Endocrine Disrupting Compounds in the Florida Keys:
Spatial Distribution and Sampling Effort

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Background

- Endocrine Disrupting Compounds (EDCs)
  - Chemicals found in pharmaceutical and personal care products, pesticides, and other household products that have adverse developmental, reproductive, neurological, and immune effects in humans and wildlife.
    - Can mimic naturally occurring hormones like estrogen and thyroid hormones.
    - Bind to cell receptors and block natural hormones from activity.

Background

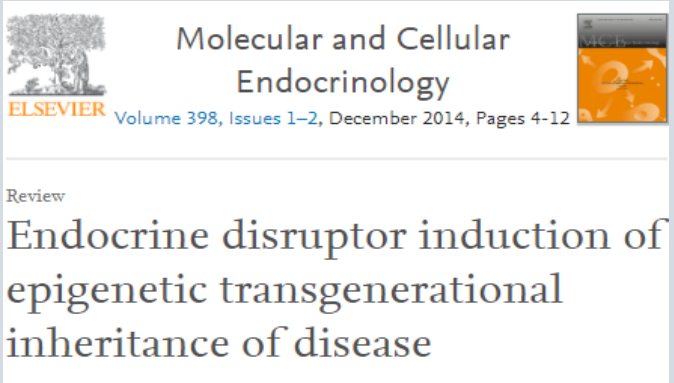
- Endocrine Disrupting Compounds (EDCs)
  - Chemicals found in pharmaceutical and personal care products, pesticides, and other household products that have adverse developmental, reproductive, neurological, and immune effects in humans and wildlife.
- Examples
  - Bisphenol A (BPA; plastics)
  - Triclosan (anti-bacterial soaps)
  - Oxybenzone (sunscreens)
  - Medications
  - Anti-fouling paint

Background

- Hundreds of compounds
  - Hormones
  - Pharmaceuticals
  - Personal care products
  - Pesticides
  - Industrial pollutants
- Human waste indicators
  - Caffeine, sucralose, acetaminophen, cholesterol

Background

- Hundreds of compounds
- Effects
  - “Epigenetic transgenerational inheritance”
    - Infertility
    - Kidney, prostate, ovarian disease
    - Behavior
  - Fish sex ratios (Ankley et al. 2009)
  - *Porites* larval settlement and survival (Stocker 2016)



EPA South Florida Initiative

- Hundreds of compounds
- Effects
- EPA South Florida Initiative Funding
  - Prepare a scientific report that reviews and evaluates sources, distribution, concentration, and effects of endocrine disruptors found in pharmaceuticals, personal care products, pesticides, wastewater, stormwater, household waste, and other sources that can adversely impact corals, fish, sponges, urchins, mollusks and other aquatic organisms found in the Florida Keys National Marine Sanctuary

EPA South Florida Initiative

- FWC: Summarize the type, concentrations, sampling gaps, and distribution of EDCs
  - There was not a central location to track EDC related work in South Florida
  - Spatial modeling
  - Disease response efforts and dashboards

Establishing the spatio-temporal distribution of endocrine-disrupting compounds (EDCs) in the Florida Keys.

