coleoptera	734	1.689	U
Coniopterygidae	16	0.037	R
Coreidae	2	0.005	R
Culicidae	395	0.909	R
undetermined Culicidae	3	0.007	R
undetermined *Culex*	14	0.032	R
Aedes/Ochlerotatus sp.	120	0.276	R
Aedes vexans	1	0.002	R
Anopheles punctipennis	131	0.301	R
Culex pipiens/restuans	126	0.290	R
Dolichopodidae	35	0.081	R
Drosophilidae	5	0.012	R
Empididae	5	0.012	R
Ephydridae	16	0.037	R
Hymenoptera	550	1.265	U
Lauxaniidae	3	0.007	R
Lepidoptera	159	0.366	R
Lonchopteridae	1	0.002	R
Milichiidae	2	0.005	R
Miridae	14	0.032	R
Muscidae (*Stomoxys*)	318	0.732	R
Mycetophilidae	3	0.007	R
Phoridae	125	0.288	R
Psocoptera	92	0.212	R
Psychodidae	4066	9.355	C
Rhagionidae	56	0.129	R
Sciaridae	298	0.686	R
Simuliidae	196	0.45	R
Tachinidae	7	0.016	R
Tethinidae	2	0.005	R
Thysanoptera	115	0.265	R
Tingidae	1	0.002	R
Tipulidae	145	0.334	R
Trichoptera	22	0.051	R
undetermined Diptera	189	0.435	R
undetermined Homoptera	4	0.009	R
Total	43,464		

Table 2. Mean per trapping day and (standard deviation) of the most frequently captured taxa and total non-targets by collection date (14 May – 20 August, 2002).

	Date Collected				
Taxon	**6 June**	**24 June**	**10 July**	**30 July**	**20 August**
Cecidomyiidae	0.30 (0.25)	9.94 (20.47)	3.36 (5.56)	2.36 (3.30)	2.94 (5.21)
Ceratopogonidae	1.17 (2.38)	23.91 (43.07)	142.78 (315.44)	33.49 (57.32)	4.09 (7.77)
Chironomidae	7.95 (4.36)	65.31 (55.00)	18.16 (24.29)	10.19 (6.49)	8.38 (7.43)
Cicadellidae	0.11 (0.09)	0.72 (0.70)	2.01 (1.89)	0.58 (0.49)	0.29 (0.25)
Coleoptera	0.38 (0.33)	2.74 (5.22)	2.30 (3.48)	0.58 (0.51)	0.75 (0.65)
Culicidae	0.19 (0.15)	0.32 (0.32)	0.94 (1.08)	0.89 (1.14)	1.09 (1.30)
Hymenoptera	0.25 (0.22)	0.78 (0.61)	1.38 (1.30)	0.92 (1.18)	1.50 (2.19)
Psychodidae	1.51 (1.31)	15.06 (19.89)	13.52 (20.50)	5.80 (5.46)	1.88 (2.30)
Sciaridae	0.36 (0.26)	0.81 (0.62)	0.86 (0.68)	0.27 (0.23)	0.36 (0.57)
Stomoxys	0.99 (1.54)	1.19 (1.34)	0.39 (0.39)	0.05 (0.08)	0.09 (0.17)
Non-targets	272.00 (74.13)	1796.33 (1428.47)	709.00 (722.74)	442.17 (112.60)	381.67 (268.86)

Table 3. Mean and (standard deviation) of the most frequently captured taxa and total non-targets by trap.

	Trap					
Taxon	**1**	**2**	**3**	**4**	**5**	**6**
Cecidomyiidae	0.60 (1.34)	3.20 (0.84)	8.40 (12.46)	69.20 (119.41)	266.80 (379.62)	70.40 (43.33)
Ceratopogonidae	0.0 (0.0)	0.20 (0.45)	1.40 (1.67)	29.60 (37.65)	3485.60 (5201.39)	680.00 (492.33)
Chironomidae	543.20 (737.38)	742.00 (996.52)	270.20 (270.86)	176.80 (36.26)	420.80 (725.57)	281.60 (436.80)
Cicadellidae	1.00 (1.73)	8.20 (6.26)	9.40 (5.90)	14.20 (10.03)	13.40 (20.42)	32.40 (31.60)
Coleoptera	0.20 (0.45)	7.20 (6.06)	9.60 (4.56)	12.20 (6.50)	87.00 (101.88)	30.60 (15.18)
Culicidae	1.60 (2.61)	7.20 (4.09)	3.80 (1.92)	11.40 (18.34)	24.60 (25.85)	29.40 (23.14)
Hymenoptera	2.20 (3.35)	5.40 (4.93)	16.60 (10.62)	12.60 (11.52)	16.60 (18.54)	56.60 (39.70)
Psychodidae	9.60 (8.73)	35.20 (13.74)	127.60 (83.58)	111.60 (108.69)	424.40 (460.48)	104.80 (103.68)
Sciaridae	1.00 (1.00)	2.20 (2.05)	17.40 (10.90)	17.40 (7.02)	10.40 (9.63)	11.20 (8.67)
Stomoxys	0.0 (0.0)	13.80 (16.27)	32.00 (42.19)	8.20 (10.50)	1.20 (2.68)	8.40 (6.27)
Non-targets	559.60 (749.35)	815.00 (1008.17)	475.00 (285.47)	462.40 (157.82)	1334.40 (1712.70)	675.00 (591.34)

