

Organic Pollutants

- More than 10,000 have used and/or created by humans
- Regulation is difficult
- Negative effects on environment and organismal health
- A variety of sources



Organic Pollutants

- Types of organic pollutants:
 - Endocrine disrupting compounds
 - Environmental estrogens
 - Agricultural fertilizers
 - Petroleum products
 - Oil
 - Gasoline
 - Chlorinated hydrocarbons
 - Pharmaceutical drugs

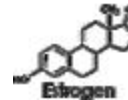


Organic Pollutants

- Problems associated with organic pollutants:
 - Costs associated with clean-up \$\$\$
 - Loss of organisms
 - Fishery
 - Terrestrial and aquatic birds
 - Microbial?
 - Changes in organisms
 - Feminization and infertility
 - Formation of human cancers

Organic Pollutants – EDCs

- Endocrine disrupting compound (EDC)
 - Definition: contaminants that may disrupt the endocrine system
 - Compounds that act as biological signals
 - Types: natural and synthetic
 - Example: environmental estrogens

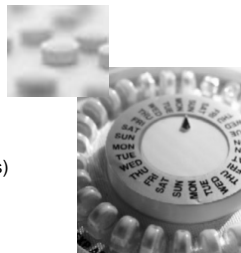


Organic Pollutants – eEDCs

- Types of environmental estrogens

1. Natural

- Human hormones
 - Released from body
 - Birth control pills
- Phytoestrogens
- Mycotoxins



2. Synthetic (estrogen mimics)

- Pesticides (i.e. DDT)
- Sunscreens
- Plastics

Organic Pollutants – eEDCs

- e-EDC (estrogen – endocrine disrupting compound)
 - e-EDCs function as estrogens and bind to estrogen receptors
 - Binding to estrogen receptors can cause organism problems:
 - Altered production, release, or action of natural hormones.
 - Laboratory studies show:
 - EDCs during development may cause permanent changes
 - Endocrine disruption may cause unforeseen effects
 - Bioaccumulation

Organic Pollutants – eEDCs

- Wildlife examples
 - Fish
 - Tadpoles
 - Nonfunctional testes in alligators
 - Mammals also affected
- Feminization could lead to other problems depending on amount of e-EDCs and organisms affected
 - Decrease in biodiversity
 - Extinction?

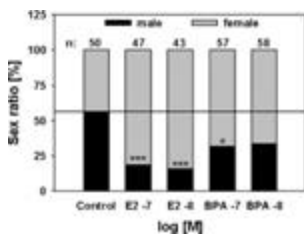


Organic Pollutants – eEDCs

- Case Study: *Xenopus laevis*, tadpoles (Levy et al., 2004)
 - Tadpoles were exposed to estrogen compounds during larval development (bisphenol A (BPA) and estradiol 17beta).
 - After developing into a frog, gonadal development was observed
 - Conclusion: BPA and estradiol induce feminization in *Xenopus laevis*

Organic Pollutants – eEDCs

- Case Study: *Xenopus laevis*, tadpoles



Key: E2 = estradiol 17beta
BPA = bisphenol A

n shows # of organisms in each group

* and *** shows statistical significance

Females were shown to increase with estrogens.

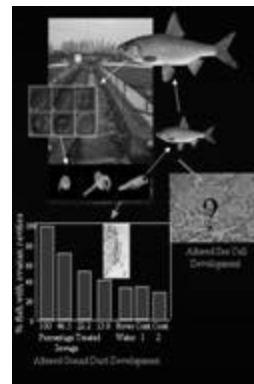
Organic Pollutants – eEDCs

Two groups of fish were looked at:

1. Treated sewage fish
2. River water fish

Sewage contains estrogens.

- The graph shows altered gonad duct development in sewage verses river water
- % of fish with ovarian cavities is higher in sewage fish



www.projects.ex.ac.uk/~critical_windows.htm

Organic Pollutants – eEDCs

- Case Study: Cheetahs at the Cincinnati Zoo (Setchell et al., 1987).
 - Cheetahs were not breeding and some had benign hepatomas
 - They suspected estrogens in the environment were contributing to the problems
 - No obvious source of estrogen was found
 - Cheetahs were getting phytoestrogens from food
 - Diet was changed, symptoms cleared up and kittens were born

A Local Connection

- A study at CU Boulder
 - Referenced S. Platte River and Boulder Creek
 - Gonadal morphology observed
 - 93% of white suckers collected in Boulder were female
 - 45% of white suckers collected in S. Platte River were female
- Why the difference??



Wastewater Effluent and Size

- Both collection sites were downstream of Wastewater Treatment Plants
 - Point-source of estrogen into aquatic environments
- They determined size of stream determines estrogen effects



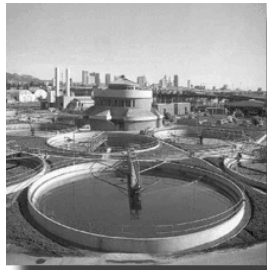
Organic Pollutants – eEDCs

- How do we solve this problem of organic pollutants like e-EDCs in our water?
- We need to go to one of the largest point sources first! – Wastewater treatment plants

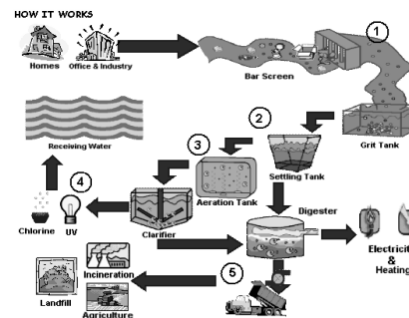
Organic Pollutants- the Clean-up

- Wastewater treatment plants

- Utilize microorganisms to degrade organics
- Current treatments remove some estrogens, but not all.



Organic Pollutants- the Clean-up Wastewater treatment



Organic Pollutants- the Clean-up Wastewater treatment

- Studies have shown that the wastewater treatment plants that allow for nitrification and denitrification aid in the removal of estrogens
- Ammonia-oxidizing *Nitrosomonas europaea* can naturally degrade certain estrogens (Shi et al., 2003)
- Hydraulic residence time (HRT), or the holding time of wastewater determines degradation that occurs.
- Most HRTs are 5-20 hours.
- The greater the HRT, the greater the biodegradation of organics– this includes estrogens.
- Johnson et al., 2000

Organic Pollutants- the Clean-up Other Solutions?

- Nanofiltration
- Activated charcoal
 - Used to absorb organic pollutants from aqueous environments (Mohan et al., 1996)
 - Does this work for estrogens?
- More research is being conducted to discover new techniques to solve the micropollutant problems.
- Water quality always a concern...