

US EPA ARCHIVE DOCUMENT

Biological Science at the USGS: Understanding the Effects of CAFOs

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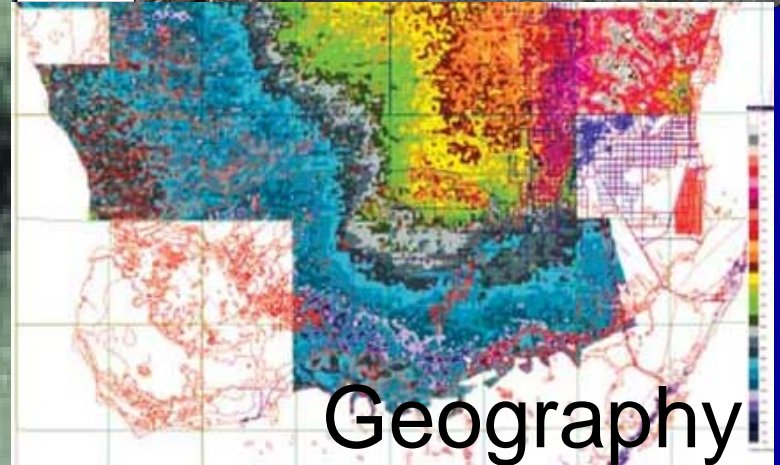
Sarah Gerould

