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Contaminants of Emerging Concern (CECs) in the Columbia River Estuary

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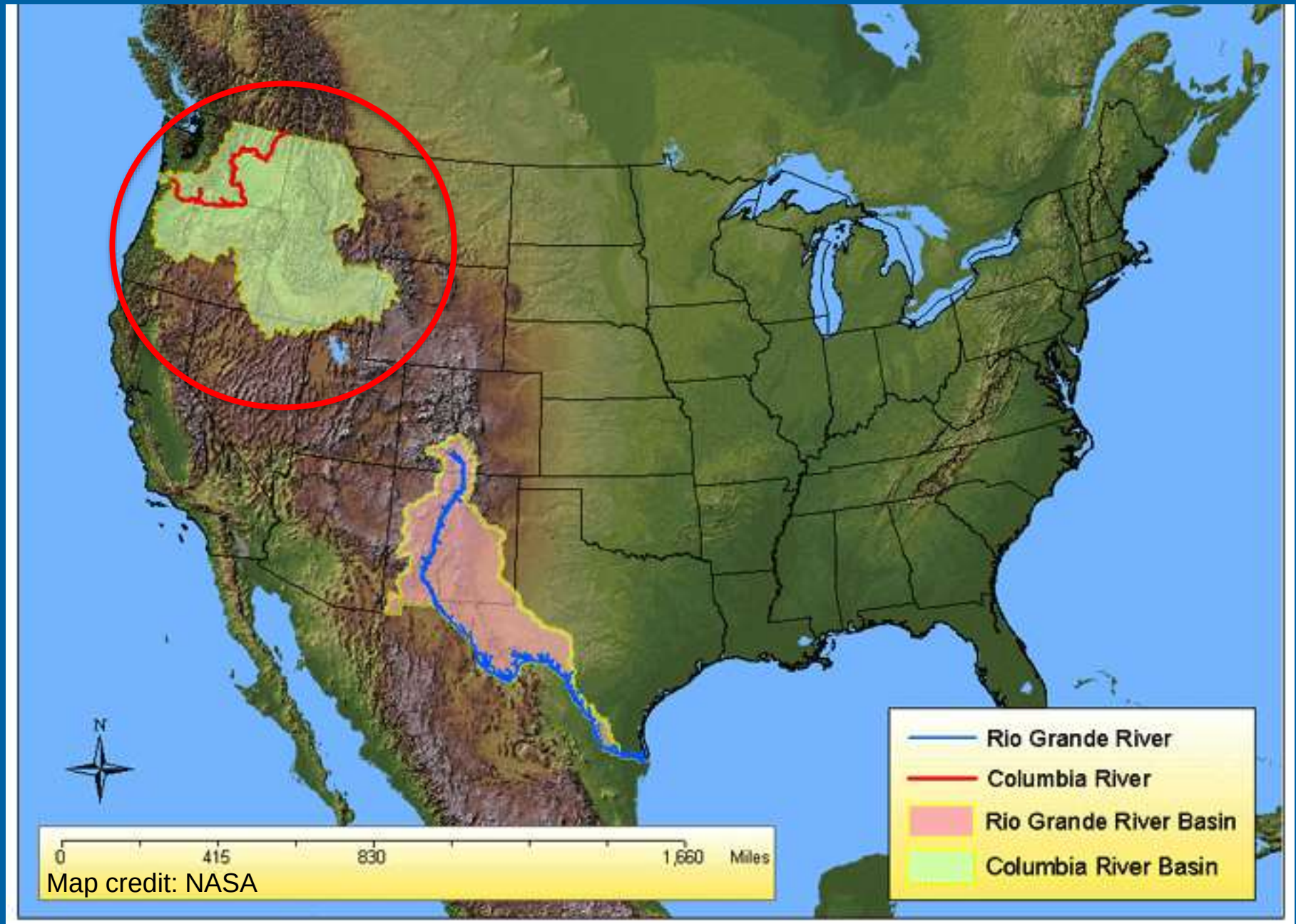
U.S. Geological Survey

Columbia River Basin



Columbia River Basin

- Fourth largest U.S. river by volume
- Largest discharge to Pacific of any river in N or S America
- 7,500 m^3/s discharge on average at the mouth
- Hydropower, agriculture, flood control, recreation, industry, etc.
- Complex treaties: US, Canada, 16 Tribal entities
- Est. 10-16 M salmon returns in prehistoric times vs largest recent 3.6 M in 1986

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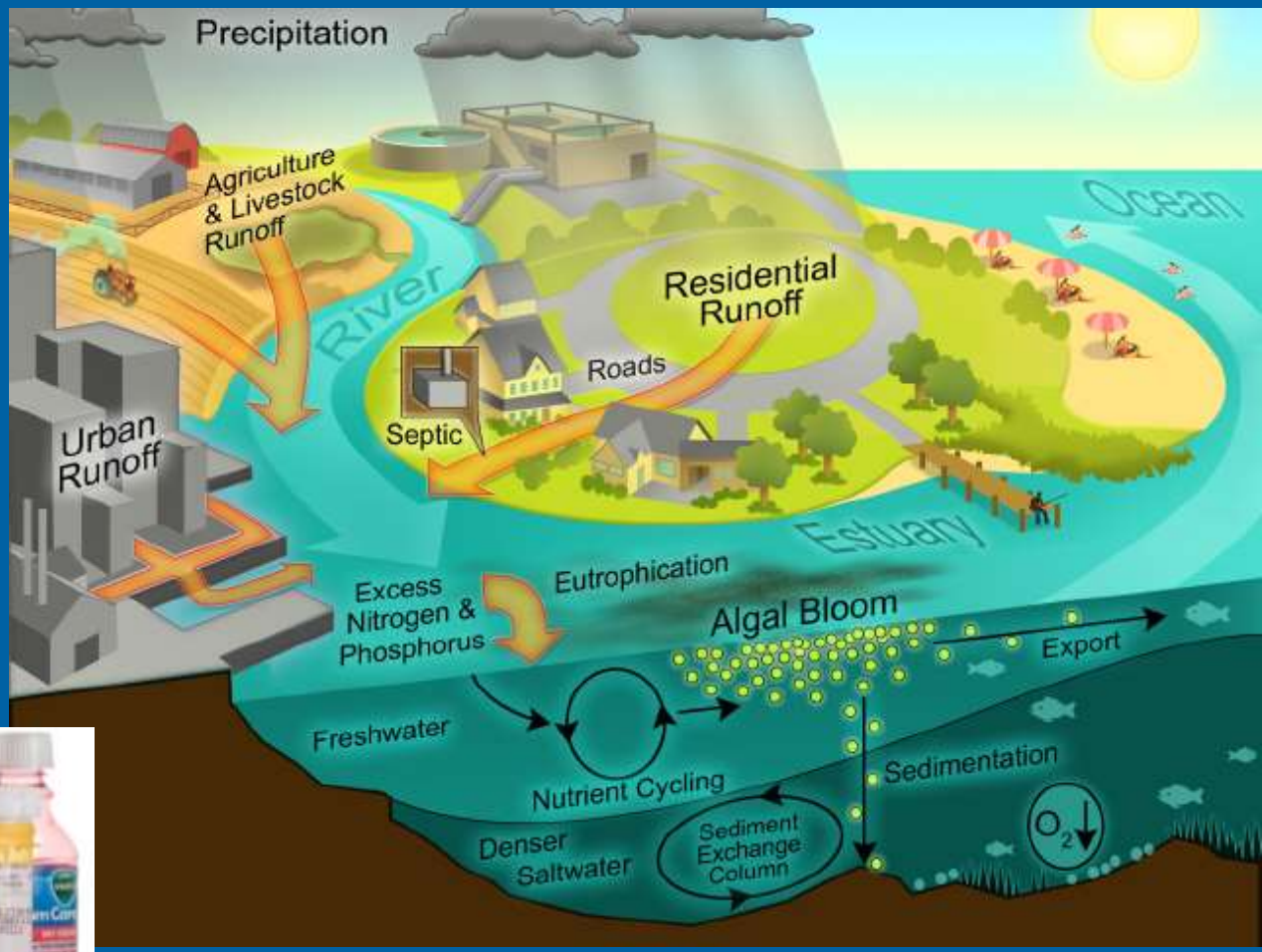
- Contaminants in the River and Estuary?

