BPC WATER QUALITY MONITORING FOR PESTICIDES: PAST, PRESENT, & FUTURE

Mary Tomlinson
Board of Pesticides Control
Maine Agricultural Trade Show
OUTLINE OF PRESENTATION

• The beginning
• Past studies:
  • Groundwater monitoring 1994-2013
  • Surface water monitoring 1994-2013
• Present: monitoring in 2014
• Future studies
The Beginning

- State law
- Guthion residue study
- Aldicarb contamination
- Collaborative groundwater studies
7 M.R.S.A. §607-A (2-A) requires water residue surveys:

- Wells or bodies of water
- Areas of possible contamination or at other locations
- At least once every 6 years
- Purpose – develop profile of pesticides present
1978 Guthion Residue Study

- To determine if guthion from blueberry spray operations moved through soils and entered various water bodies
- 8 locations selected on the Cherryfield Quadrangle map
- Sites sampled: 2 rivers, 1 brook, 2 lakes, 1 spring, 1 fish hatchery, 1 drilled well
- No detections at minimum level of detection (MLD) of 3 ppb (parts per billion)
Aldicarb (Temik™) Contamination

- **1980-1983:**
- Testing by Union Carbide due to groundwater contamination in other states
- 107 contaminated wells near potato fields in Aroostook Co.
- 11 wells over maximum contamination level (MCL = 10 ppb)
- 77 ppb highest level detected
Aldicarb (Temik™) Contamination cont.

- Label directions changed
- Filters placed on wells
- 1984: BPC mandatory buffer zones enacted

1985: 49 wells contaminated, 6 over MCL
- 20 ppb highest level detected
- No longer registered in Maine
1985-1987: Maine Geological Survey (MGS) and the Department of Agriculture, Food and Rural Resources (DAFRR):

- 3-year study in potato regions of Maine
- Objective: Evaluate impact of agricultural pesticides on groundwater quality
- Trace levels of pesticides in 14% of wells
- Conclusions: Contamination by agricultural pesticides, seems to occur more frequently in bedrock wells that are overlain by till
1989: MGS, DAFFR, and USEPA

- Private wells near potato fields in Aroostook Co.
- Traces of pesticides in 42% of 51 wells
Collaborative Studies cont.

1990: BPC and University of Maine

- Objective: Evaluate effectiveness of using immunoassay tests for monitoring groundwater for pesticides

- Of 58 wells:
  - Atrazine detected in 31%, MCL exceeded in 2
  - Alachlor detected in 12%, all exceeded MCGL
  - Carbofuran detected in 5%, all below MCL
1992 – BPC and University of Maine

- Maine Triazine Assay Survey
- Results confirmed by laboratory analysis
- Detections in 38 of 152 wells:
  - Atrazine detected in 20%
  - Simazine detected in 3%
  - Cyanizine detected in 1 sample (< 1%)
- Positive wells resampled later in year
  - Detections remained below health advisories
Past Studies 1994-2013
Groundwater Monitoring (GW) 1994-2013

- Statewide Groundwater Management Plan
- Statewide GW monitoring results
- Hexazinone State Management Plan
- Hexazinone GW monitoring results
- Corn herbicide study
Maine Generic State Management Plan for Pesticides and Groundwater

- 1994 - Adopted by BPC
- Guidance for assessing impact of labeled pesticide use on GW
- Guidance for assessing effectiveness of normal pesticide practices
- Guidance for developing pesticide-specific management plans
- Focused on commodity/use sites
- Sampling every 5-7 years
GW Study Well Criteria

- Random and targeted sampling
- Private residence
- Within ¼ mile of target crop
- Down gradient of or equal elevation with crop site
- No water bodies between crop site and well
- Grab samples
- No filters or water treatment systems
Quality Assurance/Quality Control

- Training
- Standard operating procedures (SOPs)
- Equipment blanks
- Field blanks (water and drift cards)
- Duplicate samples
- Laboratory QA/QC
- Data entry verification
Statewide GW Monitoring: Focused on Commodities

- Crop sites:
  - Potatoes
  - Corn
  - Blueberries
  - Small grains
  - Orchards
  - Christmas trees
  - Strawberries
  - Rights of way (except 2013)
  - Market gardens
## Statewide GW Monitoring Results (1994-2013)

