Efficacy and Potential for Non-Target Effects of Larvicides Used for West Nile Virus Control in Seattle Catch Basins

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A. General background
   1. Washington State and West Nile virus
   2. 2006, 2007 Sampling Schemes
   3. 2006 Larval Abundance Results

B. 2006 efficacy for three larvicides

C. 2007 efficacy for watershed basin sets

D. 2007 outflow monitoring and potential for non-target effects
Washington State and West Nile Virus

- Appearances in Washington State
  a. 2002
  b. 2005
  c. 2006

- Number and type of potential mosquito vectors
  a. Species of concern for urban areas
  b. Associated habitats

   ![Mosquito - Genus: Aedes](image1)
   ![Mosquito - Genus: Culex](image2)
Round-top (left) and Grated-top (right) catch basins within the City of Seattle
2006 Project Sampling Scheme

a. City-wide Monitoring
   • 250 round-top untreated basins monitored from June – Sept.
   • Basins proportional to city sector and zone

b. Efficacy
   • 15 round-top basins for 4 treatment groups (3 larvicide-treatment groups, 1 control group)
   • All basins in Northwest sector
   • Monitored from July – Sept. (8 weeks)
2007 Project Sampling Scheme

a. City-wide Monitoring
   • 150 treated round-top basins monitored from July - Sept.; 10 treated grated-top basins
   • 50 control round-top basins monitored from June – Sept. (same as in 2006); 10 control grated-top basins

b. Efficacy
   • Thornton sub-basin: 13 basins (11 GT, 2 RT)
   • Pipers sub-basin: 9 basins (1 GT, 8 RT)
   • Longfellow sub-basin: 8 basins (1 GT, 7 RT)

c. Outflow Monitoring
   • Thornton (5 sites), Pipers (2 sites), Longfellow (3 sites)
2006

• Efficacy for 3 larvicides of interest

  a. Mosquito Dunks® and Bits® (Bti), VectoLex® WSP (Bs), and Altosid® Briquets (methoprene)

  b. Monitored for 8 weeks

     - Number of pupae per 3 dips (Bs, Bti)
     - Percent emergence success (methoprene)
2006

- Bs, Bti efficacy
- Methoprene efficacy

*VectoLex® WSP (Bs) was most effective*
2006 City-wide efficacy and abundance

- Mosquito season generally lasts from mid-June through Sept.
- VectoLex® WSP (Bs) was most effective
2007 Objectives

• Efficacy of city-wide larvicide treatments;

• Efficacy of larvicides within catch basins in the Longfellow, Thornton, and Pipers creek watersheds;

• Outflow monitoring within local watersheds and potential for non-target effects of four larvicides on coho salmon (*Oncorhynchus kisutch*)
2007 City-wide efficacy and abundance

Monitoring

- Time frame: June through September
- Parameters measured: Dissolved oxygen, pH, basin water temperature, conductivity, type and extent of debris, larvae, pupae

Data analysis

- Efficacy determination: 1-sided Mann-Whitney test (alpha = 0.05)
- Abundance comparison: Graphical comparisons
2007 City-wide efficacy and abundance

Round-top basins

Efficacy for Treatment Week 1 RT Basins

Efficacy for Treatment Week 2 RT Basins

Efficacy for Treatment Week 3 RT Basins
2007 City-wide efficacy and abundance

Grated-top basins

Efficacy for Treatment Week 2 GT Basins

Avg. Mosquito Pupae/3 Dips:

- Control
- Treated

Week:

31 32 33 34 35 36 37 38 39
2007 City-wide efficacy and abundance

- RT basins realized statistical efficacy for almost every week
- GT basins realized statistical efficacy for only 1 week, however difference between control, treated minimized by precipitation
- Precipitation had dramatic effects on counts of pupae and larvae in 2007; relatively no precipitation in 2006
2007 Monitoring for watershed basin sets

• 2 weeks pre-treatment, 11 weeks post-treatment
• Average pupae/3 dips was efficacy indicator; treatments were efficacious if pupae counts for each set ≤ city-wide control basins
• Collected water samples at -2, 1, 3, 5, and 7 weeks for Pipers and Longfellow; collected at -2, 1, 3, and 5 weeks for Thornton (cfu/ml)
2007 Efficacy for watershed basin sets

**Fate Basin Efficacy by Watershed**

- **Control**
- **Longfellow**
- **Pipers**
- **Thornton**

**Average Pupae/3 Dips**

- **Week**: 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39
2007 Efficacy for watershed basin sets

- Besides Thornton basins, treatment mostly reduced pupae to zero
- Lack of efficacy in Thornton associated with GT basins; may be due to greater mixing of larvicide
2007 Outflow monitoring, potential for non-target effects
2007 Outflow monitoring, potential for non-target effects

• Monitoring
  • Baseline water samples: pre-treatment and at least 5 weeks post-treatment
  • Precipitation samples: 1 pre-treatment and 3 post-treatment samples
  • Water samples taken if flow had increased (water height, width in outflow pipe) and at least 0.03 inches of rain accumulation

• Data analysis
  • Concentrations (cfu/ml) are compared graphically through time
2007 Outflow monitoring, potential for non-target effects

• Standard 96-hour toxicity tests
  • Test 1: Bs, Bti, methoprene larvicides singly
  • Test 2: Bs, Bti, methoprene larvicides in various combinations

• Methods
  • 50-Gallon Drums
  • Juvenile coho (0.8g/L fish weighting approximately 18 g)
  • Larvicides at max concentrations when fish were added
  • Collected water samples at hour 0 and hour 96
2007 Outflow monitoring, potential for non-target effects

2007: Maximum Larvicide Amounts in Outflows and Test Drums

- Longfellow Outflows
- Thornton Outflows
- Pipers Outflows
- Toxicity Test Drum

Colony forming units/ml

- Bti
- Bs
2007 Outflow monitoring, potential for non-target effects

- In all samples, very little (if any) Bs was detected.
- No adverse effects of larvicides on juvenile coho salmon even when larvicides were applied at maximum concentration.
Summary

- Need for larvicide treatment is weather-dependent
- VectoLex® WSP (Bs, Bti) caused no adverse effects in coho and is effective at reducing mosquito pupae
- In subsequent research, even lower levels (cfu/ml) of Bs and Bti were detected in outflow samples
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