

Investigations of the Acute Effects of Mosquito Control Activities on Water Quality, Fish, and Shrimp in the Salt Marshes of Suffolk County, NY

R. Turner¹, A. McElroy², C. Gobler², B. Brownawell², R. Barnes², S. Terriciano³, and B. Gibbins⁴

¹C.W. Post Campus of Long Island University, ²Stony Brook University, ³U.S. Geological Survey, and ⁴Southampton College of Long Island University

In the summer of 1999, an unprecedented outbreak of the mosquito-borne West Nile Virus occurred in the New York metropolitan area. West Nile Virus has since spread to all of the lower 48 states, killing thousands of animals and a reported 782 people. As a consequence, many state and local governments have stepped-up efforts to suppress mosquito populations. In Suffolk County, NY, these efforts have included the seasonal spraying of insecticides in wetlands and salt marshes, as well as the maintenance and expansion of grid ditch systems in salt marshes. The potential non-point source pollution impacts of these activities have recently been investigated in conjunction with the Suffolk County Vector Control and Wetlands Management Long Term Plan and Environmental Impact Statement.

A study was conducted during summer 2004 to assess the effects of ultra low volume application of methoprene- and resmethrin-based solutions (Altosid® and Scourge®, respectively) on water quality and animal health in salt marsh ditches. Four experiments were conducted on the ground to coincide with aerial applications of the Altosid® larvicide. Two identical experiments were conducted to capitalize on application of the Scourge® adulticide. Methods associated with these experiments included:

- ◆ Deployment of at least 168 adult grass shrimp (*Palaemonetes pugio*) and 240 juvenile sheepshead minnows (*Cyprinodon variegatus*) one day before a spray event in flow-through cages in ditches or small tidal creeks located within two sprayed and two reference marshes (at least 3 cages of shrimp and 3 adjacent cages of fish per site);
- ◆ Monitoring of caged fish and shrimp mortality on a daily basis for 5 days;
- ◆ Recording of temperature and dissolved oxygen every 30 minutes at all study sites for 5 days;
- ◆ Water sampling in the field site ditches at 0.5 hrs, 2 hrs, 9 hrs, 48 hrs and 96 hrs and subsequent analysis for pesticides for four of the six experiments;
- ◆ Analysis of pesticide concentrations in ditch sediment samples;
- ◆ Assessment of fish growth and shrimp prey capture ability at the end of each experiment to evaluate sublethal effects; and
- ◆ Static renewal toxicity tests performed on shrimp in the laboratory using water collected from each site 30 minutes after spraying.

In experiments where water samples were analyzed, up to 300 ng/l of resmethrin or up to 3,000 ng/l of methoprene was detected 0.5 hrs after aerial application at the sprayed sites. Resmethrin concentrations dropped below detection limits (0.5 ng/l) within 9 hours on the August 18 Scourge® spray event while methoprene concentrations in the ditch water dropped below detection limits (0.5 ng/l) at all sampled sites within 48 hours after an Altosid® spray event. However, methoprene was detected in marsh sediments where spraying occurs. Neither resmethrin nor methoprene were ever detected at the control sites.

Shrimp exposed to water samples collected 30 minutes after spraying exhibited excellent survival. There was no significant difference in the prey capture ability of shrimp, or in the growth rates of fish, brought back to the lab after 5 days caged in the sprayed and unsprayed ditches. Significant mortality of caged shrimp and fish was observed in the field, but it was not limited to field sites where insecticides were applied. In all cases where high mortality was observed, dissolved oxygen concentrations dropped below 20% saturation every morning and were likely low long enough to be the primary cause of mortality. Organisms deployed in cages just beyond the ditch mouths in freer-flowing, deeper channels enjoyed much better survival, underscoring how the physical characteristics of the area can have a great influence on the water quality.

We did not consistently see enhanced acute mortality or sublethal effects in organisms caged in sprayed versus unsprayed marshes. We cannot, however, rule out increased stress from exposure to Scourge® and Altosid®, nor can we evaluate long-term effects on fish, shrimp, and other more sensitive marsh organisms. The presence of methoprene in the sediments indicates persistence long after spraying. The potential chronic effects on infaunal organisms should be assessed. Also, resuspension of marsh sediments where spraying occurs may represent a more continuous source of the pesticide to the estuarine waters and organisms.

Other investigations by the authors and their students on the potential non-point source pollution impacts of vector control activities include:

- ◆ Species composition and abundance of benthic macrofauna in study site ditches after the end of the mosquito spraying season;
- ◆ The potential for salt marsh ditches to act as conduits for upland runoff;
- ◆ The chemical and biological characteristics of water exported by salt marsh ditches;
- ◆ The influence of salt marsh ditches on epiphytic growth on eelgrass in adjacent estuaries; and
- ◆ The reaction of juvenile sheepshead minnows in laboratory experiments to methoprene and other pollutants.

