Assessment of Reactive Catch Basin Larvicide Treatments Toward Improved Water Quality Using FourStar® Briquets and CocoBear™ Larvicide Oil

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OPERATIONAL NOTE

ASSESSMENT OF REACTIVE CATCH BASIN LARVICIDE TREATMENTS TOWARD IMPROVED WATER QUALITY USING FOURSTAR® BRIQUETS AND COCOBEAR™ LARVICIDE OIL

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ABSTRACT. Because it is often logistically impossible to monitor all catch basins within an operational area, local mosquito control programs will preemptively treat catch basins with larvicides each season. However, these larvicides can, ostensibly, be considered water quality pollutants. To experimentally reduce the use of larvicides toward improving water quality, 30 basins within a small 0.7-km^2 residential area were monitored weekly for the presence of larvae and pupae for 14 wk in the summer of 2013. Once a basin was found to reach a threshold of 12 mosquitoes per dip sample, it received a FourStar® Briquet (a 180-day briquet formulation of 6% *Bacillus sphaericus* and 1% *B. thuringiensis israelensis*). Each week a FourStar-treated basin surpassed this threshold, it was treated with an application of CocoBear™ oil (10% mineral oil). By the end of trials, all but one basin received a briquet and 13 required at least 4 treatments of CocoBear, suggesting that preemptive treatment is appropriate for the study area.

KEY WORDS catch basin, CocoBear™, FourStar®, water quality

In many urban areas, stormwater catch basins are common sources of the West Nile virus (WNV) vectors *Culex pipiens* (L.) complex (Munstermann and Craig 1977, Anderson et al. 2011). As such, these structures are routinely targeted by local mosquito control districts and WNV prevention programs for larvicide treatments. Because thousands of these permanent structures can exist in a district's operational area, they create a logistical challenge for mosquito reduction efforts. For example, the North Shore Mosquito Abatement District (NSMAD), which has 8 full-time staff members and approximately 12–15 seasonal workers serving the predominantly suburban 207-km^2 area just north of Chicago, IL, must manage approximately 50,000 catch basins seasonally in addition to other responsibilities. As it is logistically impossible to routinely monitor every basin for the presence of mosquitoes and then treat only basins holding mosquitoes, the NSMAD preemptively treats all basins early in the season (May to July) with specially formulated extended-release catch basin larvicides. These larvicides have included methoprene (Zoecon Altosid® XR Extended Residual Briquets [Wellmark International, Schaumburg, IL]), spinosad (Natular™ XRT tablets [Clarke Mosquito Control Products, Inc., Roselle, IL]), and the 180-day FourStar® Briquets formulation (Microbial Products LLC, Sag Harbor, NY) containing 6% *Bacillus sphaericus* Neide and 1% *B. thuringiensis israelensis* de Barjac.

Although routine larvicide applications to catch basins can benefit public health by reducing the number of WNV vectors, in the USA the process of applying a larvicide to the standing water present in catch basins is considered a point source of water pollution and requires permitting through National Pollutant Discharge System under the Clean Water Act 1977 (Harbison and Bhattacharya 2013). Therefore, these larvicides can ostensibly be considered water quality pollutants. Thus, it was desired to know if the amount of larvicide applications could be reduced in certain safely accessible basins through regular monitoring and reactive treatments instead of routine preemptive applications. This could be of particular interest if a municipality or other entity covered by NSMAD had specific concerns of water quality. This investigation also created an opportunity to explore the combined use of FourStar and CocoBear™ larvicide oil (Clarke Mosquito Control Products, Inc., Roselle, IL). CocoBear is a formulation of 10% mineral oil that leaves a thin film on the surface of treated water, potentially killing larvae and pupae via contact or suffocation. Because this film tends to break down quickly, particularly when the water surface is disturbed, this larvicide is considered to be effective for a much shorter duration than FourStar and other extended-release larvicides. To perform trials, 30 curbside catch basins of approximately the same size (about 1-m diam, 1.2 to 1.6 m deep) were randomly selected within a small 0.7-km^2 residential area of the District for

