

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



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Board of Pesticides Control  
Maine Agricultural Trade Show  
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# 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



# State Law

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

01 DEPARTMENT OF AGRICULTURE, FOOD AND RURAL RESOURCES  
026 BOARD OF PESTICIDES CONTROL  
Chapter 41: SPECIAL RESTRICTIONS ON PESTICIDE USE

**SUMMARY:** This chapter describes special limitations placed upon the use of  
(1) aldicarb (Temik 15G) in proximity to potable water bodies;

- **1985:** 49 wells contaminated, 6 over MCL
  - 20 ppb highest level detected
- No longer registered in Maine



# Collaborative Studies

**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





# Collaborative Studies cont.

**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



# Collaborative studies cont.

## 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%
  - Cyanazine 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  $\frac{1}{4}$  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

- 1994, 1999, 2005, 2013
- Crop sites:
  - Potatoes
  - Corn
  - Blueberries
  - Small grains
  - Orchards
  - Christmas trees
  - Strawberries
  - Rights of way (except 2013)
  - Market gardens



# Statewide GW Monitoring Results (1994-2013)

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

\*\*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)

	1994	1998	2002	2006	2011
<b>Number of wells sampled</b>	<b>20</b>	<b>42</b>	<b>49</b>	<b>46</b>	<b>52</b>
<b>Number of wells with positive detections</b>	<b>15</b>	<b>18</b>	<b>29</b>	<b>32</b>	<b>21</b>
<b>Percent of wells with positive detections</b>	<b>75</b>	<b>72.8</b>	<b>59.2</b>	<b>69.6</b>	<b>41</b>
<b>Mean Concentration (ppb)*</b>	<b>1.08</b>	<b>0.41</b>	<b>1.45</b>	<b>0.98</b>	<b>0.62</b>
<b>Highest concentration</b>	<b>5.97</b>	<b>2.15</b>	<b>11.41</b>	<b>8.43</b>	<b>5.36</b>
<b>Number of detections above EPA health advisory 400 ppb</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

\*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
- LC<sub>50</sub> concentration for fish + 246,000-320,000 ppb  
(LC<sub>50</sub> – lethal concentration to 50% of test population)
- Hexazinone metabolite B detected in 4 of 19 samples
- All detections from Machias, Narraguagus, Pleasant Rivers

