SEASONAL ABUNDANCE AND CONTROL OF *CULEX* SPP. IN CATCH BASINS IN ILLINOIS

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ABSTRACT. Street catch basins in western Cook County, IL, were examined regularly June through August of 1987 to determine their seasonal larval production, adult mosquito harborage and the influence of abiotic factors on the associated mosquito population. Only larvae of *Culex pipiens* (63% of total) and *Cx. restuans* (37% of total) were recovered. These 2 species and *Cx. erraticus* were the most frequently collected adults. The abundance of mosquito larvae within catch basins was not correlated with water pH and only showed a weak, positive correlation with water temperature. Only a partial flushing of larvae (22-34% reduction) from catch basins by normal rainfall (< 25mm) was generally recorded. Treatments with larvicide oil (mineral seal oil/kerosene 175/tergitol) at a rate of 60-90 ml/catch basin resulted in a mean larval reduction of 97%. Adult females showed a mean reduction of 87%.

INTRODUCTION

Storm-water street catch basins are prolific sources of particular, stagnant water, container mosquitoes *(Culex restuans* Theobald and *Cx. pipiens* Linn.) because the basins retain water and much organic debris for long periods of time (Covell and Resh 1971, Munstermann and Craig 1977). The treatment of catch basins should be an important part of any mosquito control operation because of the close proximity of basins to human activity and their potential to serve as harborage and production sites of *Cx. pipiens*, a known vector of St. Louis encephalitis (Monath 1980).

Since its establishment in 1927, the DesPlaines Valley Mosquito Abatement District has recognized the importance of controlling mosquito development in catch basins (Wray 1954, Martin 1963). The current study was undertaken to better understand the conditions that affect mosquito development and their control in catch basins. The objectives of this study were: 1) to determine the species and seasonal activity of mosquitoes which breed in catch basins in northeastern Illinois; 2) to determine what species of adult mosquitoes diurnally harbor in catch basins; 3) to observe the effects of water temperature, pH and rainfall on mosquito breeding and 4) to assess the effectiveness of larviciding oil in the control of larval and adult catch basin mosquitoes.

MATERIALS AND METHODS

The study area lies within the jurisdiction of the DesPlaines Valley Mosquito Abatement District, an area of 1,982 km in the western Chicago suburbs. Over 30,000 street catch basins occur within its boundaries. Many of these basins consist of a hollow, concrete cylinder (1.2 m diam) with an outlet pipe ≥ 0.6 m above the basin bottom. An open grate cover allows water and debris to enter from the street and accumulate. Catch basins described here are similar in design to that described by Maddock et al. (1963).

Forty catch basins divided among 2 sites were selected as the study area. Normal district control operations were omitted in the experimental area during the study period. From June 6 to August 29, 1987, the catch basins were inspected twice per week. An inspection consisted of: 1) recording pH and water temperature approximately 125 mm below the water surface; 2) sampling larval mosquitoes with a dipper (3 dips/basin with a standard 300 ml dipper) to determine the species and estimate their density, and note the stages present and 3) sampling adult mosquitoes without replacement for 2 min/basin with a modified version of a mechanical aspirator (Meyer et al. 1983). Each test site was independently treated with larvicide oil twice during the study period on July 13 and August 4 (site 1), and July 21 and August 10 (site 2) using right-hand drive AM General Dispatchers equipped with pressurized sprayers (Johns 1968). Larvicide oil, consisting of a mixture of 60% mineral seal oil, 40% kerosene 175, and 0.5% tergitol spreader, was applied at an application rate of 60-90 ml/catch basin. The 4 control basins were untreated. Pretreatment data was collected 1-3 days prior to treatment and posttreatment data was collected 1-3 days following treatment. Results from the inspections were evaluated quantitatively and through observations. The influence of temperature and pH on larval abundance within catch basins was evaluated using the Product-Moment Correlation Coefficient; rainfall and larvicide treatments on larval and adult mosquitoes were analyzed by comparing the pre-rain or pretreatment data to the post-rain or posttreatment data using the *t*-test for paired samples (Sokal and Rohlf 1981).

