# Evaluation of *Culex pipiens* Populations in a Residential Area with a High Density of Catch Basins in a Suburb of Chicago, Illinois

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# OPERATIONAL NOTE

## EVALUATION OF *CULEX PIPIENS* POPULATIONS IN A RESIDENTIAL AREA WITH A HIGH DENSITY OF CATCH BASINS IN A SUBURB OF CHICAGO, ILLINOIS

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ABSTRACT. The North Shore Mosquito Abatement District applies extended release larvicides including methoprene-based Altosid® XR Extended Residual Briquets to approximately 40,000 catch basins in the southern half of the District's operational area at the beginning of each season. Treatments begin in May and typically again 9 to 10 wk later when larvicide efficacy appears to wane. In 2013 spinosad-based Natular™ XRT tablets were applied to basins, and a subset were monitored for larvae and pupae weekly with a standard dipper. When setting the threshold for retreatment as 12 juveniles per dip sample it was observed that basins required a second application 9 wk after the initial application, a time period similar to Altosid despite utilizing a different active ingredient. Average counts of weekly larval samples appeared to be positively associated with average numbers of *Culex pipiens* collected the following week in a gravid trap located among catch basins, highlighting the importance of basins as sources of these mosquitoes.

**KEY WORDS** Larvicide, catch basin, mosquitoes, West Nile virus

Because catch basins can be abundant habitats for the West Nile virus vector, *Culex pipiens* L., the North Shore Mosquito Abatement District (NSMAD), the mosquito control agency serving the north shore suburbs of the city of Chicago, focuses much of its seasonal efforts on applying larvicides to these structures. Each year, the NSMAD treats approximately 40,000 catch basins in the southern half of its operational area with an application of an extended release (generally 180 days) larvicide twice a breeding season. The second round of treatments generally occurs 9 to 10 wk after the initial treatment and initiated on the basis of intermittent catch basin sampling, experiences from previous years, and availability of seasonal staff. In the past this second application has occurred. Because the financial costs of purchasing and applying larvicides to catch basins can be significant, finding a product that reduces the need for a second treatment would be ideal. Historically basins have been treated with Altosid® XR Extended Residual Briquets (Wellmark International, Schaumburg, IL), a product with methoprene as an active ingredient. In 2011, NSMAD began evaluating Natular™ XRT tablets (Clarke Mosquito Control Products, Roselle, IL) as a potential alternative to Altosid in southern basins. Natular utilizes spinosad (a mixture of spinosyn A and D) as the active ingredient.

Based on initial efficacy studies using 60 basins within a small 0.7 km area of the District, Natular was observed to reduce mosquitoes in basins for 8 to 14 wk (Harbison et al. 2013, 2014). It was thus desired to more rigorously test the larvicide on a wider scale and evaluate the time period this product could effectively reduce mosquitoes before requiring a second application. To do this, one of the NSMAD 2.6 sq km operational zones within the southern half of the District was chosen for weekly catch basin monitoring during the 2013 season because it held a relatively higher density of basins (approximately 750). All 750 of these structures that could be safely inspected for monitoring and remained unobstructed by parked cars were identified for a total of 123 study basins. The day before the initial Natular treatment was applied to all 750 basins in June 13, 2013, and then continuing for 14 wk after, 20 of the 123 study basins were randomly selected and inspected weekly for mosquito juveniles by taking 2 standard dip samples and the number of immature mosquitoes recorded. If 1 or more larvae or pupae were found in a basin a dose of CocoBear (Clarke Mosquito Control Products) was applied. Cocobear is a formulation of 10% mineral oil that temporarily leaves a thin film on surface of treated water. It was also determined that all catch basins within the study area should be retreated once the average number of larvae and pupae found in all larval samples for a week surpassed 12. This threshold was chosen based on the results of past NSMAD Natular studies that found 75% of dips of untreated basins and 90% of dips of treated basins held this number of mosquitoes or less. Previous work in the NSMAD operational area also found *Cx.*

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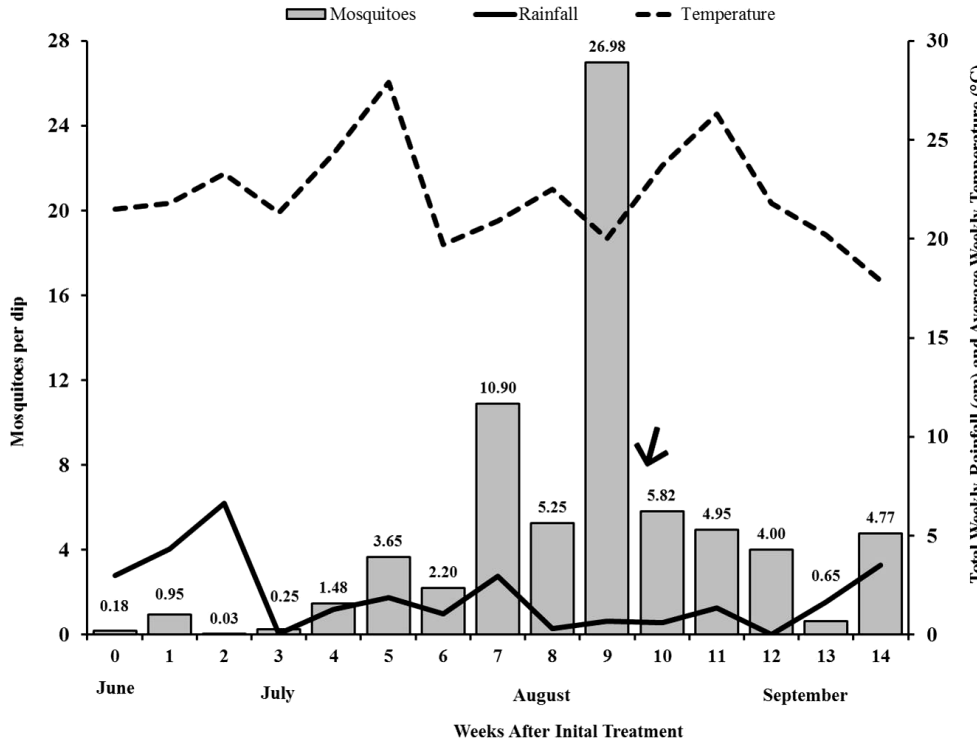