EPA Grant Number: 00D83318

FWRI Grant# 4415

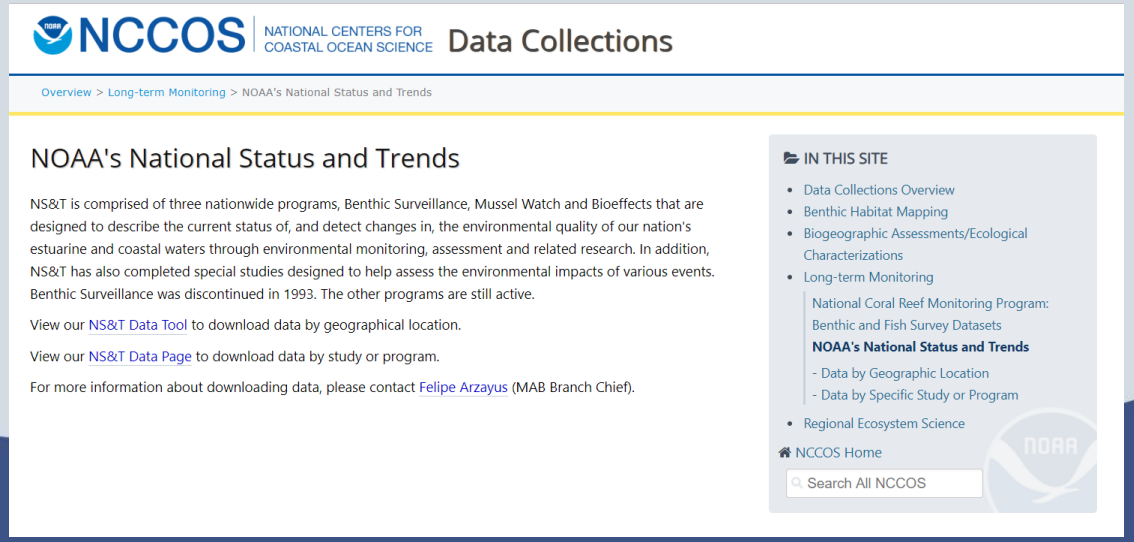
EPA South Florida Initiative

- Summarize the type, concentrations, sampling gaps, and distribution of EDCs
  - Outreach campaign
    - Literature review
    - Permit review
    - Networking
  - Construct a geodatabase
  - Summarize point pattern data to identify sampling gaps and hot spots

EPA South Florida Initiative

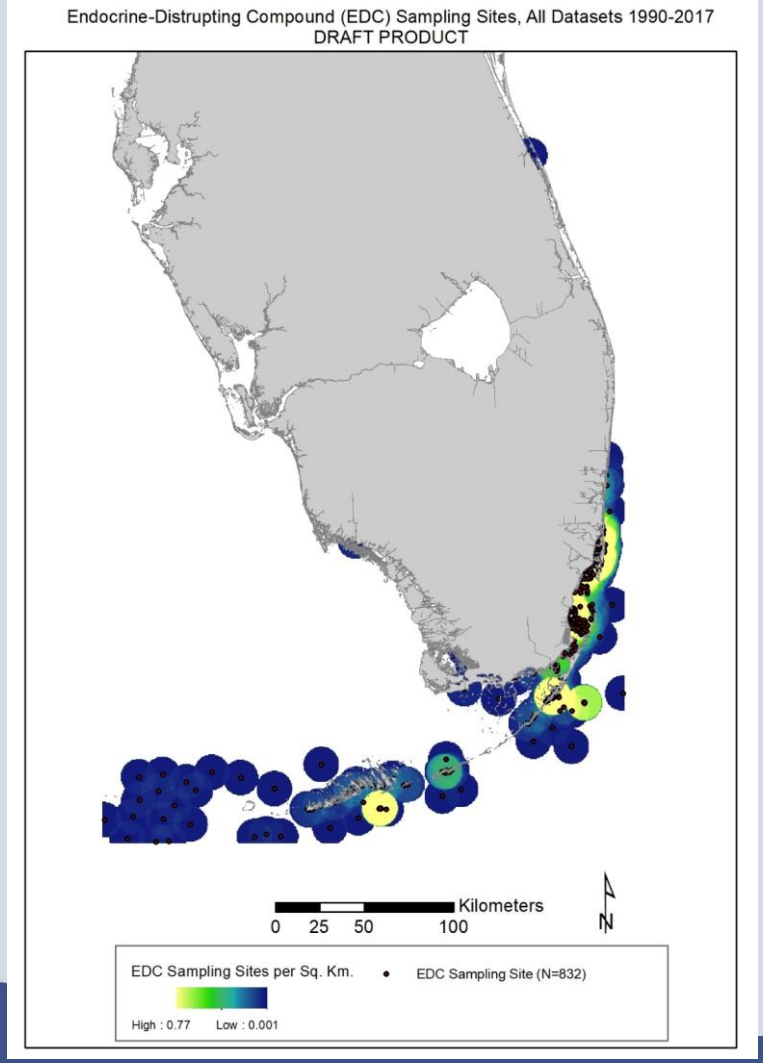
- Outreach
  - 45 Stakeholders
  - 18 Datasets
  - 832 Sampling Locations
  - 1990-2016