Program Coordinator

Contaminant Biology Program

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

USGS Science Disciplines



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

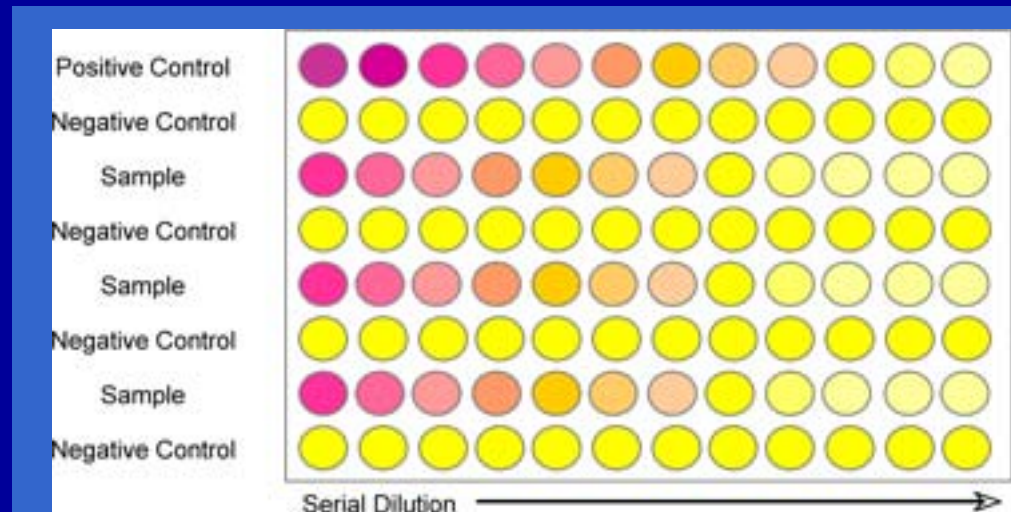


Contact: David Alvarez

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

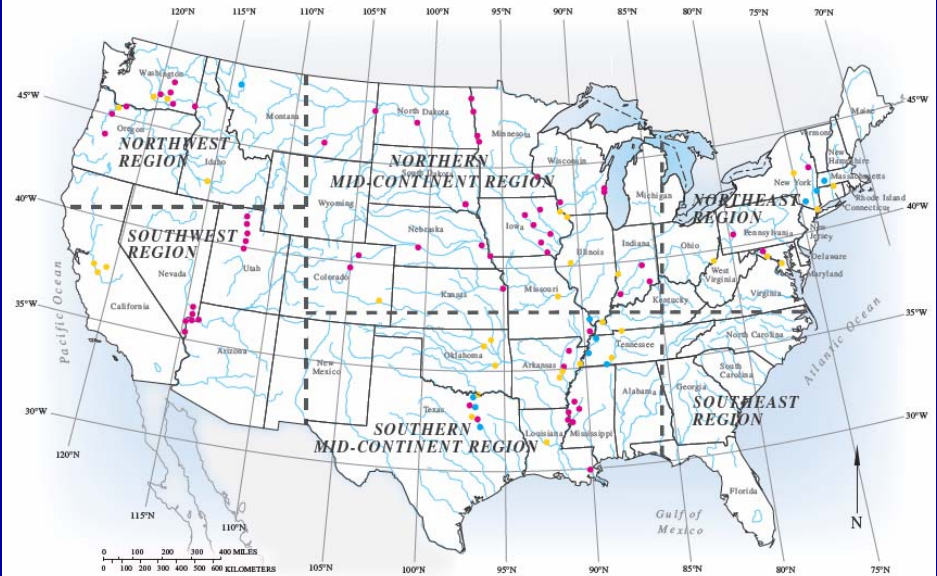
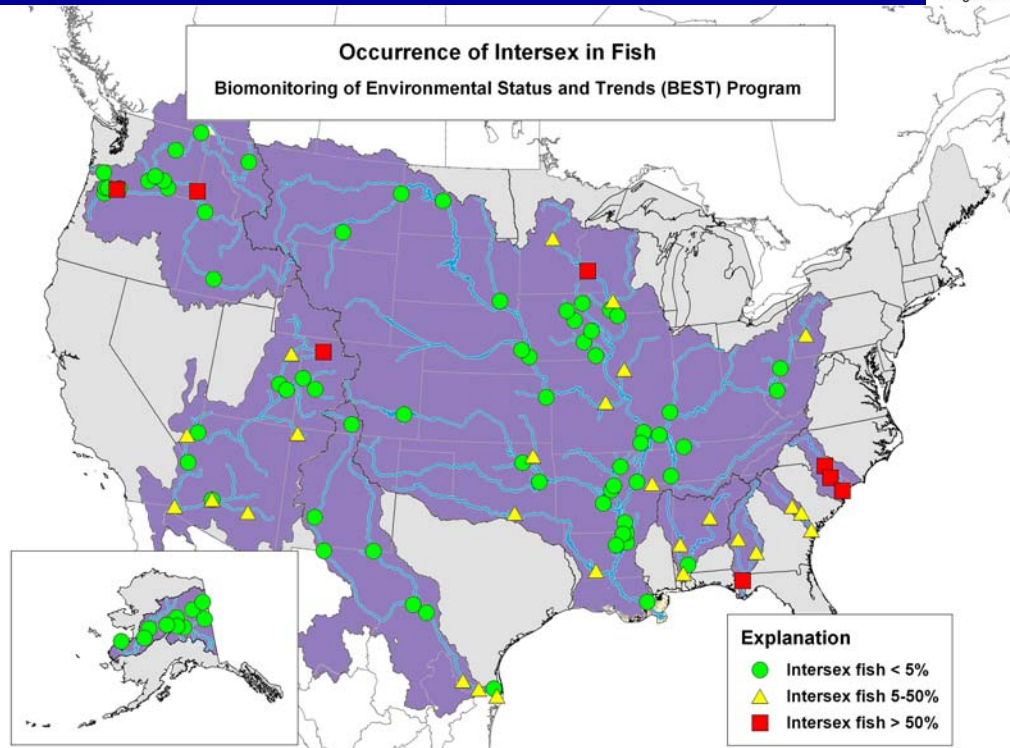


Figure 1. Regional boundaries and collection sites for common carp (magenta), largemouth bass (blue), and both common carp and largemouth bass (gold).

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

Contact: Teresa Newton

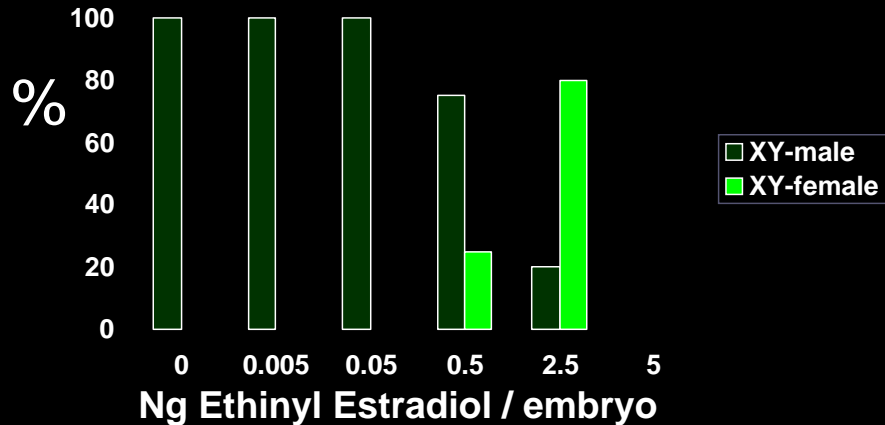
Effects of Estrogen on Brown Bullhead Leukocytes

- **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**

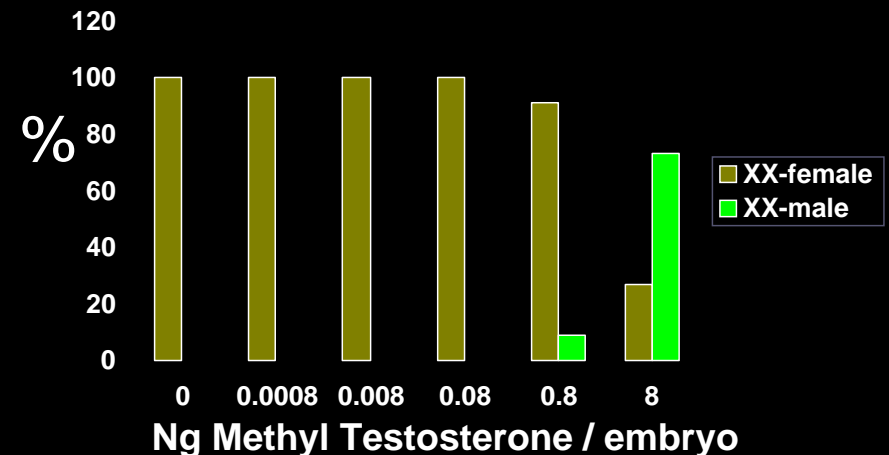
Contact: Vicki Blazer

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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