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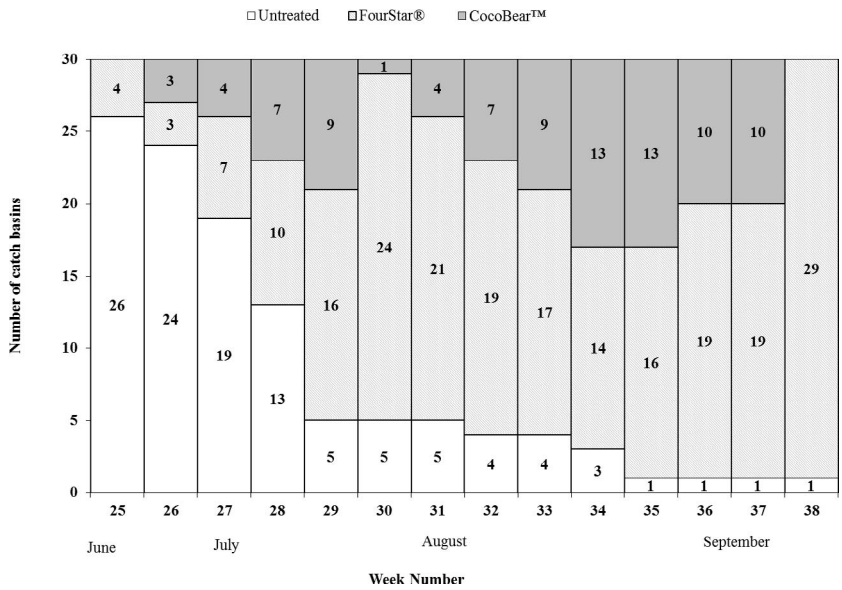

Fig. 1. Number of catch basins (30) monitored weekly from June to September 2013 that were left untreated, received or held FourStar®, or received CocoBear™ treatment. Catch basins found to have 12 or more mosquitoes per dips were initially treated with FourStar and then subsequently treated with CocoBear each time this threshold was surpassed.

14 wk of weekly monitoring from June to September 2013. This area has been used previously for other larvicide trials specifically because of the low vehicular traffic that allowed a NSMAD technician to safely remove manhole grates and collect dip samples from basins (Harbison et al. 2013, 2014). During each weekly monitoring event (2 dip samples per basin), the number of larvae and pupae collected by each dip for each basin was recorded. The dip samples consisted of using a standard 350-ml dipper and recording the number of larvae and pupae collected by each dip. As per common sampling protocol, time was given after removing the catch basin grate and between dips to allow for resettling of larvae and pupae. If an untreated catch basin was found with a weekly average of 12 mosquitoes per dip or more, it received 1 FourStar briquet during that week's monitoring event. All FourStar-treated basins with a weekly average with 12 or more mosquitoes per dip were treated with an application of CocoBear oil. This threshold (12 mosquitoes per dip) was chosen based on the results of previous NSMAD catch basins larvicide trials (Harbison et al. 2013, 2014) in the same study area. These studies found that 75% of dips from untreated basins and 90% of dips from basins treated with extended-release larvicides (FourStar or Natular) held this number of mosquitoes or fewer. This and previous NSMAD studies also found *Cx. pipiens* to be almost exclusively the sole species found in 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 Atmospheric Administration–National Weather Service Forecast Office located at the Chicago O'Hare Airport, Illinois. All monitoring was performed by the same inspector.

