JOHNS HOPKINS BLOOMBERG SCHOOL of PUBLIC HEALTH

Antimicrobial Pesticides in Aquatic Environments

Implications for the Great Lakes

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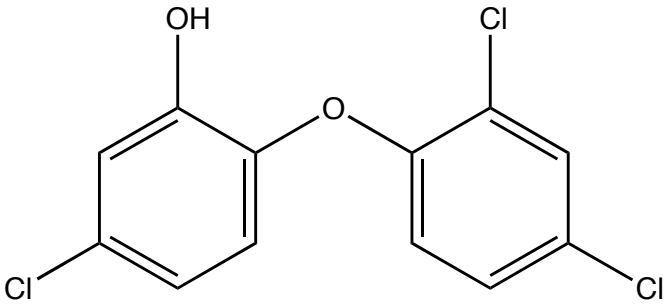
Overview

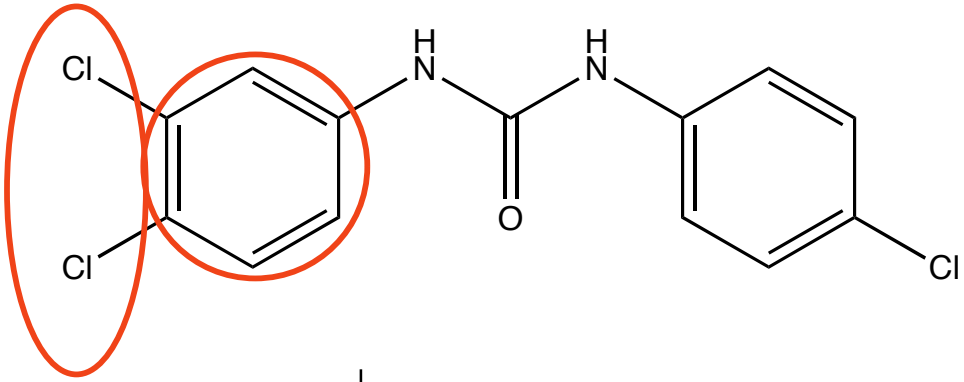
- **Emerging pollutants**
  - Wastewater treatment plants as sources
- **Antimicrobials in sediment**
  - Data from the Chesapeake Bay & Jamaica Bay
- **Implications for the Great Lakes**
  - The aquatic food web

Antimicrobials

Triclosan (TCS)



Triclocarban (TCC)



Property	Triclosan	Triclocarban
Year Introduced	1964	1957
Log K_{OW} (at 25ºC, pH 7)	4.8	4.9

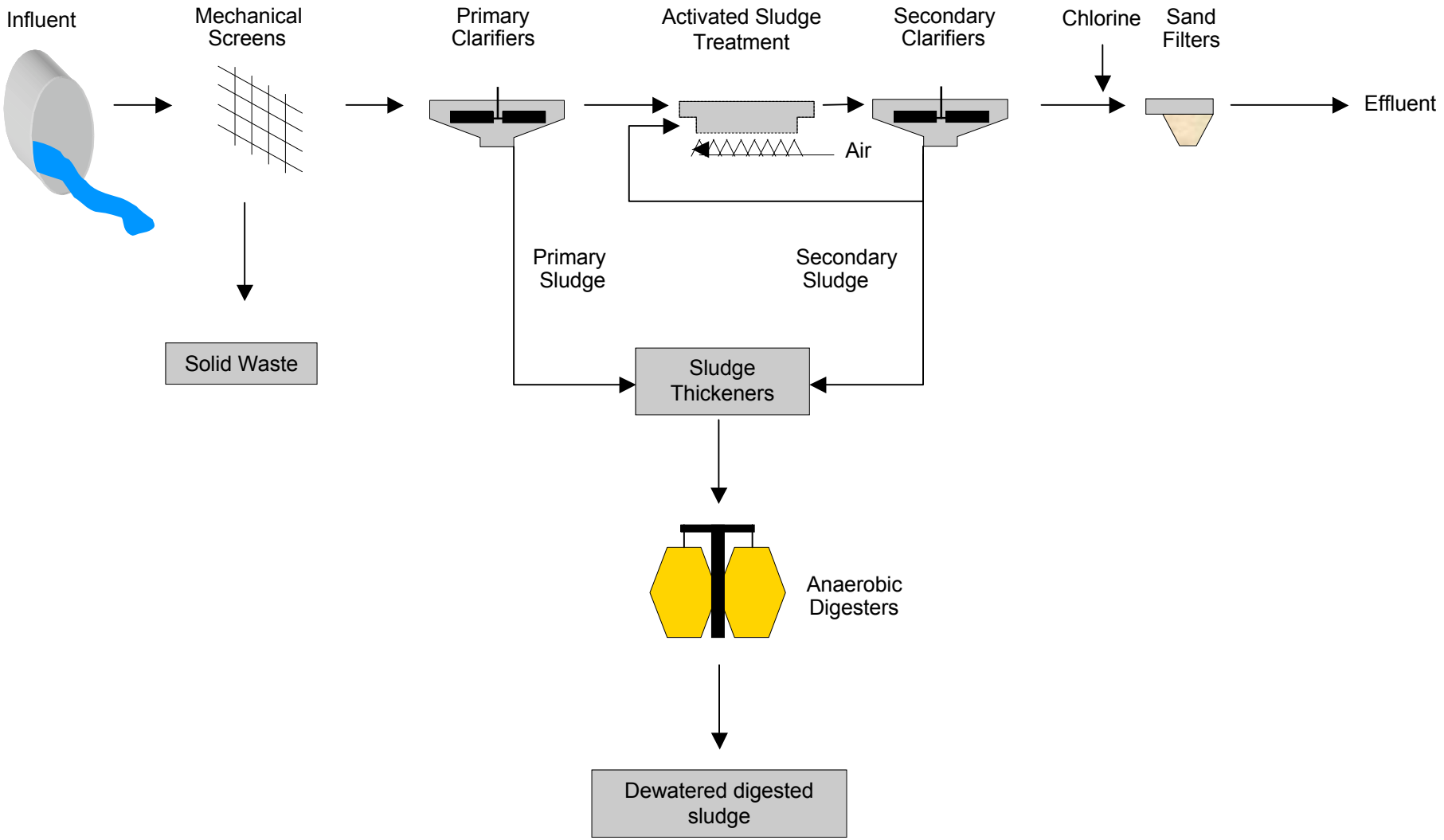
For each molecule in water, there are ~10^5 in octanol (fat)

