

Emerging and Legacy Contaminants in the Foodweb:

Columbia River Contaminants and Habitat Characterization (ConHab) Project

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(2008-2012)

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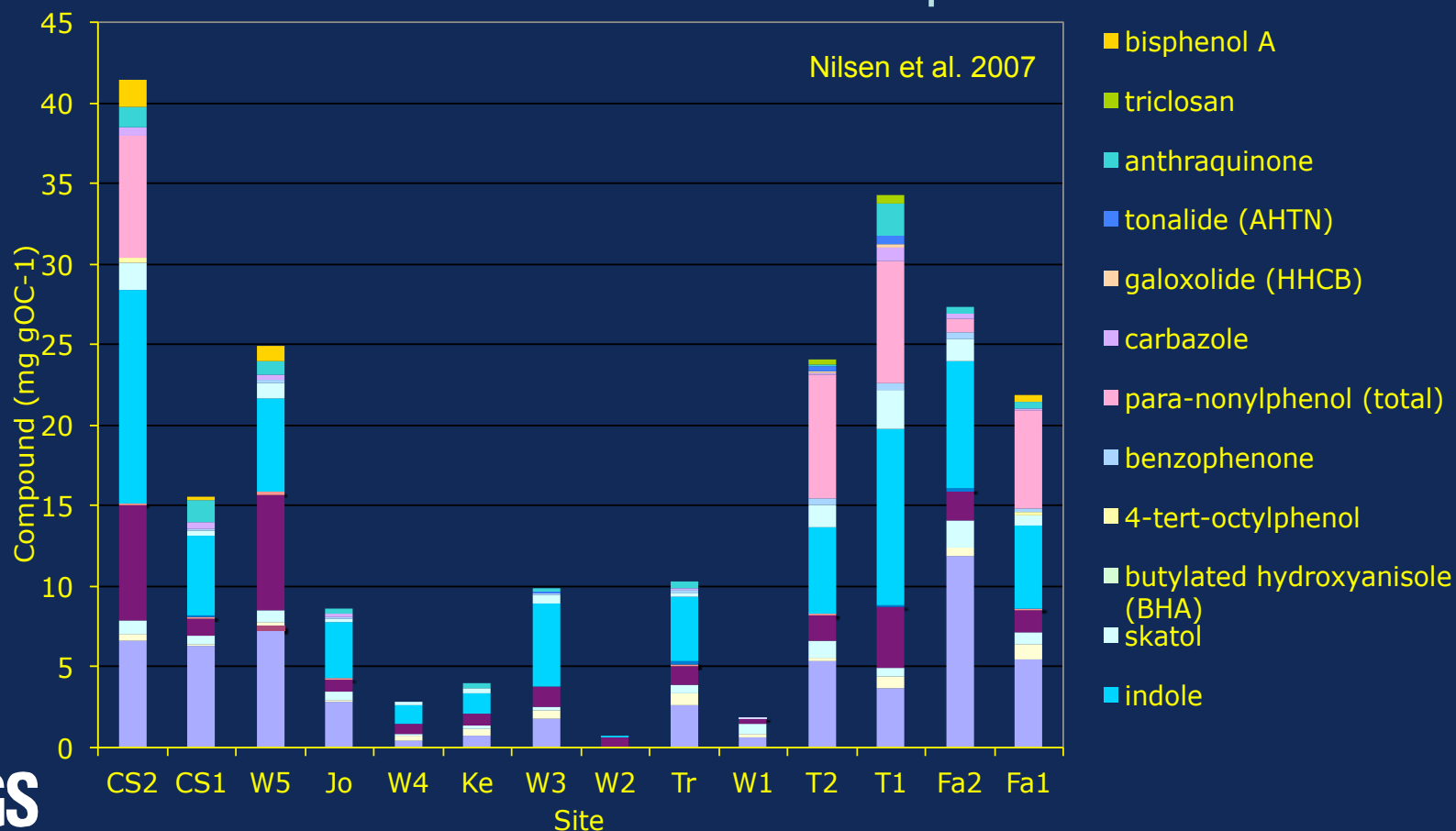
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WRD, Oregon Water Science Center



Motivation

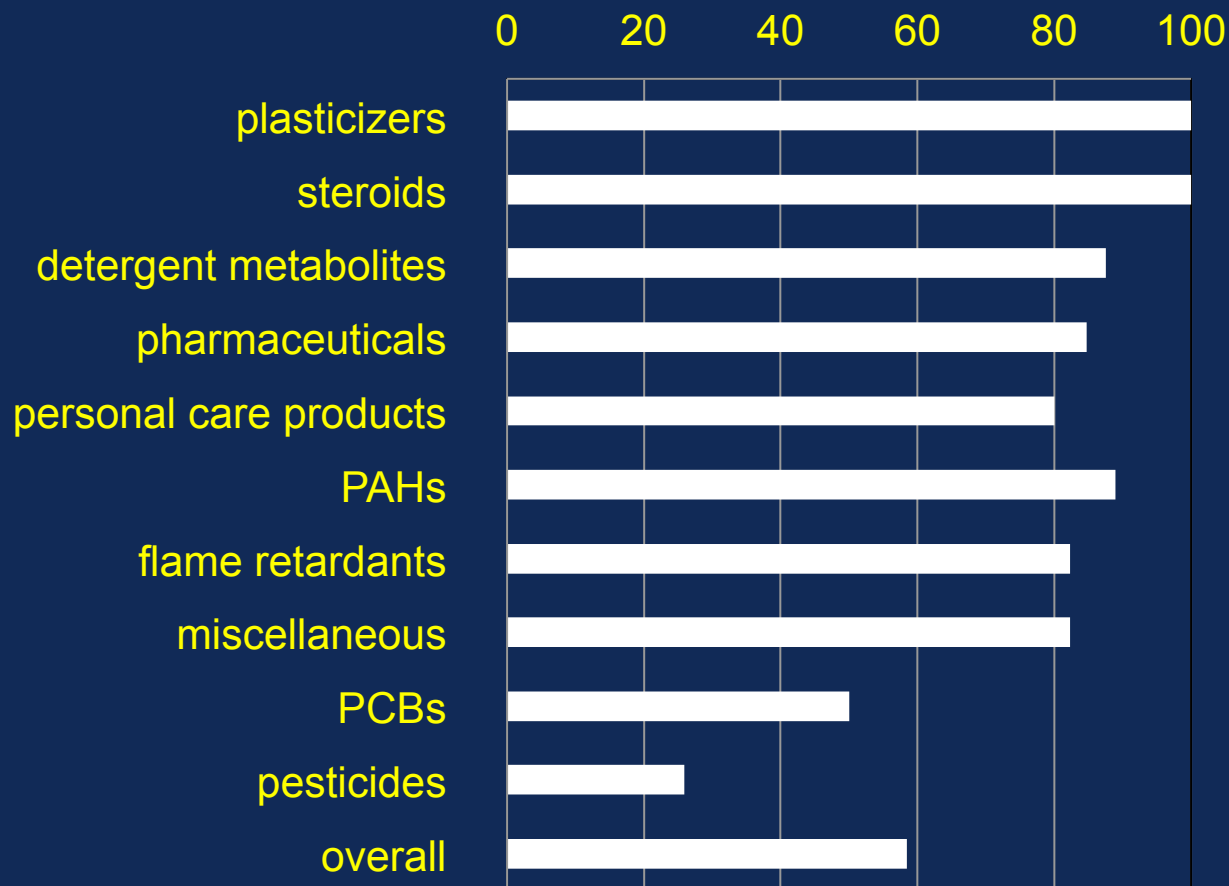
- Forty-nine wastewater indicator contaminants detected in CR basin sediments
- Endocrine disrupting compounds (EDCs) detected at 22 of 23 sites sampled





