

The ABC's of EDCs: Endocrine Disrupting Chemicals in the Environment

David Quanrud

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What is an endocrine disrupting compound?

“An endocrine disruptor is an exogenous substance or mixture that alters function(s) of the endocrine system and consequently causes adverse health effects in an intact organism, or its progeny....”

From: *“Global Assessment of the State-of-the-Science of Endocrine Disruptors.”* International Programme on Chemical Safety, World Health Organization (2002).

Documented effects of EDCs in wildlife

- Adverse effects on fish development and reproduction
- Eggshell thinning in birds of prey
- Alligator population decline in a polluted lake (FL)
- Development of male sex organs in female marine animals such as whelks and snails

EDCs in the News

Denver Post (September 6, 2006)

Gender-bending pollution

Strange fish live downstream from Boulder and Denver sewage plants, a new study reports. Researchers found white sucker fish with sexual deformities and far more female fish than males in certain sections of Boulder Creek and the South Platte. New work identifies hormone-laden wastewater treatment effluent as the cause. Utilities aren't required to test for the chemicals, but federal officials are supporting more research to learn where the contaminants come from, how much is cleaned up in the treatment process and whether the contaminated river water could affect people.



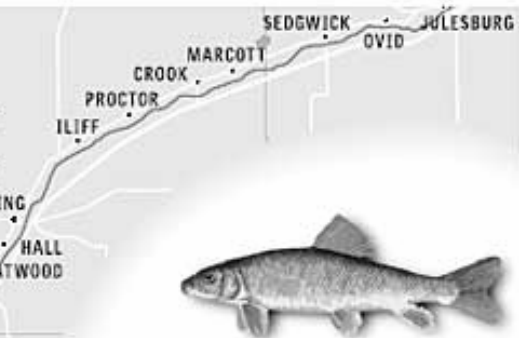
STUDY RESULTS IN THE FIELD
White sucker fish:

Upstream from Boulder's wastewater treatment plant:
18 females, 14 males, no intersex fish

Downstream:
49 females, 5 males, 4 intersex fish

Upstream from Denver's wastewater treatment plant:
4 females, 2 males, no intersex fish

Downstream:
16 females, no males, 4 intersex fish



White sucker
(Catostomus commersoni)

White suckers are the only fish found at some of the sites where wastewaters enters rivers, so field scientists compared sucker numbers, gender and physiology above and below wastewater treatment plants. Suckers grow between 12 and 20 inches long.



Fathead minnow
(Pimephales promelas)

Captive-bred fathead minnows are the EPA's test organism, used in controlled experiments. The small, quick-growing fish (about 2 to 3 inches long) are the "lab mice" of aquatic science.

