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science for a changing world

Emerging Contaminants in the Environment

EDC Roundtable
Elgin, IL

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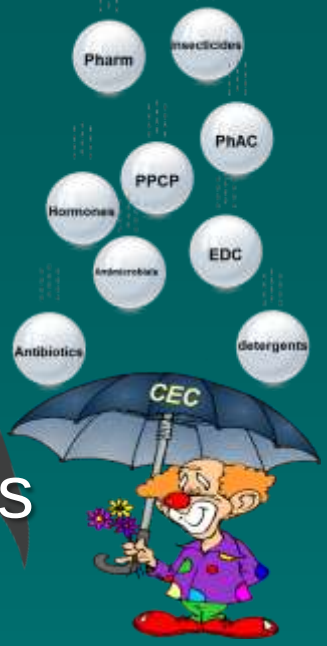
U.S Department of the Interior
U.S. Geological Survey

EC "umbrella term"

- Antibiotics
- Hormones
- Natural toxins
- Fragrances
- Detergents
- Plastics
- PFOS / PFOA
- Pathogens
- Resistance genes
- Human/vet drugs
- Byproducts
- Fire retardants
- Disinfectants
- Fumigants
- Plant/animal sterols
- Insecticides/Repellants
- Algal toxins/mycotoxins
- Nanomaterials