Motivation

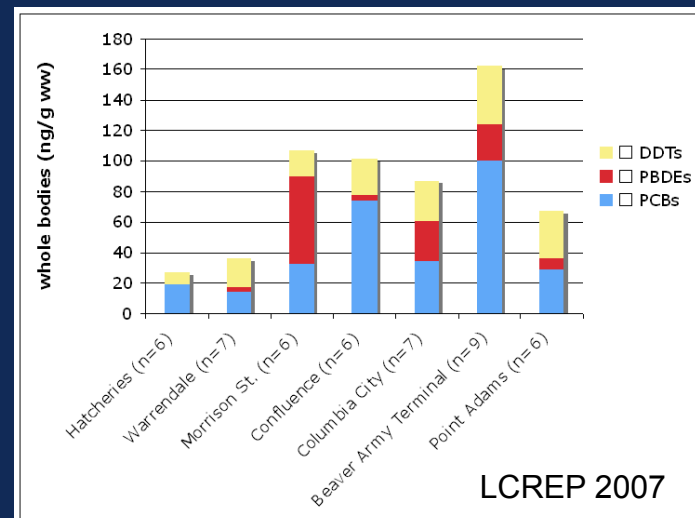
Percent of compounds detected in WWTP effluent



Motivation



- PBDEs doubling in fish in upper Columbia River (CR) every 1.6 years early 2000s (Rayne et al. 2003)
- PBDEs adversely affecting osprey reproduction; egg concentrations increased rapidly in 2000s
- PBDE widespread in lower CR (LCREP 2007)
- Urban/industrial signal in Salmon bodies (LCREP 2007)



Motivation

Endocrine Disrupting Compounds (EDCs)

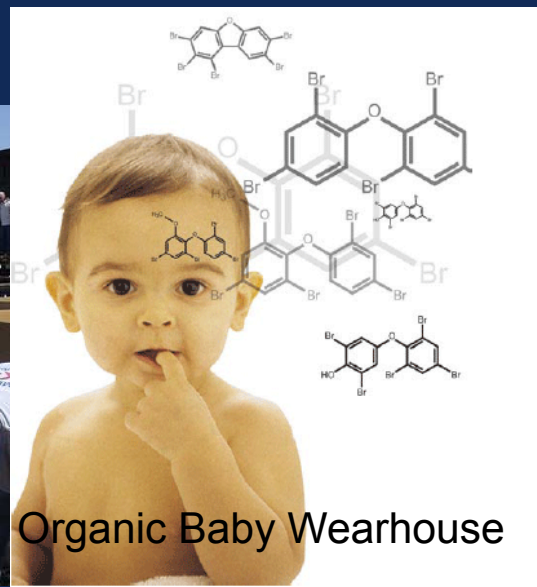
- What they do: mimic or block hormones and disrupt normal function
- Examples of affected wildlife:
 - Feminization of males; collapse of lake population of fathead minnow in Ontario, Canada (Kidd et al., 2007)
 - Common carp in Lake Mead, Nevada (e.g., Patiño et al., 2003; Snyder et al., 2004)
 - Reproductive biomarker responses by multiple species in Columbia River Basin (Hinck et al., 2006) and Colorado Basin (Hinck et al., 2007)



Motivation

Endocrine Disrupting Compounds (EDCs)

- Affect organism development & population viability
- PBDEs (Kuriyama et al. 2005)
 - Alter thyroid function
 - Reduce sperm counts
 - Delay sperm maturation
- Goal: sample foodweb across sites representing a chemical gradient