Source	Sampling Years	# of Sites
2015 Florida Keys NMS	2015	30
Azua Thesis (2005)	2001-2005	75
Downs et al. (2006)	1996-2000	3
Downs, unpublished (2015)	2015	2
Gardinali and Zhao (2002)	2000	12
Harman-Fetcho et al. (2005)	2002-2004	13
Maxey Dissertation (2006)	2003-2006	97
NCCOS NS&T: Benthic Surveillence	1990-1991	2
NCCOS NS&T: Biscayne Bay	1995-1999	256
NCCOS NS&T: Deepwater Horizon	2010-2010	4
NCCOS NS&T: Mussel Watch	1986-2012	9
Potter et al. (2014)	2002-2006	3
Rand & Gardinali (2005)	2001-2002	13
Singh Dissertation (2005)	2004-2006	68
Stocker (2016)	2013-2014	4
STORET, ORGID: Dade Environmental Resource Management (Florida)	2005-2014	4
STORET, ORGID: FL Dept. of Environmental Protection	2006-2016	14
STORET, ORGID: FL Dept. of Environmental Protection, Southeast	2017	7
STORET, ORGID: Fl. Dept. of Environmental Protection, South Dstrict	2005-2006	98
Wang Dissertation (2012)	2006-2011	47
Woodley and Downs, unpublished	2015	5
Total Number of Sites		**832**



Sampling Effort

- Geodatabase
  - EDC sampling density map for South Florida from all data providers.
  - Colors indicate sampling effort; colors do not indicate EDC prevalence.