All basins were found to hold mosquitoes during the monitoring period (up to approximately 200 mosquitoes in a dip). All but one catch basin was found to have 12 or more mosquitoes per dip during at least one weekly monitoring event, with most structures needing to be treated by the 4th and 5th weeks of monitoring (Fig. 1). The single basin that remained untreated did have up to 12 mosquitoes in a single dip, but the average of 2 dips from a weekly monitoring event never surpassed this number. From this basin at least one larva was observed in a dip sample during 7 of the 14 monitoring weeks. Most treated structures (22 of 30) received a FourStar briquet and at least one subsequent application of CocoBear during the study period. Of these 22 basins, 1 met the threshold for a CocoBear application twice, 3 basins met it 3 times, 6 basins 4 times, 2 basins 5 times, 3 basins 6 times, 1 basin 8 times, and 1 basin 10 times. The average temperature and total precipitation was 20.28°C and 15.82 cm for June, 22.89°C and 5.64 cm for July, 22.78°C and 4.29 cm for August, and 19.56°C and 6.53 cm for September.

There appears to be a need for preemptive catch basin larvicide treatment within the study area, given that 97% (29 of 30) basins were above

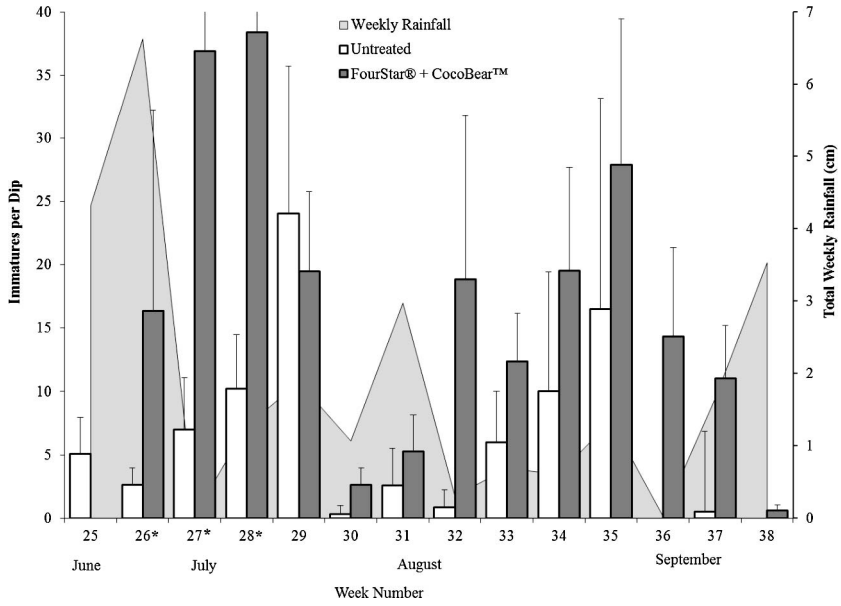

Fig. 2. Average mosquitoes per dip from 30 catch basins monitored weekly from June to September 2013 that were treated with larvicides (FourStar® and subsequent CocoBear™ treatments) beginning on or after week 25 or left untreated. Total weekly rainfall is included. * Denotes a significant difference ($P < 0.01$) between treated and untreated averages.

the 12-mosquito threshold at some point in the season. Even the single catch basin that remained untreated held mosquitoes, albeit at much lower level than the majority of others. Although the study area did allow safer access for NSMAD technicians to monitor basins and reactively treat these structures, the results of this study do support the NSMAD preemptive treatment policy in the study area.

The degree to which FourStar and CocoBear appeared ineffective was surprising when observing the combined use of these larvicides (Fig. 2). In each of the first 3 wk following initial larvicide applications, treated basins held significantly more larvae and pupae than those that remained untreated. The rest of the study period showed no difference between treated and untreated basins. FourStar had previously been evaluated in the study area (Harbison et al. 2014) and, in that study, FourStar-treated basins held significantly fewer mosquitoes than untreated basins for 8 consecutive weeks. However, given this study's design, comparisons between treated and untreated basins should be made with caution. That such negative results were found in this study could suggest, among other potential uncontrolled factors, that the basins randomly selected for inclusion in this study were inherently more prone to mosquito infestation and/or flushing of larvicides. It is also unknown if there was an antagonistic effect between the active ingredients of the 2 larvicides used in this study. These findings indicate a need for further study, especially as results may vary among different geographic and ecological zones and from year to year.

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