RESULTS AND DISCUSSION

Species distribution: Larvae of *Cx. pipiens* (63%, *n* = 2,147) and *Cx. restuans* (37%) were essentially the only mosquito larvae recovered from street catch basins in northeastern Illinois. Figure 1 shows the seasonal abundance of both species within catch basins. *Culex restuans* was predominant up to the end of June, after which numbers of *Cx. restuans* declined and *Cx. pipiens* increased. Similar changes in the dominance of these 2 species from catch basins have been observed in northern Indiana, where the species change-over occurred in mid-July (Munstermann and Craig 1977), and in Kentucky, where the species change-over occurred in early June (Covell and Resh 1971). The 3-week difference between northern Indiana and northern Illinois, both being about the same latitude, is probably due to temperature differences between the 2 study years. Kentucky's 3 to 6 week earlier change-over, compared with the 2 northern locations, is likely a combination of latitudinal temperature differences and temperature differences between study years. A very small number of *Aedes vexans* (Meigen) larvae were also present (0.1%), suggesting that it is not a habitual catch basin breeder and that its occurrence is accidental (Covell and Resh 1971).

Several species of mosquitoes used catch basins as a diurnal resting place (Table 1). The majority (> 99%) of adults collected were *Cx. pipiens*, *Cx. restuans* or *Culex erraticus* (Dyar and Knab). As expected, the species most often

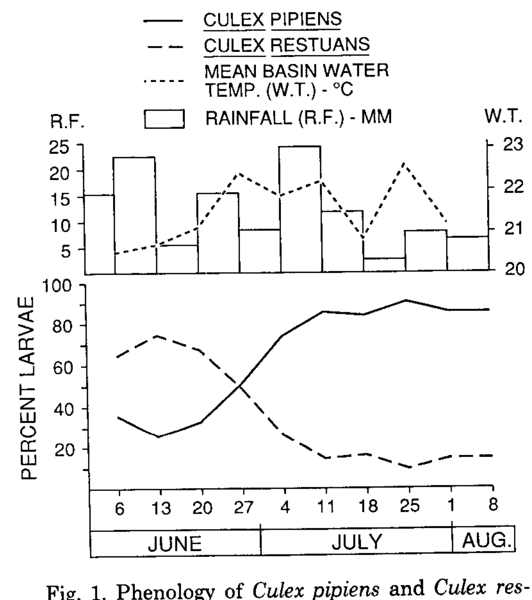

Fig. 1. Phenology of *Culex pipiens* and *Culex restuans* larvae collected from 40 street catch basins in western Cook County, IL, 1987.

Table 1. Adult mosquitoes collected from street catch basins in western Cook County, IL, 1987.

Species	Females Total (%)	Males Total (%)
Culex pipiens	8,426 (81)	7,164 (85)
C. restuans	1,534 (15)	832 (10)
C. erraticus	481 (5)	438 (5)
Aedes vexans	3 (<1)	2 (<1)
C. territans	2 (<1)	4 (<1)
Uranotaenia sapphirina	2 (<1)	0
Ae. triseriatus	1 (<1)	0
C. salinarius	1 (<1)	0
Anopheles punctipennis	0	1 (<1)
Totals	10,450 (100)	8,441 (100)

found as larvae in catch basins were the same as that harboring there as adults, with one exception. Larval *Cx. erraticus* were never recovered from catch basins but from mid-July onwards adults were found harboring there, often outnumbering *Cx. restuans*. Figure 2 shows the seasonal variation of these 3 predominant species which use catch basins as harborage sites.

Environmental effects: The summer mean water temperature in the basins was 21.6 ± 0.7°C (range 17–28°C, *n* = 507). Water temperature showed only a weak, positive correlation (coefficient = 0.13, $P < 0.01$) with larval dip counts.

The mean pH of the catch basin water was 6.1 ± 0.8 (range 6.0–8.0, *n* = 694). Water pH had no (coefficient = 0.02) effect on mosquito abundance.

The amount of accumulated organic debris within the catch basins appeared to affect the incidence of mosquito larvae and their control. As expected, larvae seemed to be more abundant in basins with some organic debris. However, even basins lacking debris supported a larval population of 6.3 larvae/dip average for the study period. A basin that was replaced during the study contained larvae within a week of replacement in the absence of foul water. Control of mosquito larvae with larvicide oil in basins heavily laden with debris crusting on the surface of the water was difficult. In the presence of floating debris, the oil film fragmented and failed to spread evenly over the water surface, thus preventing an effective kill of the larvae.