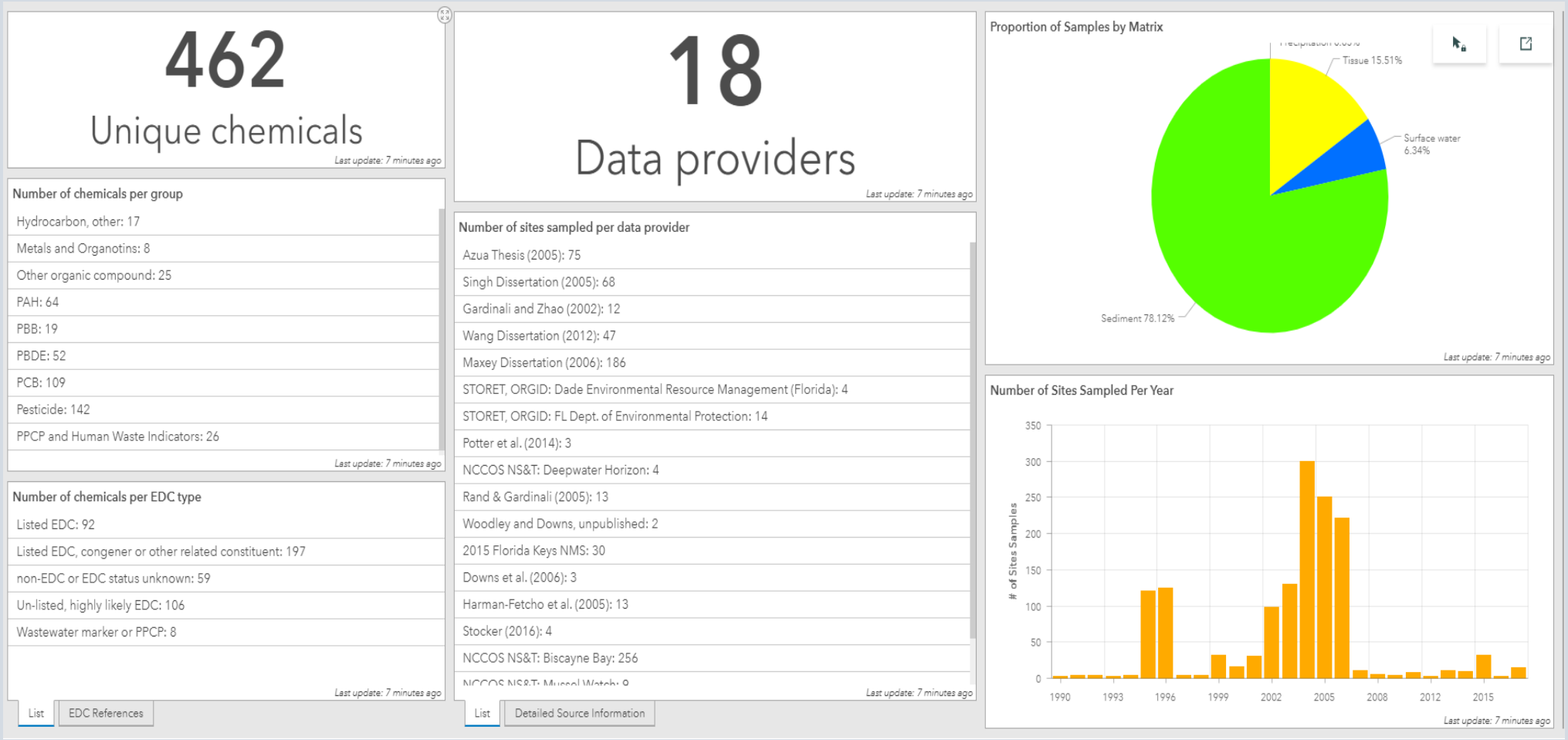
Types of EDCs

PAH: hydrocarbons

PBDE: flame retardants

PCB: plastics, BPA

PPCP: Pharmaceuticals and personal care products



Web map demo

- https://tinyurl.com/tf9b9xd

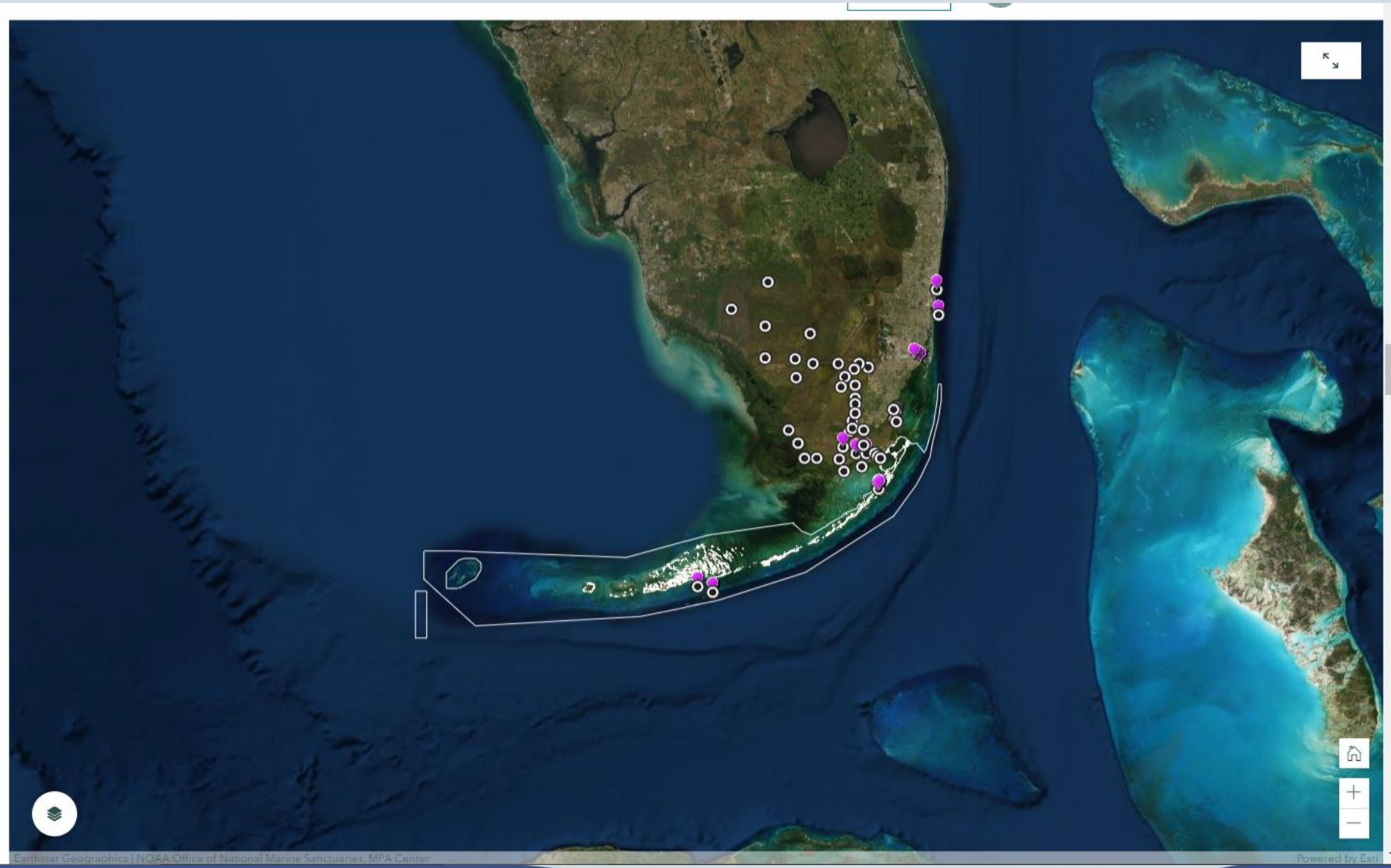
Data distribution/access

- ArcGIS Online Story Map