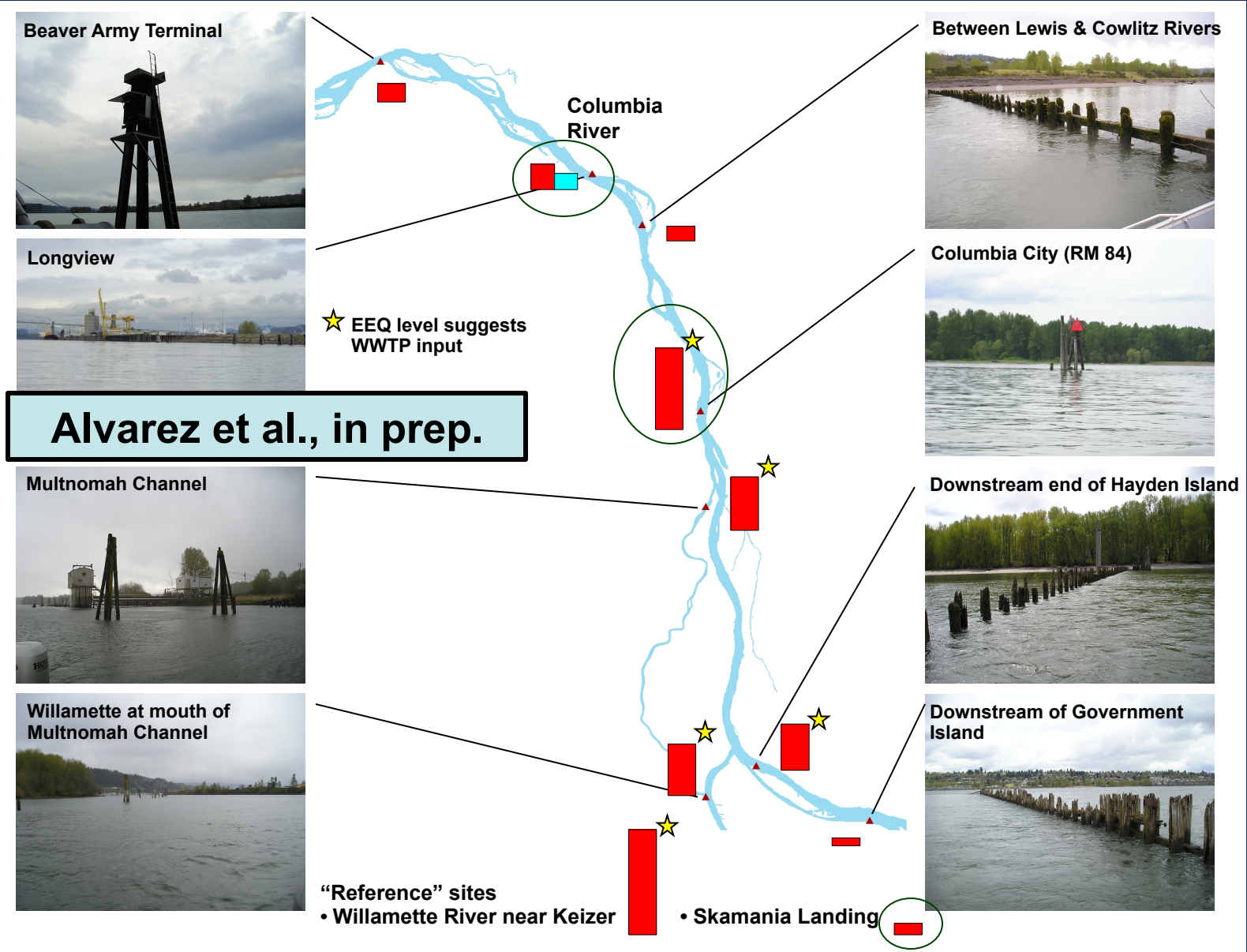


Area Map



Estrogenicity (YES) Passive Samplers

Spring 2008



PBDEs and PCBs Passive Samplers

Spring 2008

Beaver Army Terminal



Longview

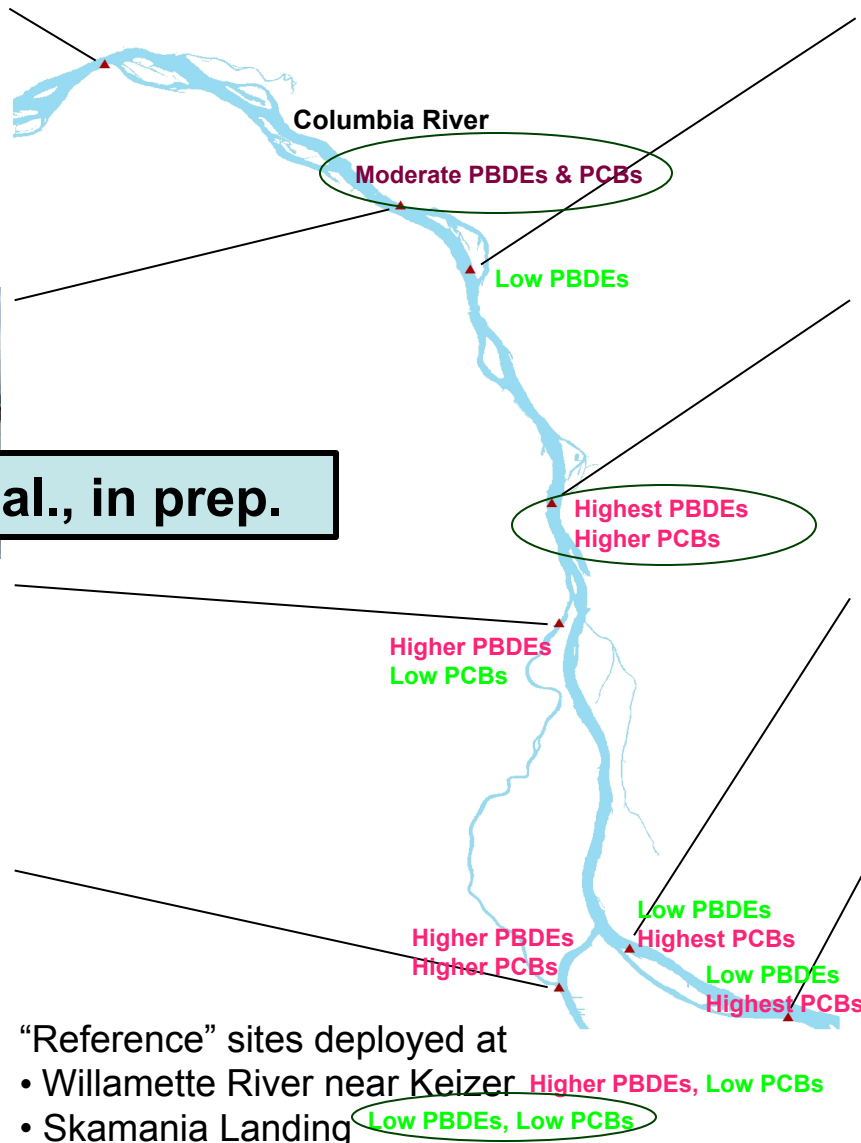
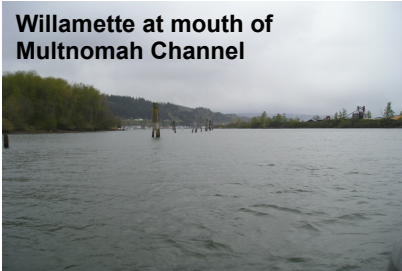


Alvarez et al., in prep.

