

FDEP

Pilot Study on the Occurrence of Emerging Substances of Concern in Florida's Flowing Waters

...but not on all 14 million compounds or so.

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Study Objectives

1. Determine occurrence of ESOCS at detectable concentrations
2. Measure of biological effects, such as hormonal activity, in the water sample
3. Determine if the molecule sucralose (Splenda®) is an appropriate tracer for ESOCS in Florida waters.

What are Emerging Substances?

- Real or perceived threat to the environment
- Most common exposure routes are through food ingestion (especially breast milk in infants)
- Published health or aquatic criteria for ESOCs lacking as criteria development is still evolving
- Some ESOCs are endocrine disrupting compounds
- New industrial and agricultural chemicals may be potential ESOCs
- ESOCs are discharged in trace amounts in waste water releases and as surface water runoff

Categories of ESOCs

Organic Waste Water Compounds (OWC)

- Pharmaceuticals and Personal Care Products (PPCP)
- Synthetic Hormones
- Disinfectant By-products

Current Use Pesticides

Brominated Flame Retardants

Akylphenolic Substances

Perfluorinated Compounds (PFCs)

Chlorinated Paraffins

Found in waste water effluent



Municipal WWTPs and industrial waste are both sources of ESOCs

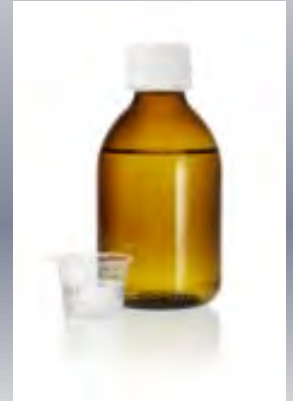


Disinfectant By-Products

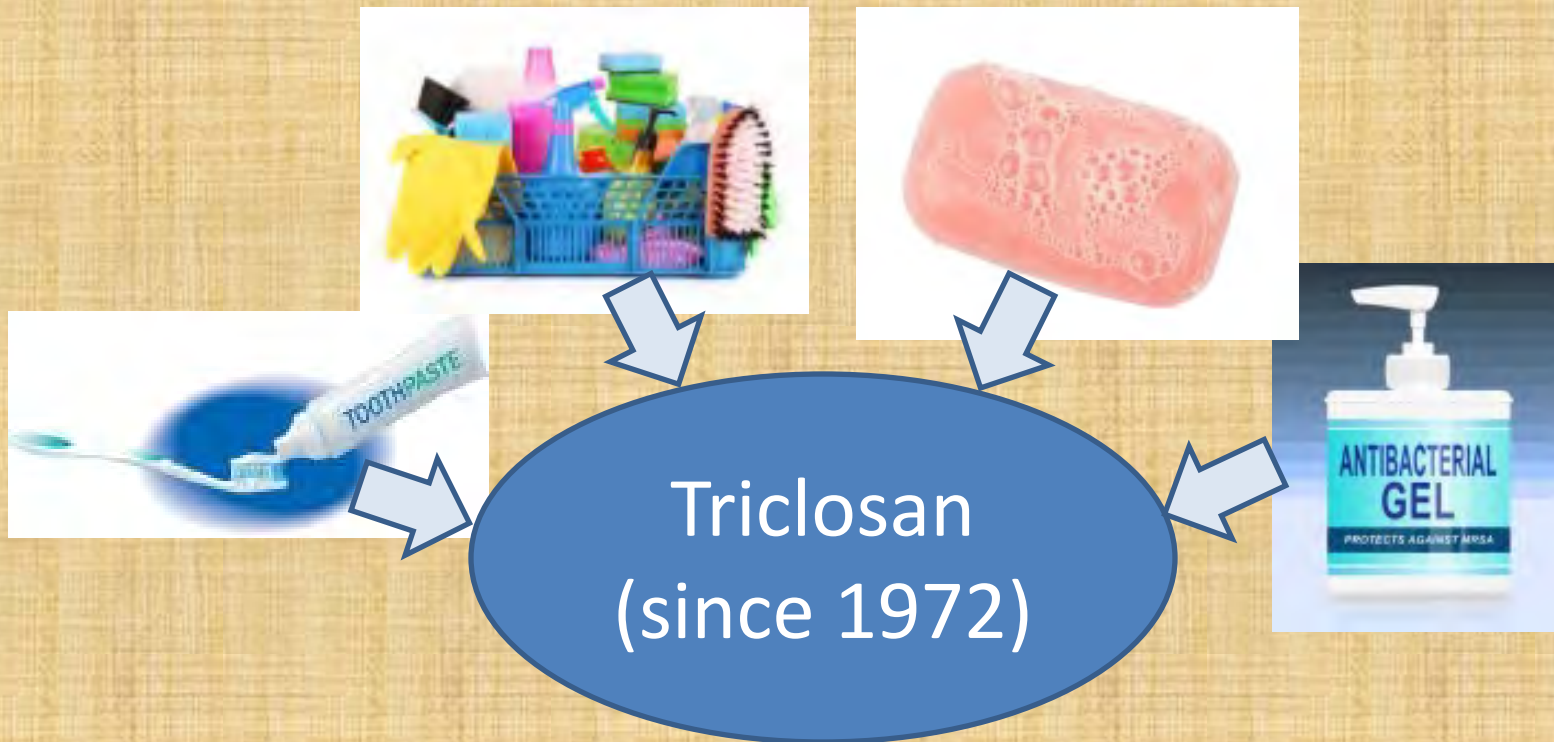
- Disinfection by-products (DBPs) result from reactions between organic matter in water with chemical treatment agents such as chlorine, ozone and bromine during disinfection.
- The USEPA considers certain DBPs, such as the trihalomethanes and N-nitrosodimethylamine (NDMA), to be emerging drinking water contaminants , some with regulatory thresholds.

