Investigations of Sucralose and Select Pharmaceuticals and Pesticides as Tracers for Contaminants of Concern in Florida’s Ambient Freshwaters

Division of Environmental Assessment and Restoration
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The Question

In 2011 we were asked by our Division Director, ‘How prevalent are emerging contaminants in Florida’s ambient freshwaters?’.
Contaminants of Concern
AKA Emerging Contaminants

- Chemicals and microorganisms which are not included in routine monitoring that pose a real or perceived threat to the environment
- Lack published human health or aquatic life criteria and their synergistic effects are largely unknown.
- Effects may include behavior modification, reduced fecundity, sterility and increased mutagenicity and toxicity
Contaminants of Concern

- **Organic Waste Water Compounds**
  - pharmaceuticals and personal care products (PPCPs), synthetic hormones, disinfectant by-products

- **Current Use Pesticides (over 20,000!)**

- **Brominated Flame Retardants**
  - found in furniture, mattresses, carpet padding, insulation, & automobile seats

- **Akylphenolic Substances**
  - additives for fuels, and lubricants

- **Perfluorinated Compounds (PFCs)**
  - surfactants including fire fighting foam, used in the production of teflon and other fluorinated polymers

- **Chlorinated Paraffins**
  - lubricants, plasticizers, flame retardants, plastic products including PVC pipe
Can’t sample for all of these compounds!
Need indicators to predict where they may be found.
FDEP’s probability-based status monitoring network a good place to add indicators to estimate occurrence statewide.
Indicators of Emerging Contaminants

- **Sucralose** (provided by DEP lab since 2010)
  - Wastewater

- **Pharmaceuticals at trace levels** (provided by DEP lab since 2014)
  - Wastewater (acetaminophen is mostly removed by wastewater treatment)

- **Pesticides at trace levels** (provided by DEP lab since 2013)
  - Land use applications
Sucralose

- Not metabolized by body and is not removed by waste treatment
- Typical values found in receiving waters impacted by sewage treatment effluent - 0.004 - 10 µg/L
Select Pharmaceuticals

- **Acetaminophen** – Anti-pain
  - Removed by standard wastewater treatment

- **Carbamazepine** – Anti-seizure
  - May be removed by standard wastewater treatment

- **Primidone** – Anticonvulsant
  - May be removed by standard wastewater treatment
Select Pesticides

Occurrence in absence of Sucralose and Pharmas may indicate land use application practices

- Imidicloprid – Most widely use insecticide in the world
  - Widespread use in agriculture, termiticide, pet protection

- Diuron - Herbicide
  - Used for weed control

- Linuron - Herbicide
  - Used for weed control
GOALS:

- Characterize statewide water resource conditions
- Infer percentage of each resource that meets standards or designated use (surface & ground water) with known confidence
Random Stratified

Strata include

- Water Resource: canals, rivers, streams, large and small lakes, and confined and unconfined aquifers
- Geography: 6 regions based on the Florida Water Management District boundaries

2015 Design Document found at
http://www.dep.state.fl.us/water/monitoring/pubs.htm
Probabilistic Design

Random Stratified
- 7 water resources
- 6 geographic areas
  - 15 random samples per surface water resource per zone per year
  - 20 randomly selected wells per ground water resource per zone per year
Sampling Process

- Reconnoiter first site. If site falls into one of the ‘exclusion categories’, exclude site, record reason for exclusion and move on to next site in the site list.
- Continue procedure until desired number of sites are sampled or the random selections of the resource are exhausted.
Sucralose added to all status monitoring for 2012

- Results show presence in all water resources is ubiquitous, with the exception of confined aquifers.
  - Values ranged from 0.018 - 27 µg/L
Select pharmaceuticals/pesticides and sucralose added to Status resources for 2015 sample survey.

Did not add them to confined aquifers due to low occurrence of sucralose in 2012 survey.
2015 Sample Surveys

- Sucralose, pharmaceuticals and pesticides collected at 528 sites
  - 60 canal sites
  - 90 river sites
  - 90 stream sites
  - 90 large lake sites
  - 78 small lake sites
  - 120 unconfined wells

2015 Status Sites Sampled for Select Pharmas/Pesticides

N = 528

Water Resource
- CANAL
- LARGE LAKE; SMALL LAKE
- LARGE RIVER; SMALL STREAM
- UNCONFINED AQUIFER

Created April 7, 2016 by Jay (James) Silversides, Division of Environmental Assessment and Restoration, Watershed Monitoring Section. This map is a representation of ground conditions and is not intended for further analysis. James.Silversides@dep.state.fl.us
Water Resource % with Detectable Sucralose

2015 Sample Surveys
2015 Sample Surveys

Water Resource % with Detectable Pharmaceuticals

- **Acetaminophen**
  - 9 detections (0.002 µg/L to 0.011 µg/L) only one quantified.

- **Carbamazapine**
  - 82 detections of carbamazepine (0.00044 µg/L to 0.068 µg/L) 21 quantified. Notice the MDL is ~ an order of magnitude lower than Acetaminophen/Primidone

- **Primidone**
  - 11 detections (0.0058 µg/L to 0.088 µg/L) two quantified.
Canals | Rivers | Streams | Large Lakes | Small Lakes | Unconfined Aquifers
---|---|---|---|---|---
Imidicloprid | 210 detections (0.0021 µg/L to 0.52 µg/L), 103 quantified.
Diuron | There were 142 detections (0.002 µg/L to 0.35 µg/L), 58 were quantified.
Linuron | was found at one canal site | 0.2 µg/L and it was quantified
While no existing health or aquatic benchmarks were exceeded

- Very low levels of human waste indicators are found in all status resources in Florida.
- Very low levels of the commonly used pesticides imidicloprid and diuron are found in all status surface waters and in status unconfined wells.
Next Steps

We are pursuing means to integrate these indicators into some of our monitoring plans (strategic and basin management action plan monitoring).

Investigating additional sampling means (passive sampling devices) to collect a more extensive list of contaminants, including hormones.
• FDEP, Northwest Florida WMD, & St. Johns River WMD
  • Sampling staff

• David Whiting and Timothy Fitzpatrick FDEP Central Lab
  • Development of laboratory methodologies for EC indicators

• Dr. Tony Olsen US EPA & Dr. Chris Sedlacek WMS FDEP
  • Monitoring Design and Data Analysis

• Andy Woeber & Stephanie Sunderman – WMS FDEP
  • Geographic Information Systems and Quality Assurance
Questions?

Watershed Monitoring’s Web Page:

http://www.dep.state.fl.us/water/monitoring/index.htm