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Washington State Department of Ecology

RE: Aquatic Mosquito Control NPDES Permit Comments

The Washington State Department of Health (DOH) appreciates the opportunity to comment on the Washington State Department of Ecology's (Ecology) proposed revisions to the National Pollution Discharge Elimination System (NPDES) permit for aquatic mosquito control.

At the request of Ecology, DOH is providing comment on the concept of including pesticide resistance testing of mosquitoes in the permit, and on a toxicological review of Deltamethrin, the new proposed product for inclusion in the permit. DOH also agreed to make available general guidance on mosquito trapping protocols.

In preparing these comments, DOH met with Benton County Mosquito Control as a front-line expert in mosquito control and customer for our services. We also discussed these topics in open forum at the Northwest Mosquito and Vector Control Spring Workshop. And we conducted literature review and consulted with internal staff with expertise in the areas in question.

Pesticide Resistance Testing

DOH supports the concept of pesticide resistance monitoring of vector mosquitoes as part of an integrated pest management approach to aquatic mosquito control. The agency reviewed three primary methods for assessing resistance levels in mosquitoes and considered the feasibility for the purposes of the permit. Our analysis of each method is summarized below.

Pre and Post Trapping

Methods. One method used as a surrogate for resistance is the measure of effectiveness of a treatment by pre- and post-trapping. This method is carried out over a four-day period. At the site of proposed treatment, a pre-treatment trap is set out the evening prior to the proposed treatment, and retrieved the following morning. The treatment then occurs the evening of the pre-treatment trap retrieval. A post-treatment trap is deployed the evening of the treatment, and retrieved the following morning. If treatment is effective, we expect a relative reduction in the number of mosquitoes counted in the post-treatment trap as compared to the pre-treatment trap.

Analysis. Several limitations inherent in this method make it unsuitable for the purposes of the permit.

1. *Representativeness.* Resistance to pesticides is unique to discrete populations of mosquitoes. A single result from one trapping site does not reflect resistance levels in mosquitoes across a region. The post-treatment trapping results may be skewed by emerging or returning mosquitoes not affected by treatment and inclement weather events. High winds frequently occur within most regions of Washington State covered by mosquito control districts (MCDs) making results from the method highly questionable.
2. *Logistics.* The logistics of carrying out this method over several days is highly problematic. Resources needed to carry out this method are intensive. To use this method effectively across a region would require resources beyond the ability of the MCDs.

Bottle Bioassay

Methods. "Bottle Bioassay is a surveillance tool for detecting resistance to insecticides in vector populations. It is designed to help determine if a particular formulation of an insecticide is able to control a vector at a specific location at a given time. This information, combined with results of bioassays using synergists and those of biochemical and molecular assays, can assist in determining which insecticide should be used if resistance is detected." – Centers for Disease Control.

Guidelines for carrying out bottle bioassays are published by CDC at https://www.cdc.gov/malaria/resources/pdf/fsp/ir_manual/ir_cdc_bioassay_en.pdf

Analysis. The measures of resistance in vector mosquitoes in this method are highly improved over pre- and post-treatment trapping surrogate method. However, there remain significant challenges to the application of this method to meet the purposes of the permit.

1. *Representativeness.* A single result from one trapping site does not reflect resistance levels in mosquitoes across a region. To be an effective tool, this method would need to be applied to each trapping site at least once at the beginning of the season, and once towards the end of the season.
2. *Accuracy.* Mosquito control districts that have carried out Bottle Bioassay report the results on the benchtop assessment have not always been reflected in the field application. This may indicate false-positive results or other factors not controlled for in the method.

Molecular Analysis

Methods. Resistance to pesticides in mosquitoes is the result of gene mutations over time. Similar to pests in agriculture, antibiotic resistance in bacteria and soil fungi, mosquitoes can develop gene mutations that allow them to express resistance to pesticides. Resistant genes can be targeted with Polymerase Chain Reaction (PCR) technology. Accuracy is extremely high and operational costs are relatively low. However, there is no ability to understand if the gene is being expressed.

Analysis. There are still significant challenges to deploying this technology for mosquito control districts for the purposes of the permit.

1. *Infrastructure.* No MCD currently has PCR equipment to conduct these tests.
2. *Training.* No MCD has staff trained to perform PCR.
3. *Cost.* Up-front costs to establish this capacity are likely not budgeted for in any MCD. If a MCD was to propose this increased capacity, it may require tax increases to be approved through the governing board, and potentially voters.
4. *Representativeness.* As with other methods, a single result from an individual trap will not represent the genes across a region.

Biosecurity

Laboratory Safety. Inherent in all of these methods are biosecurity issues, and the need to manage laboratory risk. West Nile virus is considered a Biosecurity Level (BSL) 3 pathogen. Handling of infected mosquitoes indoors for the purposes of laboratory analysis requires at least BSL 2 practices to maintain laboratory safety. Rearing mosquitoes indoors presents other risks that would need to be addressed.

Any of these activities should follow the *Arthropod Containment Guidelines* and *Biosafety in Microbiological and Biomedical Laboratories*.

Human Health Toxicology

The Washington State Department of Health completed a review of human health risk for Deltamethrin. Deltamethrin is a type II Pyrethroid containing an alpha-cyano group and is very neurotoxic to arthropods. It delays sodium channel closure and prolongs the depolarization of neurons.

Deltamethrin is less toxic to humans compared to currently permitted organophosphate adulticides products which are cholinesterase inhibitors and have shown evidence of mutagenicity, carcinogenicity, or effects on the fetus. And other organophosphates have shown delayed onset neuropathy.

Conclusions and Recommendations

Conclusions

Deltamethrin appears to be a safer alternative to existing pesticides allowed in the current Aquatic Mosquito Control NPDES permit. Deltamethrin is less toxic to humans than arthropods due to larger body size, higher body temperature, and decreased sensitivity of sodium ion channels.

The Bottle Bioassay is currently the most feasible option for pesticide resistance testing for MCDs. However, given its limitations, it is still not a feasible option for MCDs to implement as a condition of an Aquatic Mosquito Control NPDES permit.

Recommendations

The Washington State Department of Health recommends resistance monitoring not be included as a requirement in the current amendment to the Aquatic Mosquito Control NPDES permit at this time.

The Washington State Department of Health recommends that Deltamethrin be allowed for inclusion under the amendment to the Aquatic Mosquito Control NPDES permit.

The Washington State Department of Health recommends that MCDs begin work towards funding that builds capacity for resistance testing as a business practice supporting their integrated pest management plans of operation.

The Washington State Department of Health recommends that the Washington State Department of Ecology work jointly with DOH to explore ways to support increasing statewide capacity for resistance monitoring in mosquito vector populations.

Thank you again for the opportunity to comment on the Aquatic Mosquito Control NPDES permit. Please contact Wayne Clifford at wayne.clifford@doh.wa.gov or 360-236-3181 if you have questions or need clarification.

Sincerely,

Wayne Clifford, Manager
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