Multnomah Channel



Willamette at mouth of Multnomah Channel



Between Lewis and Cowlitz Rivers



Columbia City (RM 84)



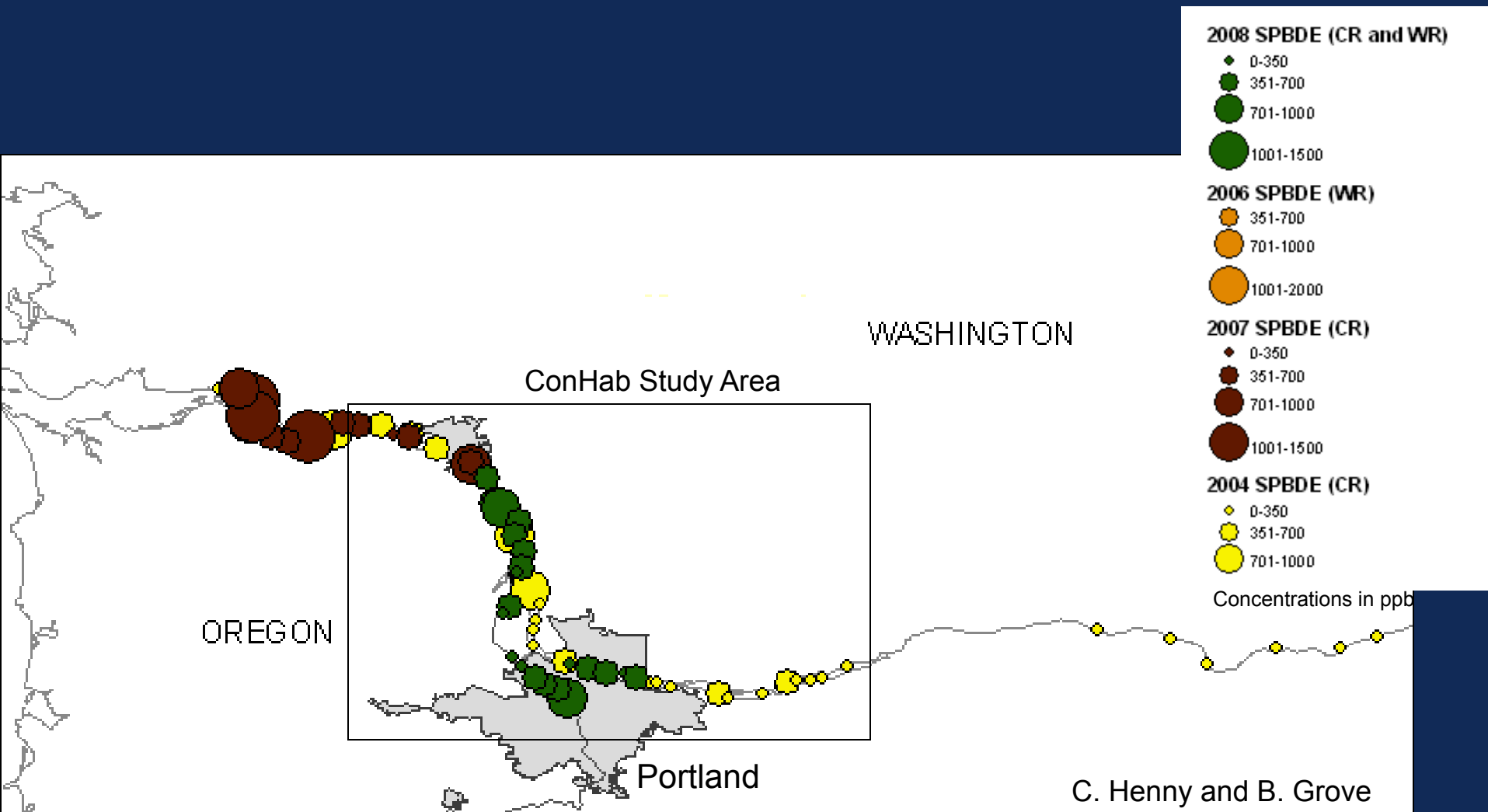
Downstream end of Hayden Island



Downstream of Government Island

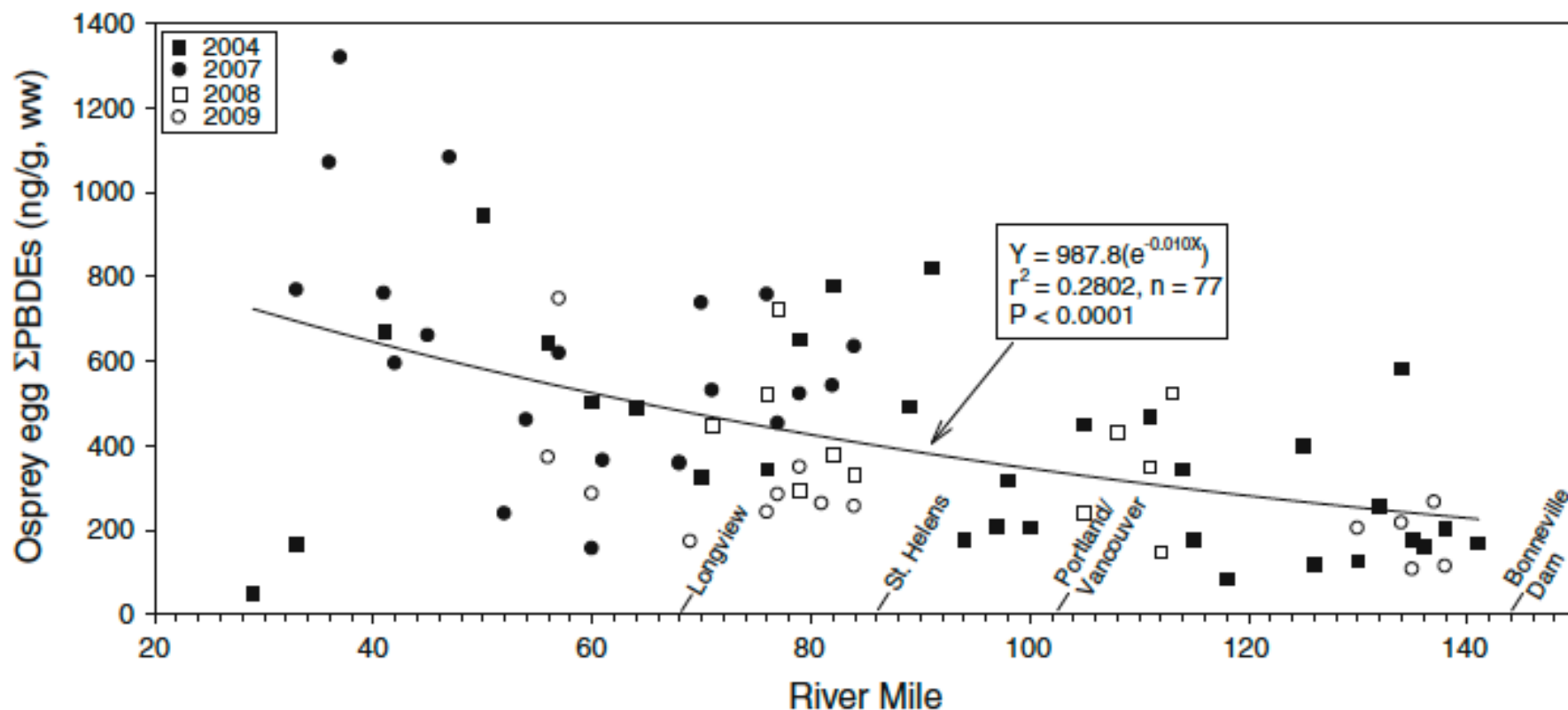


PBDEs in Osprey Eggs



PBDEs in Osprey Eggs

Henny et al., 2011*



Longview



Columbia City



A scenic view of a wooden pier extending into a calm lake, with lush green mountains in the background. A white cooler is visible in the foreground on the left. The text "Skamania" is overlaid in the bottom right corner of the image.



Foodweb Site Map

Legend

- 2009_sediment sites
- Osprey_Nests_2009
- USGS_Sucker_2009
- Passive_samples_2009

0 3.5 7 14 Kilometers

Legend

- 2009_sediment sites
- Osprey_Nests_2009
- USGS_Sucker_2009
- Passive_samples_2009

Longview

 Columbia City/St. Helens