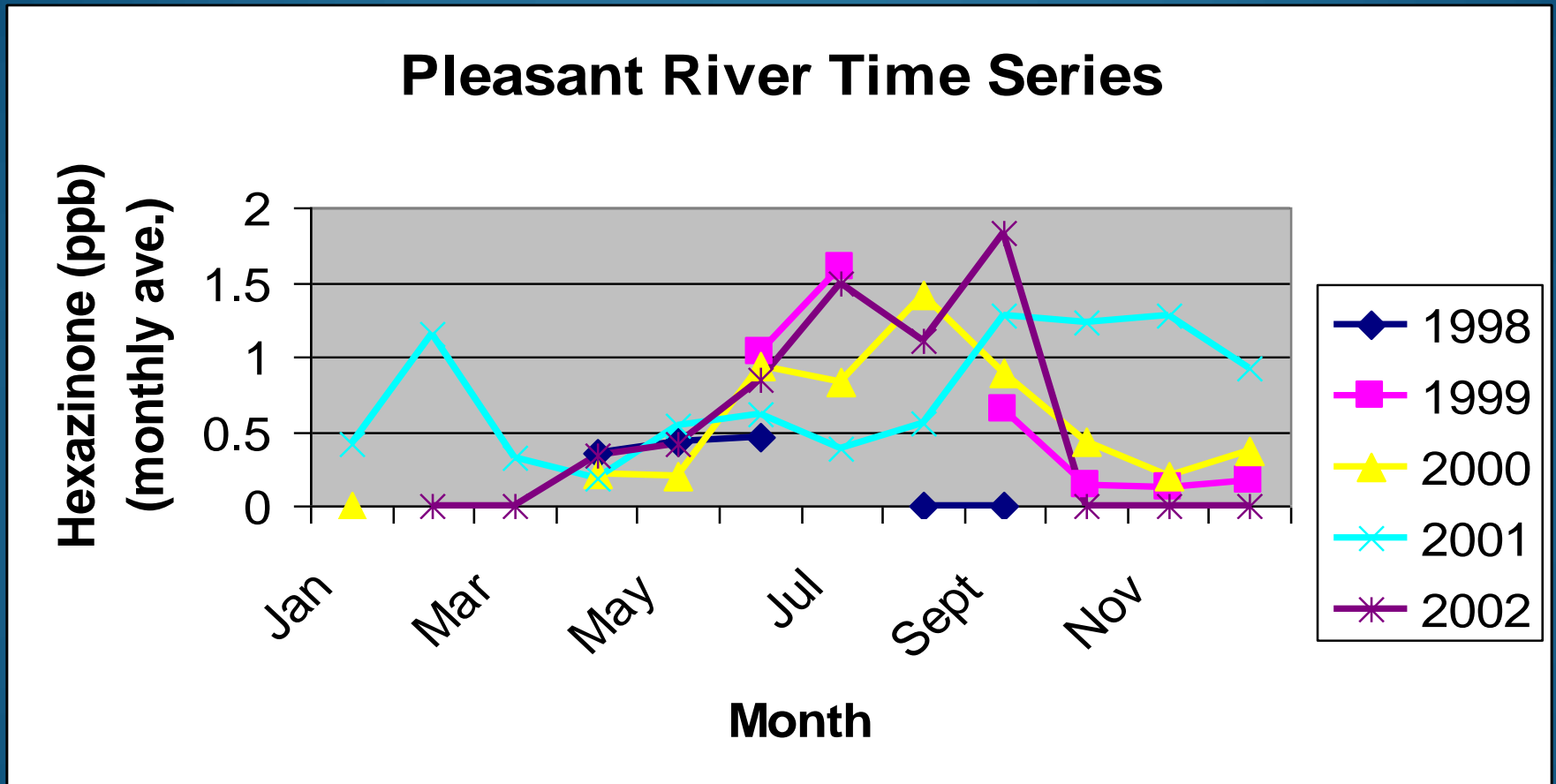


# Pleasant River Time Series Study 1998-2002

- 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



# Pleasant River Time Series

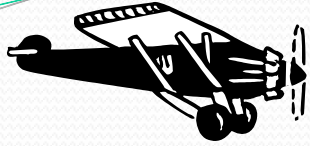




# Blueberry Drift Studies 1999-2004

- 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

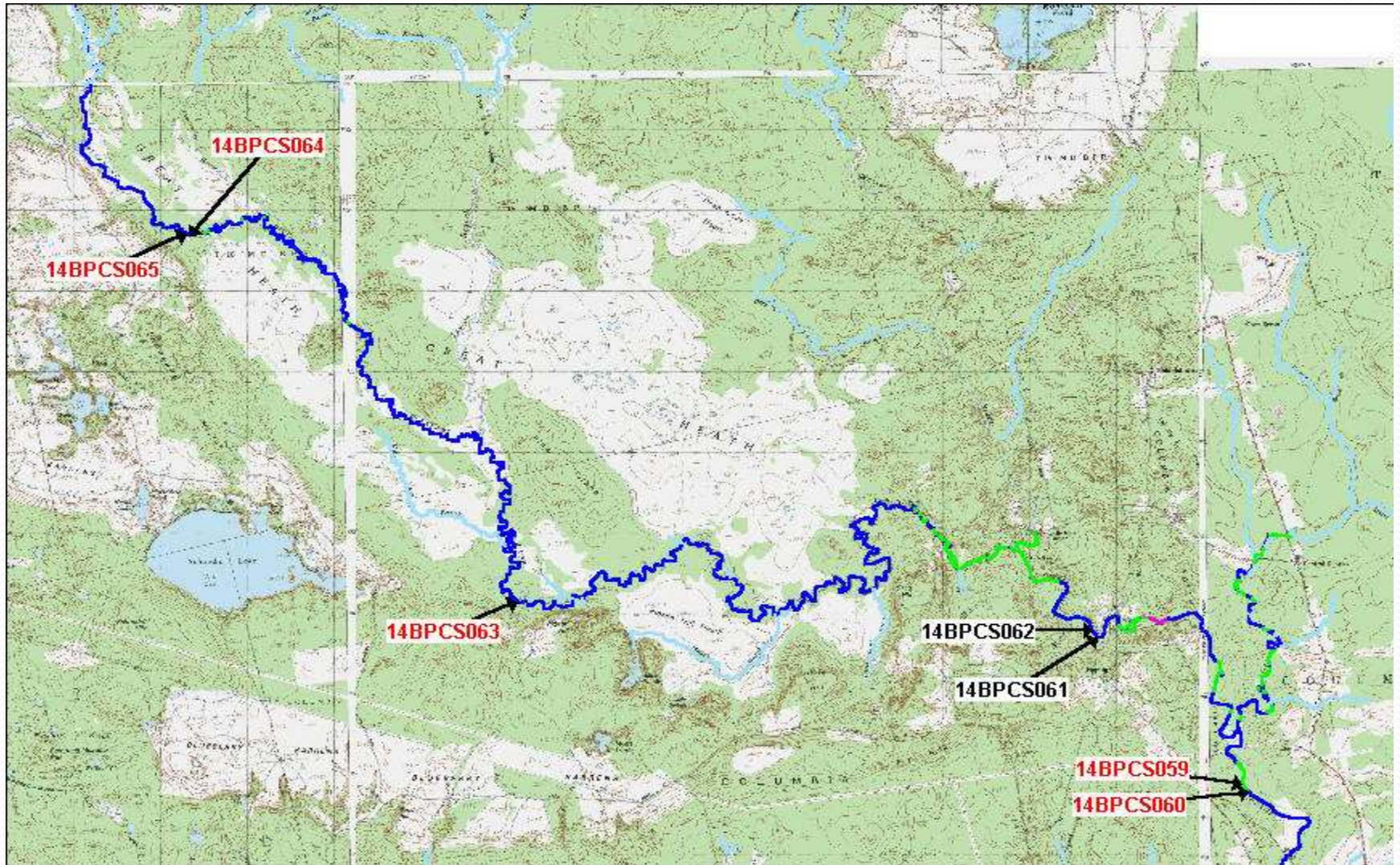
- Analyzed water samples and drift cards
- Phosmet
  - Most commonly detected
  - Found in all years
  - Different site each year