Better Living Through Chemistry

From our homes, farms and workplaces

To our water resources

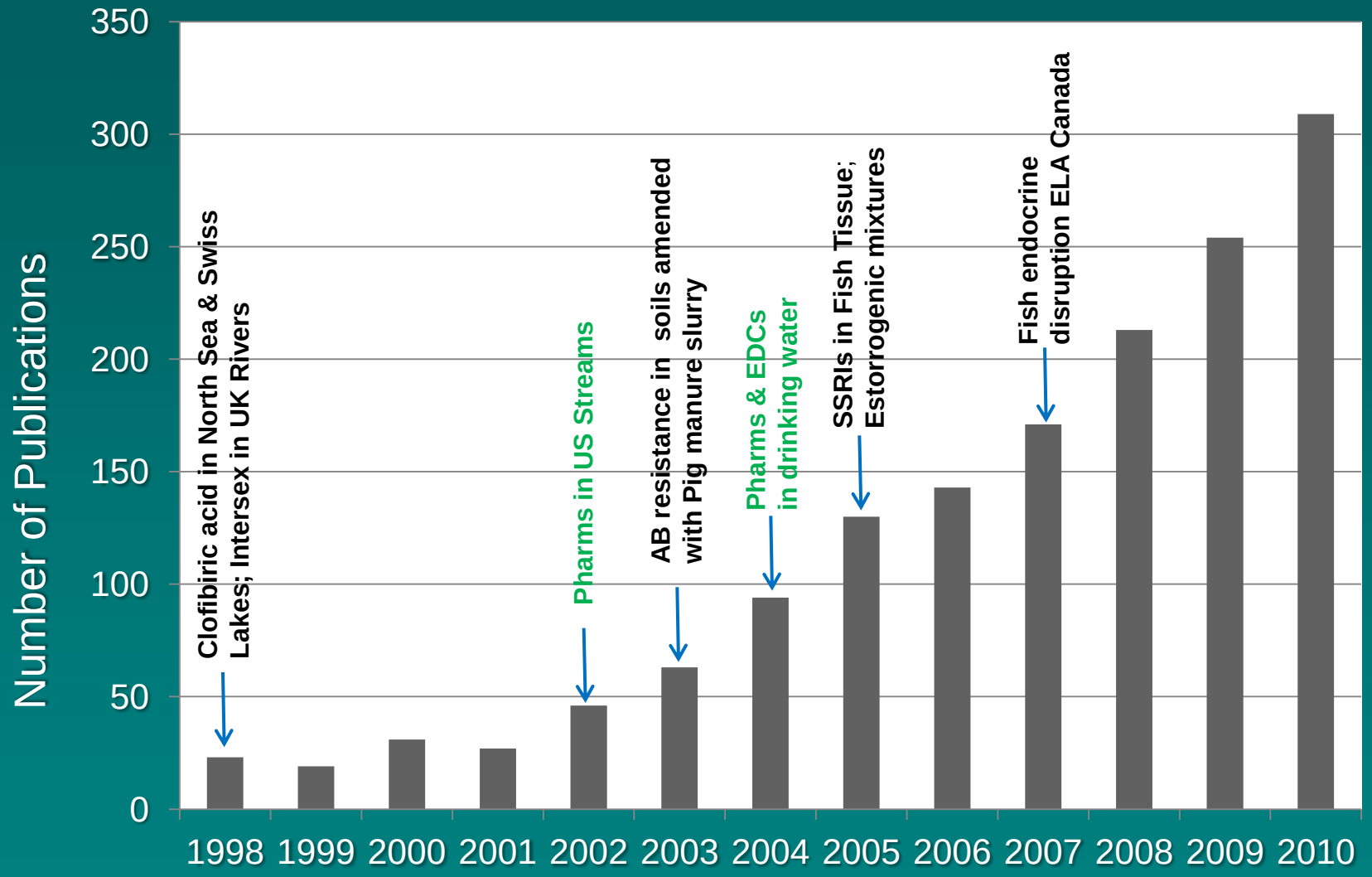
x1000s of chemicals are in use daily

Not your father's caffeine….

Fundamental Research Questions

- *Are ECs entering our environment?*
- *What are the sources (signatures)?*
- *What happens to them in the environment?*
- *Do they have adverse ecological health effects?*
- *Do unintended exposures pose a human health risk?*
- *How can we minimize their entry to the environment or remove them?*

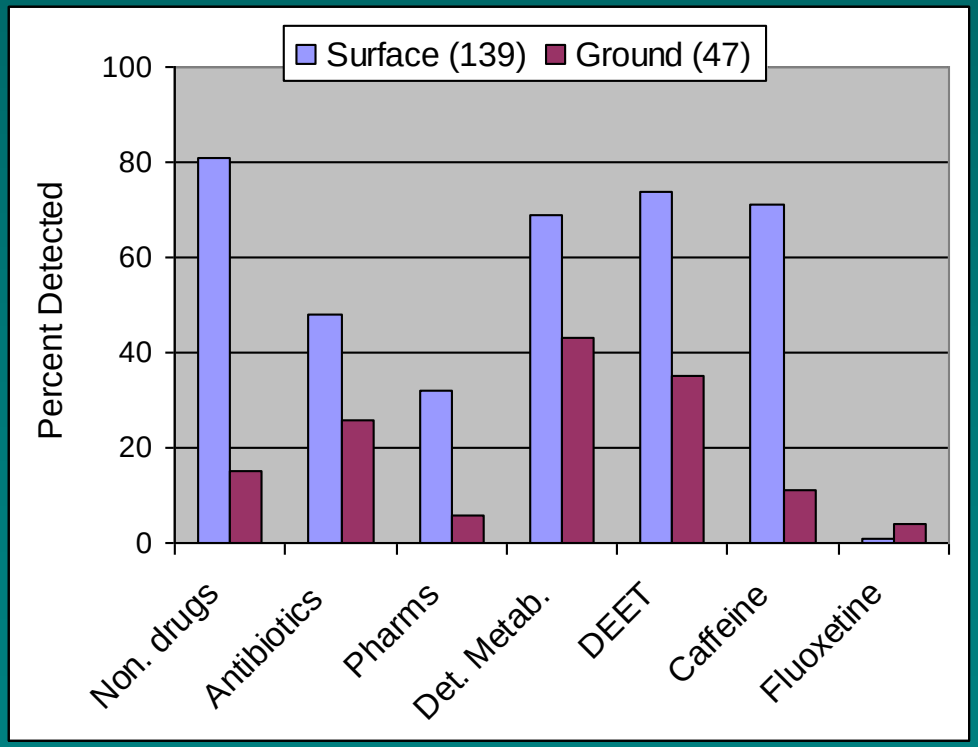
Increasing Research on ECs - Six target journals



Glassmeyer, 2010

Are ECs entering our environment?

- Present in ground water and streams at *sub-ppb conc.'s*.
- Present as complex *mixtures*.
- Entering via *human & animal waste pathways*.