>1500 New Antimicrobial Products Since the Year 2000

- Production is increasing
- Benefits have been called into question (FDA, 2005)
- New risks are emerging

Image: Beyond Pesticides

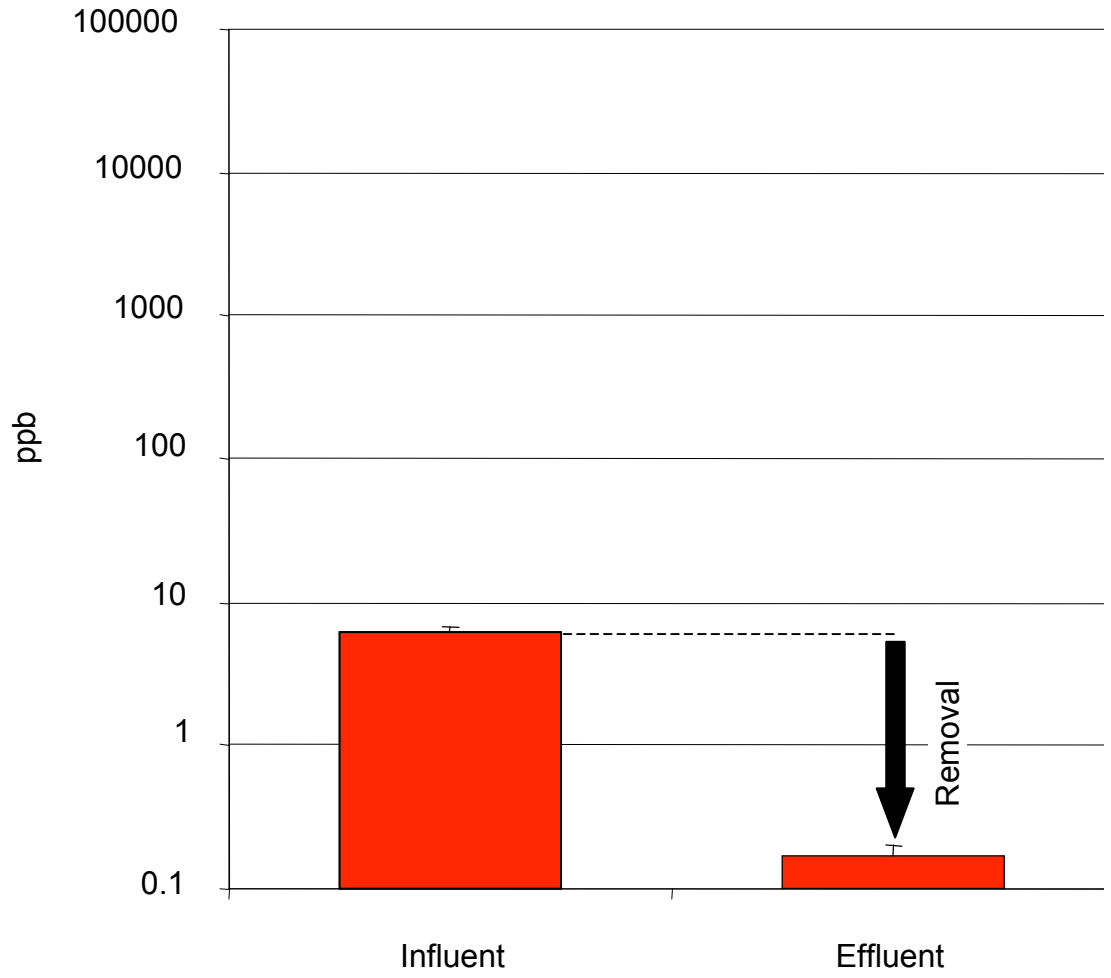
Wastewater Treatment:
use of optimized natural processes for water purification



