

# Biological Science at the USGS: Understanding the Effects of CAFOs

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**Sarah Gerould**

**Program Coordinator**

**Contaminant Biology Program**

<http://biology.usgs.gov/contaminant/>

# USGS Science Disciplines



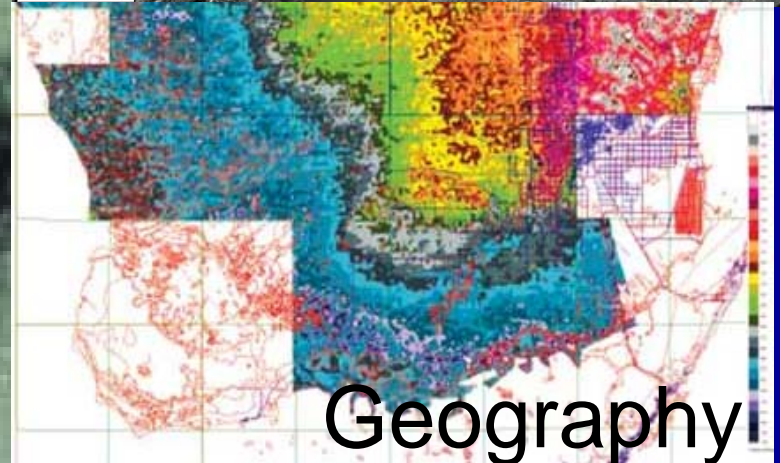
Biology



Geology



Hydrology



Geography

USGS

# Contaminant Biology Program

Program Goal	Relevant Research topics
Toxicology	endocrine system effects
Chemistry	methods of sampling and analysis
Contaminated habitats	CAFOs
Multiple stressors	veterinary pharmaceuticals, DO, UV

# Types of Studies

- Field bioconcentration and effects using Membrane Devices
- Analytical chemistry and technique development
- Biomarkers and assays
- Reproductive effects
- Molecular biology
- Histology



Male shovelnose sturgeon with eggs



# Tools and Techniques

Membrane Devices for  
Time-Integrated  
Sampling

**SPMD**

**Semipermeable**

**Membrane Device**

Flat PE tube  
encasing a neutral  
lipid (triolein)

Sequesters  
hydrophobic  
chemicals from water  
and air

Mimics  
bioconcentration of  
organisms exposed to  
lipophilic chemicals



# POCIS - Polar Organic Integrative Sampler

Concentrates waterborne polar organic chemicals

Microporous polyethersulfone membrane envelops solid phase sorbents and/or mixtures of sorbents.

Sorbent can be tailored to application (polar pesticides, pharmaceuticals, and personal care products)

Pat

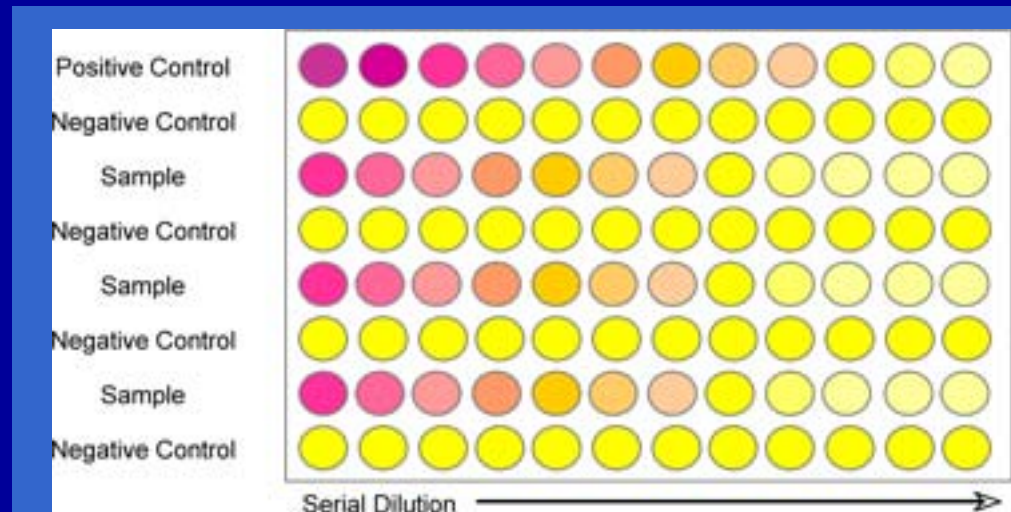


Contact: David Alvarez

# Screening for Effects

1. Fractionate into extracts
2. Screen extracts for endocrine disruption
  - a) YES (yeast estrogen screen)
  - b) YAS (Yeast Androgen Screen)
3. Screen extracts for Toxicity (TIE)
4. Identify Compounds