Portland

Skamania/Rooster Rock

0 3.5 7 14 Kilometers

Foodweb Sampling

Passive samplers



- contaminant analyses
- estrogen screen

Sediments



- contaminant analyses
- sediment transport modeling

Invertebrates



- contaminant analyses
- community assessment

Largescale Suckers



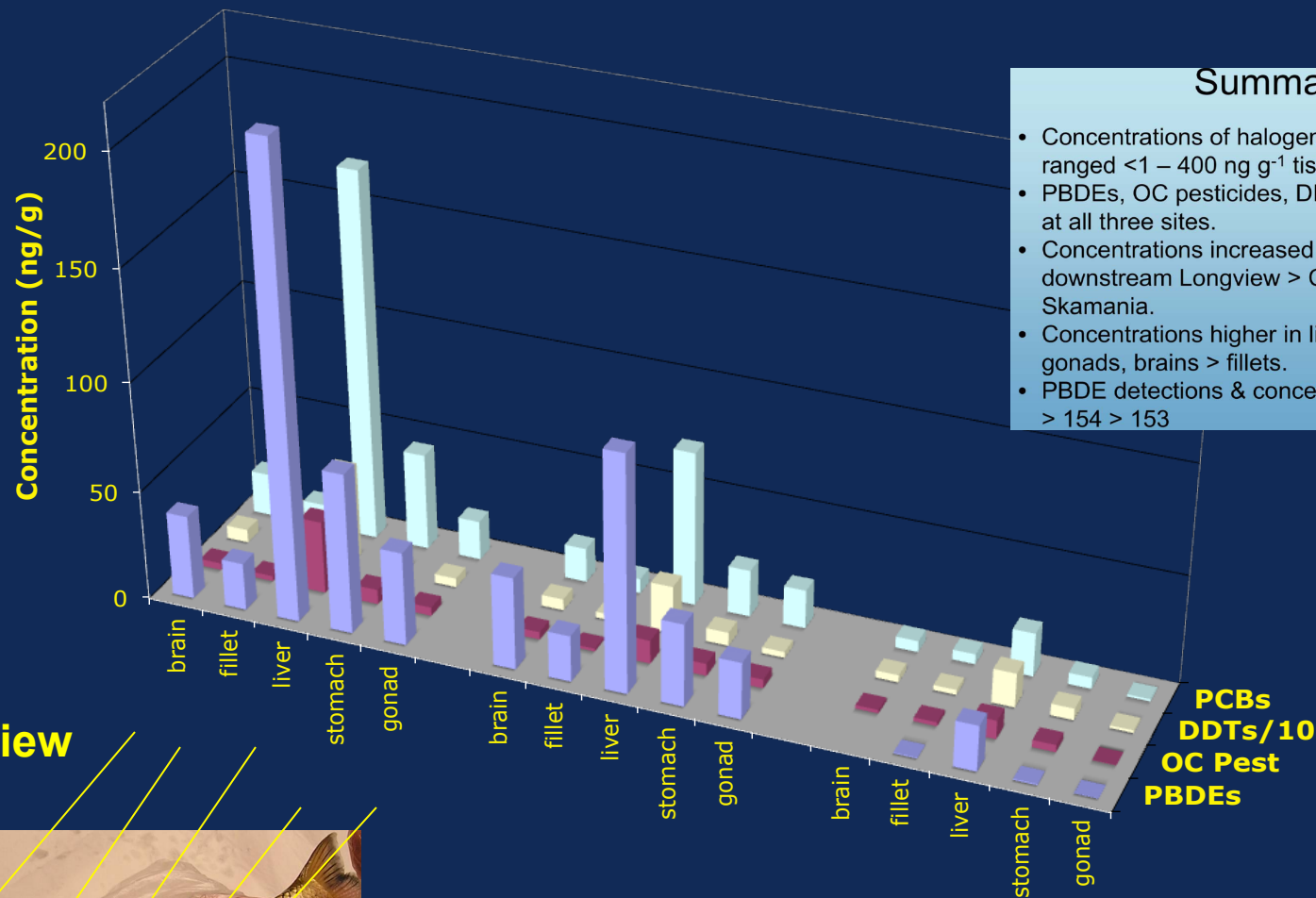
- contaminant analyses
- biomarkers

Osprey



- contaminant analyses
- productivity assessment
- well bird blood analyses

Contaminants in Fish Tissues 2009



Summary

- Concentrations of halogenated compounds ranged $<1 - 400 \text{ ng g}^{-1}$ tissue.
- PBDEs, OC pesticides, DDTs, PCBs detected at all three sites.
- Concentrations increased moving downstream Longview > Columbia City > Skamania.
- Concentrations higher in livers > stomachs, gonads, brains > fillets.
- PBDE detections & concentrations: 47 > 100 > 154 > 153