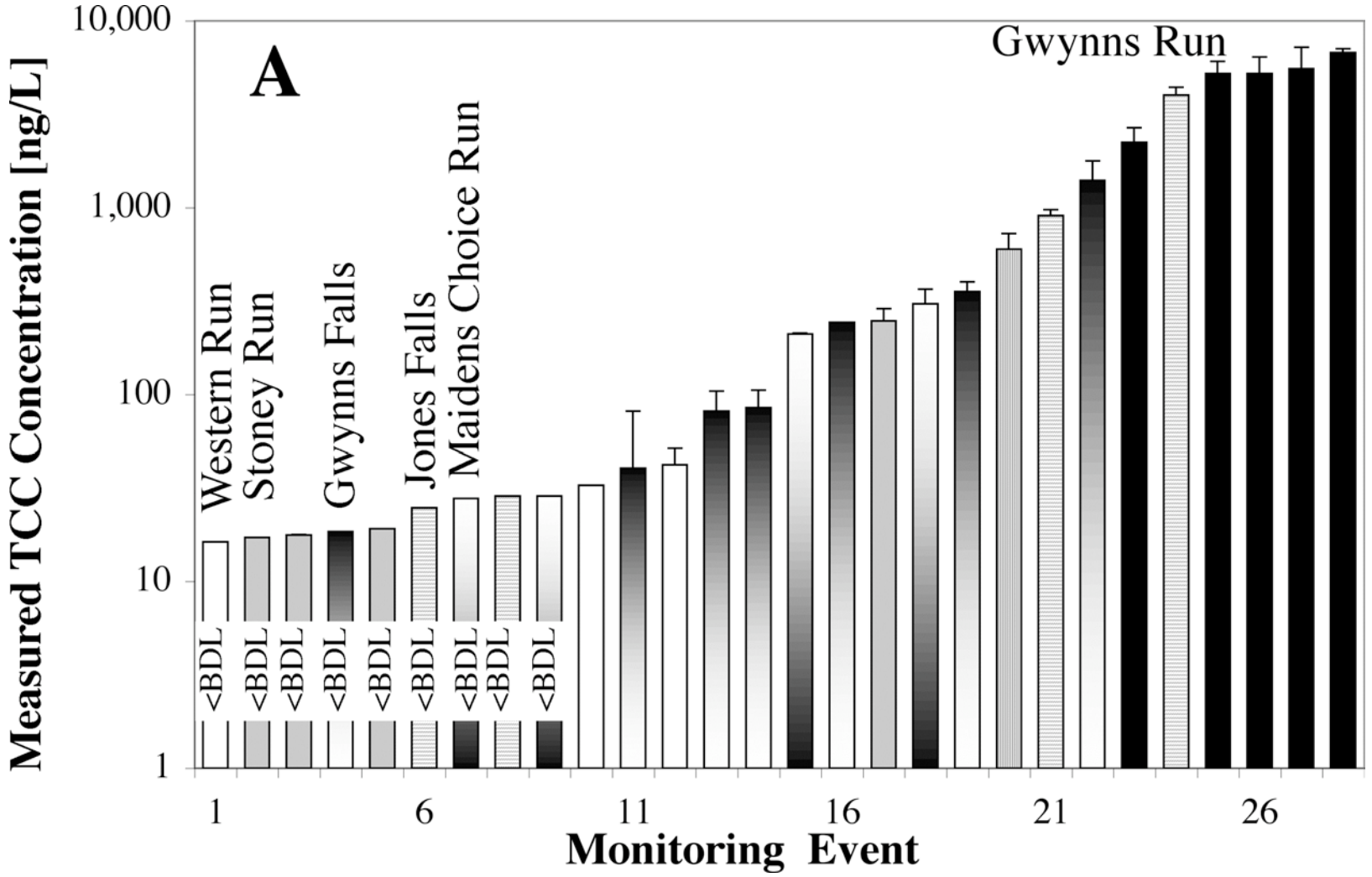
ES&T 40(11) 3634-39, (2006)

Are Low Effluent Concentrations A Problem?