Contaminants of Emerging Concern (CECs)

Industrial compounds
Personal care products
Pharmaceuticals



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Why do we care about CECs?

- Some are endocrine disrupting compounds
  - Mimic or block hormones and disrupt normal function
- Examples of affected wildlife
  - Diseases and mortalities exacerbated by endocrine disruption of marine mammals and seabirds (Tanabe, 2002)
  - Feminization of males; collapse of a population of fathead minnow in Ontario, Canada (Kidd et al., 2007)
  - Reproductive biomarker responses in multiple species in the Columbia River (Hinck et al., 2006)

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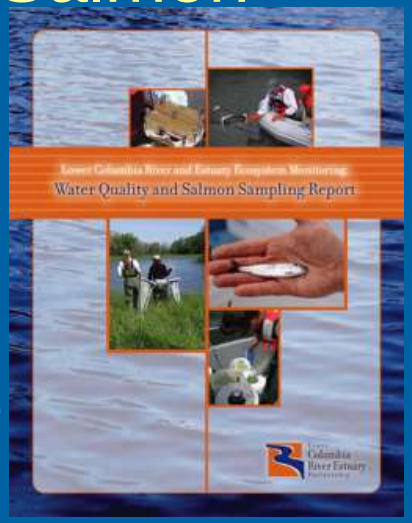
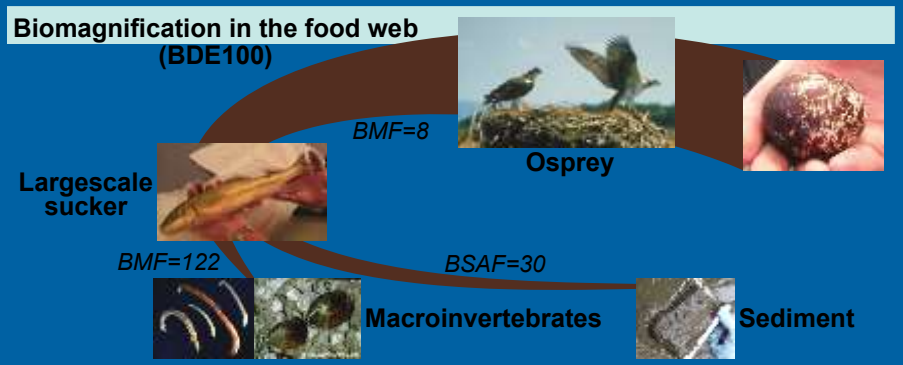
Recent Studies: CECs Bioaccumulate and Affect Species of Concern

Juvenile Salmon

Johnson LL et al., 2007. *Sci Total Environ* 374: 342-366



Food Web



Nilsen EB and Morace JL, 2014. *Sci Total Environ* Special Issue 484:319–389

White Sturgeon

Nilsen EB, et al., 2016. USGS Data Release

Larval Pacific Lamprey

Nilsen EB et al., 2015. *Environ Pollut* 201: 121-130.

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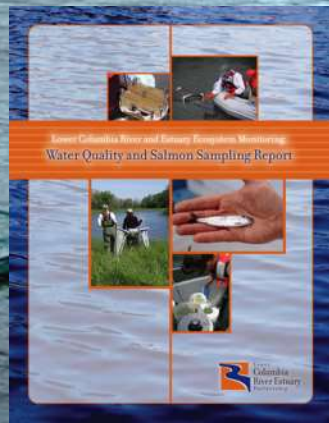
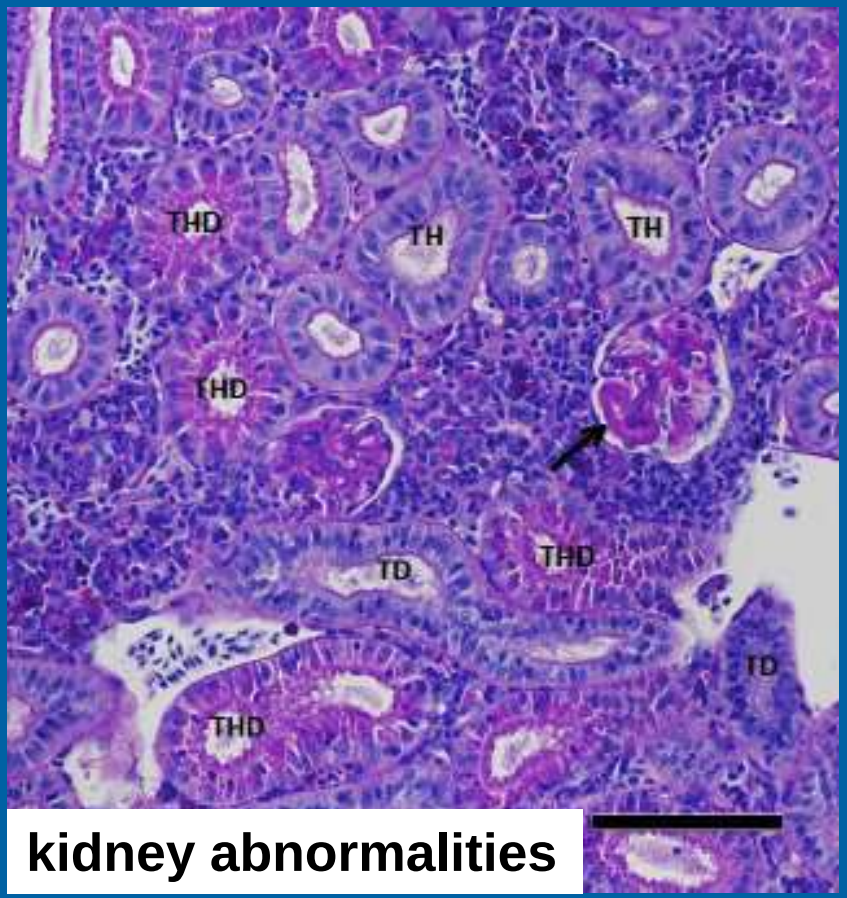
Contaminants in the Lower Columbia

