

Investigating the presence of and effects from Endocrine Disrupting Compounds (EDCs) within the mainstem Ohio River

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Ohio River Facts

- 981 miles long
- 305,000 sq. mile drainage area
- 600+ permitted discharges
- 180 municipal wastewater treatment plants
- 50 CSO communities
 - 1400 CSO outlets
 - 15% of the nation's CSOs

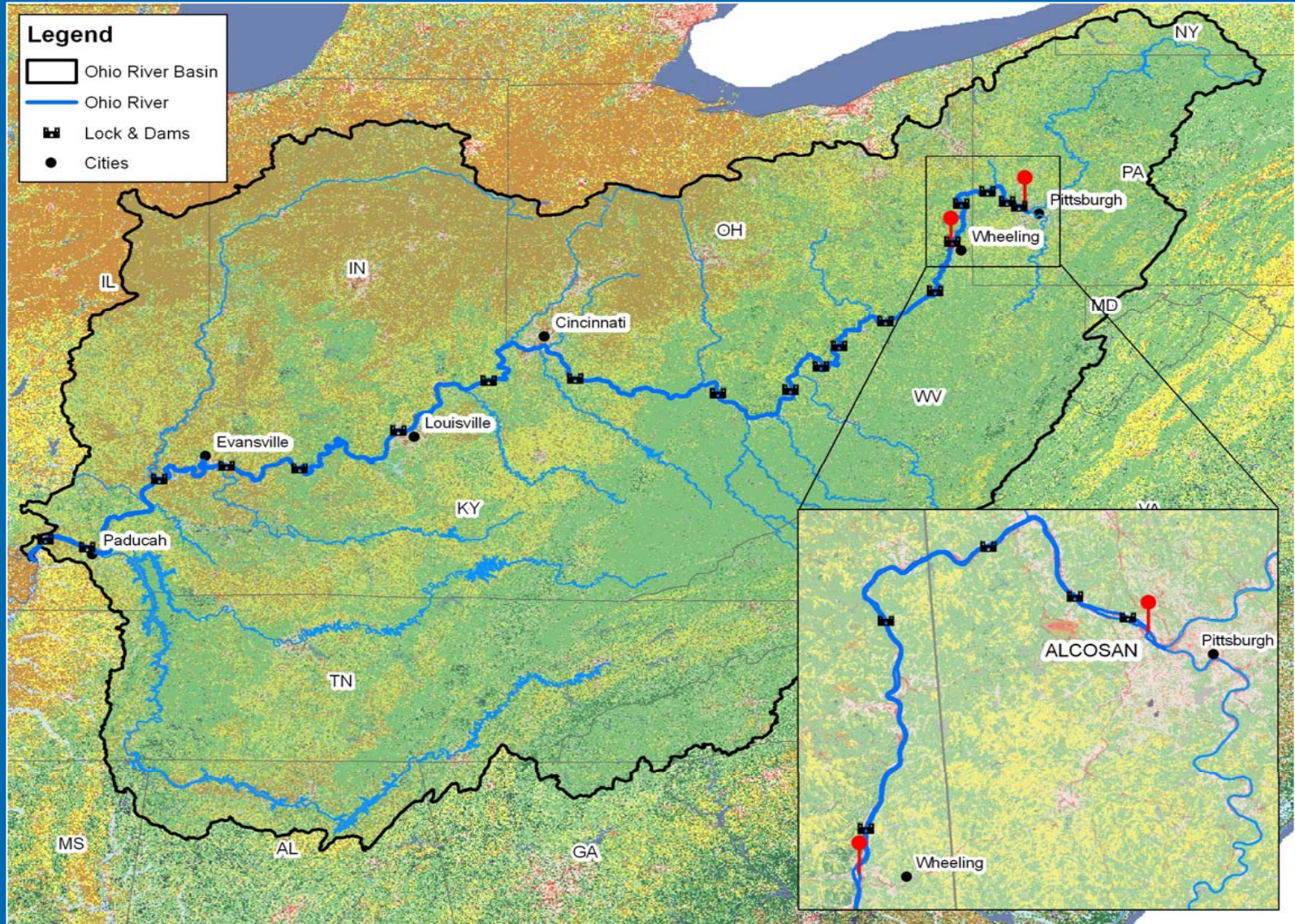
Study Focus

- Can we detect EDCs in the water column?
- Can we demonstrate linkages between the occurrence of EDCs and adverse biological effects among indigenous fish species?