  - Web maps
  - GIS data
  - Tables, figures
  - Text summaries, etc
- Limited access, requires user log-in

Occurrence of Hormones

Map includes sites where the following chemicals were sampled and detected:

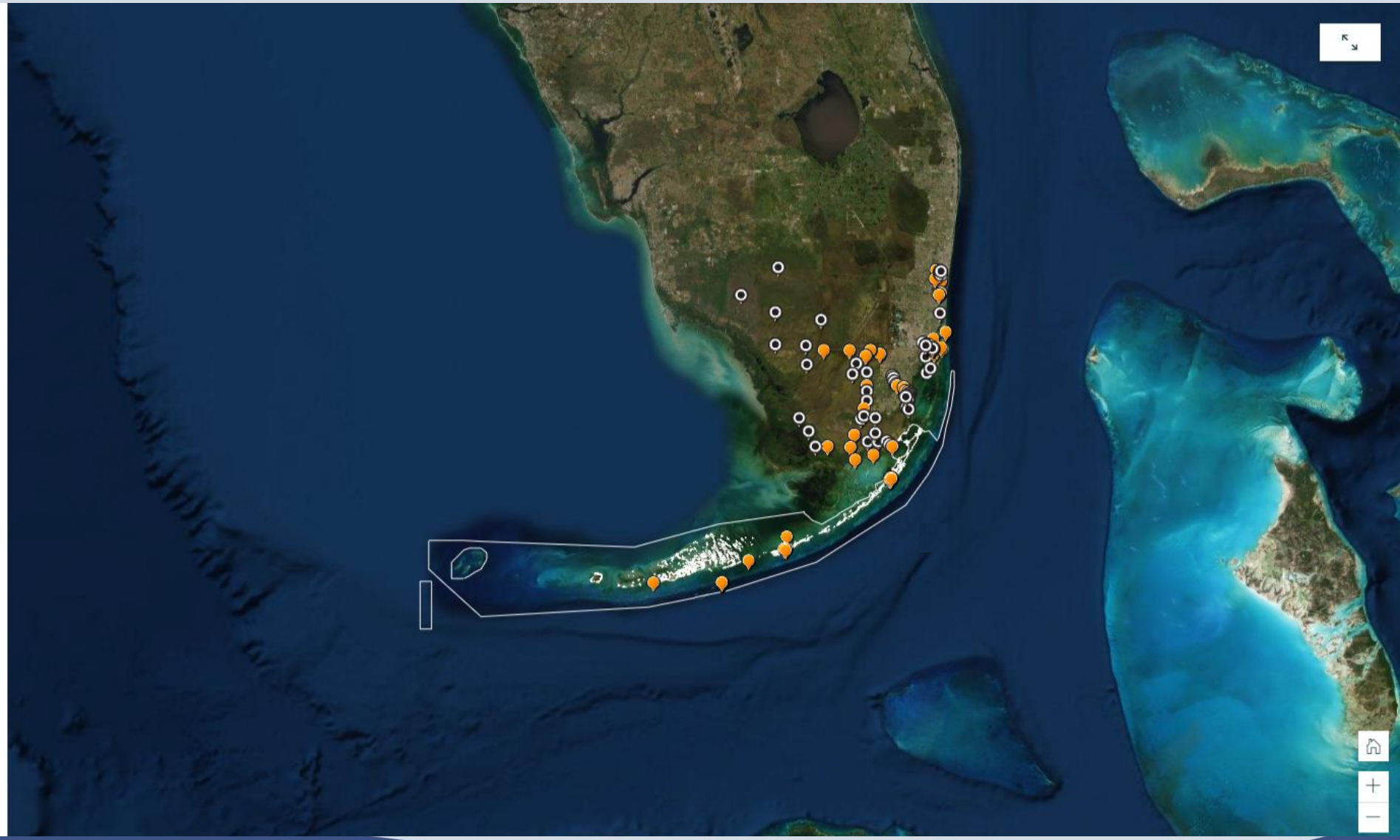
- Progesterone
- Estrone
- Equilin
- Androsterone
- 17β-Estradiol