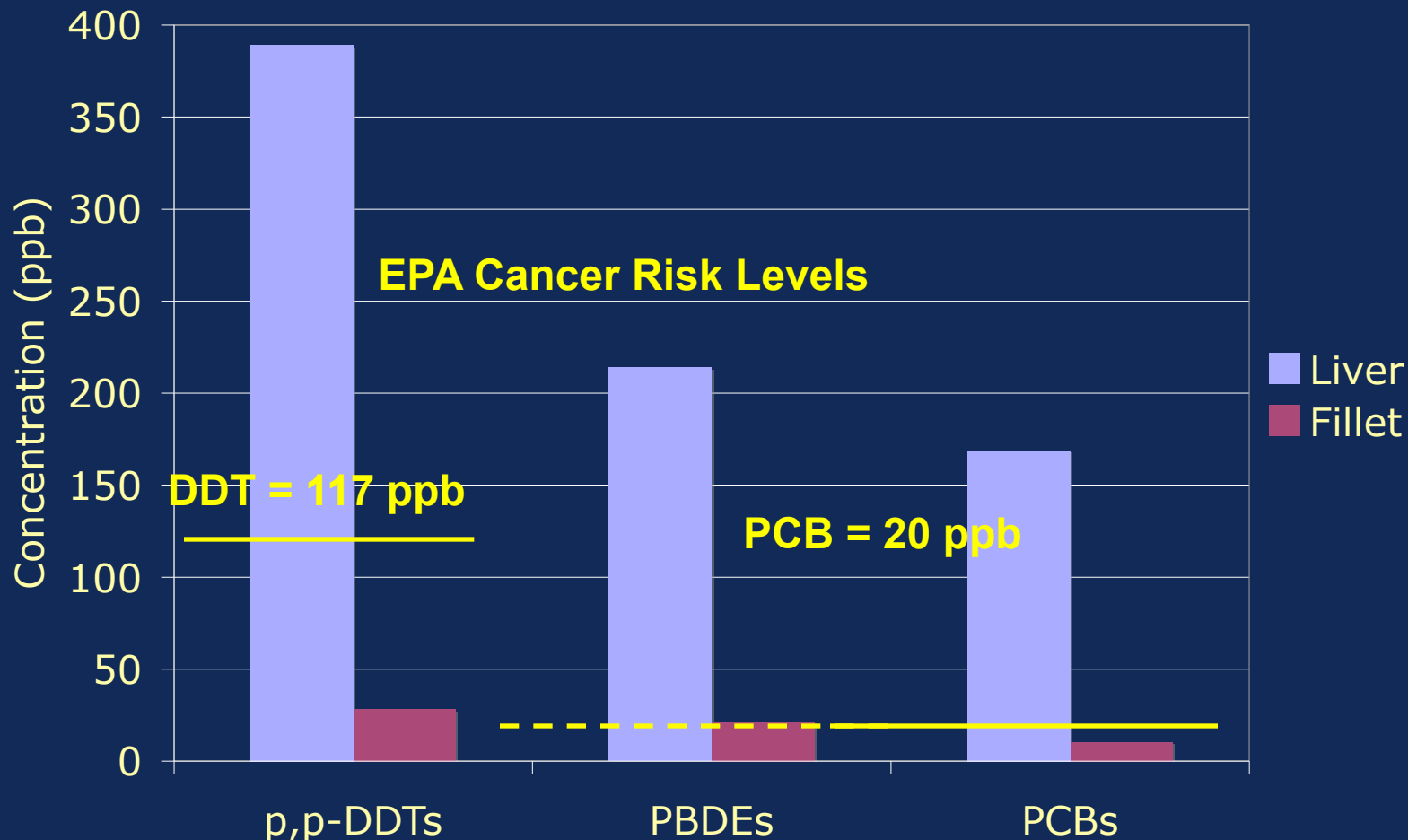
Nilsen et al., in prep.