  - Water: ND-0.815 ppb
  - Filters: ND-21.978 ng per filter
- Febuconazole detected in one site in 2004



# Pleasant River Spring Study 2000

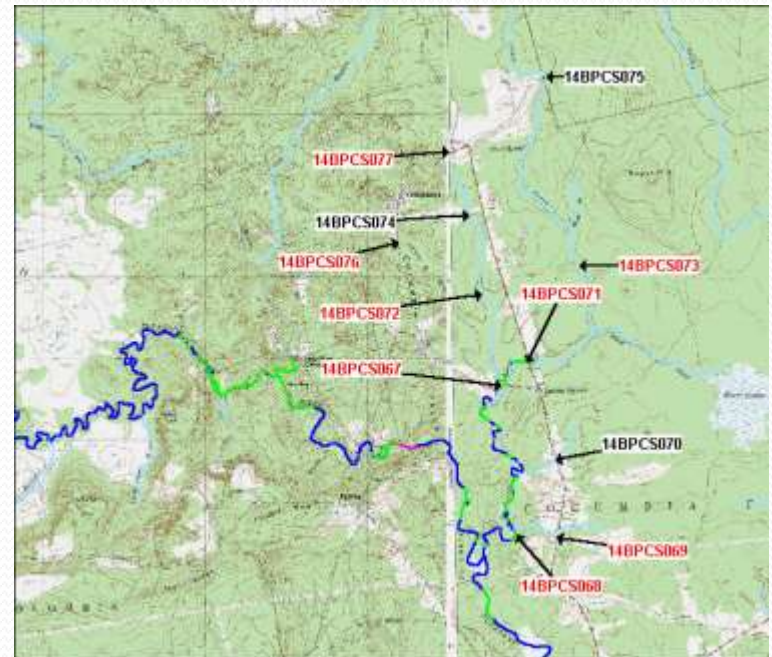
- Objective: Compare levels of hexazinone discharging from groundwater with historic levels into main stem of river
- Analyzed for 11 blueberry pesticides
- 6 of 8 samples positive
- Hexazinone only pesticide detected
  - Hexazinone 0.17-3.08 ppb
  - Hexazinone metabolite B 0.045-0.098 ppb (3 samples)