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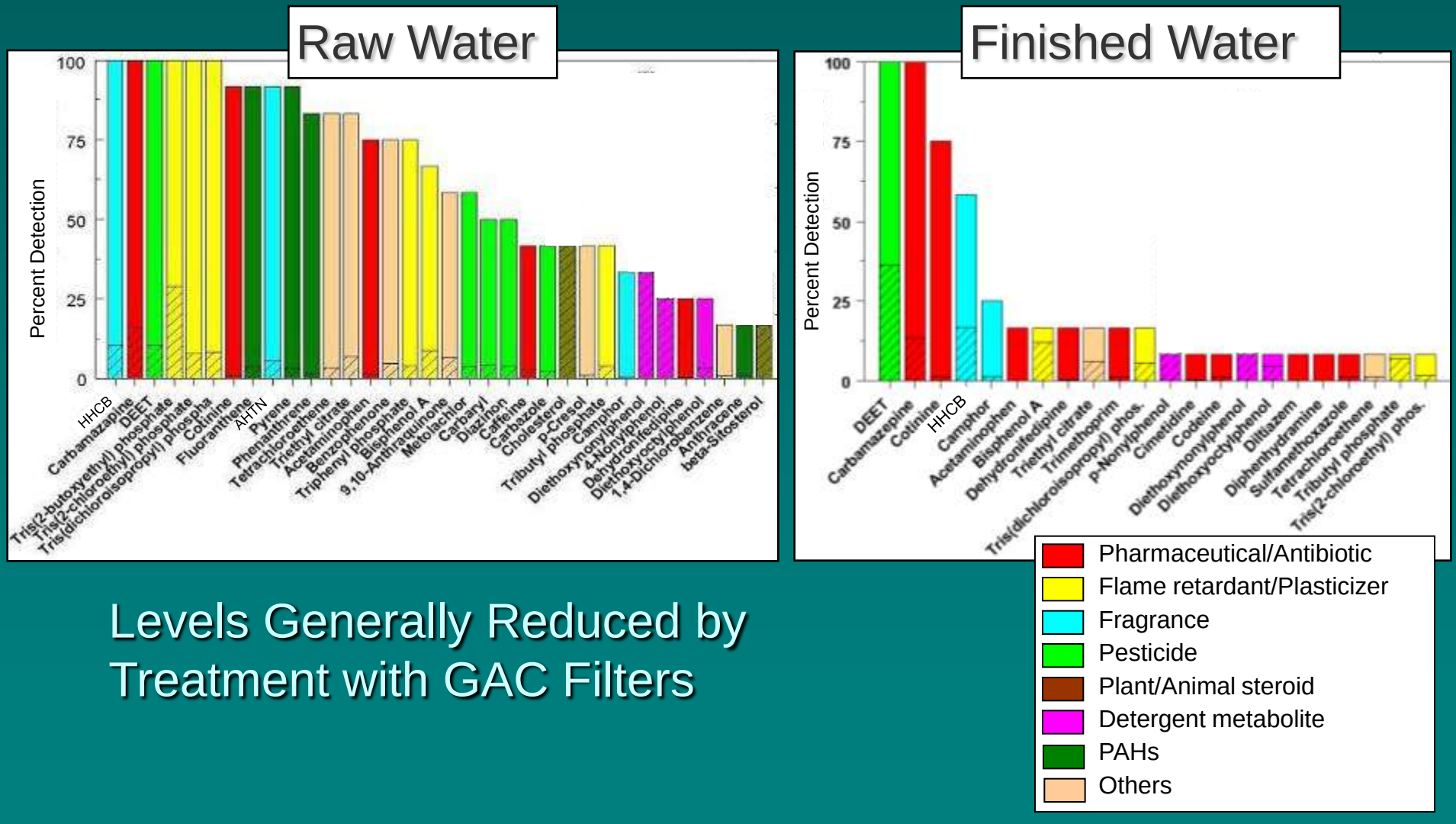
(Kolpin, et al., 2002; Barnes et al., 2008; Focazio et al., 2008)