Occurrence of pharmaceuticals and personal care products (PPCPs) and other human waste indicators

Map includes sites where the following chemicals were sampled and detected:

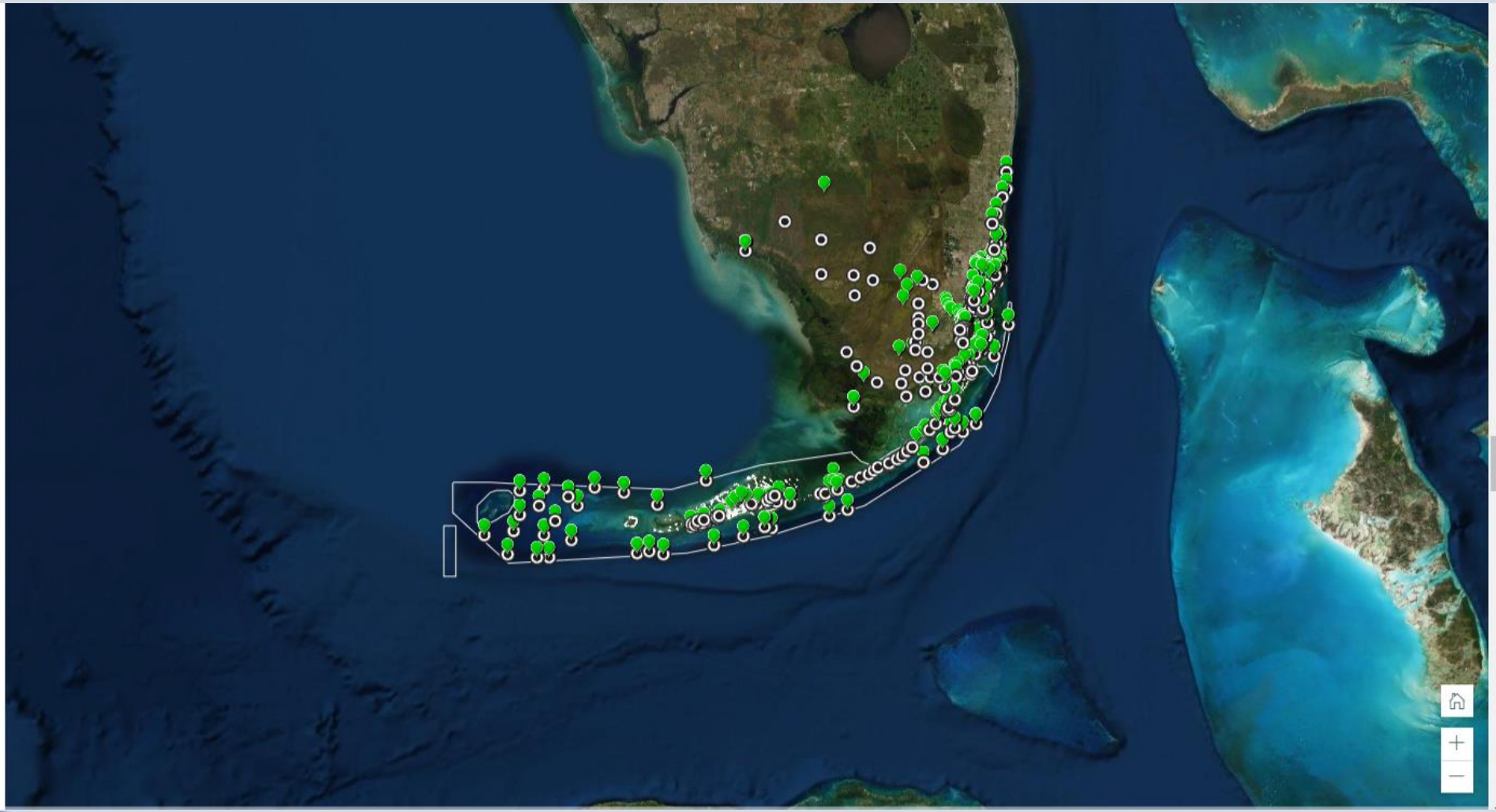
- Acetaminophen
- Caffeine
- Carbamazepine
- Cholesterol
- Coprostane, & Coprostanol, Coprostanone
- Primidone
- Sucralose
- Triclosan
- Camphor (4MBC)
- Avobenzone
- Ethylhexyl methoxycinnamate (EHMC)
- Octocrylene (OC)
- Oxybenzone (benzophenone-3)
- PABAs