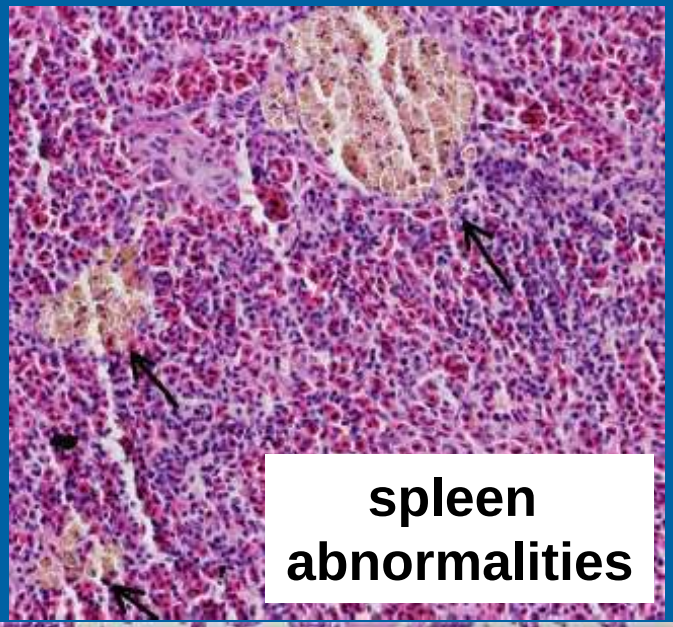
- Contaminants of emerging concern (CECs) in effluent discharged to the Columbia River (Morace, 2012)
- Several types of contaminants present in juvenile salmon and other species of concern
- Some concentrations are greater than effects thresholds



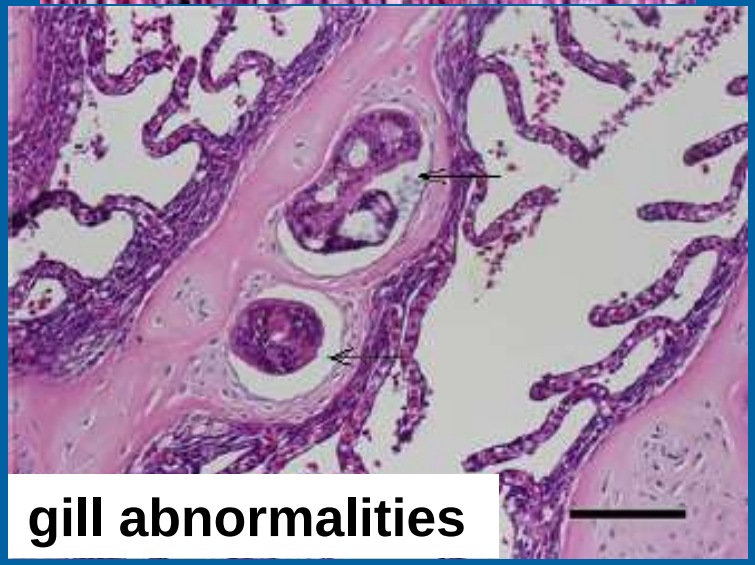
Biomarkers Indicate Stressed Fish



kidney abnormalities



spleen abnormalities



gill abnormalities

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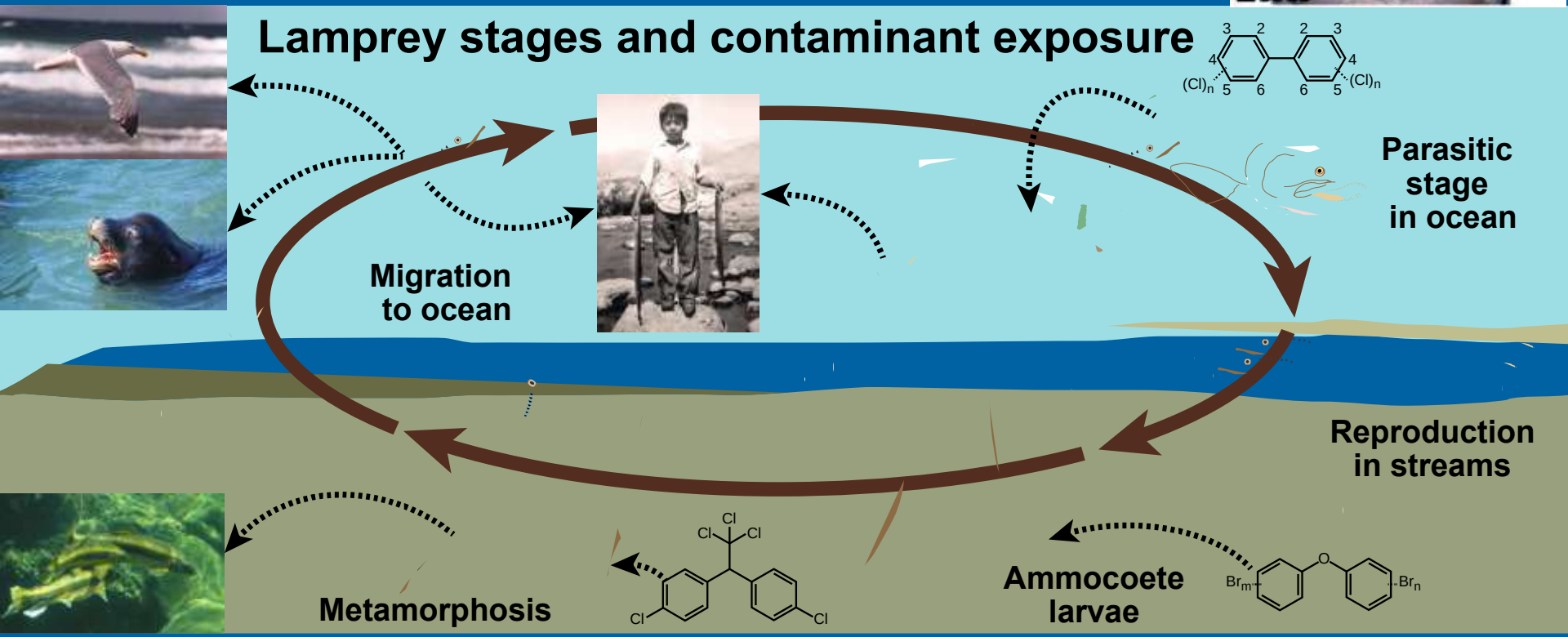
Torres et al. 2014, *STOTEN*

Pacific Lamprey Life Cycle and Contaminant Transfer

2-3 years



3-7 years

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Nilsen et al. 2015, *Env. Poll.*

Some Contaminants Exceeded Effects Levels for Other Fish Species

- **PAHs (from fossil fuels)**: disrupt heart development (Incardona et al. 2014)
- **Chlorpyrifos (pesticide)**: behavioral effects and synergistic toxicity (Laetz et al. 2009)
- **PBDEs (flame retardants)**: increase disease susceptibility (Arkoosh et al. 2010)
- **Mercury**: adverse effects on growth and reproduction (Depew et al. 2012)