# PLEASANT RIVER SPRING STUDY 2000



# Pleasant River Tributary Study 2000

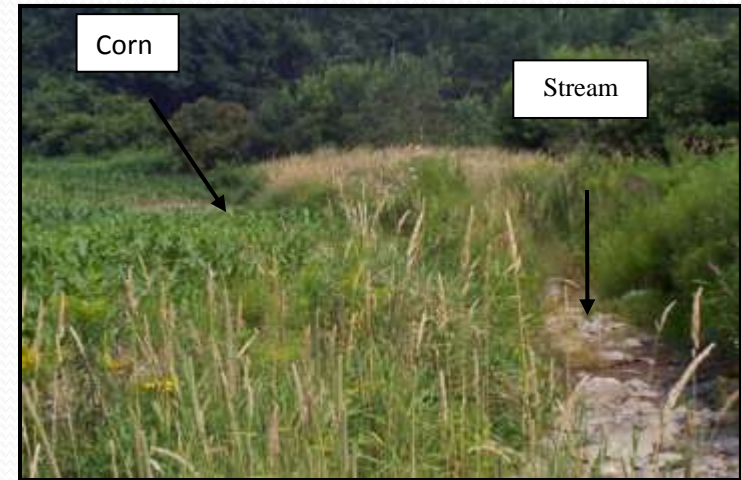
- Sampled first-order streams
- Objective: Compare levels of hexazinone in tributaries to historic levels in main stem of river
- 8 of 11 samples positive
- Concentration range 0.1-0.803



# 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

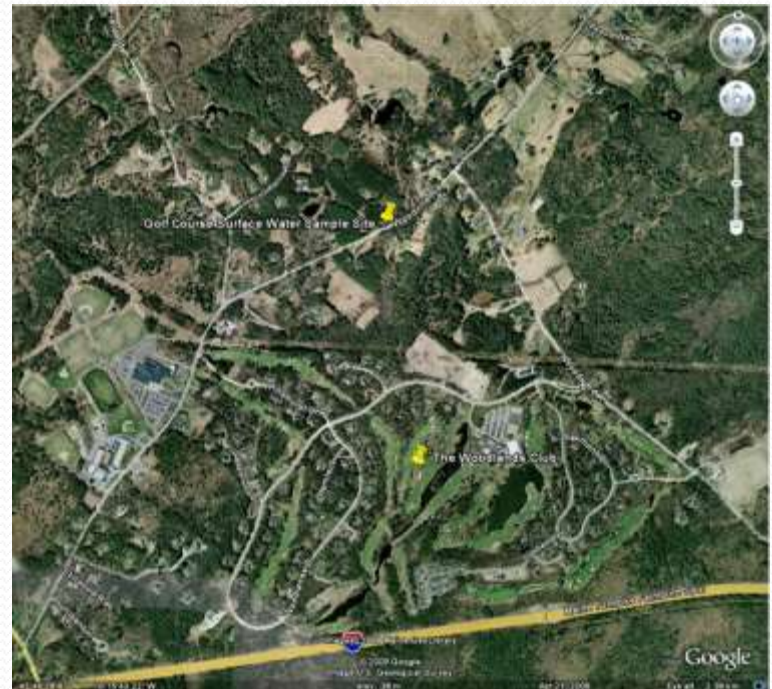
- **Penobscot River, Brewer**
  - 6 samples analyzed for 8 pesticides
  - Dicamba: 1 sample, 3.5 ppb
  - 2,4-D: 1 sample, 1.2 ppb
- **Small streams in Augusta & Scarborough**
  - non-detect
- **Friends of Casco Bay (FOCB)**
  - 10 samples analyzed
  - Dicamba: 3 samples, 2.2-4.1 ppb
  - Propiconazole:
    - 2 samples, 0.057 -0. 075 ppb
  - Clopyralid: 1 sample, 0.91 ppb