Personal Care Products & Pharmaceuticals

Many induce estrogenic effects in aquatic life.



Personal Care Products & Pharmaceuticals



Set to be banned in Canada and some European nations, the USEPA recently stated it is safe for use, although it will revisit its decision in four yrs.

Synthetic Hormones

Many induce estrogenic effects in aquatic life, especially vertebrates



Municipal WWTP do not remove hormones (i.e. birth control compounds) completely.

In agricultural situations, such as a feedlot or a dairy, runoff water that may contain hormones is often not treated.



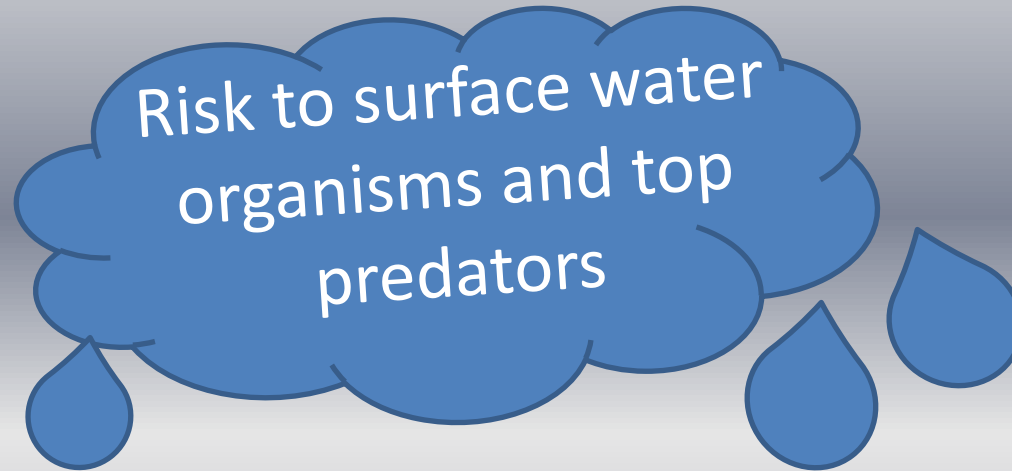
Many induce estrogenic effects in aquatic life.

Current Use Pesticides

Over 20,000 pesticide products are presently registered for use in the United States.



Brominated Flame Retardants



- BFRs are found in polyurethane foam in furniture, mattresses, carpet padding, insulation, and automobile seats.
- It is everywhere a human population resides.
- BFRs have been detected in Florida dolphins.

Akylphenolic Substances

Toxic &
Estrogenic

Nonylphenols

Industrial and household
cleaning agents



Pesticides



Rubber



Paints & Plastics

Perfluorinated Compounds (PFCs)

Many induce estrogenic effects in aquatic life

PFOs

PFOA

853 total



Chlorinated Paraffins (CPs)



The largest use of CPs is lubricants in metal working operations. The second largest use is as both a plasticizer and a flame retardant in rubber, paints, and plastic products, especially PVC pipe.