Occurrence of common EDC-related pesticides

Occurrence of the top 14 frequently occurring pesticides with known or potential endocrine disrupting properties, including:

- Aldrin
- Arsenic
- Chlordane (cis, gamma, oxychlordane)
- DDT and metabolites (2,4' and 4,4'; DDT, DDD, and DDE)
- DEET
- Dieldrin
- Endosulfan (alpha, beta, Endosulfan sulfate)
- Endrin
- Heptachlor and Heptachlor epoxide
- Hexachlorobenzene (HCB)
- Hexachlorocyclohexane (alpha, beta, delta, gamma-Lindane)
- Irgarol and M1 (Irgarol metabolite)
- Mirex
- Phenanthrene



Explore detailed results

Filter the layer by specifying values.

EDC Site Summary Results

All of the following expressions must be true.

Select a chemical group

Common pesticide

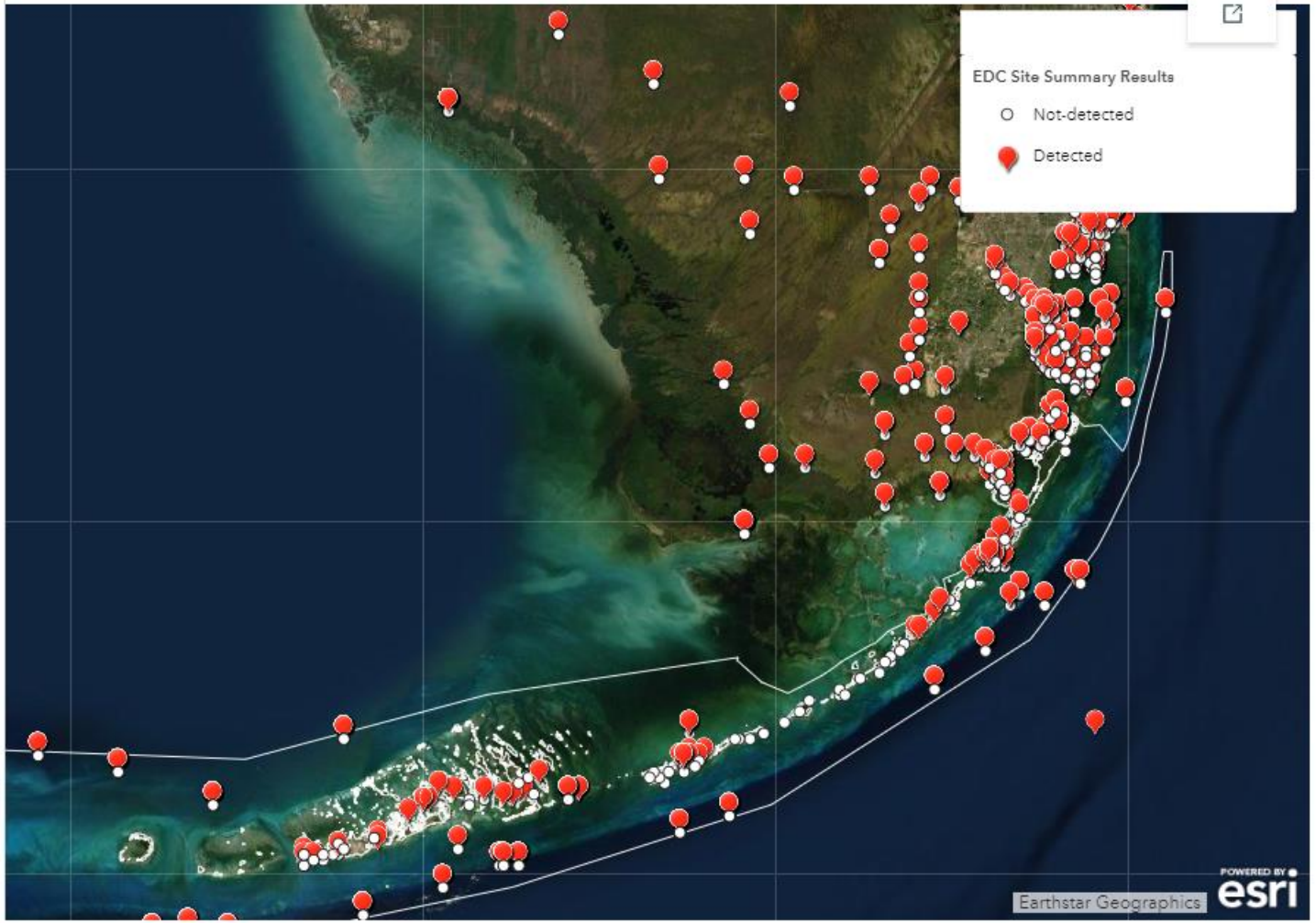
Chemical group

Narrow your results by sample type

Surface water

Water, sediment, tissue, etc

Apply



Status

- Map Application under review by data providers
- Incorporate edits, comments
- Improve data visualization, e.g. locations with several samples
- Publish final Map Application, publish data services, and notify end users: March 2020

Lessons learned

- Data compatibility
  - Different chemical naming formats
- Non-tabular data
  - Raw samples v. pooled data
  - Missing metadata
- Concentrations v. presence/absence
  - Different detection limits

Follow-Up and Acknowledgements

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Data source citations

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Appendix

Table 3. Organic contaminant classes summarized in this report. A complete list of the organic contaminants monitored by the Mussel Watch Program is available online at **http://NSandT.noaa.gov**.