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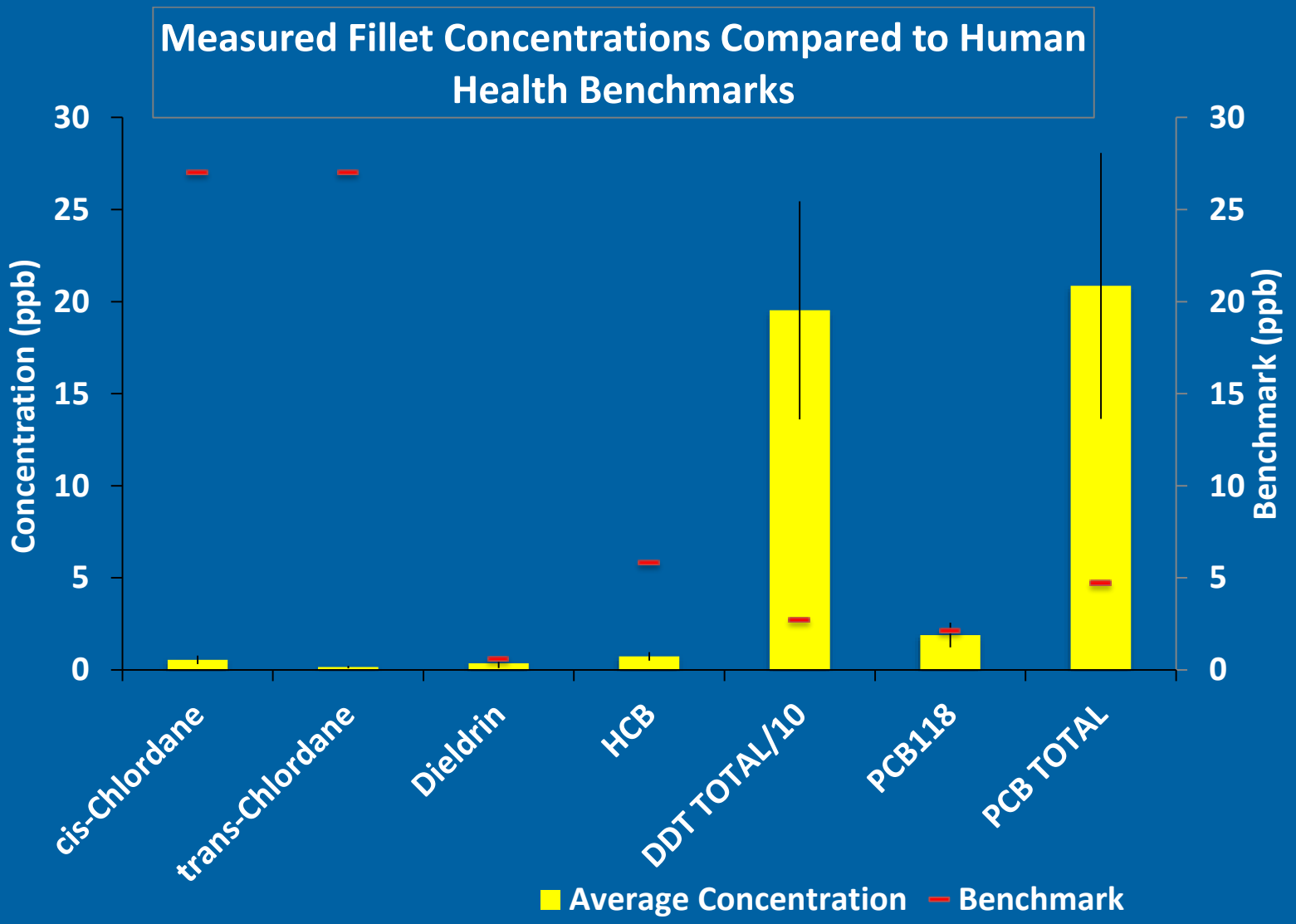
Contaminants in White Sturgeon



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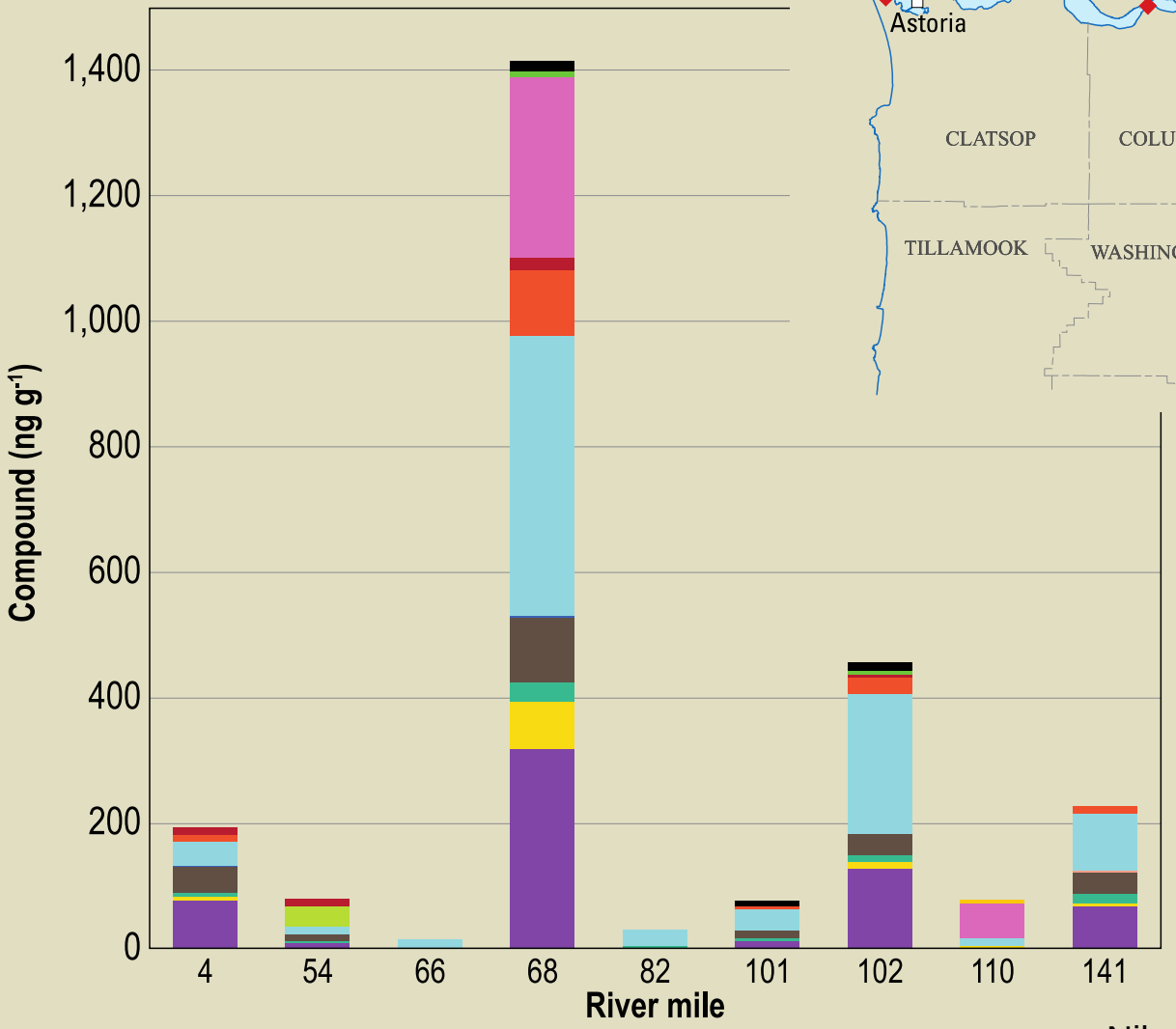
Nilsen et al. 2016, *USGS Data Release*