Study Design

- Two potential study locations chosen.
 - ALCOSAN - PA
 - 200+ MGD WWTP
 - Chosen because of size
 - No chemistry, looked at fish only
 - Wheeling - WV
 - 15 MGD WWTP
 - Earlier EPA screening study indicated low level estrogenic activity
 - Main focus of study

Study Area



Study Design

➤ Grab Samples – Effluent

- Chemistry
- In-lab **Vitellogenin (Vg)** gene analysis
 - Vg is an egg yolk precursor protein expressed only in female fish and is normally dormant in male fish.

➤ Deployments

- Vg - Caged (♂) Fathead Minnows (*Pimephales promelas*)
- POCIS/SPMD

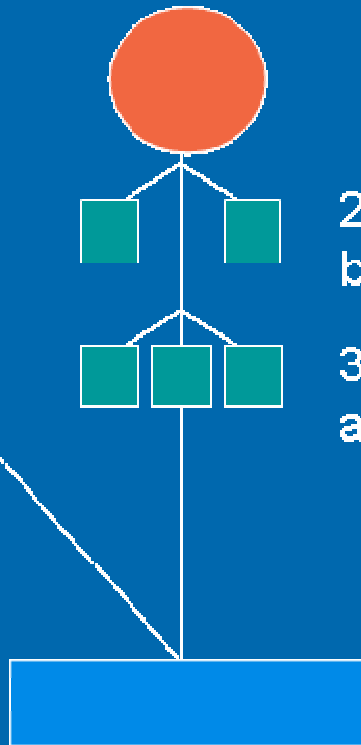
➤ Indigenous Fish

- Vg
- Histopathology



Site Set-up

29 lbs buoy to support
deployments



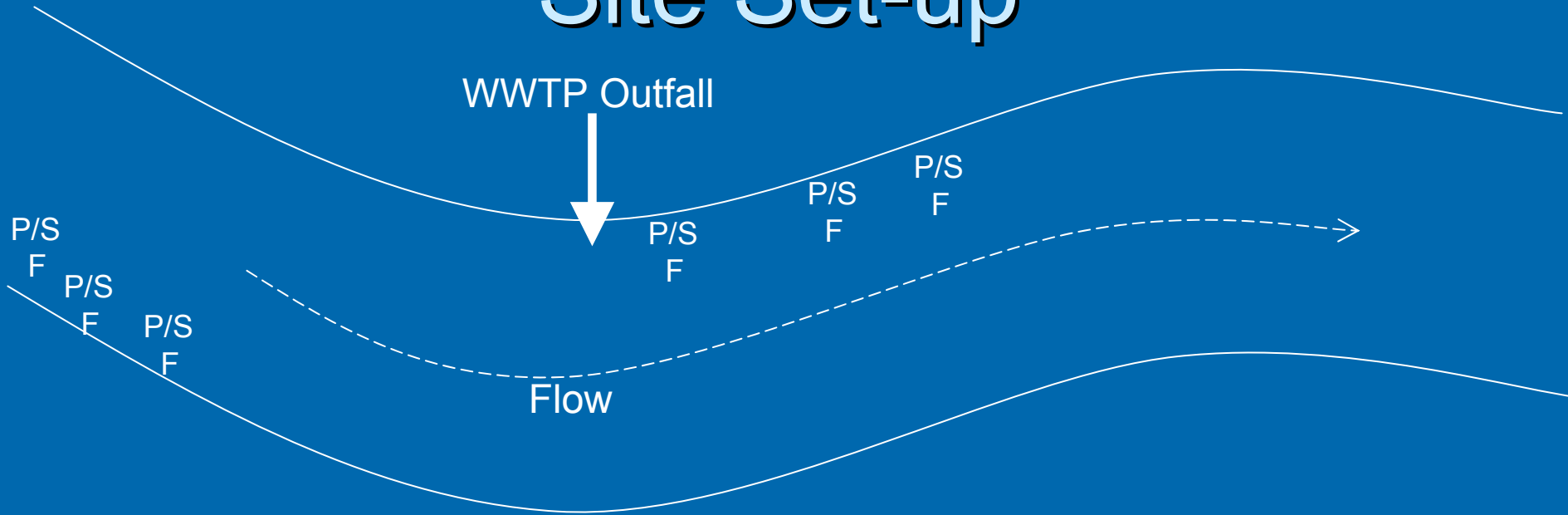
2 Passive samplers per
buoy 7 day time point

3 Minnow cages 1, 4,
and 7 d (N = 10/cage)

Anchor



Site Set-up



Upstream Reference.

