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
How to address the Q???

- 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) Shiervina, 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.Shiervina@dep.state.fl.us
2015 Sample Surveys

Water Resource % with Detectable Sucralose

Canals, Rivers, Streams, Large Lakes, Small Lakes, Unconfined Aquifers, Confined Aquifers

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.
2015 Sample Surveys

Water Resource % with Pesticide Detection

- **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.
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Watershed Monitoring’s Web Page:

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