Pesticides in Washington State
Stream Sediment

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Natural Resources Assessment Section
What is NRAS?

Natural Resources Assessment Section (NRAS)

- Research group
- 11 employees; hydrogeologists, natural resource scientists, toxicologists
What does NRAS do?

- Surface Water Monitoring
  - 12 locations, ~150 pesticide analytes (current, legacy, degradates)

- Agricultural Land Use Mapping
  - Windshield surveys + remote sensing data

- Pesticide Use
  - Grower surveys
2015 Sediment Sampling Pilot

**Goal 1:** Determine if pesticides are present in sediment at the selected sites

**Goal 2:** Assess if the measured concentrations have the potential for toxicity to benthic invertebrates

**Goal 3:** Determine if pesticide monitoring in sediment be added to the monitoring program

**Goal 4:** Provide a thorough analysis of pesticides in sediment for Stormwater Action Monitoring (SAM) Program municipal stormwater permittees.
Collaboration between WSDA, SAM and USGS

- Additional funding from WSDA and support from SAM and USGS allowed the initial project to expand from 15 sampling events to 96.

**WSDA**
- Sample Collection
- Funding
- Result analysis

**SAM**
- Collaboration and support

**USGS**
- Sample Collection
- Collaboration and support

This Sediment Project

Images(s)
Study Area

- 5 WSDA Sites x 3 sample events.
- 81 SAM Sites x 1 sample event.
- Urban and agricultural land use
Methods

• Collection
  • Top 2 cm collected with scoop. All subsamples homogenized then sieved to <2.0 mm.
  • At WSDA sites, water samples for pesticide analysis were also collected.

• Analysis
  • Manchester Environmental Laboratory (MEL)
  • 126 pesticides and break down products, QuEChERS extraction, EPA 8270D (GCMS).
  • Total Organic Carbon, PSEP 1986.
Results: Summary of detections

- 45 total detections
- 12 unique compounds.

<table>
<thead>
<tr>
<th>Name</th>
<th>Count of detections</th>
<th>Frequency (%&lt;sup&gt;1&lt;/sup&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,4'-DDD</td>
<td>1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>4,4'-DDx</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>Bifenthrin</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>Chlorpyrifos</td>
<td>1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>cis-Chlordane</td>
<td>1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Dimethoate</td>
<td>1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Ethoprop</td>
<td>1</td>
<td>&lt;1</td>
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<tr>
<td>Fluridone</td>
<td>1</td>
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<tr>
<td>trans-Chlordane</td>
<td>1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>trans-Nonachlor</td>
<td>1</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>
Results

**Bifenthrin**
- Current use pyrethroids
- Found in both homeowner and agricultural products

**DDx**
- Banned since 1972
- Still around in measurable quantities
Results

Chlorpyrifos
- Current use organophosphate
- Frequent found at levels toxic to invertebrates in water
- Broad spectrum insecticide used on many crops

Chlordane
- Banned 1988
- A mixture of cis/trans-chlordane, trans-nonachlore and others
- Home structure uses (termites)
Results

**Dimethoate**
- Current use organophosphate
- Fruits, vegetables, ornamentals

**Ethoprop**
- Current use organophosphate
- Vegetables, ornamentals, herbs (hops)

**Fluridone**
- Current use herbicide
- Aquatic (canal, ditch bank, drinking water)
Toxic Unit Analysis

• All measured concentrations were normalized to % Total Organic Carbon (TOC)
• Assessment criteria for most compounds gathered from Nowell et al. (2016) and Weston, You & Lydy (2004).

\[
\frac{\text{Measured concentration}}{\text{Assessment criteria}} = TU
\]

• In samples with mixtures (similar MoA), all were summed.
• All TU>=1.0 were considered toxic.


Results: Toxic Unit Analysis

- In all cases where TU>1.0, bifenthrin contributed the most.
- DDx contributions were negligible.
- Eastern Washington sites did not have any samples in which TU>1.0
Results: Water vs Sediment

- 15 sediment and water samples collected during the same sampling event.
- One sample event had one analyte in both samples.
  - Chlorpyrifos, Brender Creek April 2015
- Overall detection frequency is much higher in water samples, much lower method reporting limits.
- Bifenthrin and DDx were found more frequently in sediment than in water, hydrophobicity.
Conclusions

Expansive analyte list, low frequency of detection
- Good news

Method reporting limits near assessment criteria (with typical TOC)
- 12 ug/Kg DW
- Pyrethroids
- Lower method reporting limits will increase confidence in TU calculations.
Conclusions

Pesticides found at concentrations toxic to benthic invertebrates

- Bifenthrin is found in products available for both homeowner and agricultural products.
  - Focused education and outreach to problem areas
  - Reaching residential pesticide consumers is a challenge
  - What about nano-encapsulated products?

Photo Credit: NRAS Staff

Upper Big Ditch, Mount Vernon, WA
Questions?

Crop map web map:

Surface water monitoring web map:

Search: “WSDA NRAS”
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