<table>
<thead>
<tr>
<th></th>
<th>1994</th>
<th>1999</th>
<th>2005</th>
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<tbody>
<tr>
<td><strong>Number of wells sampled</strong></td>
<td>129</td>
<td>194</td>
<td>127</td>
</tr>
<tr>
<td><strong>Number of samples</strong></td>
<td>129</td>
<td>194</td>
<td>137</td>
</tr>
<tr>
<td><strong>Percent of wells with positive detections</strong></td>
<td>24</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td><strong>Number of samples with positive detections</strong></td>
<td>31</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td><strong>Percent of samples with positive detections</strong></td>
<td>24</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td><strong>Number of pesticides detected</strong></td>
<td>10</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td><strong>Number of pesticides analyzed</strong></td>
<td>38</td>
<td>32</td>
<td>31</td>
</tr>
<tr>
<td><strong>Number of detections above HAL, MEG, MCL</strong></td>
<td>1**</td>
<td>0</td>
<td>0</td>
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</tbody>
</table>

**Diazinon applied around well casing for ant control**
Hexazinone State Management Plan for the Protection of Groundwater

- **1994:** Most frequently detected pesticide in first statewide GW monitoring study
  - 35 of 48 sites positive in follow up sampling
- **1996:** Adopted by BPC to retain use of hexazinone (blueberry pesticide)
  - Private, domestic wells
  - Sampling every 5-7 years
  - Previously positive and new wells
# Hexazinone Monitoring Results (1994-2011)

<table>
<thead>
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<tbody>
<tr>
<td>Number of wells sampled</td>
<td>20</td>
<td>42</td>
<td>49</td>
<td>46</td>
<td>52</td>
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<tr>
<td>Number of wells with positive detections</td>
<td>15</td>
<td>18</td>
<td>29</td>
<td>32</td>
<td>21</td>
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<tr>
<td>Percent of wells with positive detections</td>
<td>75</td>
<td>72.8</td>
<td>59.2</td>
<td>69.6</td>
<td>41</td>
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<tr>
<td>Mean Concentration (ppb)*</td>
<td>1.08</td>
<td>0.41</td>
<td>1.45</td>
<td>0.98</td>
<td>0.62</td>
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<tr>
<td>Highest concentration</td>
<td>5.97</td>
<td>2.15</td>
<td>11.41</td>
<td>8.43</td>
<td>5.36</td>
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<tr>
<td>Number of detections above EPA health advisory 400 ppb</td>
<td>0</td>
<td>0</td>
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</table>

*Mean concentration was calculated assuming that non-detections were equal to half the limit of quantification*
Hexazinone Monitoring Results cont.

Additional Pesticides Analyzed 1999-2011
- Azinphos-Methyl
- Captan
- Chlorothalonil
- Diuron
- Fenbuconazole
- Phosmet
- Propiconazole
- Terbacil
- Tribenuron methyl

Detections and Concentrations
- **1999**: Propiconazole
  - 0.18 ppb
  - 1 sample
- **2011**: Terbacil
  - 0.103-0.467 ppb
  - 4 samples
1996 Corn Herbicide Study

- Objective: To determine effectiveness of label changes and BMP education efforts
- Sampled 38 positive wells from 1992 Triazine Survey
- Pesticides analyzed: atrazine, simazine, cyanazine, alachlor, metolachlor, acetochlor
- 12 of 38 with detectable levels of pesticides
  - Atrazine, simazine, alachlor, metolachlor
- No exceedances of human health guidelines
Surface Water Monitoring
1994-2013

- Blueberry studies
  - Salmon River Study
  - Pleasant River Time Series
  - Blueberry Drift Studies
  - Pleasant River Spring Study
- Storm event projects
- Browntail moth monitoring
- Urban watershed monitoring
Salmon River Study 1997

- Directive of the *Atlantic Salmon Conservation Plan for Seven Maine Rivers*
- Objective: Baseline assessment of impact of pesticide use on surface water
- 7 Maine Atlantic salmon rivers and 2 tributaries sampled 2 months after application
- 33 pesticides analyzed
- Hexazinone detected in 19 of 64 samples: 0.10-1.7 ppb
- LC50 concentration for fish + 246,000-320,000 ppb
  (LC50 – lethal concentration to 50% of test population)
- Hexazinone metabolite B detected in 4 of 19 samples
- All detections from Machias, Narraguagus, Pleasant Rivers
Pleasant River Time Series Study 1998-2002

- 5-year study initiated due to frequent detections of hexazinone near blueberry production areas
- Objective: Assess presence and temporal variation of hexazinone concentrations over 1 year at 3 sites
- Grab samples
- Detected at least once in every month of the year
- Concentration ND-1.98 ppb
Table by Heather Jackson
Blueberry Drift Studies 1999-2004

- Pleasant and Narraguagus Rivers watersheds
- Objective: Determine presence of off-target drift in surface waters and on drift cards adjacent to sprayed fields
- Low levels of drift detected up to 1000 ft. from target fields in 4 of 6 years
Blueberry Drift Studies cont.