TCC

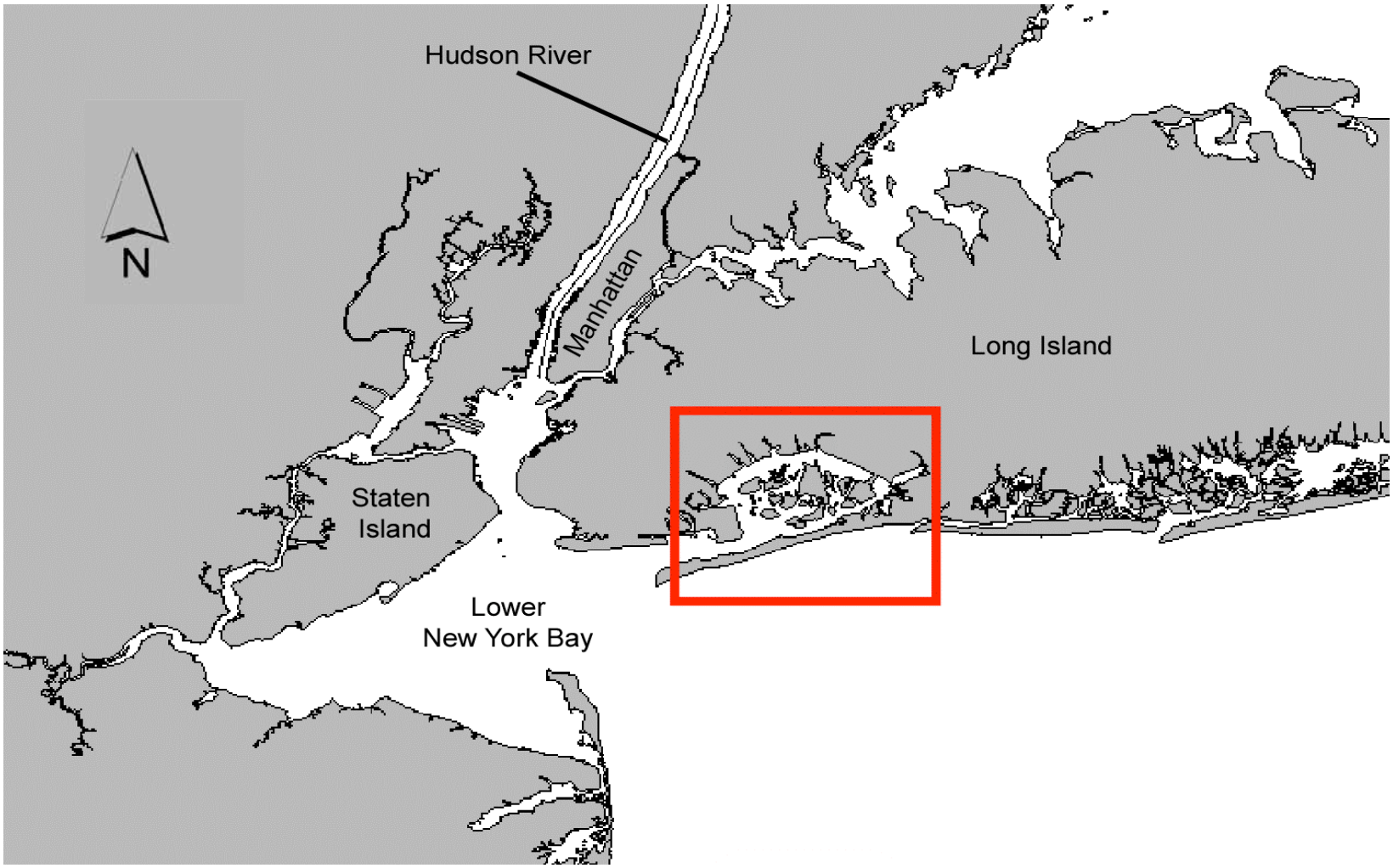


Triclocarban Contamination in Baltimore Streams



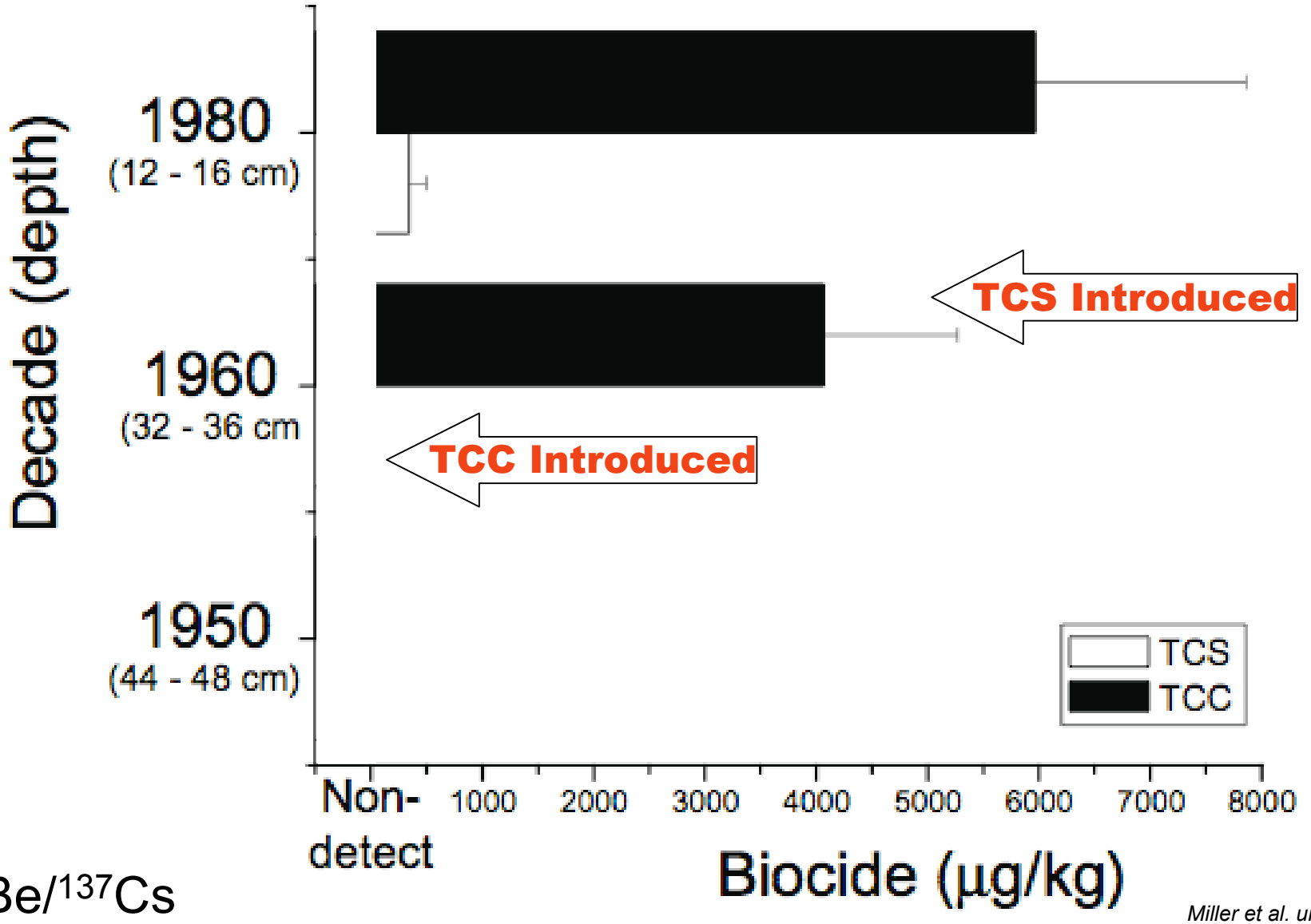
Halden & Paull, ES&T 38(18):4849-4855 (2004)