THE LABORATORY

...sed in three types
...stewater effluent;
...upstream water
...and upstream

...ffluent and dilute
...producing a female
...higher than most

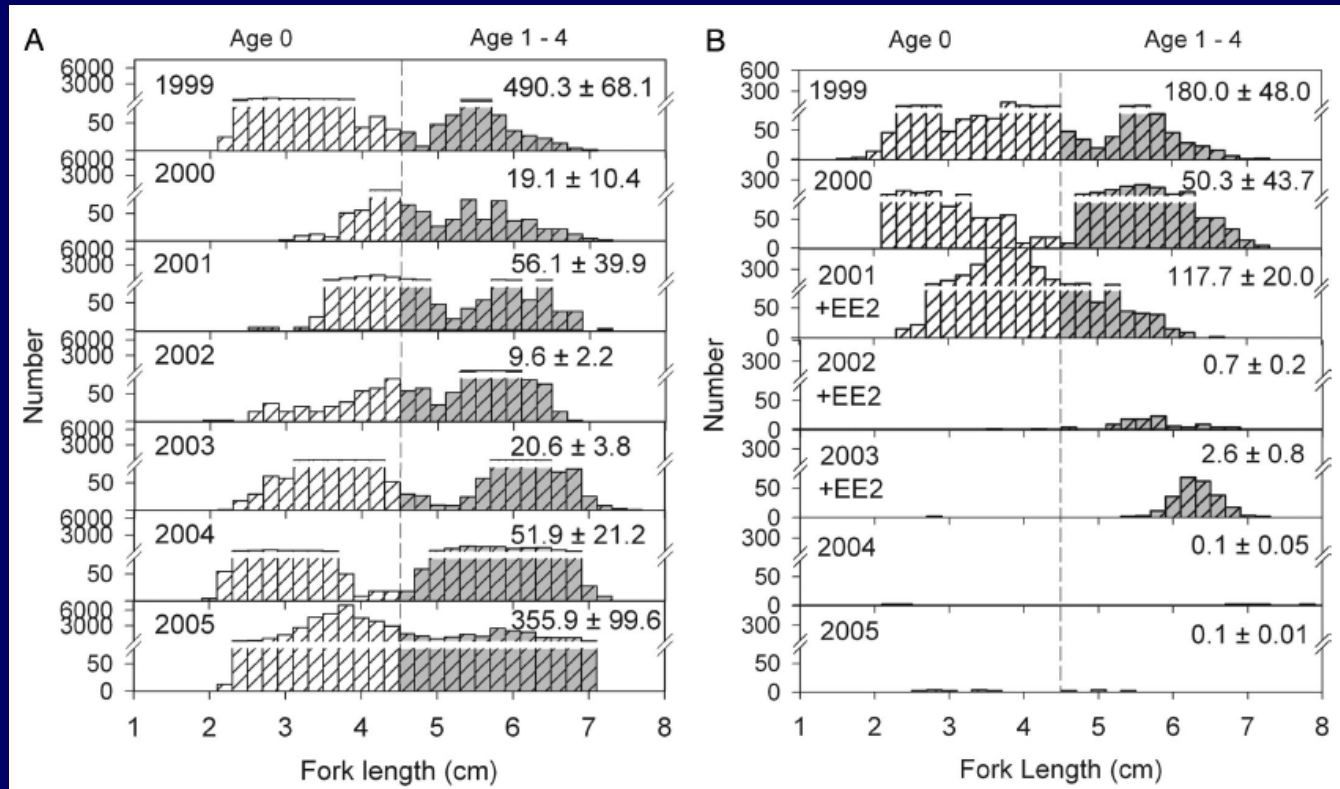
...effluent and dilute
...to lose their
...whisker-like
...ed with mating

...effluent and dilute
...diminish
...because they are
...perm

Sources: David Norris, University of Colorado, Comparative Biochemistry and Physiology

EDC effects at the population scale

- Field study at Canadian research lake, Ontario
- Fathead minnow population collapsed after two years of estrogen addition

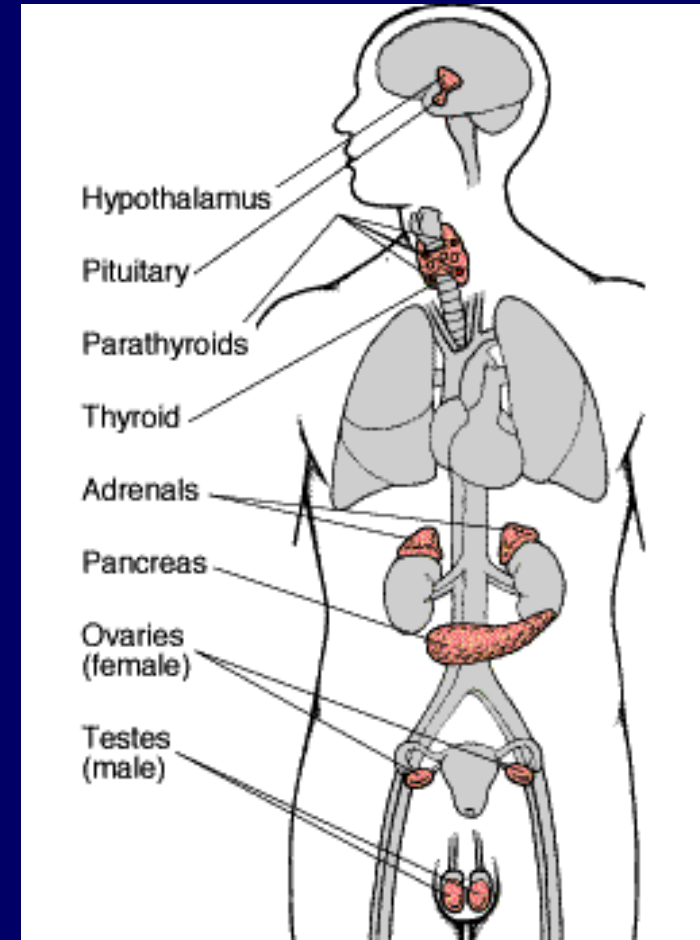


Speculated effects of EDCs in humans

- Reductions in male fertility and declines in the numbers of males born
- Abnormalities in male reproductive organs
- Female reproductive diseases including fertility problems, early puberty, and early reproductive senescence
- Increases in mammary, ovarian, and prostate cancers

How do endocrine disrupting compounds act?