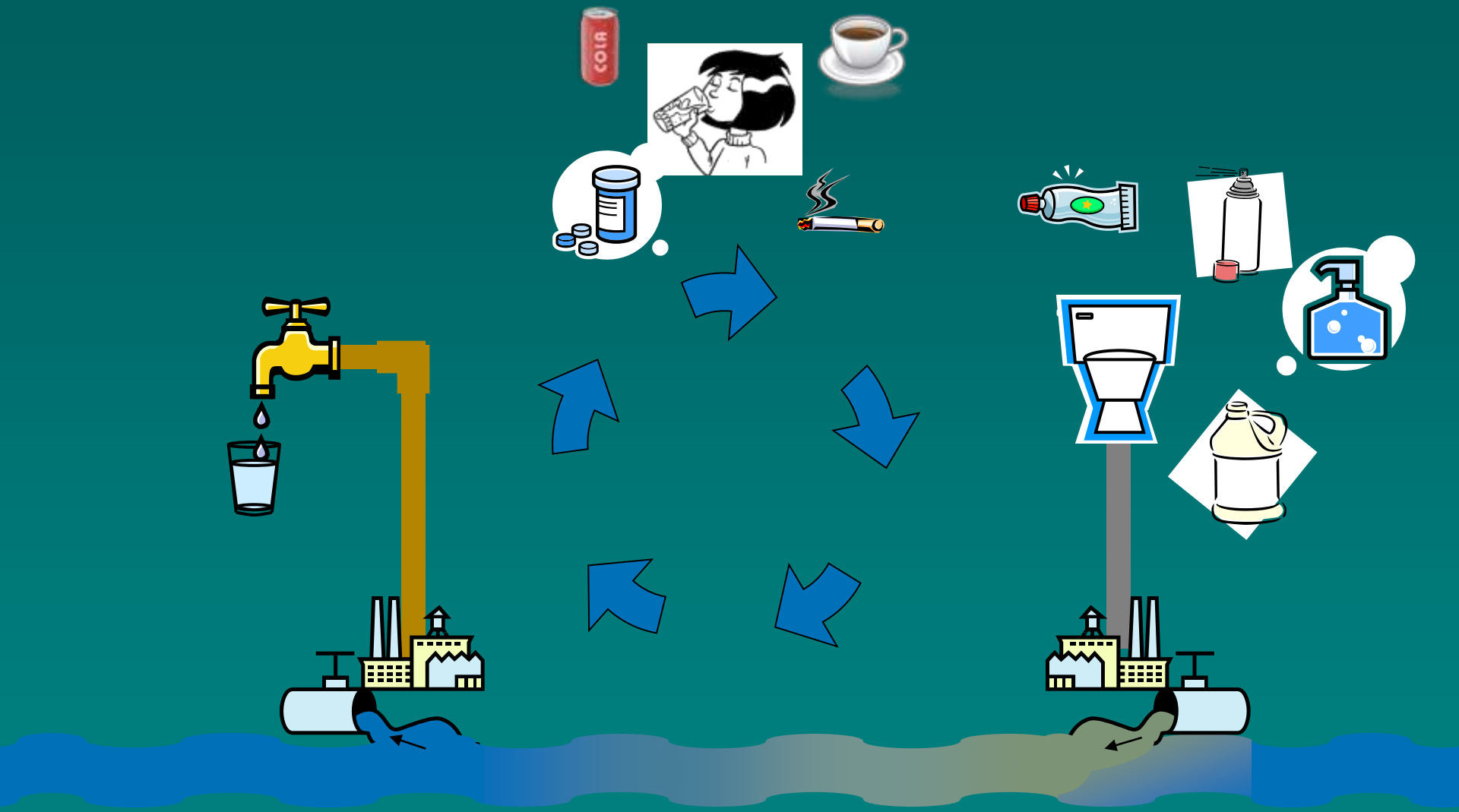
Removal in Treatment, NJ Facility



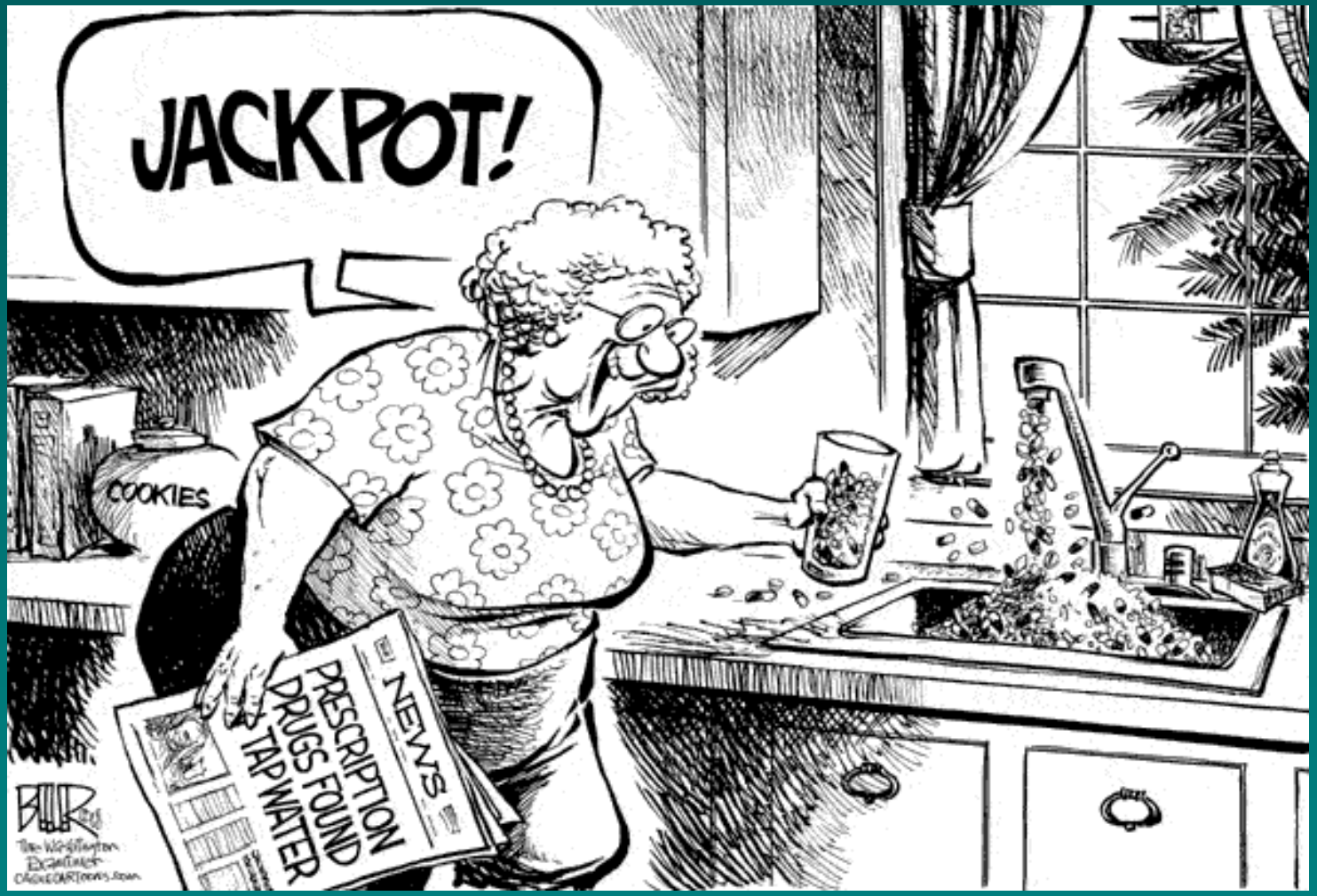
Levels Generally Reduced by Treatment with GAC Filters

Stackelberg et al., 2004 & 2007

Water “Cycle”



EPA Susan Glassmeyer


JACKPOT!
COOKIES
NEWS
PRESCRIPTION DRUGS FOUND IN TAP WATER

Uptake into Plant and Animal Tissue

- Trimethoprim: in carrots & lettuce; *Boxall et al., 2006*
- Sulfamethazine: in corn, lettuce, potatoes; *Dolliver, et al., 2007*
- Triclosan & Trimethoprim: in earthworms; *Kinney et al., 2008*
- Diclofenac: in mussels; *Ericson et al., 2010*
- BPA: in fish; *Mita et al., 2011*
- Antidepressants: in fish; Schultz et al., 2010
- Triclosan: in dolphins; *Fair et al., 2009*

Ubiquitous Human Exposure

Dermal

- cosmetics, soaps, other personal care products
    - exposure to triclocarban after showering (Schebb et al., 2011)