Determining the Analyte List of Priority ESOCs

Category	Exposure routes	Aquatic life effects	Water Solubility
Brominated fire retardants	House dust, sediment, food web, carcinogen, breast milk	Bioaccumulative, endocrine disrupting, toxic, persistent	Low
Pharmaceuticals & Personal Care Products	Water	Endocrine disrupting	High
Synthetic hormones	Water	Endocrine disrupting	High
Chlorinated Paraffins	Sediment, food web	Bioaccumulative, toxic, persistent	Low
Current Use Pesticides	Water, sediment, food web	Toxic	High
Perfluorinated Compounds	Food web, breast milk	Bioaccumulative, Endocrine disrupting	Low

Determining an ESOCS Sampling Method

- ESOCS are compounds with a wide array of chemical characteristics that occur at very low levels of detection (parts per trillion or ng/L)
 - ESOCS range from non-polar (brominated flame retardant) to polar (hormones) molecules
- Estimate exposure of aquatic organisms to ESOCS with whole water samples and integrative sampling devices.

Benefits of Whole Water Grab Samples

1. Only one sampling trip required
2. Quantitative results
3. Allows a direct comparison to known sucralose concentrations



Benefits of Integrative Samplers

1. Time-Integrated Sample
2. Allows for higher number of detected ESOs based on larger water volumes
3. May mimic contaminant accumulation in fish tissue

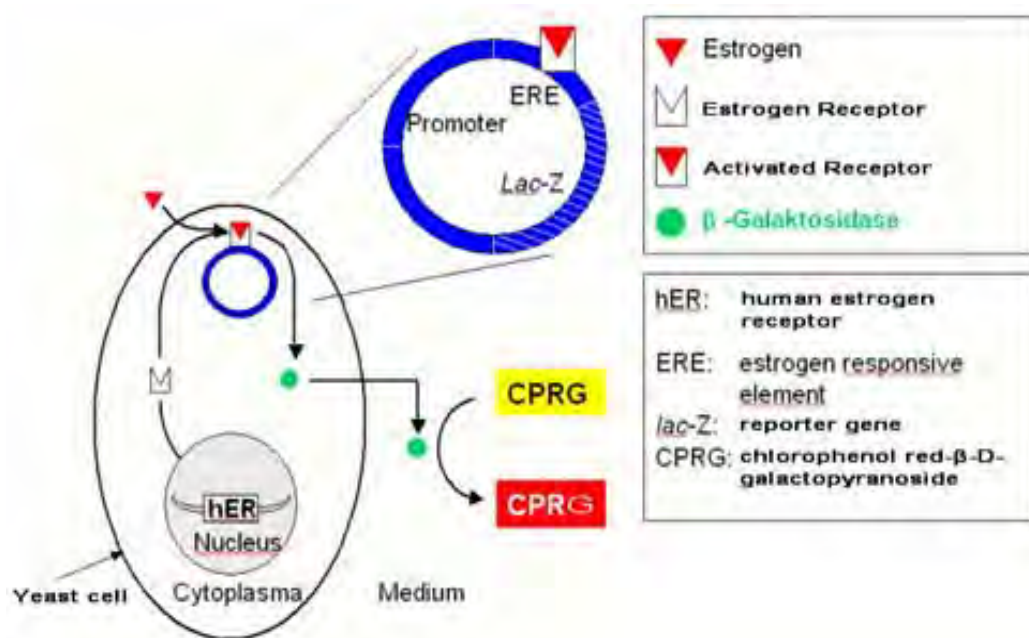


Polar Organic Compound
Integrative Sampler (POCIS)