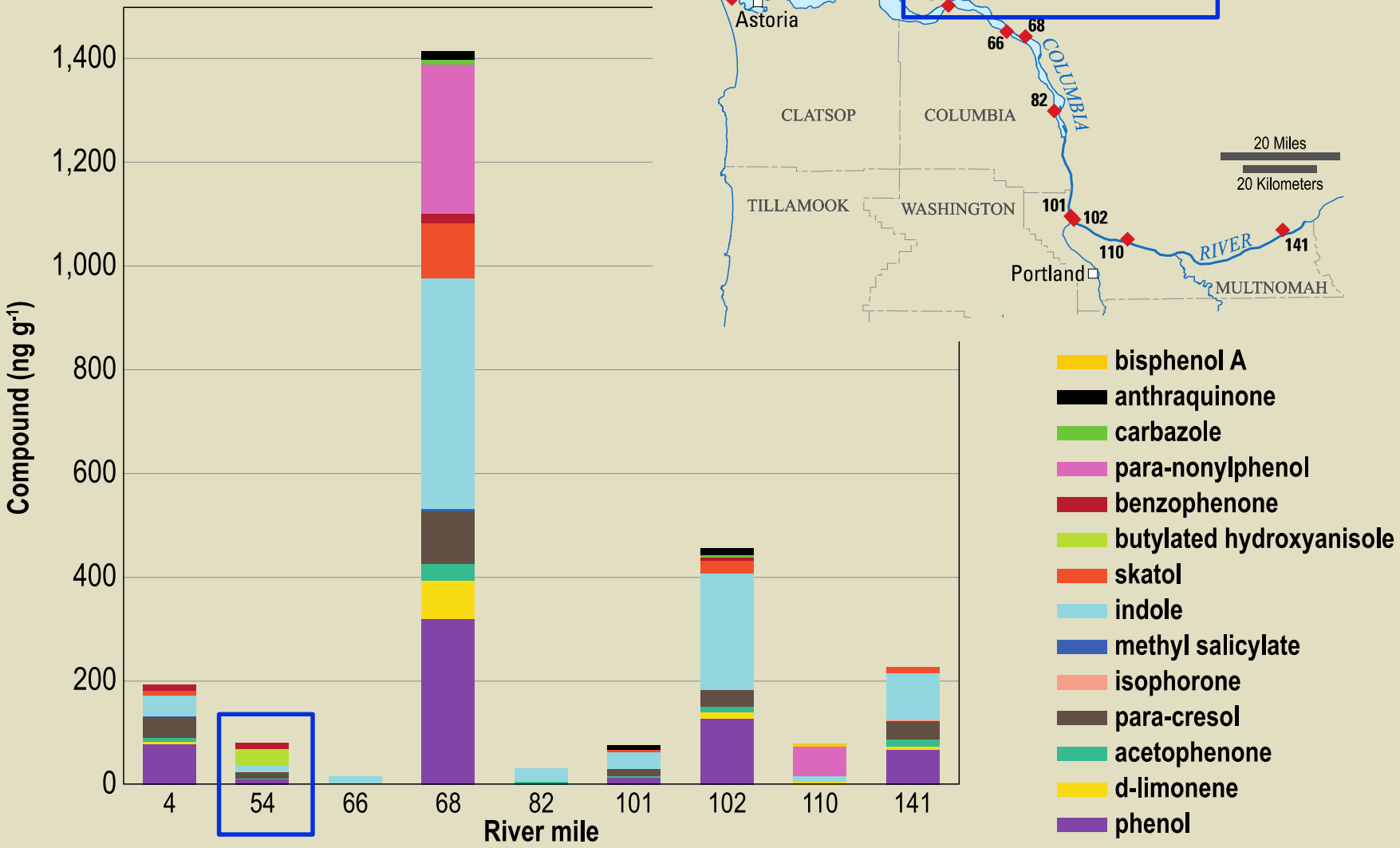
CECs in Lower Columbia River Sediments



- bisphenol A
- anthraquinone
- carbazole
- para-nonylphenol
- benzophenone
- butylated hydroxyanisole
- skatol
- indole
- methyl salicylate
- isophorone
- para-cresol
- acetophenone
- d-limonene
- phenol