Diet

- food and drink

Inhalation

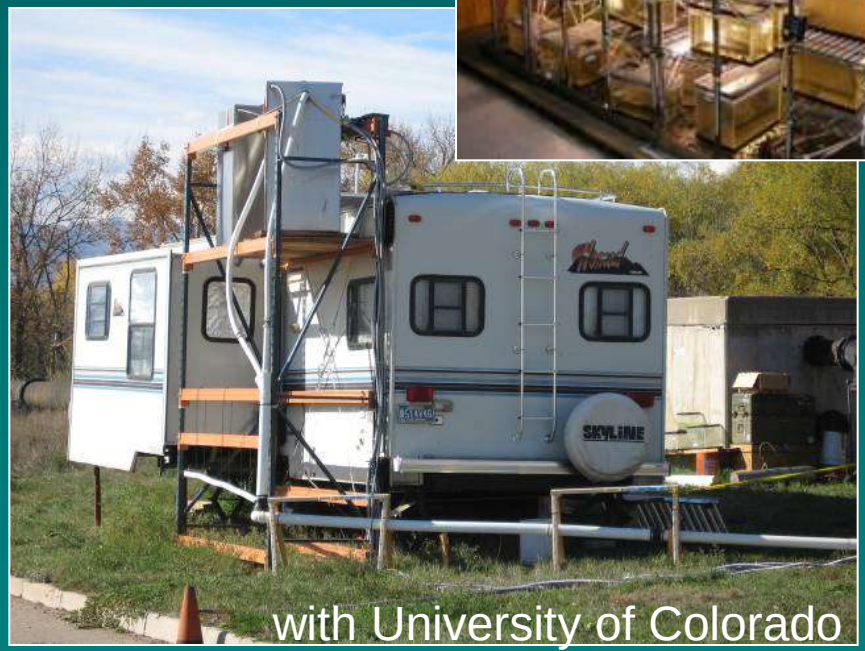
- e.g. household dust

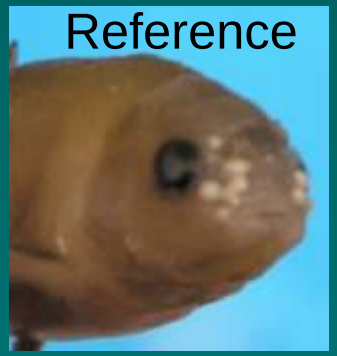
Occupational exposure

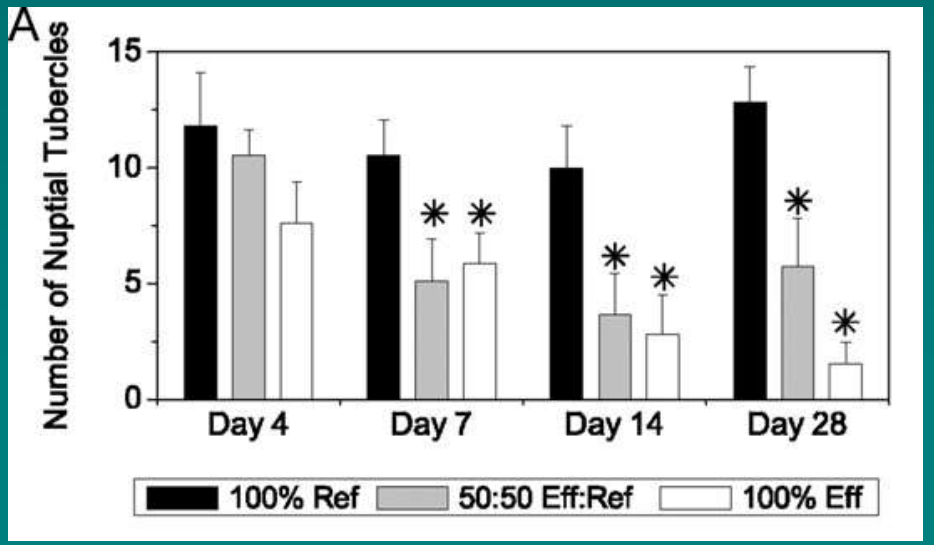
Evidence for Ecological Effects

- Progestin: Disruption of oviduct and ovary development in frogs; *Kvarnryd et al., 2011*
- Sulfamethoxazole: Affected denitrification rates in bacteria; *Underwood et al., 2011*
- Triclosan: Inhibited soil microbial respiration; *Butler et al., 2010*
- Trenblone: Irreversible fish masculinization; *Morthorst et al., 2010*
- Antidepressants: Impaired predator avoidance behavior larval fathead minnow; *McGee et al. 2009.*

An Approach to Linking Chemical Exposure and Endocrine Disruption







On Site - stream waters with controlled photo-period and water temp.

Vajda et al., 2011

Human Health Effects?