Compound Class	Organic Compound
PCB* (Sum of 18 PCBs) Polychlorinated biphenyls	PCB8/5, PCB18, PCB28, PCB44, PCB52, PCB66, PCB101/90, PCB105, PCB118, PCB128, PCB138, PCB153/132/168, PCB170/190, PCB180, PCB187, PCB195/208, PCB206, PCB209
PAH** Polycyclic aromatic hydrocarbons (Sum of 19 parent PAH compounds plus 19 groups of alkylated PAHs)	**Sum of 7 parent low molecular weight PAHs (with 2 or 3 rings):** naphthalene, biphenyl, acenaphthene, acenaphthylene, fluorene, phenanthrene, anthracene **plus the sum of 12 parent high molecular weight PAHs (4 or more rings):** fluoranthene, pyrene, benz[*a*]anthracene, chrysene, benzo[*b*]fluoranthene, benzo[*k*]fluoranthene, benzo[*e*]pyrene, benzo[*a*]pyrene, perylene, dibenz[*a,h*]anthracene, indeno[*1,2,3-cd*]pyrene, benzo[*ghi*]perylene **plus the sum of 19 groups of alkylated PAHs:** C1-Chrysenes, C1-Dibenzothiophenes, C1-Fluoranthenes/Pyrenes, C1-Fluorenes, C1-Naphthalenes, C1-Phenanthrenes/Anthracenes, C2-Chrysenes, C2-Dibenzothiophenes, C2-Fluorenes, C2-Naphthalenes, C2-Phenanthrenes/Anthracenes, C3-Chrysenes, C3-Dibenzothiophenes, C3-Fluorenes, C3-Naphthalenes, C3-Phenanthrenes/Anthracenes, C4-Chrysenes, C4-Naphthalenes, C4-Phenanthrenes/Anthracenes
DDT (Sum of 6 compounds)	2,4'-DDD; 2,4'-DDE; 2,4'-DDT; 4,4'-DDD; 4,4'-DDE; 4,4'-DDT
Butyltin (Sum of 3 compounds)	Monobutyltin, Dibutyltin, Tributyltin
Chlordane (Sum of 4 compounds)	Alpha-Chlordane, Heptachlor, Heptachlor-Epoxide, Trans-Nonachlor
Dieldrin (Sum of 2 compounds)	Aldrin, Dieldrin

* Currently 51 PCB congeners are quantified by the program.
** Currently 65 PAHs are quantified by the program.