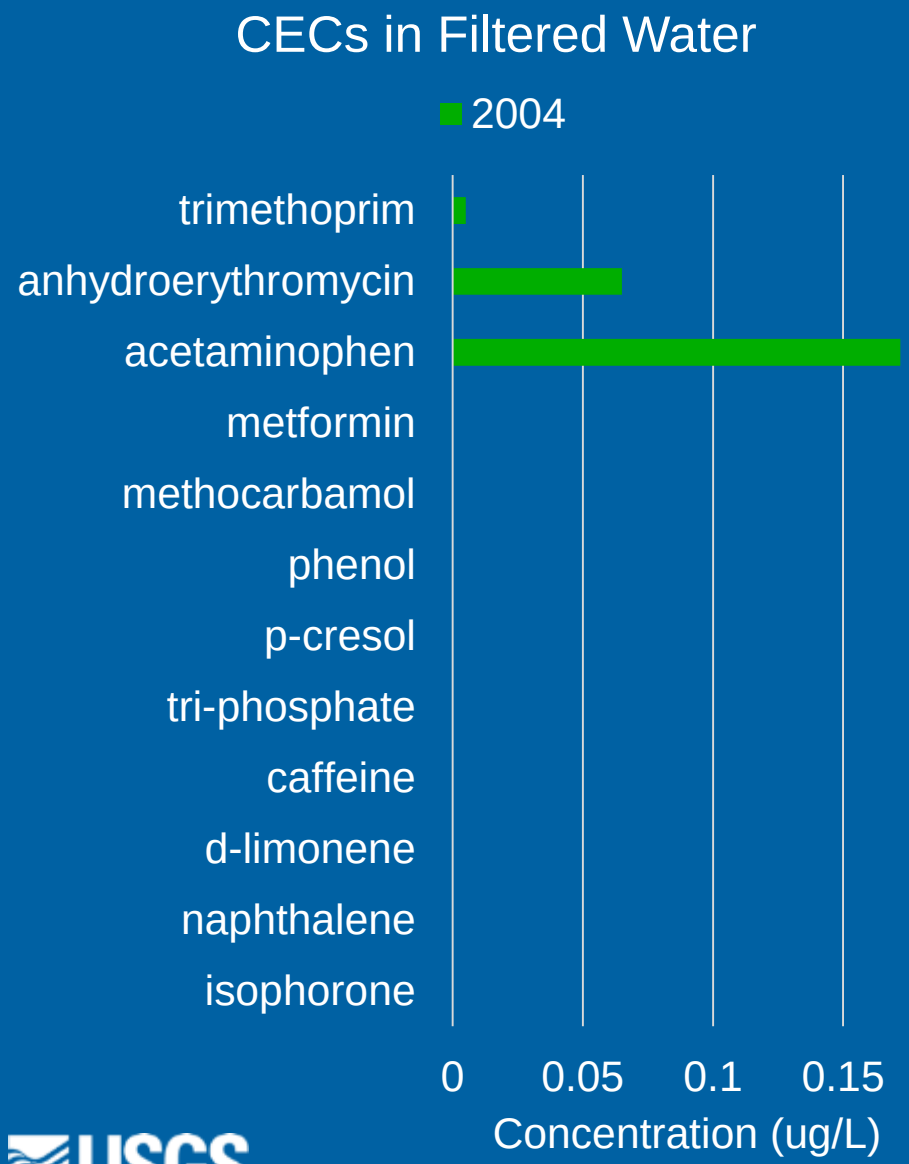
Nilsen et al. 2014, *JAWRA*

CECs in Lower Columbia River Sediments



Nilsen et al. 2014, *JAWRA*

CECs at Beaver Army Terminal



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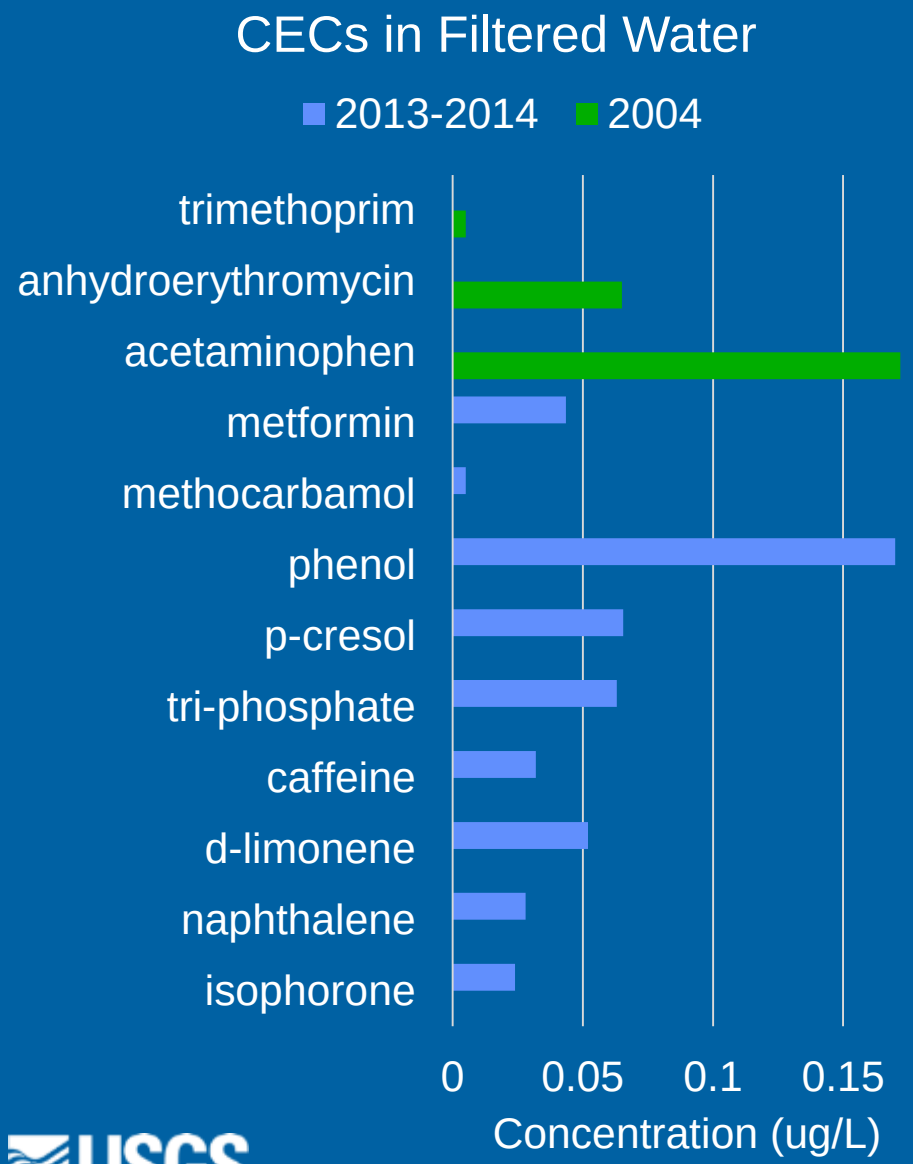
Provisional data; subject to revision

CECs at Beaver Army Terminal



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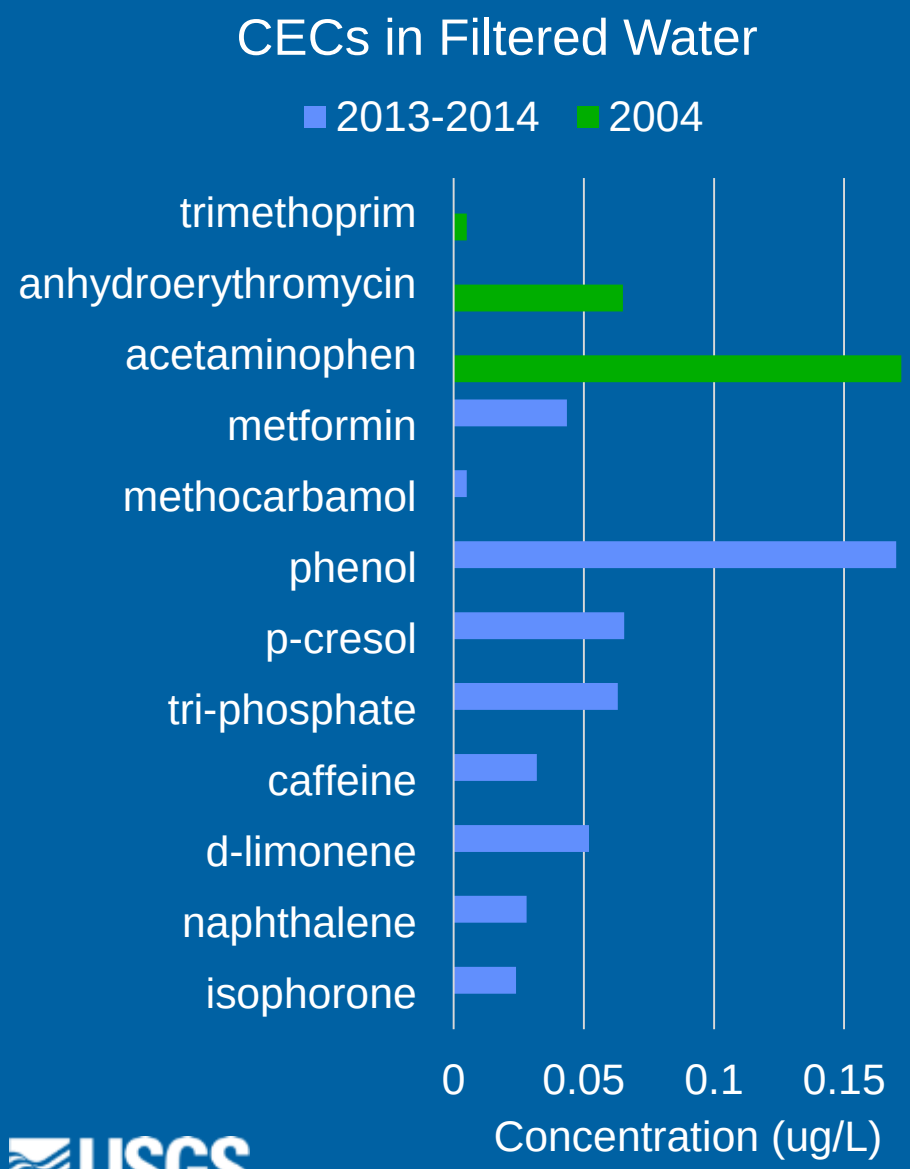