- POCIS/SPMD
 - 7, 28 and 56 days
- Fish deployment
 - 1, 4 and 7 days

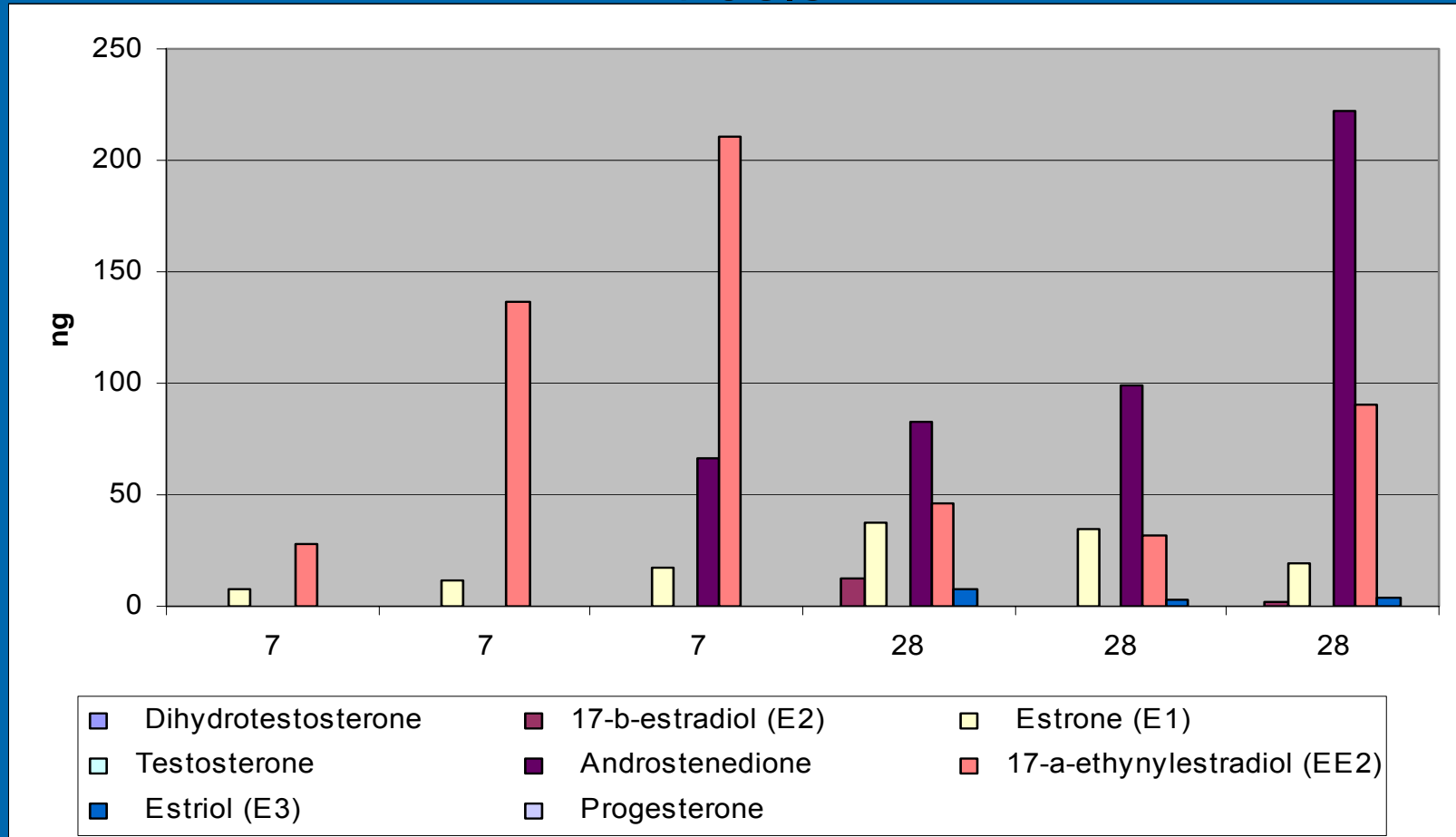
P - POCIS
S - SPMD
F - Fish

Downstream.