- reduce hormone production in endocrine glands
- mimic or counteract hormones at target tissues



The USEPA has identified three important categories of EDCs

- Estrogenic
- Androgenic
- Thyroid active

Examples of known EDCs in wastewater

- Natural hormones (*estrogens*)
 - Estradiol
 - Estrone
 - Estriol
- Synthetic compounds
 - Ethinyl estradiol (birth control pill)
 - Alkylphenols, e.g. nonylphenol (surfactant byproduct)
 - Bisphenol A (polycarbonate plastic)
 - PBDEs (flame retardant; partially phased out)

EDCs in the News

AZ Daily Star (March 18, 2007)

Common chemical in hard plastics may be hazardous to health

By Susanne Rust

MCCLELLY TRIBUNE

Although its name may not be familiar, bisphenol-A is everywhere. It's in the lining of your soup can, the clear plastic of your baby's bottle and the sealants covering your teeth.

But it might be harmful to your health.

An expert panel of endocrinologists, statisticians and biologists was called together this month by a federal agency to review a report on this ubiquitous chemical. The final review, which was supposed to be announced earlier this month, was postponed.

For several years, scientists have been

concerned about bisphenol-A. Hundreds of papers have shown that it can be toxic in extremely low doses.

Traces of bisphenol-A have been found in nearly every American tested for it.

The chemical mimics estrogen and binds to estrogen receptors on cells. In more than 100 experiments conducted

on lab animals, it has been shown to cause genetic changes leading to prostate cancer, as well as decreased testosterone, low sperm counts and signs of early female puberty.

Work also has been done on human

See BISPHENOL-A, A5

SAFETY TIPS

Polycarbonates can be identified by the recycling No. 7, which often appears with arrows in the shape of a triangle on the bottom of containers. Bottles that show wear, are cracked, or are cloudy should be discarded. Exposing these products to high temperatures should be avoided.

Bisphenol A

- Ingredient in polycarbonate plastic, epoxy resin
- Water bottles, CDs, epoxy lining in metal cans
- Controversial: some studies find low dose estrogenic effects, other studies do not

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Answers to these and other questions: What are **endocrine disruptors**? How do we know **endocrine disruptors** are dangerous? What can I do to reduce my risk of ...

www.nrdc.org/health/effects/qendoc.asp - 19k - [Cached](#) - [Similar pages](#)

[Endocrine disruptor - Wikipedia, the free encyclopedia](#) ✓

Endocrine disruptors are exogenous substances that interfere with the **endocrine** system and disrupt the physiologic function of hormones. ...

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US EPA's **Endocrine Disruptor** Screening Program (EDSP) home page.

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Describes the coordination of US federal government efforts to examine the hypothesis that there are chemicals present in the environment of humans and ...

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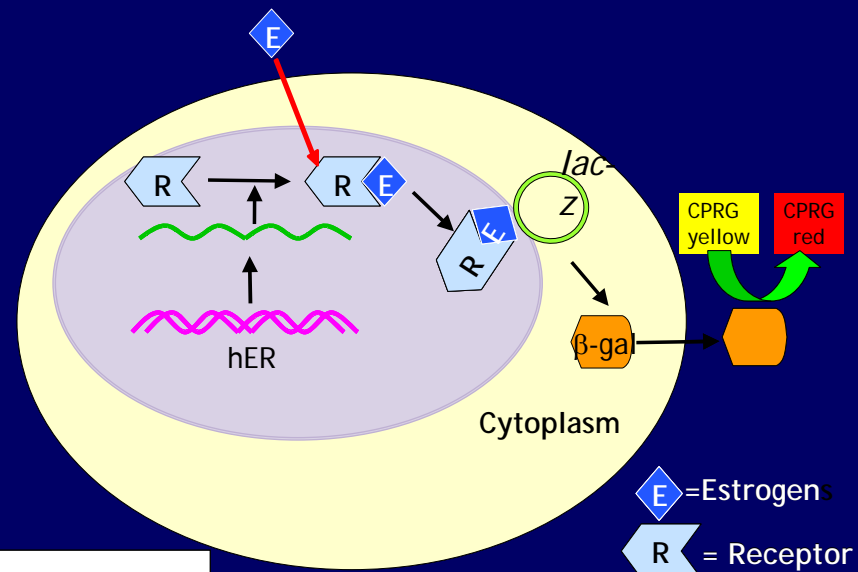
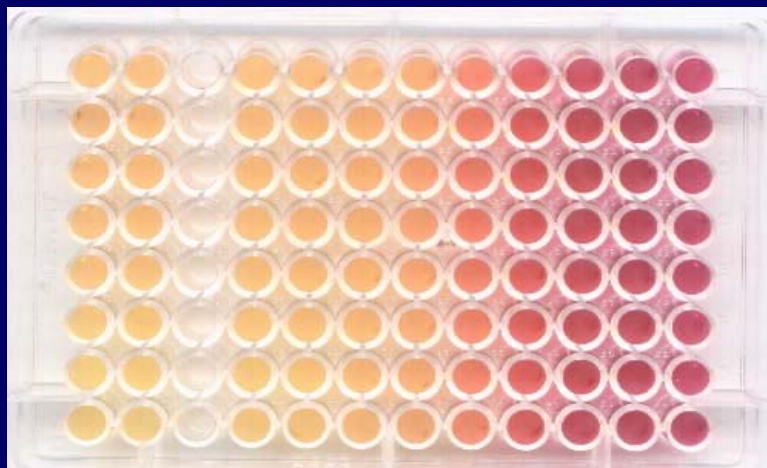
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Question:

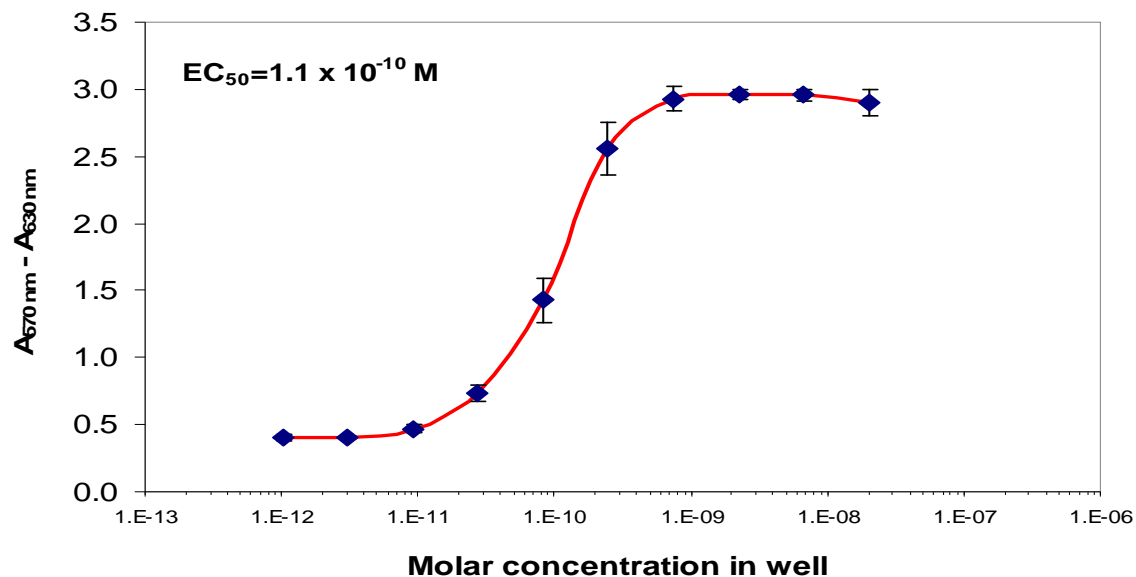
How can we measure estrogenic compounds in environmental samples?

- Individual chemical measurements
- Collective measurement using bioassays
  *Total estrogenic activity*