Jamaica Bay, New York




Wastewater
Treatment
Plant
JFK Airport

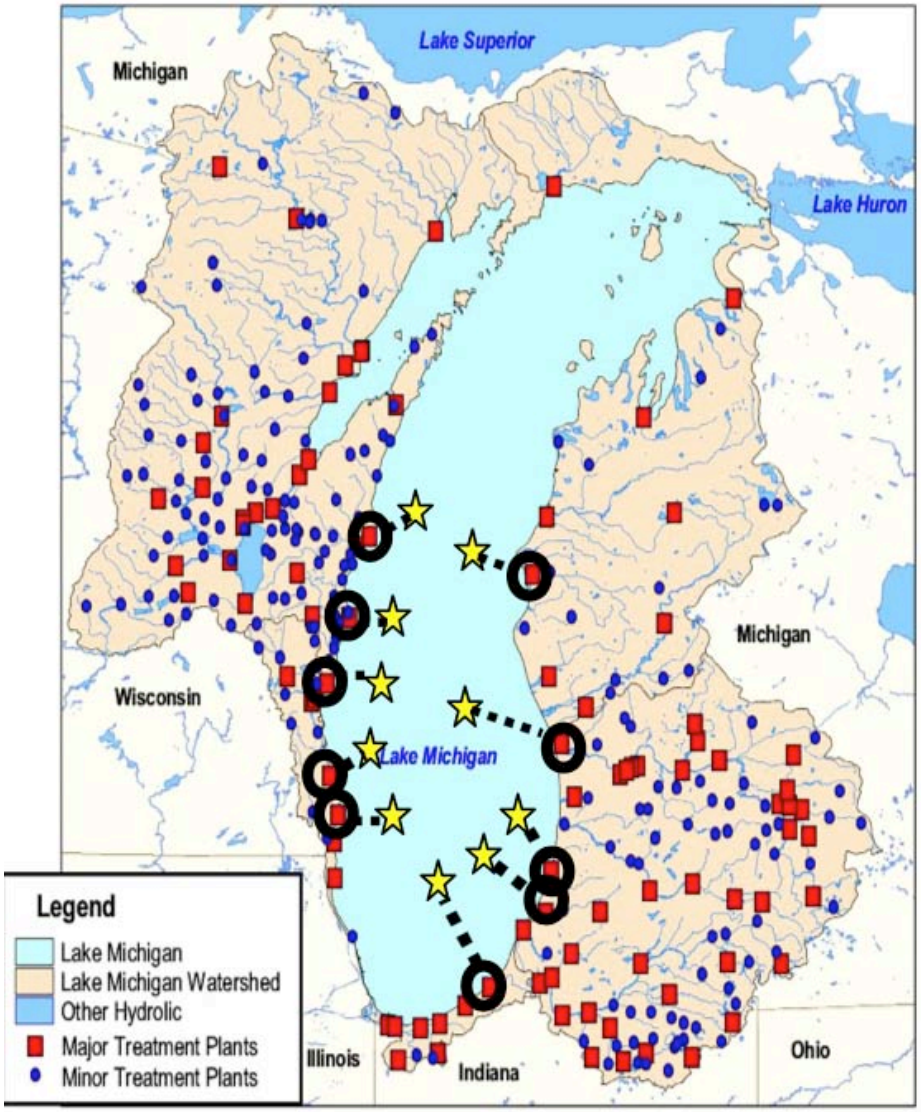
Aquatic Sediment Concentrations: A Mirror of Biocide Production History