- POCIS/SPMD
 - 7, 28 and 56 days
- Fish deployments
 - 1, 4 and 7 days

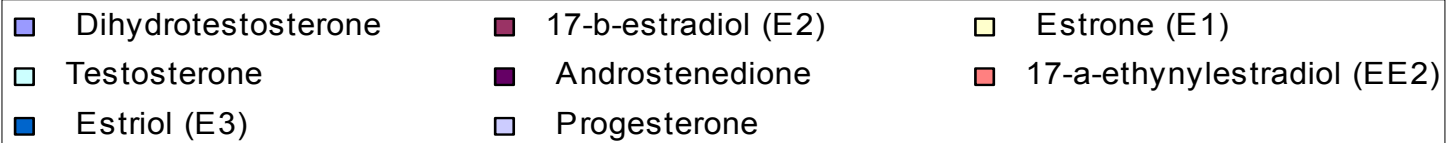
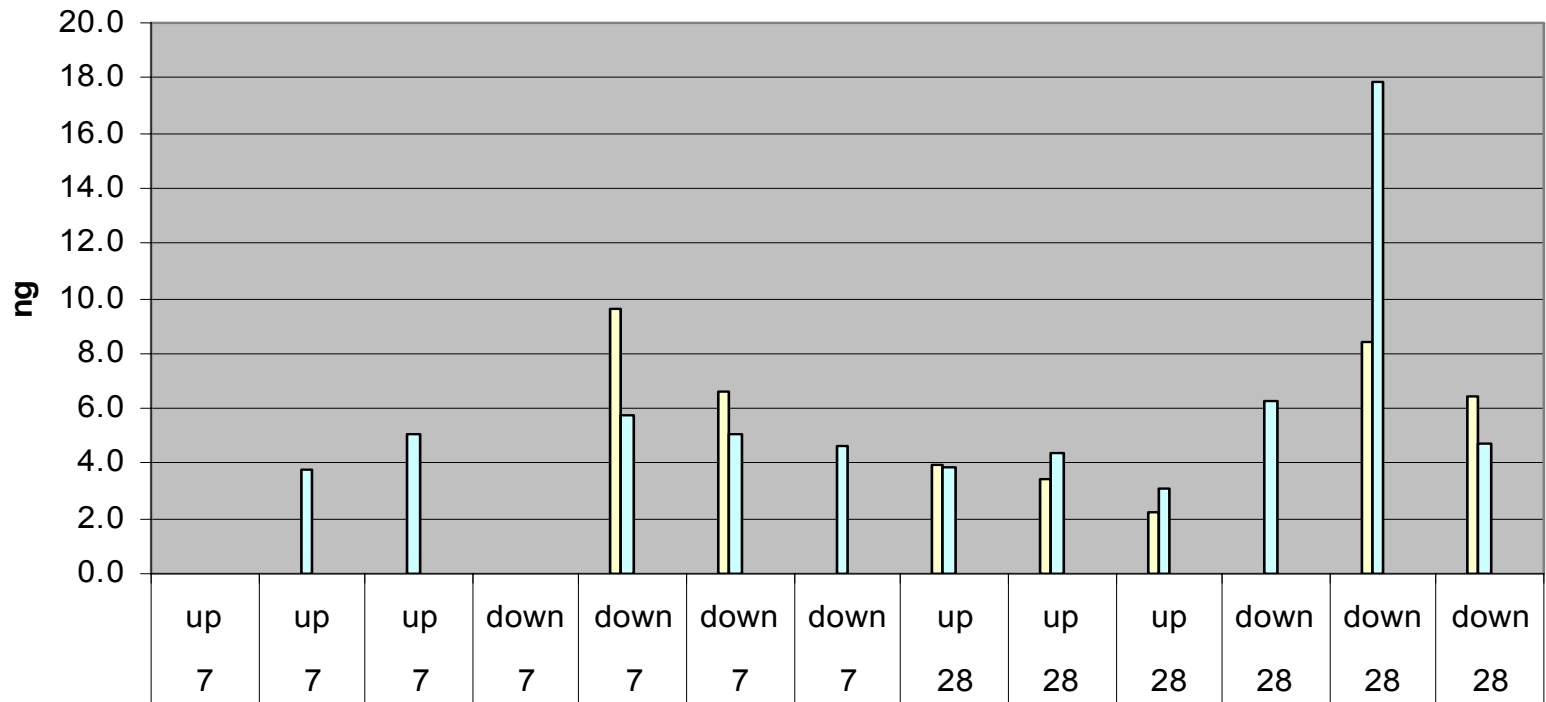
Detecting EDCs in the Water Column