Yeast estrogen screen (YES) bioassay

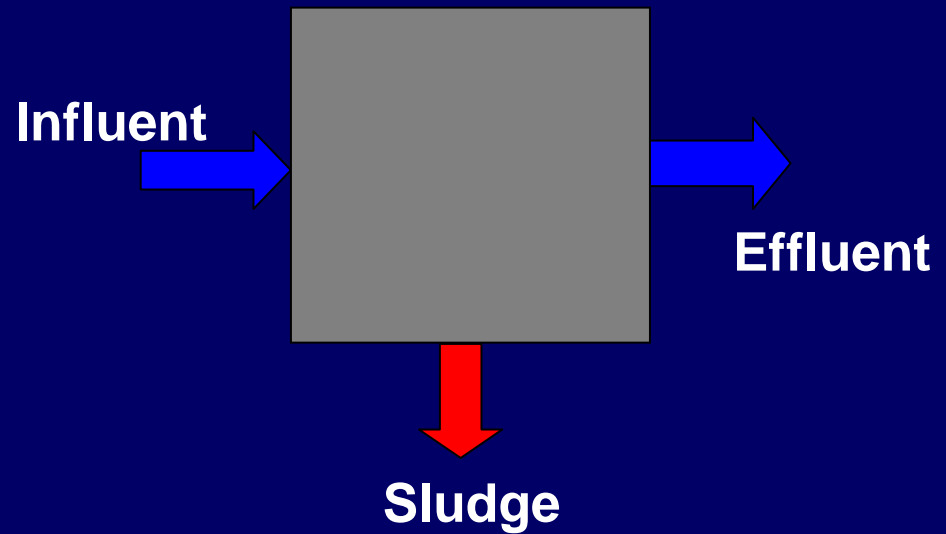


17- α Ethinylestradiol



Estrogenic Activity: Comparison of six Arizona WWTPs

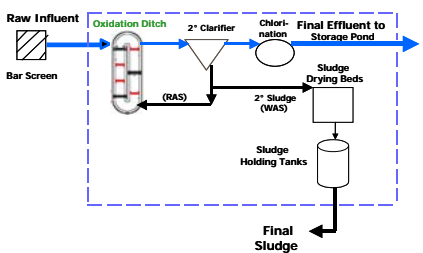
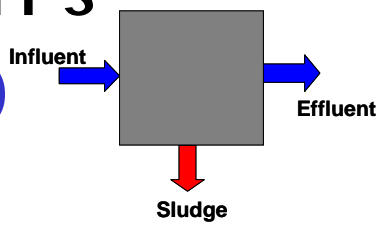
Oxidation ditch
Membrane bioreactor
Nitrification/denitrification
Activated Sludge (pure O ₂)
Biotower #1
Biotower #2 (longer SRT)



Preliminary Comparison of six Arizona WWTPs

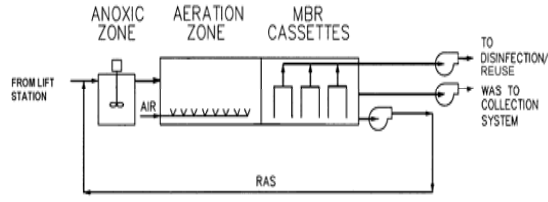
Influent to effluent estrogenic activity removal (%)

Overall estrogenic activity removal (%)



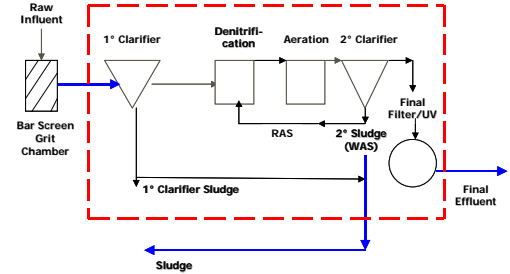
Oxidation ditch

98 97



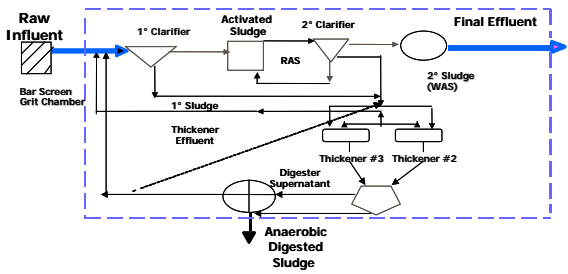
Membrane bioreactor

98 97



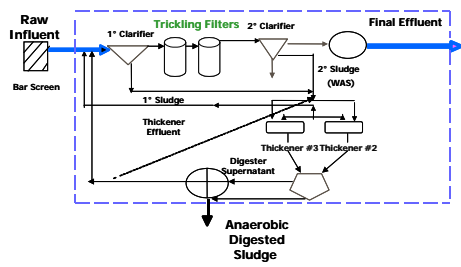
Nitrification/denitrification

99 99



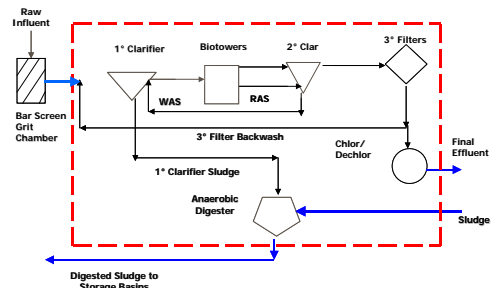
Activated sludge

71 65



Biotower #1

31 26



Biotower #2

85 54

Summary

1. EDCs include estrogens, androgens, and thyroid active compounds
2. Removal of estrogenic activity during wastewater treatment is dependent on process selection/efficiency
3. There is a lot we don't know about a lot of trace organics in wastewater