Contaminants in Fish Tissues 2009

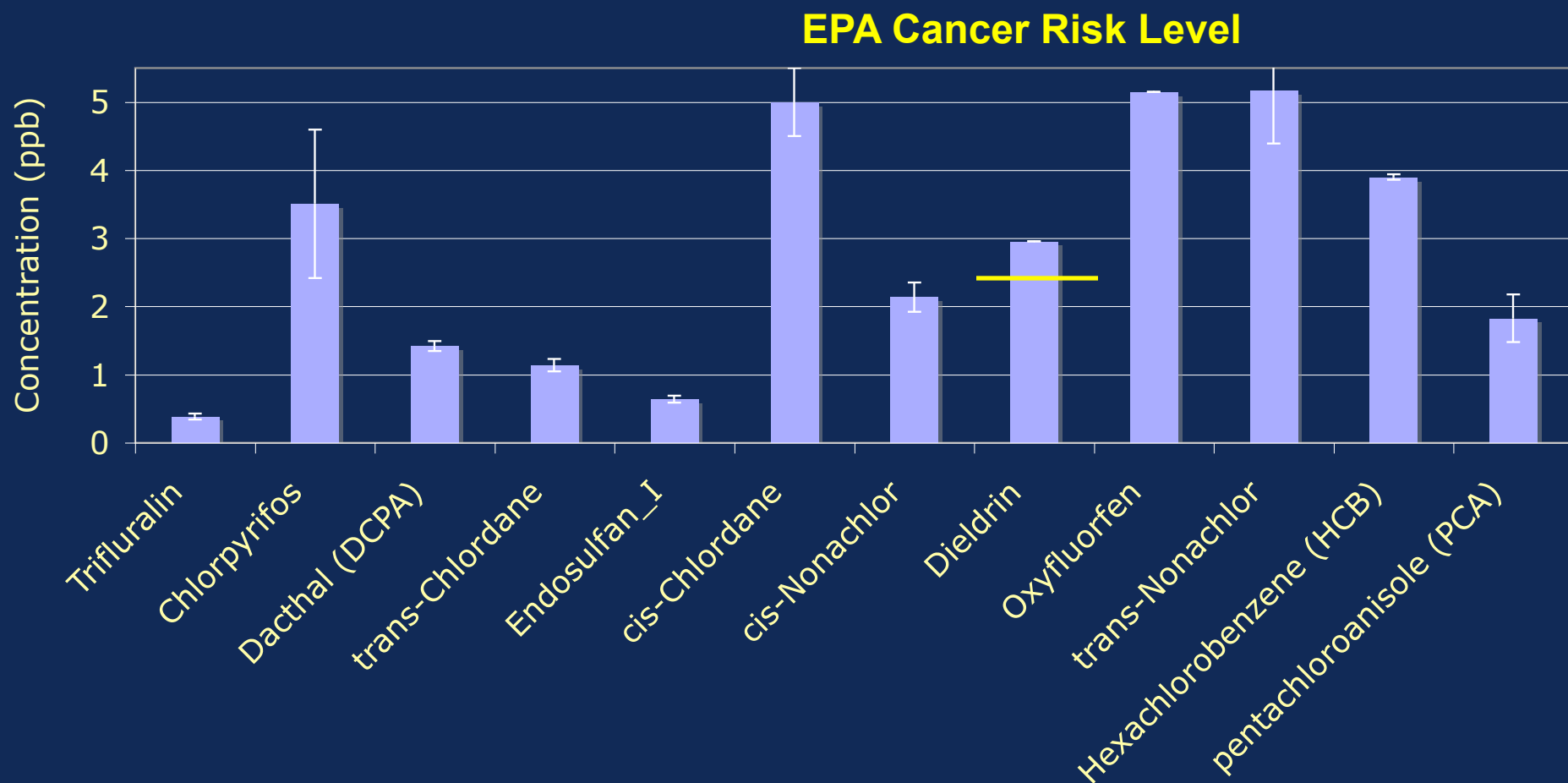
FDA Action Levels

DDT = 5,000 ppb

PCBs = 2,000 ppb



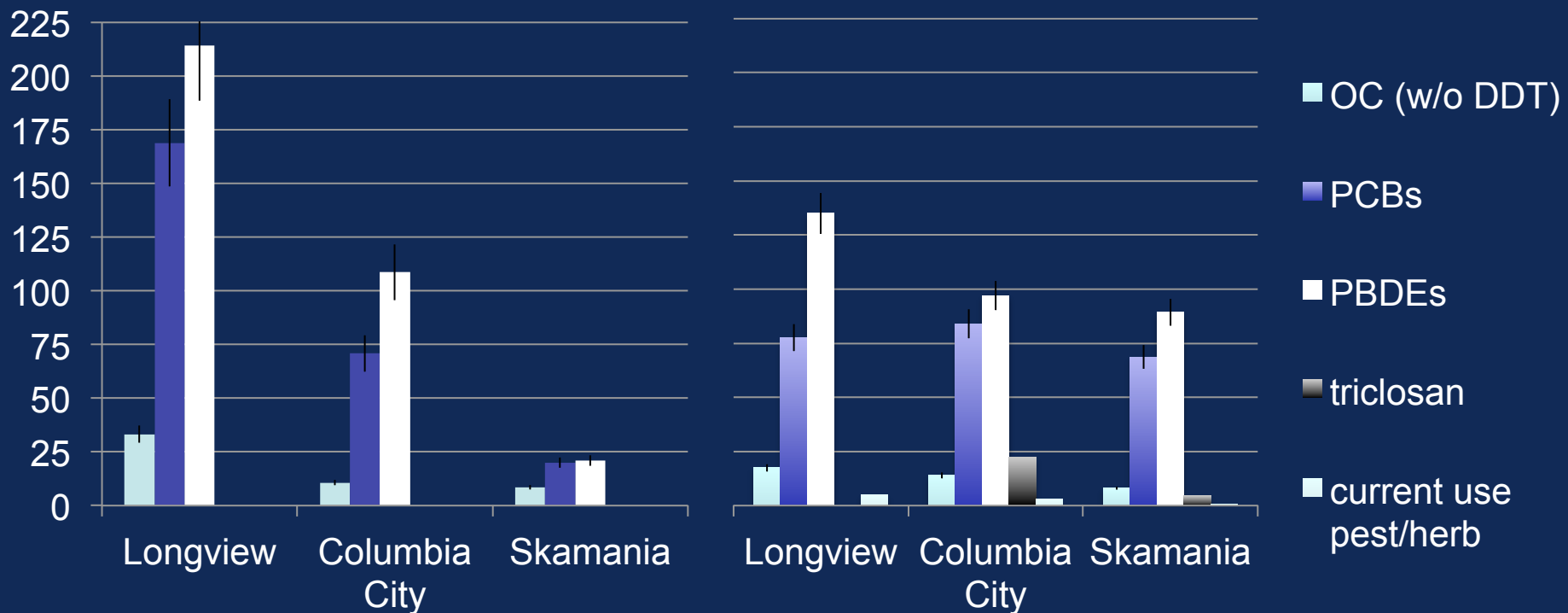
Contaminants in Fish Livers 2009



Contaminants in Fish Livers (ng/g)