Wheeling Reference – July
POCIS



Detecting EDCs in the Water Column

Wheeling - August



Detecting EDCs in the Water Column

➤ Round 1

- 5 hormones at upstream reference site
 - Vandalism!
 - No outfall data

➤ Round 2

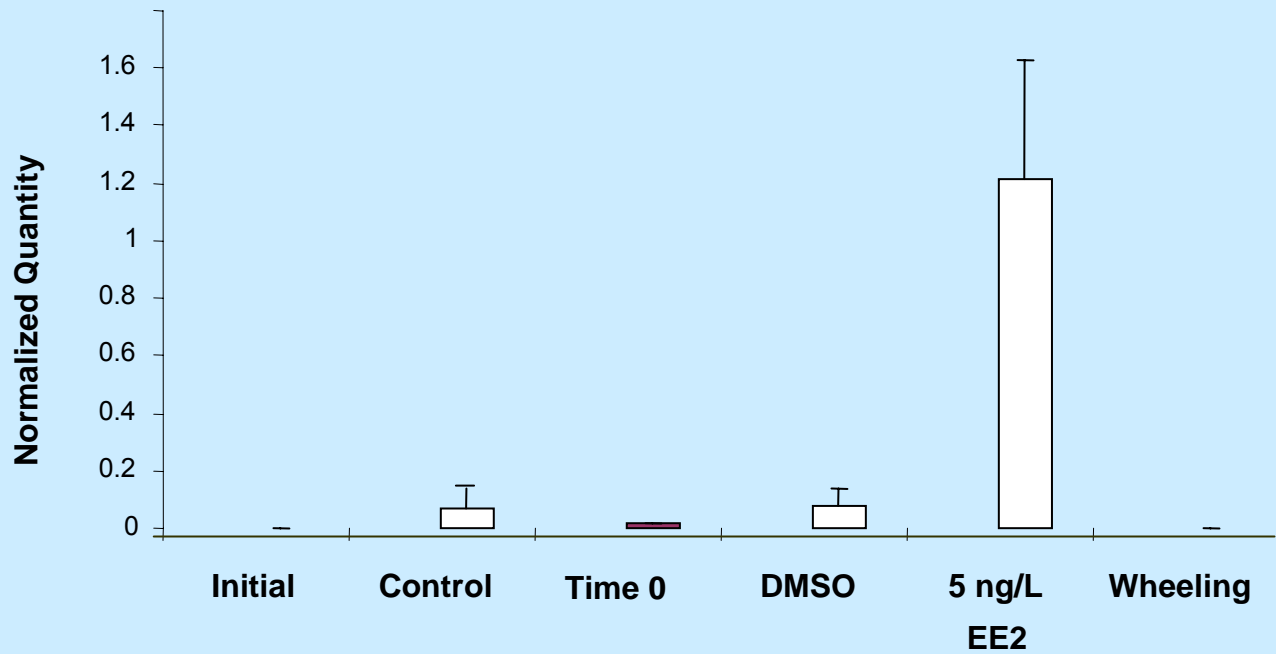
- 2 hormones found
 - Reference and outfall locations
 - Outfall levels only slightly higher