$^{7}Be/^{137}Cs$

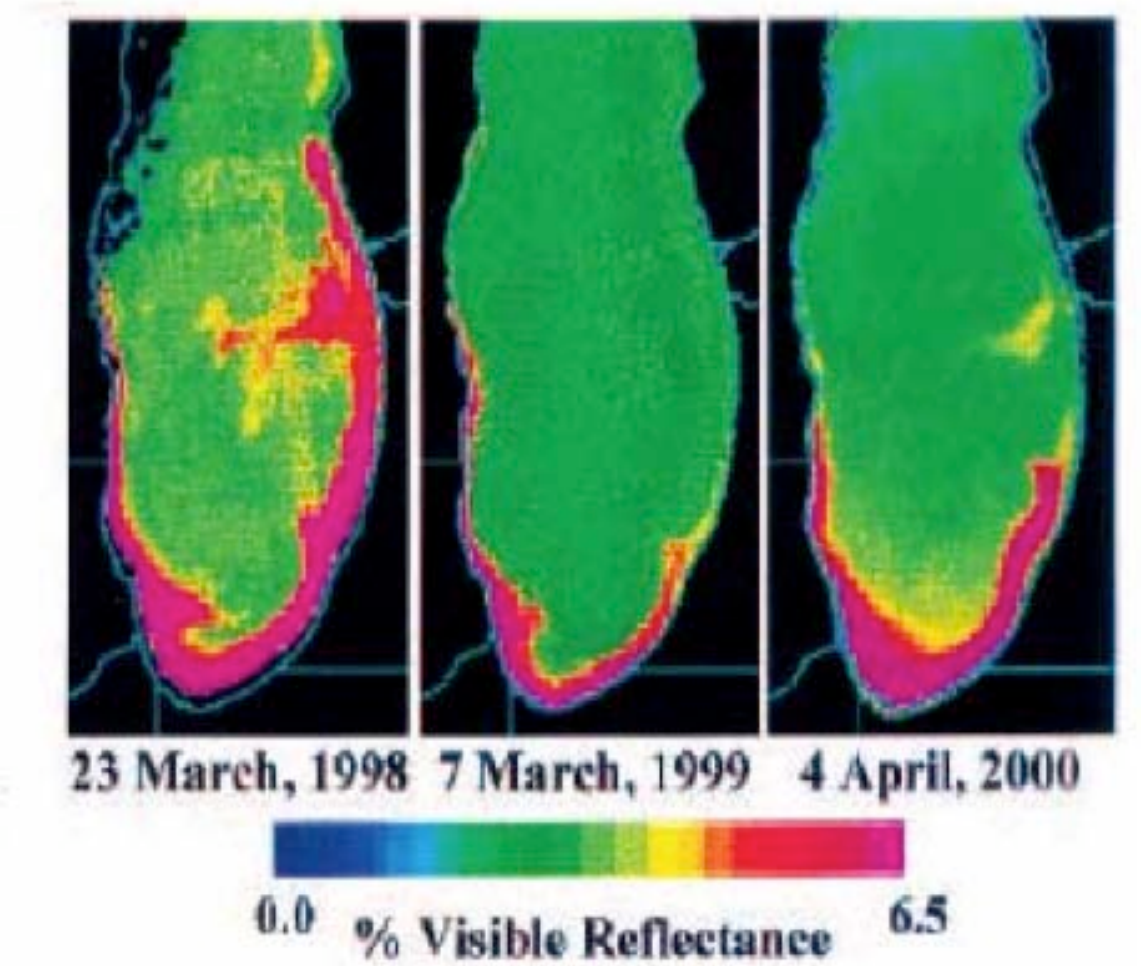
Miller et al. unpublished data

Implications for the Great Lakes



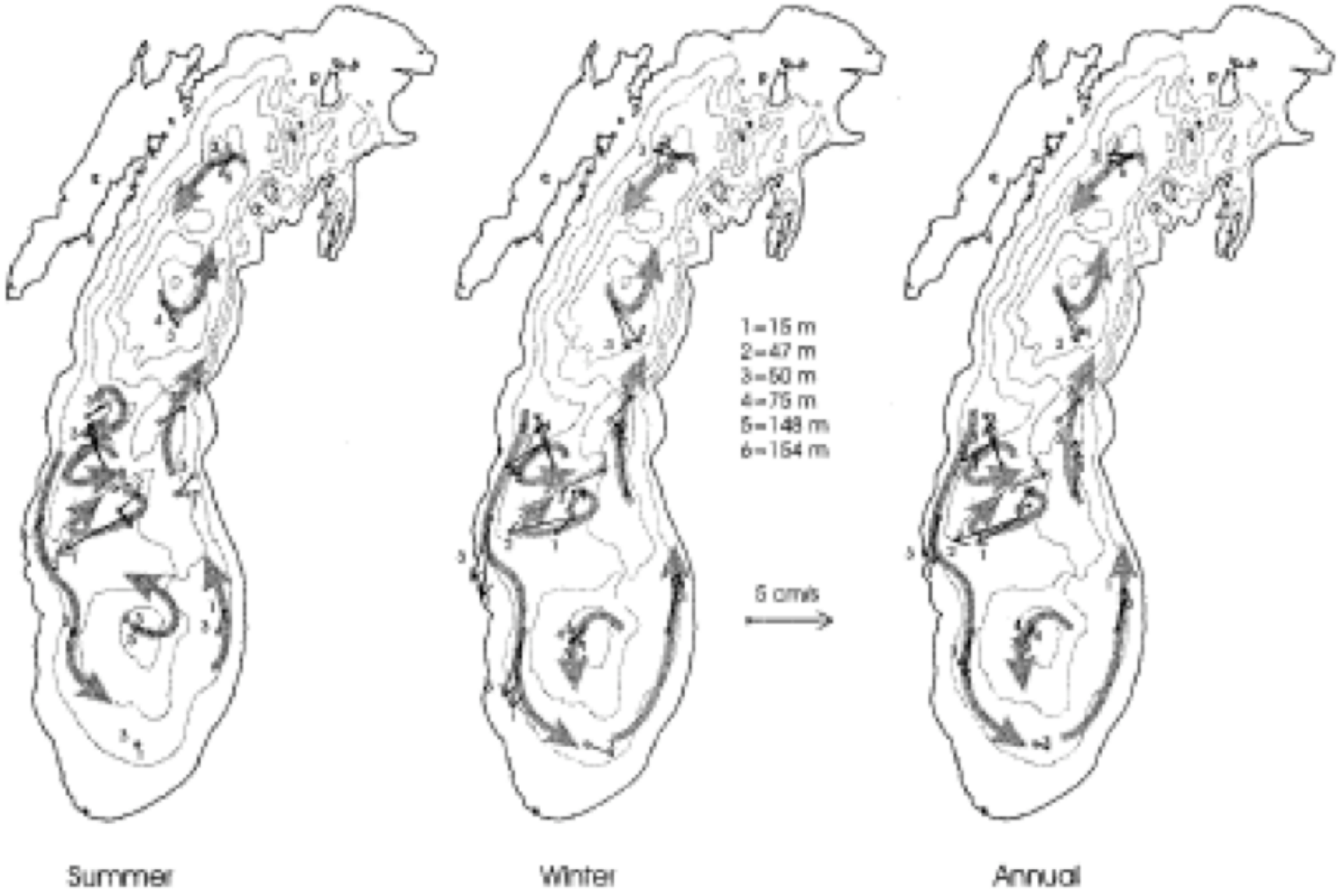
USGS, Gingerich et al.