Fig. 1. Average counts of juvenile mosquitoes from 20 randomly selected catch basins sampled weekly from June 12 to September 17, 2013, by standard dipper with average weekly temperatures and total weekly precipitation. Natular XRT tablets were applied to all basins after week 0 and, as noted by arrow, again after week 9.

*pipiens* to be almost exclusively the sole species found catch basin larval samples, and thus to conserve time and resources all larvae and pupae observed in this study were assumed to be of that species. Precipitation and temperature data were collected from a nearby weather station of the National Oceanic and Atmospheric Administration–National Weather Service Forecast Office located at Chicago O'Hare Airport.

Opportunely 1 of the 14 NSMAD permanent gravid trap site locations used for adult surveillance each year was situated approximately within the center of the study area. This allowed for a comparison between adult *Cx pipiens* captured in the trap and juveniles observed in basins. Hamer et al. (2014) estimated that 90% of female *Culex pipiens* on average dispersed within only 1.15 km of their catch basin larval habitat, a distance similar to that of this study's single gravid trap to that of the furthest catch basin (1.4 km). Therefore it was believed that because of the relatively high abundance catch basins in the study area and the limited dispersal of *Cx. pipiens* it was reasonable to hypothesize that gravid traps could capture *Cx. pipiens* originating from these structures. This is of interest because of the occupational hazards associated with sampling catch basins, in particular exposure of staff to vehicular traffic. If numbers of *Cx. pipiens* collected in a gravid trap can relate to numbers of juvenile mosquitoes observed in nearby catch basins over some time period, then adult *Cx. pipiens* samples could be used as a proxy for juvenile samples. When attempting to calculate the timing of the second round of catch basin treatments this would reduce the need to directly sample catch basins and thus minimize exposure to vehicular traffic. For this study the gravid trap was run continuously during the study period and checked every 2 to 3 days with captured mosquitoes counted and identified to species. Pairwise Pearson's correlations were performed comparing average weekly larval samples with average numbers of *Cx. pipiens* adults collected in the gravid trap the week of, the week after, and 2 wk after that week's monitoring event.

For the 15-wk monitoring period, 300 inspections were made, and of the 123 study catch basins most ($n = 35$) were sampled once, 33 were sampled twice, 29 sampled 3 times, 20 sampled 4 times, and 5 sampled 5 times. One basin was sampled 7 times. Mosquitoes were detected 148 times (49.3% of all catch basin inspections) from 83 different catch basins. Overall 3,094 immature

mosquitoes were observed from larval samples with the mode of larval sample observations being zero, mean of 4.8 (5.1 during weeks with treatment applied), and a maximum of 153 immature mosquitoes. Of the total number of immature mosquitoes observed 1,324 were 4th instars (42.8%) and 390 pupae (12.6%). During wk 9 after the initial catch basin treatment, the average immature samples surpassed the 12 mosquito average threshold, and therefore a second application of Natular was made to all 750 basins in the map zone between wk 9 and 10 (Fig. 1). This was approximately the same time period to retreatment as was observed with Altosid in previous years. Although both Altosid and Natular are labeled to be effective for up to 180 days (or 25 wk), this and previous work suggests catch basins larvicides may have a much more reduced effective period (Anderson et al. 2011; Harbison et al. 2013, 2014). As stated in product labels of both of these larvicides the presence of debris or sediment and high rainfall or strong water flow can reduce dispersion and the residual life of the active ingredient. Unfortunately, by nature of their design and function to capture runoff, such adverse conditions are common to catch basins, making the possibility of having a single treatment last an entire season rather difficult regardless of the type of active ingredient.

Average weekly counts of immatures appeared to be positively associated with the average numbers of *Cx. pipiens* collected the following wk ($r = 0.22$, $P < 0.0001$, $n = 300$). Obviously the gravid trap collected an unknown percentage *Cx. pipiens* from aboveground, and this association should be considered carefully. Gravid traps may capture few or no *Cx. pipiens* originating from catch basins in areas where these structures are less prevalent and/or during times when aboveground sources of *Cx. pipiens* are more abundant. During summer months with less precipitation, such as that noted in 2012 (Weaver 2013), catch basins may become the more important sources of *Cx. pipiens*, especially as ephemeral aboveground sources of standing water dry out. Alternatively, catch basins may be less important during times of greater precipitation when wet aboveground natural and artificial containers are prevalent and influxes of runoff may "flush" mosquitoes out of basins (Lebl et al. 2013). Further study is needed to see if such an association is evident in following years as precipitation varies and in other areas with similarly high basin densities.

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