In general, some flushing of mosquito larvae from catch basins due to rainfall can be expected (Maddock et al. 1963, Munstermann and Craig 1977). In this study, larval mosquito incidence in catch basins varied with the amount of rainfall. A low rainfall (7–17 mm) resulted in 22–34% larval reduction, a moderate rain (22 mm) yielded a 45% reduction, and a strong rain (102–127 mm) resulted in a 85–91% reduction. High variance of dip counts and small sample sizes failed to yield statistically significant results; however, the results do suggest that a significant number of *Culex* larvae remain in street catch basins following a normal (< 25mm) rainfall and that a flooding (102 mm) rain is necessary to substantially reduce larval numbers.

Larval treatment: The use of oil to control mosquito larvae in catch basins has been evaluated by Schmidt et al. (1973) and Pfunter (1978). Pfunter realized a 90–100% mortality 24 h after treatment using Golden Bear 1356 oil (WITCO Chem. Corp., Los Angeles, CA), with egg rafts found 2 days on average after treatment and live larvae found 3 days on average after treatment. In this study the treatment of catch basins with larvicide oil resulted in a high level of larval control, with a mean reduction of 97% following application (Table 2). Although it was difficult to assess the recovery time of larvae subsequent to the treatments, qualitative observations and the data suggested that larval occurrence was suppressed about 10 days on average, after which larval populations quickly recovered.

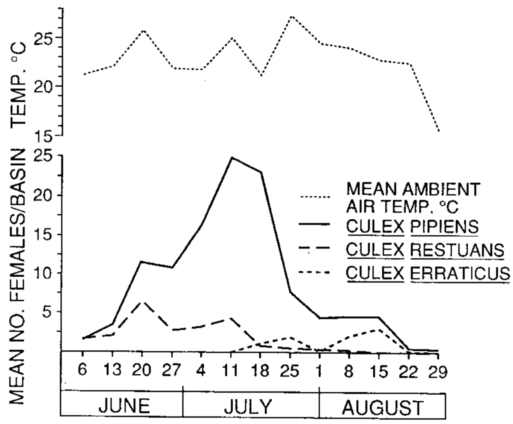

Fig. 2. Adult female mosquitoes collected from 40 street catch basins in western Cook County, IL, 1987.

The effect of larvicide oil treatment on adult female mosquitoes harboring in the catch basins is summarized in Table 2. Overall, the mean number of adults recovered from the basins declined 86% following larviciding. Adult males showed a similar drop in their abundance (data not shown). The substantial decreases in adult mosquitoes recorded is probably due in part to a lack of emerging adults. Additionally, the larvicide oil may have a repellent effect. Observations at the time of treatment indicate that the adults harboring in the basins did not leave immediately upon treatment. It is unknown whether the majority of adult mosquitoes residing within basins at the time of their treatment were killed or flew to more desirable, untreated areas nearby. However, dip samples taken 1–3 days after treatment yielded a small number of dead adults, indicating that there was at least some adult mortality.

In conclusion, this study has shown that not all catch basins flush thoroughly after an average rainfall, thus requiring treatment in spite of rain. The size and style of catch basins are important considerations in any control program. In the control of catch basin mosquitoes, larvicide oil (mineral seal oil/kerosene 175/tergitol) applied at 60–90 ml/catch basin will probably yield effective control of *Culex* larvae for at least 10 days.

ACKNOWLEDGMENT

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Table 2. Control of larval and adult female mosquitoes in catch basins with larviciding oil (mineral seal oil/kerosine 175/tergitol), western Cook County, IL, 1987.

				Mean no. larvae/dip[a]			Mean no. female adults/basin[a]		
	Date	Site	No. basins sampled	Pre-treatment	Post-treatment	% change (±SE)	Pre-treatment	Post-treatment	% change (±SE)
Treatment	Jul. 13	1	14	30.9	0.7	−98 (23)[b]	31.9	2.3	−93 (41)[c]
	Jul. 21	2	16	77.2	4.9	−94 (17)[b]	23.9	4.6	−81 (32)[c]
	Aug. 4	1	17	42.8	0.5	−99 (20)[b]	7.4	0.7	−90 (28)[b]
	Aug. 10	2	12	40.3	1.0	−98 (22)[b]	6.1	0.9	−85 (34)[c]
Control	Jul. 21	2	3	84.0	44.7	−47 (38)	11.3	33.3	194 (231)
	Aug. 10	2	4	65.0	89.8	38 (26)	42.5	36.0	−15 (12)

[a] Data collected 1–3 days prior to treatment and 1–3 days after treatment.
[b] Statistically significant, $P < 0.01$, t-test.
[c] Statistically significant, $P < 0.05$, t-test.

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