2000-2004 studies
- Analyzed water samples and drift cards
- Phosmet
  - Most commonly detected
  - Found in all years
  - Different site each year
  - Water: ND-0.815 ppb
  - Filters: ND-21.978 ng per filter
- Febuconazole detected in one site in 2004
Pleasant River Spring Study 2000

- Objective: Compare levels of hexazinone discharging from groundwater with historic levels into main stem of river
- Analyzed for 11 blueberry pesticides
- 6 of 8 samples positive
- Hexazinone only pesticide detected
  - Hexazinone 0.17-3.08 ppb
  - Hexazinone metabolite B 0.045-0.098 ppb (3 samples)
PLEASANT RIVER SPRING STUDY 2000
Pleasant River Tributary Study 2000

- Sampled first-order streams
- Objective: Compare levels of hexazinone in tributaries to historic levels in main stem of river
- 8 of 11 samples positive
- Concentration range 0.1-0.803
Kennebec Co. Storm-Event Project 1998

Corn Herbicide Project

- 1 site, first-order stream
- Kennebec Co.
- Atrazine detected in 6 of 7 samples
- 0.59-8018 ppb, above MCL 4 days after application
- Concentration directly proportional to stream rise
Aroostook County Storm-Event Project 1998

Potato Herbicide Project
One site, first-order stream

- Metribuzen
  - Four of seven samples
  - 23.7-520 ppb
  - Exceeded Lifetime Health Advisory Level (HAL) of 100 ppb

- Chlorothalonil
  - Three of six samples
  - 0.398-117
  - Exceeded Maine Maximum Exposure Guidelines (MEG) of 15 ppb
Storm-Event Studies 2003

Corn Herbicide Study
- Five sites: Waldo, Kennebec, York Counties
- 20 samples analyzed for 11 pesticides and metabolites
- Atrazine: 7 samples, 0.03-0.62 ppb
- Metolachlor: 2 samples, 0.07 ppb-0.37 ppb

Potato Pesticide Study
- 1 site
- 2 samples
- Metribuzin: both samples at 2.14-1.49 ppb
- Chlorothalonil and imidicloprid not detected
Railroad ROW Herbicide Drift Study 2003

- **Objective:** To determine adequacy of 10 ft. buffer between railroad application areas and surface water bodies
- **Sites:** river, lake, pond, well, one site not near water
- **Results:** No detection of imazapyr
- **Conclusion:**
  - Unlikely to find imazapyr in lake water 1.5 months after application or 48 hours after significant rainfall
  - More data needed
Browntail Moth Monitoring 2006

- PL 2006, Chapter 553: Established temporary restrictions on pesticide applications for browntail moth control
- Objective: Monitor pesticide drift to determine whether untreated buffer areas or other BMPs are necessary to prevent unreasonable drift into marine waters.
Browntail Moth Monitoring cont.

- Four sites: Yarmouth, Harpswell, Freeport, Falmouth
- Two sites treated with cyfluthrin, two sites with permethrin
- Results: low levels of pesticides detected as far as 250’
- BPC Recommendations: extend BTM restrictions and prohibit spraying when wind speed is less than 2 mph

Water sensitive cards from Freeport site. Left to right: 250’, 150’, 50’ downwind from target.
Residential Pesticide Studies 2003

Objective: Look for presence of homeowner use pesticides in surface water

- **Penobscot River, Brewer**
  - 6 samples analyzed for 8 pesticides
  - Dicamba: 1 sample, 3.5 ppb
  - 2,4-D: 1 sample, 1.2 ppb
  - **Small streams** in Augusta & Scarborough
    - non-detect

- **Friends of Casco Bay (FOCB)**
  - 10 samples analyzed
  - Dicamba: 3 samples, 2.2-4.1 ppb
  - Propiconazole:
    - 2 samples, 0.057-0.075 ppb
  - Clopyralid: 1 sample, 0.91 ppb

All results below current aquatic life benchmarks
Urban Surface Water Sampling

Collaborations with FOCB and City of South Portland 2008

- Downstream from 3 golf courses and 1 residential area
- Analyzed for 9 pesticides
- Chlorothalonil:
  - 4 of 9 samples,
  - 0.08-0.22 ppb
  - Did not exceed aquatic life benchmark 0.6 ppb
Urban Sediment Sampling