All results below current aquatic life benchmarks

# Urban Surface Water Sampling

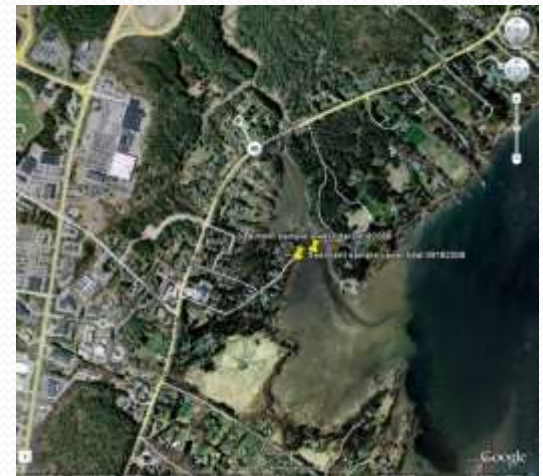
Collaborations with FOCB and City of South Portland  
**2008**

- 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





# Urban Sediment Sampling cont.

**2009-2010: Portland/South Portland**

- 6 samples each year

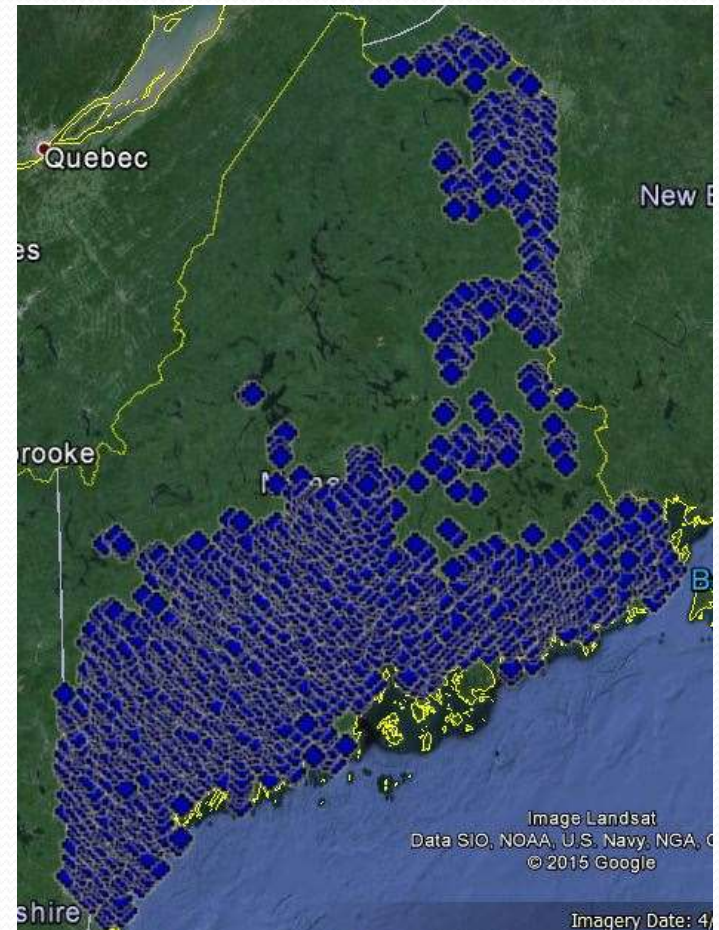
Pesticide	# of Detections 2009	# Detections 2010
Bifenthrin	5	4
$\lambda$ -Cyhalothrin	4	0
Permethrin	1	1
Cypermethrin	4	0
Sumithrin	Not tested	6
Esfenvalerate	3	1
Piperonyl butoxide (PBO)	Not tested	2

# 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)

	1994	1999	2005	2014
Number of wells sampled	129	194	127	47
Number of samples	129	194	137	50
Percent of wells with positive detections	24	9	11	68
Number of samples with positive detections	31	17	14	32
Percent of samples with positive detections	24	9	10	64
Number of pesticides detected	10	4	8	23
Number of pesticides analyzed	38	32	31	96
Number of detections above HAL, MEG, MCL	1*	0	0	1**

\*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.