Seasonal Particle Resuspension



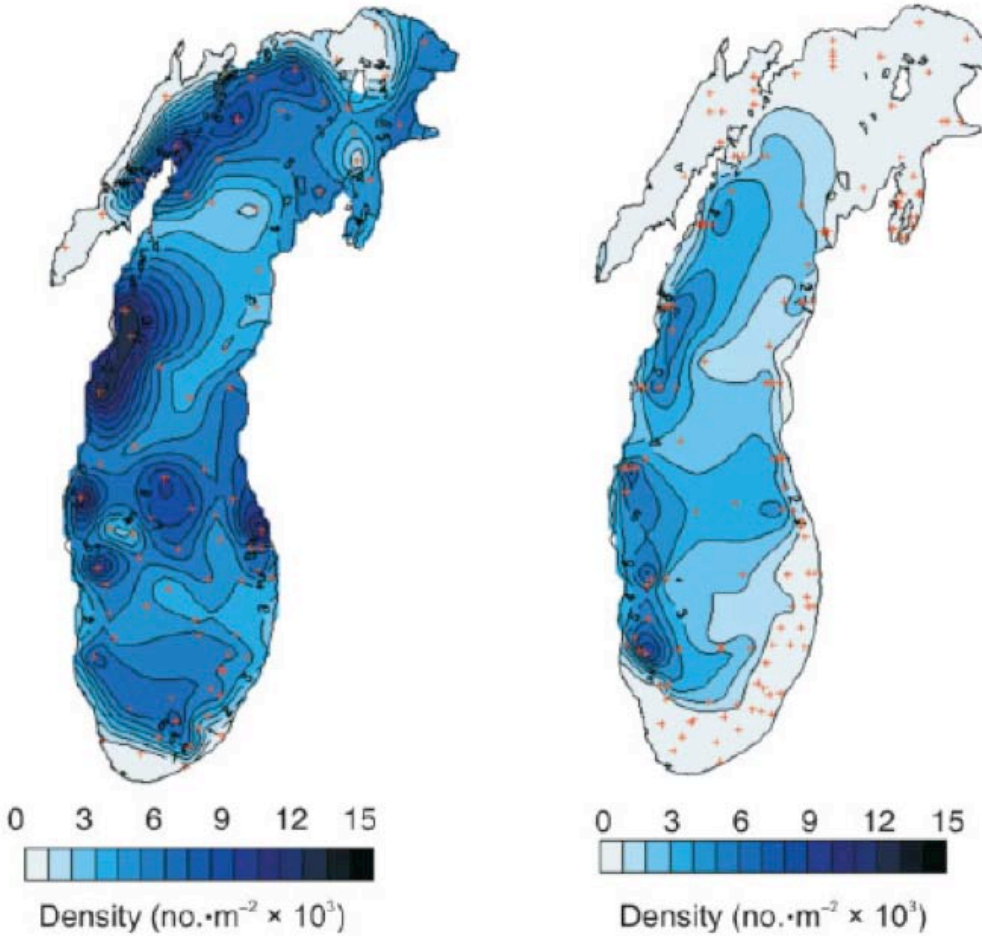
Reflectance imagery of southern Lake Michigan exhibiting patterns of spring time particle resuspension. (Millie et al., 2003)

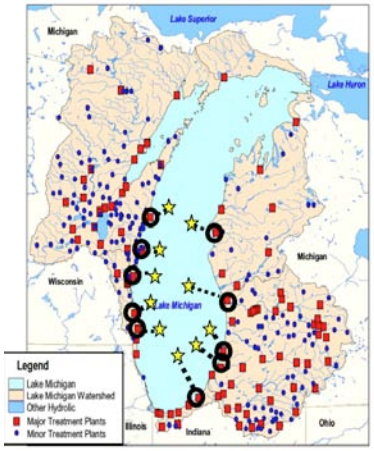
Seasonal Circulation Patterns in Lake Michigan



Seasonal circulation patterns in Lake Michigan (Beletsky et al., 1999).