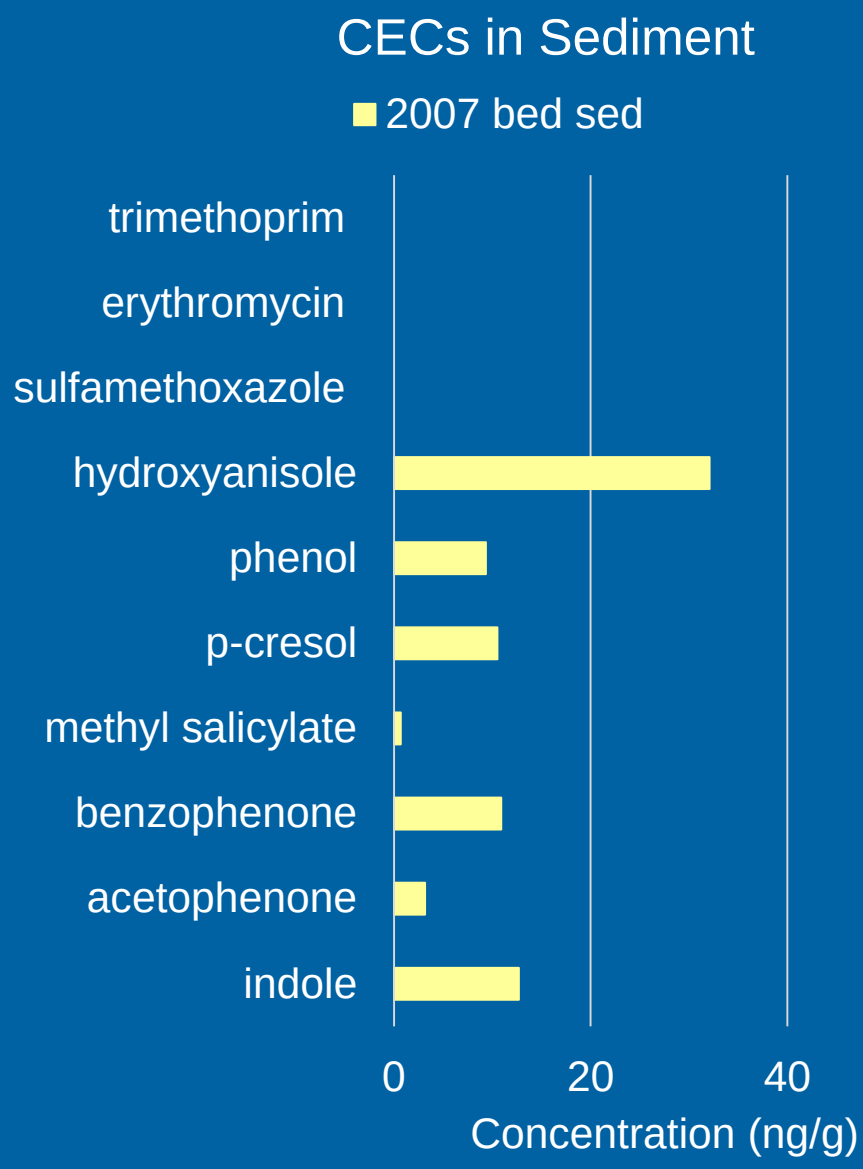

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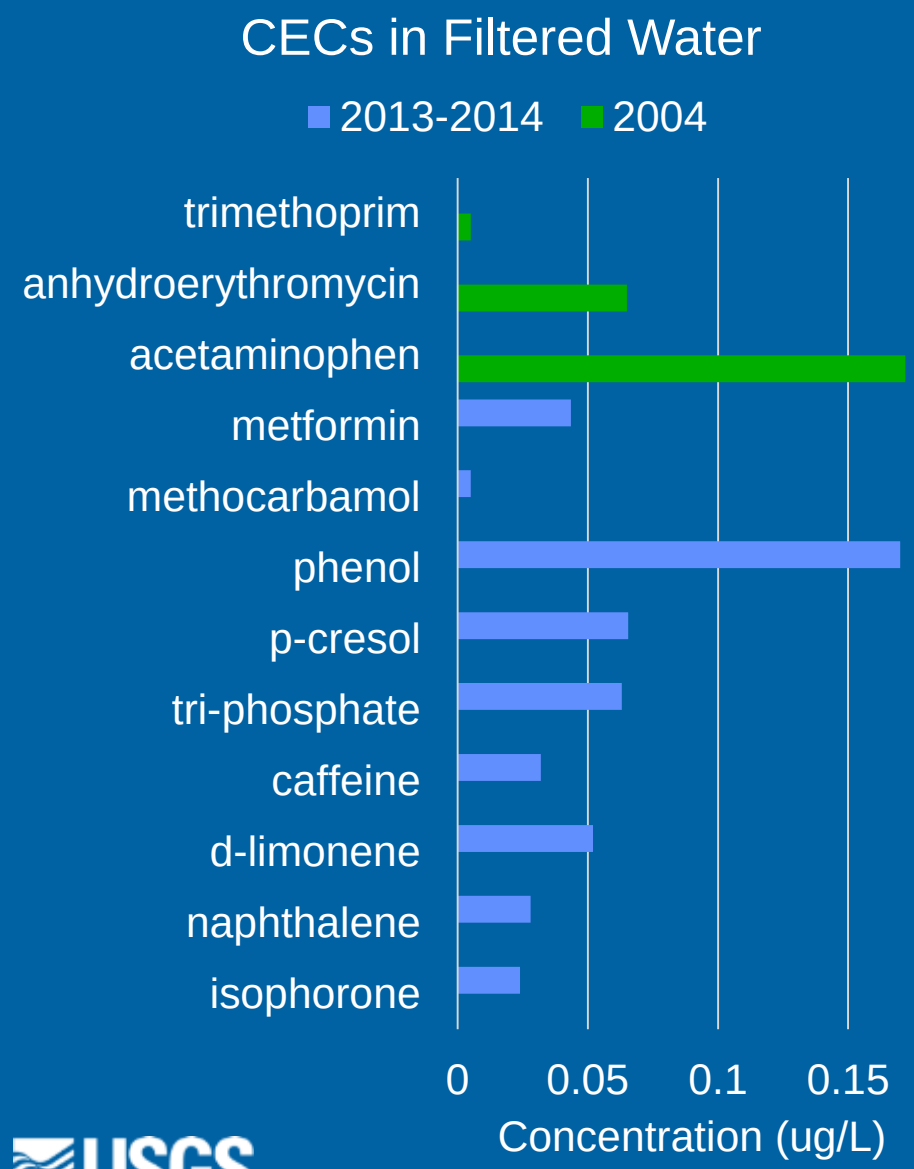