- **2007**: Back Cove
  - Non-detect; protocol flawed
- **2008**: Mussel Cove, Payson Park Creek, Back Cove Pumping Station
  - Analyzed for five synthetic pyrethroids
  - Bifenthrin
    - Detected in all 4 samples
    - 0.48-16.8 ppb
    - No aquatic life benchmarks for sediment
2009-2010: Portland/South Portland
- 6 samples each year

<table>
<thead>
<tr>
<th>Pesticide</th>
<th># of Detections 2009</th>
<th># Detections 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bifenthrin</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>λ-Cyhalothrin</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Permethrin</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Cypermethrin</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Sumithrin</td>
<td>Not tested</td>
<td>6</td>
</tr>
<tr>
<td>Esfenvalerate</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Piperonyl butoxide (PBO)</td>
<td>Not tested</td>
<td>2</td>
</tr>
</tbody>
</table>
Monitoring in 2014

- Groundwater monitoring
- Gulf of Maine Coastal Pesticide Study
Statewide Groundwater Monitoring

- Revised method for generation of potential sample points
- Used Generalized Random Tessellation Stratified (GRTS) program
  - Random points spatially-balanced across state
  - Not allocated per crop
- Used previous methodology to select actual sample sites
- Process still needs refinement
Statewide Groundwater Monitoring

- Analyzed for 96 pesticides
- Detections in 32 of 47 wells
- 81 detections of 23 pesticides and metabolites
- All detections, except one, below human health guidelines and benchmarks
- 8 analytes detected in one well
## Statewide GW Monitoring Results (2014)

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<td>194</td>
<td>127</td>
<td>47</td>
</tr>
<tr>
<td>Number of samples</td>
<td>129</td>
<td>194</td>
<td>137</td>
<td>50</td>
</tr>
<tr>
<td>Percent of wells with positive detections</td>
<td>24</td>
<td>9</td>
<td>11</td>
<td>68</td>
</tr>
<tr>
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<td>31</td>
<td>17</td>
<td>14</td>
<td>32</td>
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<tr>
<td>Percent of samples with positive detections</td>
<td>24</td>
<td>9</td>
<td>10</td>
<td>64</td>
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<tr>
<td>Number of pesticides detected</td>
<td>10</td>
<td>4</td>
<td>8</td>
<td>23</td>
</tr>
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<td>38</td>
<td>32</td>
<td>31</td>
<td>96</td>
</tr>
<tr>
<td>Number of detections above HAL, MEG, MCL</td>
<td>1*</td>
<td>0</td>
<td>0</td>
<td>1**</td>
</tr>
</tbody>
</table>

*Misuse: Diazinon applied around well casing for ant control
** Atrazine and 4 metabolites
Gulf of Maine Coastal Pesticide Study (GOM)

Initiated in response to:

- CT study, *Health Assessment Monitoring of American Lobster in Long Island Sound*, conducted 2012
- Proposed bill in Maine to ban use of methoprene and resmethrin
- National studies
Gulf of Maine (GOM) Coastal Pesticide Study cont.

- BPC Environmental Risk Assessment Committee established and convened, April, 2014
- Objective: To examine whether current pesticide residues have the potential to affect the lobster resource in Maine, directly or via impact on other marine organisms.

Photo courtesy of Gary Fish
GOM Sample Sites

20 sites selected, paired for storm water and sediment sampling
GOM Coastal Pesticide Study cont.

- No storm water samples collected
- Sediment analyzed for: methoprene, fipronil, fipronil metabolites, pyrethrins, pyrethroids, PBO
GOM Coastal Pesticide Study cont.

- Detection limits from one lab for pyrethroids too high, no detects; fipronil MDL very low, but no detects

- Results from second lab:
  - Bifenthrin: 12 of 21 samples (12 of 20 sites), 0.091-1.0 ppb
  - Cypermethrin: one sample, at 5.0 ppb
  - 12 sites with detections between Blue Hill and Kittery

- Results need to be organic carbon normalized in order to be compared
A variety of agricultural and residential use pesticides are found in GW, SW, and sediment. New technology has led to lower detection limits, resulting in more detections, than in past studies. With rare exceptions, concentrations in water are below human health advisories and aquatic life benchmarks. Most of the studies are too limited in scope and sample size; therefore, results are not statistically significant.
2015 and Beyond
2015 Plan

- Statewide GW study
- Second phase of Gulf of Maine Coastal Pesticide Study
  - Sediment sampling
  - SW sampling
Future Studies

- Plans continually evolve based on new: research, active ingredients, use patterns, and concerns.
- Consider repeating and expanding earlier studies.
- Continue GW, SW, sediment monitoring, looking for trends.
BPC WATER QUALITY UPDATE: MONITORING FOR BLUEBERRY PESTICIDES

Questions?

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