Semi Permeable Membrane
Device (SPMD) useful for
nonpolar compounds

Measuring Hormonal Effects



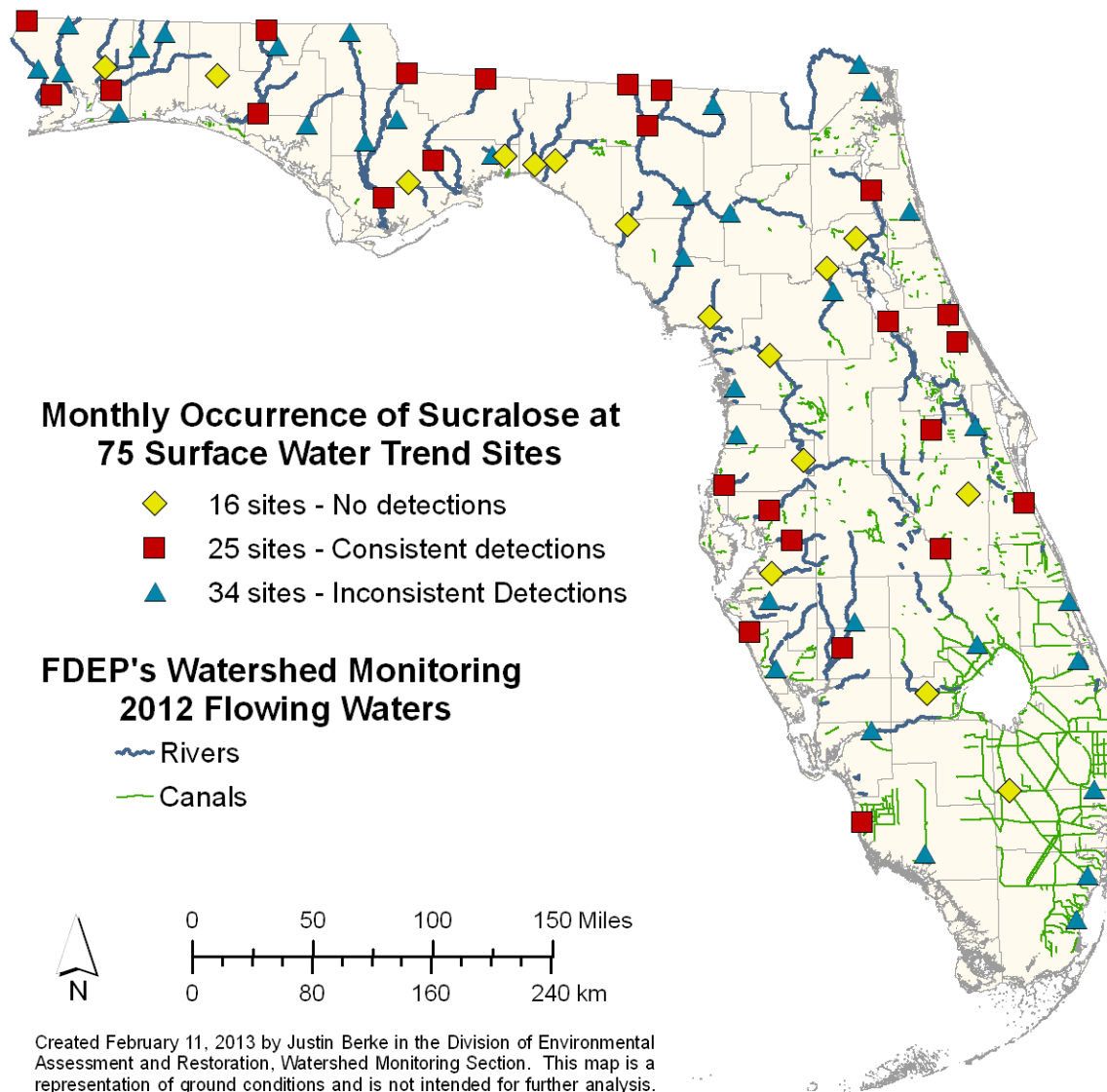
Samples are extracted from both POCIS & SPMD and screened for potential estrogenic activity using bioassay techniques such as the yeast estrogen screen (YES).

Sucralose as a Tracer for Site Selection

- Studies around the nation have detected sucralose in waters with wastewater and recreational influence.
- The vast majority of sucralose passes through waste water treatment systems in the final effluent.
- It is not affected by chlorination treatment and even survives tertiary-grade wastewater treatment.
- Sucralose is thus considered as a potential tracer compound for ESOCs found in wastewater discharges.
- Therefore FDEP added sucralose to their surface water monitoring networks for the year 2012.

ESOCs Survey Site Selection Process

- Site selection will be based on the frequency of sucralose detections at 75 Surface Water Trend sites sampled monthly from Jan – Dec 2012.
- Of the 59 sites with at least one sucralose detection, only 25 consistently detected sucralose every time or almost every time (e.g., 11 out of 12 times).
- 16 sites had no detections of sucralose in any month, and thus may serve as background sites in our study design.



Created February 11, 2013 by Justin Berke in the Division of Environmental Assessment and Restoration, Watershed Monitoring Section. This map is a representation of ground conditions and is not intended for further analysis. For more information contact Justin.Berke@dep.state.fl.us or (850)245-8551.

Future Work

- The goal of the FDEP WMS staff will be to create agreements with a series of labs, one for whole water chemical analysis and one for bioassay (YES) work.
- We anticipate a report to the Statewide Florida Water Resources Monitoring Council (FWRMC) in the future.