➤ Results were highly variable and largely insignificant

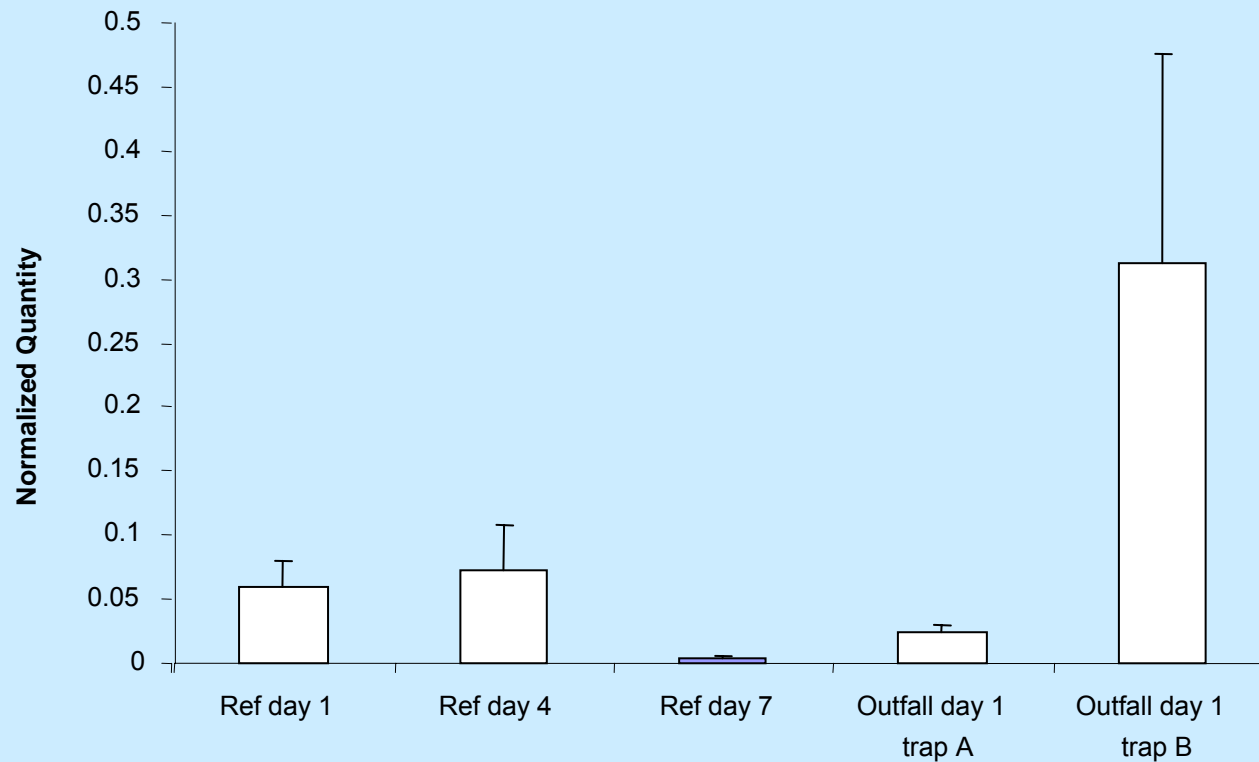
Linking EDCs to Adverse Biological Effects

- **Vitellogenin gene expression**
- **Histopathology**

Grab Sample Exposure



July Deployments



August Deployments



Vtg Results Summary

- Laboratory assay using effluent grab sample did not cause gene expression.
- Caged fish results
 - Higher gene expression rates in one of the downstream samples
 - Overall results too variable

Linking EDCs to Adverse Biological Effects

- Vitellogenin gene expression
- **Histopathology**

Linking EDCs to Adverse Biological Effects

- Fish collected using boat-mounted electrofishing.
- 355 individuals collected (244 submitted)
 - Round 1
 - 35 males (27 with anomalies)
 - Round 2
 - 142 males (108 with anomalies)
 - 67 females (56 with anomalies)
- Livers and gonads removed

Histopath Results

- No intersex found!!
- Other indications that may be due to exposure to EDCs.
 - Ripe males found at the wrong time of the year
 - Increase in spermatagonia
 - Many types of degenerative conditions noted
- Timing Issue
 - Increase in hybrids due to breakdown in timing isolation mechanism.

Problems Encountered

- \$\$ - Research isn't cheap
- Sampling platform/logistics
- Vandalism
- Gender identification - difficult
- Gonad identification - difficult
- 'Noisy' results
 - EDCs are much more than PPCPs
 - Complex mixtures

Future Considerations

- Determine which species are most sensitive.
- Complex mixtures
 - Interactions between EDCs (mode of action)
 - Interactions with the environment (WQ)
 - Rank stressors/effects
- Develop fish health indicator
 - Incorporated into IBI process
 - or-
 - Stand alone
- Lots more to do

Questions?