PROPOSAL TO GUNNISON BOARD OF COUNTY COMMISSIONERS

March 08, 2013

AN ASSESSMENT OF POTENTIAL IMPACTS ASSOCIATED WITH ADULT MOSQUITO ABATEMENT SPRAYING ON MACROINVERTEBRATE DRIFT IN STREAMS NEAR GUNNISON, COLORADO

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INTRODUCTION

Mosquitoes (Diptera: Culicidae) inhabit riparian zones and irrigated hay meadows throughout the upper Gunnison River Valley. Due to public concerns, including the spread of diseases, such as West Nile virus (Knight *et al.,* 2003), for both livestock and humans, Colorado Mosquito Control is contracted to reduce mosquito populations and reduce the adult mosquito population through the aerial application of the adult mosquito control agent BIOMIST® or similar insecticides. These insecticides that are aerially applied in the upper Gunnison River valley in an attempt to reduce the number of adult mosquitos and the impacts of hatches and outbreaks that occur in proximity to livestock and human activity (personal communication, C. Kruthaupt, Colorado Mosquito Control).

Permethrin, the active ingredient in BIOMIST® and similar insecticides, is a pesticide that is used in insect control measures and is a known toxin to insects and aquatic organisms. The introduction of Permethrin to local stream systems via unintentional airborne drift of these insecticides during aerial application to associated riparian areas and /or through return irrigation waters after application to irrigated meadows are possible ways that Permethrin could enter into streams. Upon entering a stream, Permethrin has the potential to negatively impact aquatic insect populations and reduce productivity within local streams. The aquatic insect 'die- offs' that have been recently observed along local streams may be an indication that the introduction of Permethrin through aerial drift and irrigation return to streams may be causing the reduction of aquatic insect populations in affected streams. A reduction in these aquatic insects can have negative impacts on the entire stream ecosystem and stream productivity. A substantial decline of aquatic macroinvertebrates (large aquatic invertebrates such as aquatic insects) is harmful to trout, birds, wildlife and aquatic vegetation. These

impacts reduce the quality of streams as well as the quality of stream based recreational and ecotourism activities including wildlife watching, river rafting, and fishing. A reduction in stream ecosystem quality can have negative impacts to local business and tourist based industry that is associated with recreational and commercial fishing as well as other eco-tourism activities that are a part of local commerce. Additionally, a substantial decline of macroinvertebrates could cause local streams to fail State of Colorado Water Quality Control Division's aquatic life standards, potentially causing streams to be listed as impaired.

During the summer of 2012, the Gunnison Country-Times reported aquatic insect kills and we have received personal accounts and photographs from local citizens and fishing guides of aquatic kills and reduced fishing quality in proximity to annually scheduled aerial application of Permethrin in the upper Gunnison River valley. However, there are conflicting accounts on if and how the stream communities are affected near the city of Gunnison, CO. We did document a substantial decline (about 85%) of a large charismatic stonefly in the Gunnison River near the city of Gunnison, in July 2012. Although this decline coincided with and is consistent with a possible macroinvertebrate kill from the aerial application of Permethrin, our data at this time is inconclusive and personal accounts, although credible, remain unsubstantiated.

We propose a study to determine how the aerial spraying of Permethrin in the summer of 2013 affects the macroinvertebrate drift and consequently the aquatic macroinvertebrate communities in the Gunnison River, Tomichi Creek and Ohio Creek since these streams are directly and indirectly exposed to the application of Permethrin. We hypothesize that the quantity and diversity of macroinvertebrates drifting downstream will increase significantly ($p < 0.1$) if after the aerial application of Permethrin, the Permethrin enters into the stream. Monitoring stream macroinvertebrate drift is an effective and economical means to monitor the effects of aerial spraying since if the macroinvertebrates are poisoned they will not be able to maintain their positions on the streambed and be entrained into the stream flow where they are intercepted by the drift nets.

METHODS

To determine how the 2013 mosquito spraying is affecting the aquatic macroinvertebrates in the Gunnison Valley, the number of macroinvertebrates drifting downstream will be determined in the Gunnison River, Tomichi Creek, and Ohio Creek immediately before and after spraying. Drift is a phenomenon of macroinvertebrates entering the water column and travelling downstream in the water current. This event can occur by active choice of the macroinvertebrate such as moving to a region with more food, as a response to disturbance

such as a flood or toxin, or as they die. If substantial amounts of Permethrin enter into these streams and have a negative effect, then macroinvertebrate drift will significantly increase above background levels immediately after the spraying. This would indicate a response to unfavorable conditions such as the introduction of Permethrin potentially resulting in toxic conditions. If the 2013 spraying does not have a negative impact, stream drift will not change significantly, indicating that the aquatic insects and the stream community are not substantially affected by the event.

To determine the number of macroinvertebrates naturally drifting downstream, we will deploy four 363µm mesh drift nets placed at predetermined locations near aerial spraying in each stream plus one upstream reference site prior to mosquito spraying. The nets will be secured to the bottom of the river using two foot long metal stakes. At the end of each sampling period, the macroinvertebrates will be collected from the nets and preserved in ethanol. Later in the laboratory, the macroinvertebrates will be sorted, enumerated, identified and categorized into functional groups. The nets will then be placed back in the same locations the day the aerial insecticide is applied to determine any changes in drift after the application of the aerial insecticide. Again, daily for three days, the macroinvertebrates will be collected from the nets, preserved in ethanol where they will be transported to the laboratory to be enumerated, identified and categorized into functional groups. Flow at each drift net will also be collected to determine volume of water flowing into each net to quantify drift density.

To analyze the data, an ANOVA statistical test will be done to compare the number of drifting macroinvertebrates within each functional group, before the mosquito spraying to the number drifting after the mosquito spraying. A p value less than 0.1 obtained from this research would indicate that there is a difference of macroinvertebrate drift before and after spraying, otherwise the data would indicate no difference in macro invertebrate drift before and after spraying.

BUDGET

Anticipated costs associated with a study of this nature are approximately $7600. This money will be used for equipment, traveling costs, field work, processing of macroinvertebrate samples, analysis, reporting and a student stipend.

Item	Unit Price (US Dollars)	Quantity	Total Cost (US Dollars)
Drift Nets	279	12 nets	3,348
Student Stipend	2,000	1	2,000
Miscellaneous supplies	250	1	250
Report, Analysis and Presentations	2,000	1	2,000
Total			7,598

TIMELINE

This assessment will be done in three sections. There will be sampling, laboratory processing, and then data analysis. The first set of nets will be set up in summer 2013 in conjunction with Colorado Mosquito Control's timing. The nets will be deployed for the proposed time prior to the aerial application of Permethrin and then also again immediately afterwards.

The macroinvertebrates will be returned to the laboratory for separation, enumerations and identification during the early Fall 2013. Data analysis and report production will occur late Fall 2013 with a final report and presentation in early Spring 2014 prior to decisions for 2014 mosquito control.

REFERENCES

Colorado Department of Public Health and Environment, Water Quality Control Division. 2010. Aquatic Life Use Attainment. Methodology to determine use Attainment for Rivers and Streams. Policy Statement 10-1. Approved October 12, 2010.

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