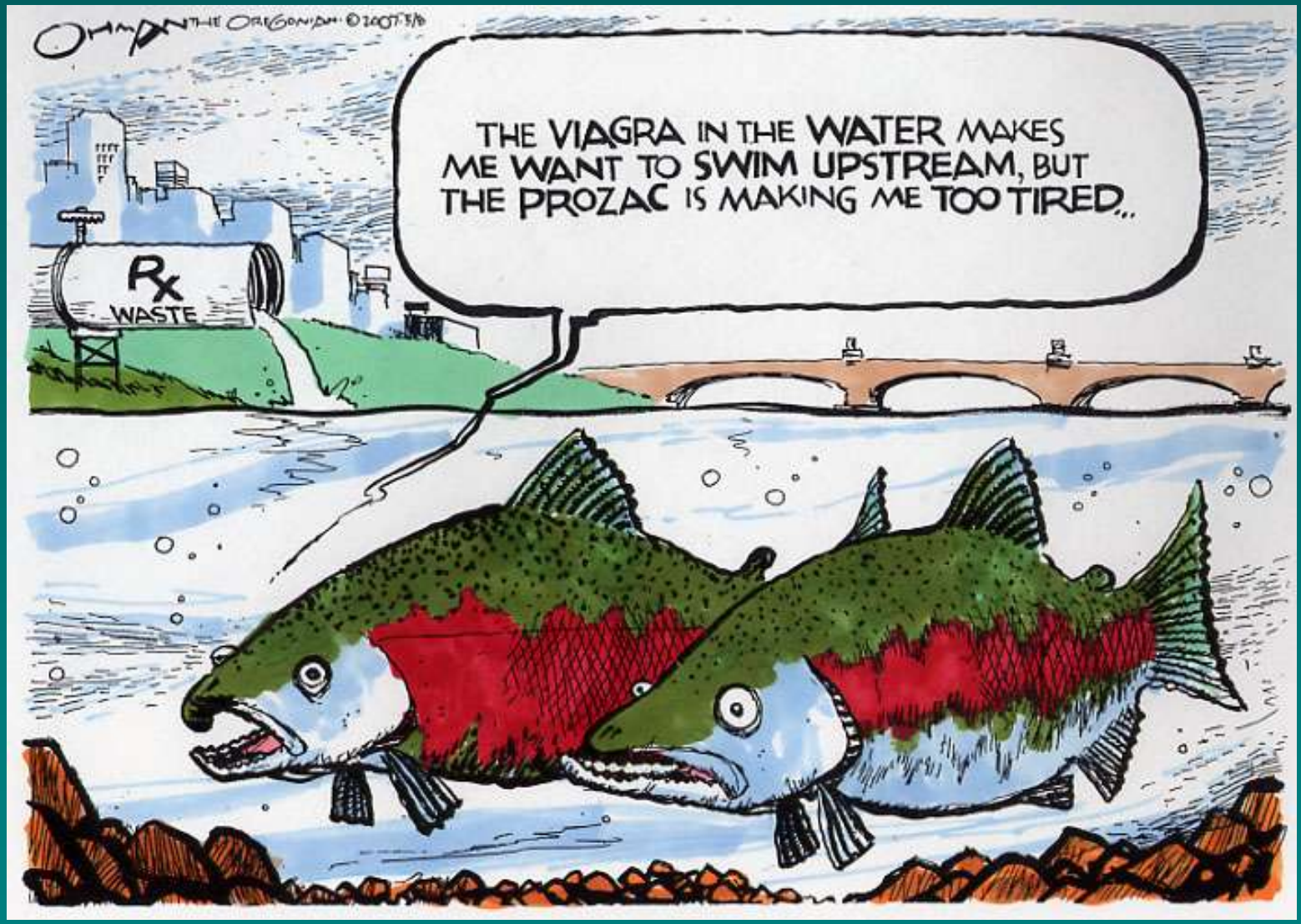
- Less is known related to human health effects
  - difficulty in conducting epidemiological studies
- Concern of fetal exposure
  - classic example: diethystilbestrol
- Animals as sentinels
- View that adverse effects from pharms in drinking water are not expected (Bruce et al., 2010; WHO, 2011)

New Questions Raised

- Epigenetics
  - e.g. chemical modification of DNA (Choudhuri, 2010)
  - fetal basis of adult disease (early exposure → late effects)
- Transgenerational transmission
  - chemicals exposed to now could impact future generations

Novel lab and field approaches needed to fully understand the ultimate effects from exposures to complex mixtures

Questions?



toxics.usgs.gov/regional/emc