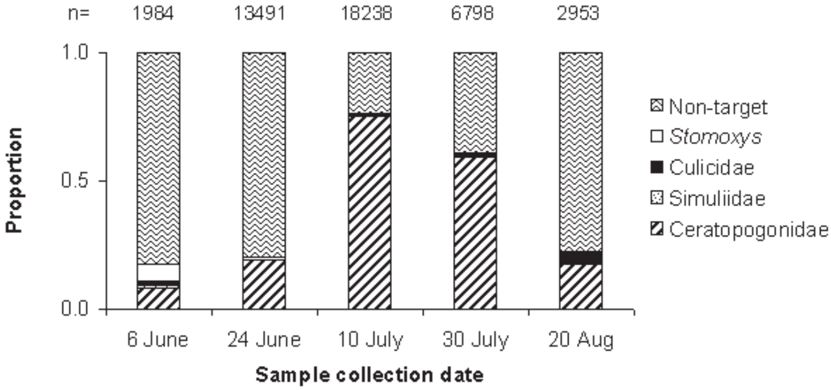

Figure 1. Proportion of biting flies and non-targets by collection date.

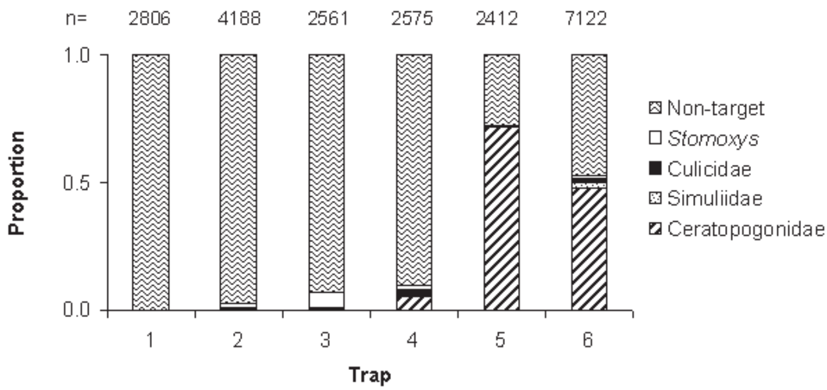

Figure 2. Proportion of biting flies and non-targets by trap.

flies) totaled 16,239, or 37.4% of the total catch during the entire study period. Other abundant non-targets included Cecidomyiidae (gall midges), undetermined Coleoptera, and undetermined Hymenoptera (Table 1).

DISCUSSION

The introduction of West Nile virus into North America has increased the demand for mosquito control. Species of *Culex* are currently the targeted vectors (CDC 2002). *Culex* was captured at a rate similar to other mosquito genera. This is consistent with Kline (1999) who showed that *C. erraticus* (Dyar & Knab) and *C. salinarius* Coquillett were captured regularly with a similar trap design. Our data were highly variable among dates and traps. Mosquitoes were always, if present, a minor component of a catch. Mosquitoes did not decline in number over time.

Non-biting flies and other insects were commonly captured in the traps. The proportion varied throughout the summer and among traps. Non-targets comprised 49.6% of insects collected, suggesting that in general, non-targets will represent a substantial proportion of insects collected in the Mosquito Magnet Pro® trap design. The large number of non-targets may indicate possible reduction of some beneficial insect populations. Ceratopogonidae and Chironomidae are occasionally considered pestiferous and were captured in large numbers. Ceratopoginid females seek blood meals, and chironomid adults are a nuisance when they enter homes and businesses.

The poor condition of captured mosquitoes (such as loss of scales) made for problematic species identifications. Therefore, a shorter collecting time interval is recommended if Mosquito Magnet Pro® traps are used for monitoring purposes.

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