Contact: David Alvarez





# Time-Integrated Sampling with SPMDs and POCIS



Prime Hook NWR Photo FWS

- Runoff and applied litter from Delmarva Peninsula chickens
- SPMD and POCIS passive samplers were deployed at 3 locations in Prime Hook and Blackwater NWRs

- 17b-estradiol and tetracycline found at sites with poultry litter field application and runoff
- Pesticides (i.e., atrazine, alachlor, metolachlor, diazinon, chlorpyrifos) associated with agriculture and human activities were also found



Blackwater NWR  
Source USGS



# National Endocrine Reconnaissance Report

- ~2200 carp and 650 bass at over 100 sites
- Seasonal differences
- Plasma steroid hormones, gonadal stage, vitellogenin
- Contact: Goodbred

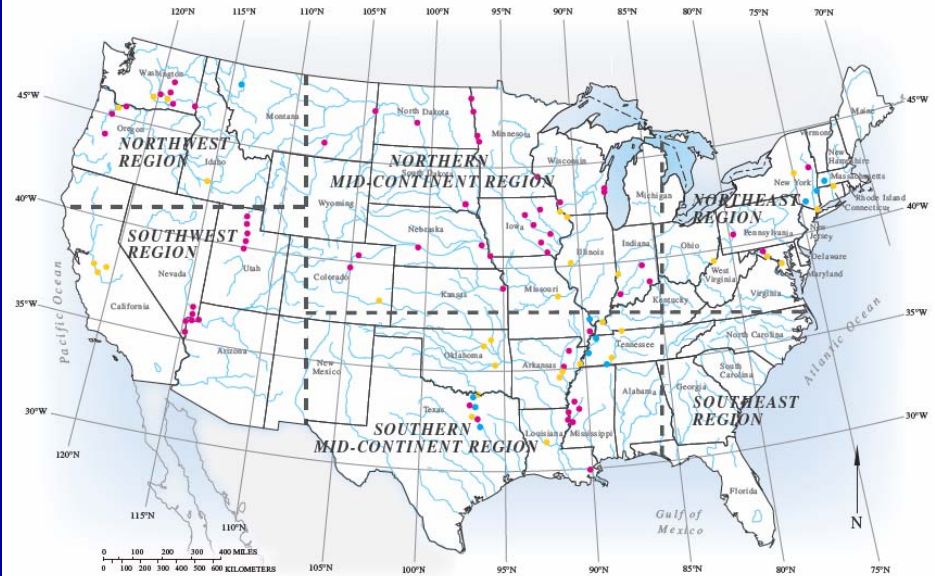
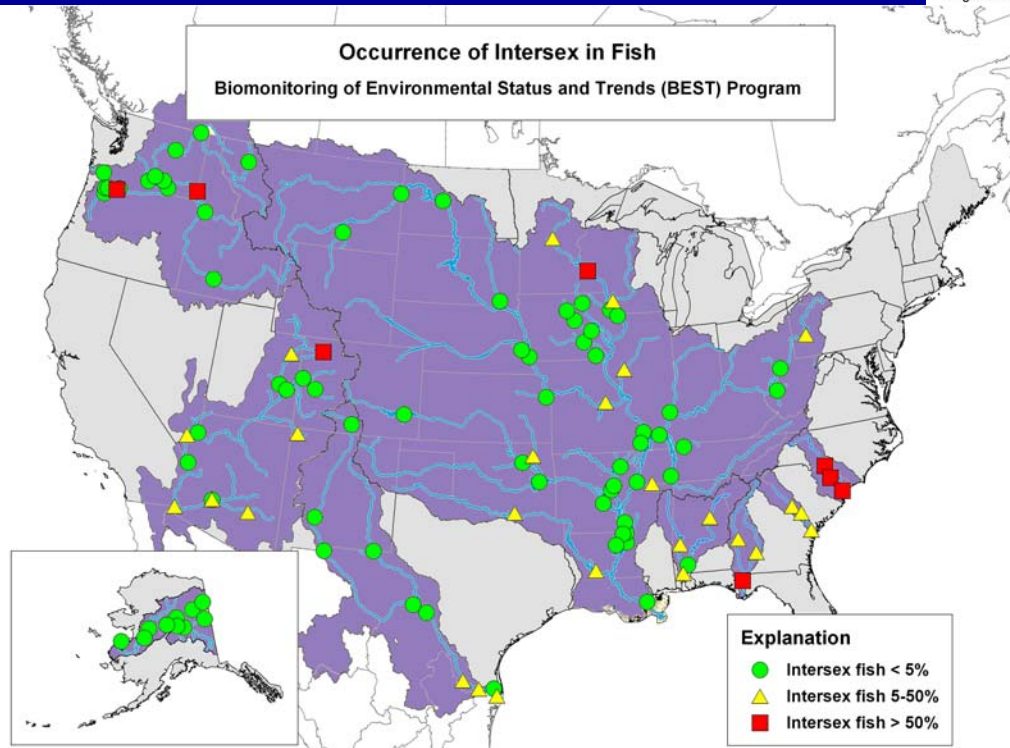


Figure 1. Regional boundaries and collection sites for common carp (magenta), largemouth bass (blue), and both common carp and largemouth bass (gold).