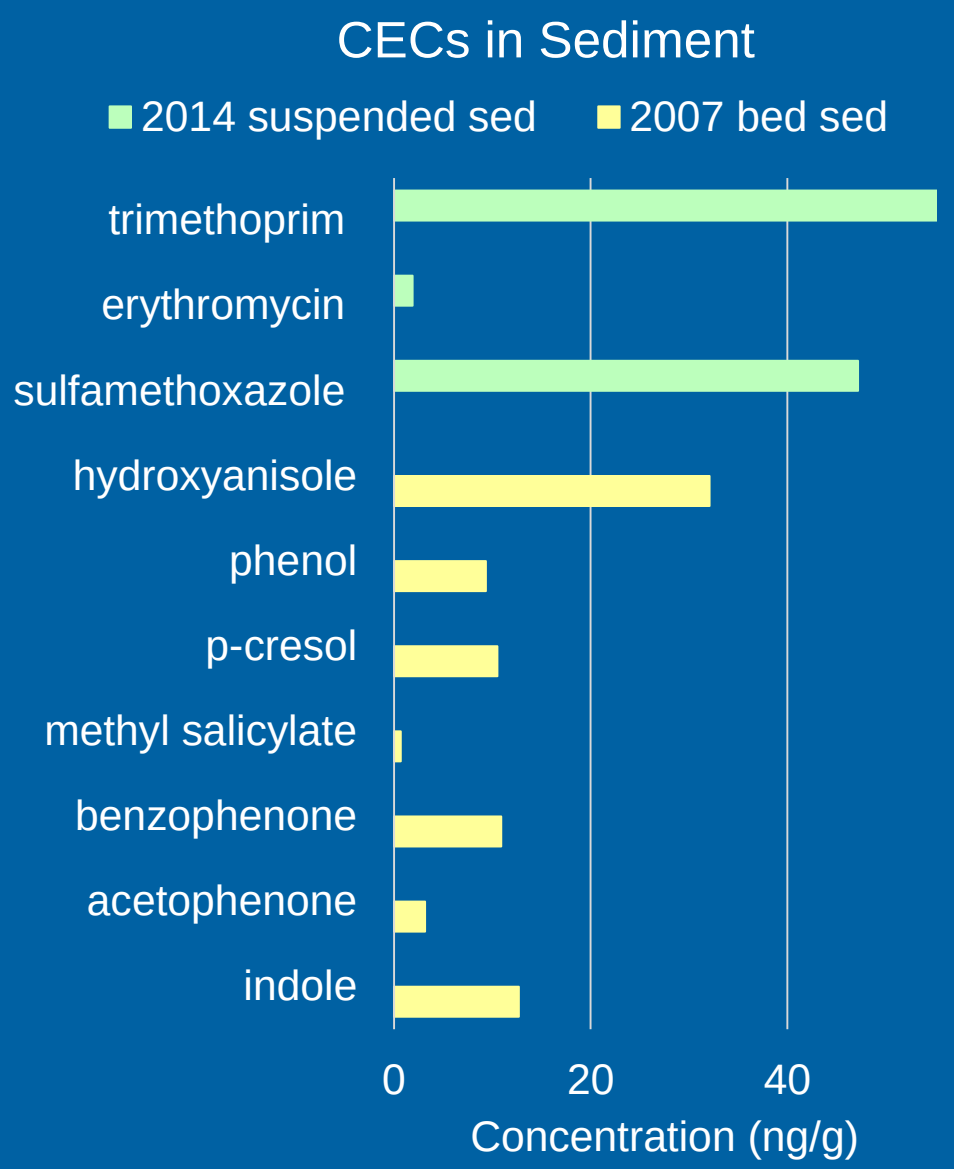

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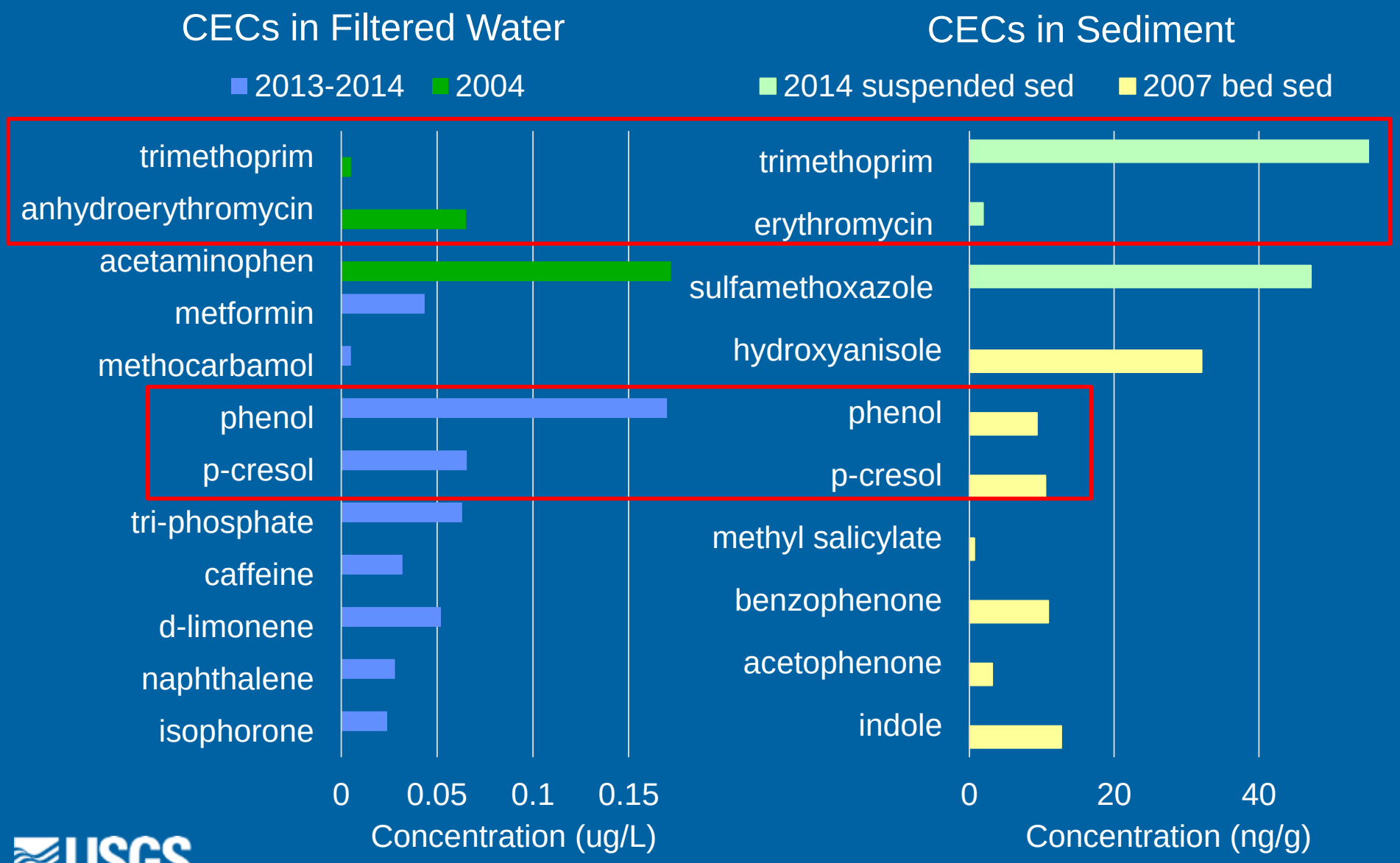

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Conclusions

- CECs are chemically diverse and have episodic inputs
- Few detections compared to what we know is entering via wastewater and stormwater effluent (Morace, 2012)
- CECs concentrations are low: < 1 ppb in surface waters; 1-60 ppb in sediments
- Sampling tissues remains a good strategy for documenting exposure to bioaccumulative compounds
- Very little data from the CR estuary -- focused and comprehensive sampling campaign is needed
- Role of primary producers in contaminant uptake pathways and transport is unknown

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Acknowledgements

Contact: Elena Nilsen
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Thanks to the organizing committee and presenters.

Questions?

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