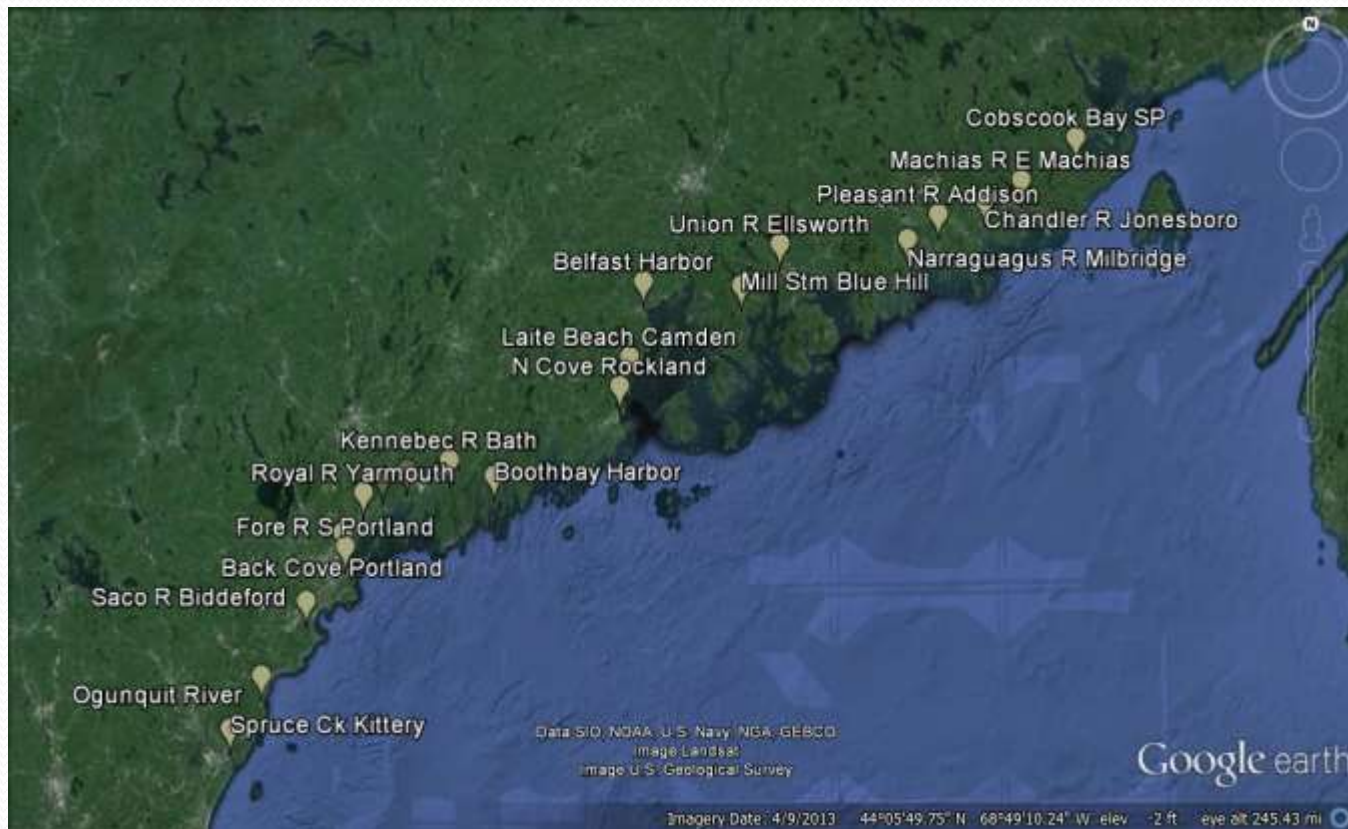
- BPC Environmental Risk Assessment Committee established and convened, April, 2014
- Objective: To examine whether current pesticide residues have the potential to affect the lobster resource in Maine, directly or via impact on other marine organisms.



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



# Implications of Studies

- 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.



Photo courtesy of Gary Fish

# BPC WATER QUALITY UPDATE: MONITORING FOR BLUEBERRY PESTICIDES

Questions?

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