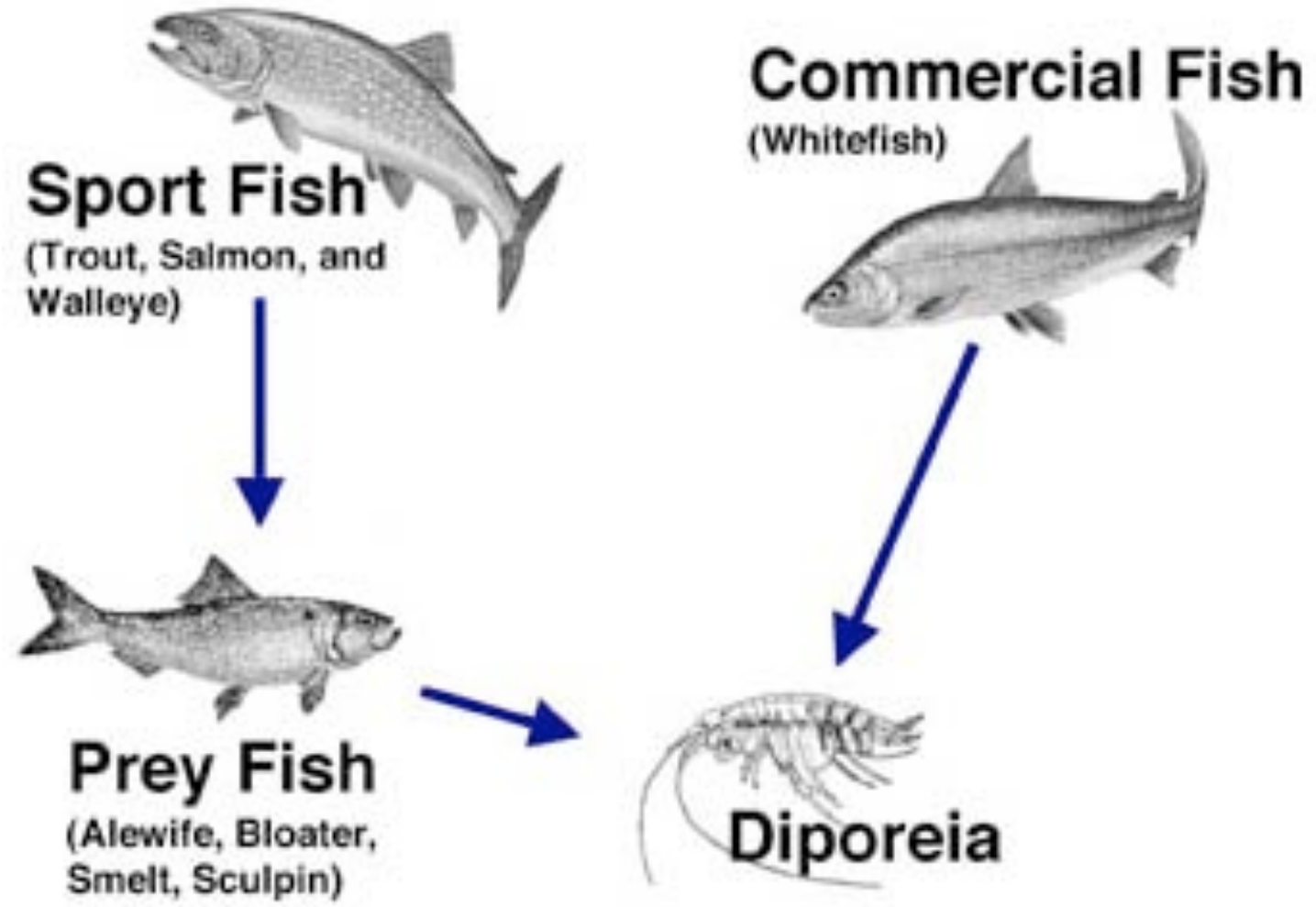
Decline of Diporeia Population





Mean density (no. m x 10) of Diporeia spp. throughout Lake Michigan. (a) 1994-1995, (b) 2000 (Nalepa et al., 2006).

The Aquatic Food Chain



http://www.glerl.noaa.gov/pubs/brochures/dipo-fish/foodweb.jpg

Summary

- Antimicrobials persist in sediments
- Production history of antimicrobials is visible in sediment profiles
- Resuspension of sediments potentially may lead to high temporal concentrations of antimicrobials which are toxic to many aquatic species, including Diporeia
- Antimicrobials are toxic to Diporeia and may contribute to loss of this species from Lake Michigan

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- Note: This presentation contains unpublished materials jointly developed with the USGS