Biological Science at the USGS: Understanding the Effects of CAFOs

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Contaminant Biology Program
http://biology.usgs.gov/contaminant/

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USGS Science Disciplines

Biology

Geology

Hydrology

Geography
## Contaminant Biology Program

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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
SPMD
Semipermeable Membrane Device

Tools and Techniques
Membrane Devices for Time-Integrated Sampling

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).

Patent pending

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
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

Contact: David Alvarez
National Endocrine Reconnaissance Report
• ~2200 carp and 650 bass at over 100 sites
• Seasonal differences
• Plasma steroid hormones, gonadal stage, vitellogenin
• Contact: Goodbred

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

Contact: Teresa Newton

Source: http://unionid.missouristate.edu/gallery/L_cardium/card004.jpg

Lampsilis cardio

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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
Potomac Watershed
Prevalence of Intersex

Data from Fall 2005  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
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