## Occurrence of Intersex in Fish Biomonitoring of Environmental Status and Trends (BEST) Program



● carp ● bass ● carp and bass

## Biomonitoring of Environmental Status and Trends (BEST)

- Large Rivers: Rio Grande, Mississippi River, Yukon, Columbia, Colorado, SE rivers
- Intersex and other biomarkers
- Contact: Hinck, Blazer, Tillitt

# Methods: Effects

- Injection techniques for fish or bird eggs
- Sex-linked color in Medaka
- Exposure of cell cultures

Tillitt, Papoulias, Heinz, Rattner, Ingersoll, Blazer



# Premature Spawning of Native Freshwater mussels

Prozac (fluoxetine) causes female  
freshwater mussels to prematurely release their larvae



*Lampsilis cardium*

Source [http://unionid.missouristate.edu/gallery/L\\_cardium/card004.jpg](http://unionid.missouristate.edu/gallery/L_cardium/card004.jpg)

Contact: Teresa Newton

# Effects of Estrogen on Brown Bullhead Leukocytes

- **Estrogen exposure reduces phagocytic index** – ability of phagocytic cells, such as macrophages and neutrophils, to engulf infectious agents
- **Estrogen reduces bactericidal activity** – ability of these cells to destroy engulfed agents by influencing at least two killing mechanisms:
  - **nitric oxide production**
  - **respiratory burst activity**

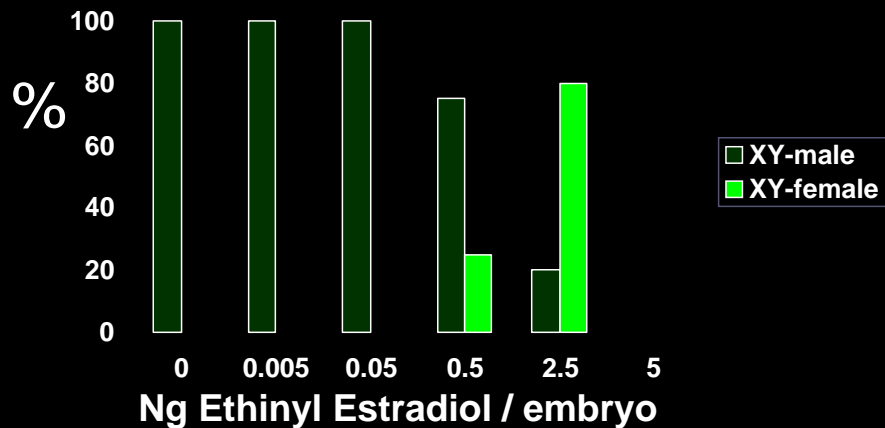
Contact: Vicki Blazer



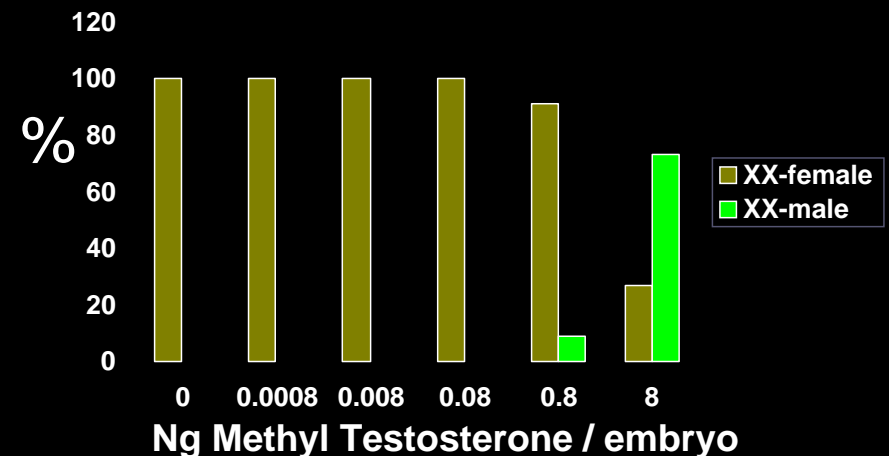


# Exposure to Hormones *in Ovo* affects Sexual Differentiation in *Medaka*

***In Ovo* Exposure to Ethinyl Estradiol Reverses Sex of Males**



***In Ovo* Exposure to Methyl Testosterone Reverses Sex of Females**



Contact: Diana Papoulias

male



female

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