2009

2010

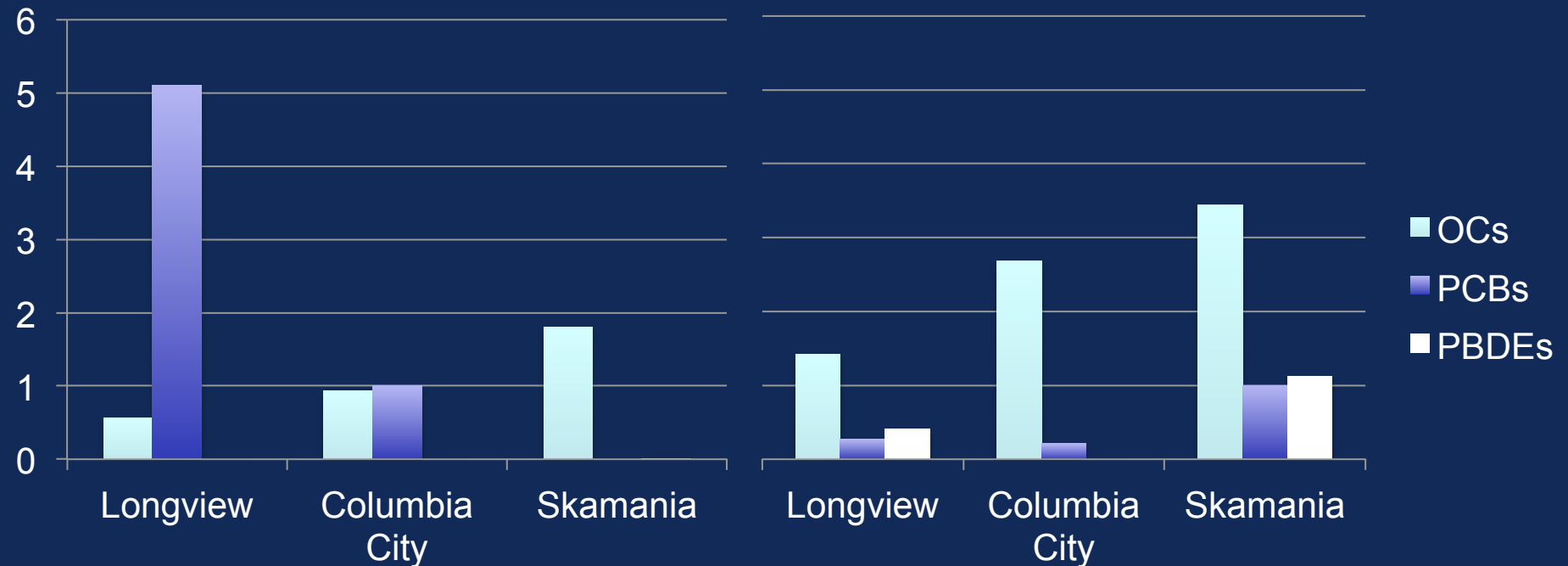


Contaminants in Passive Samplers (ng/L)

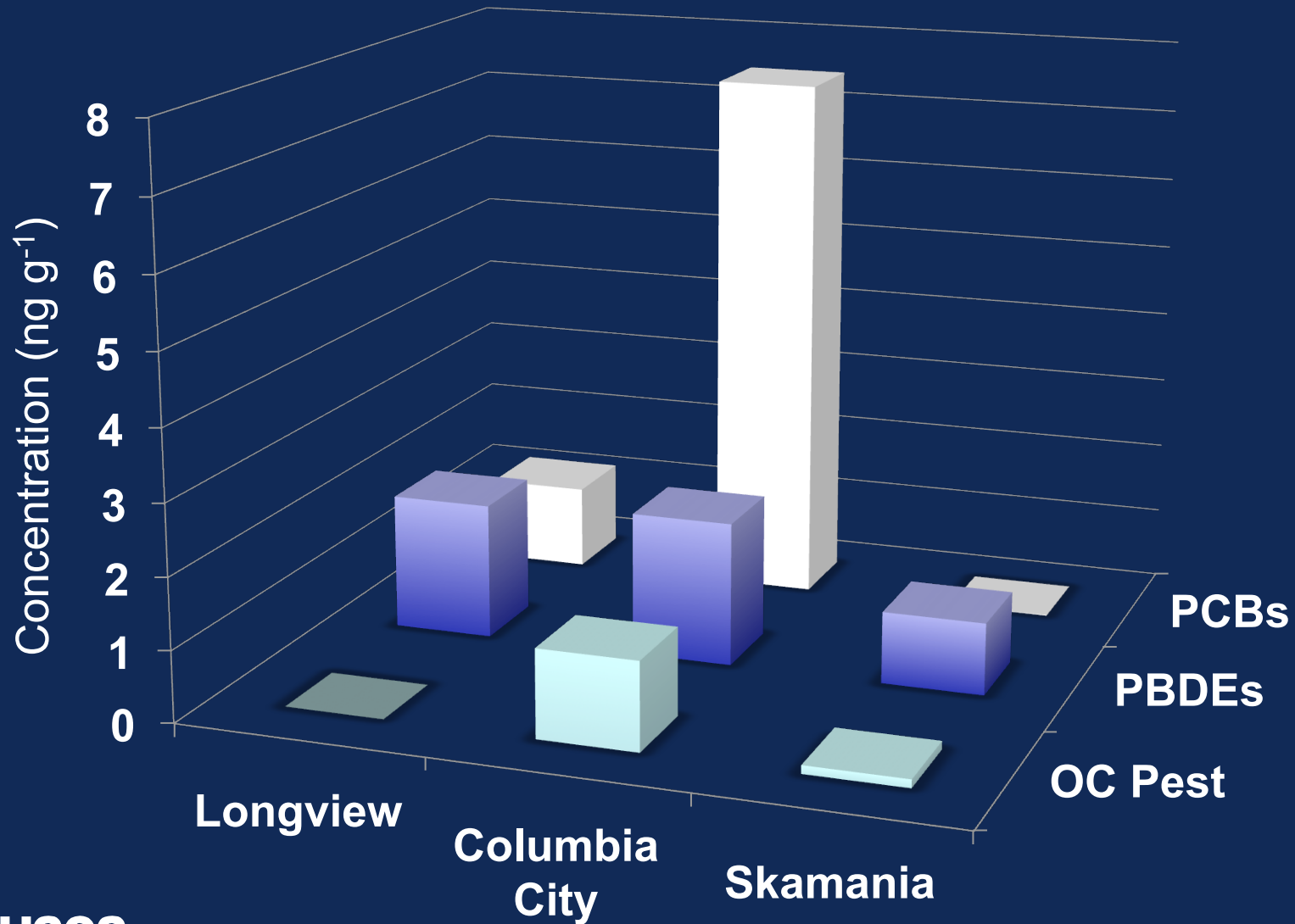
SPMD & POCIS

2009

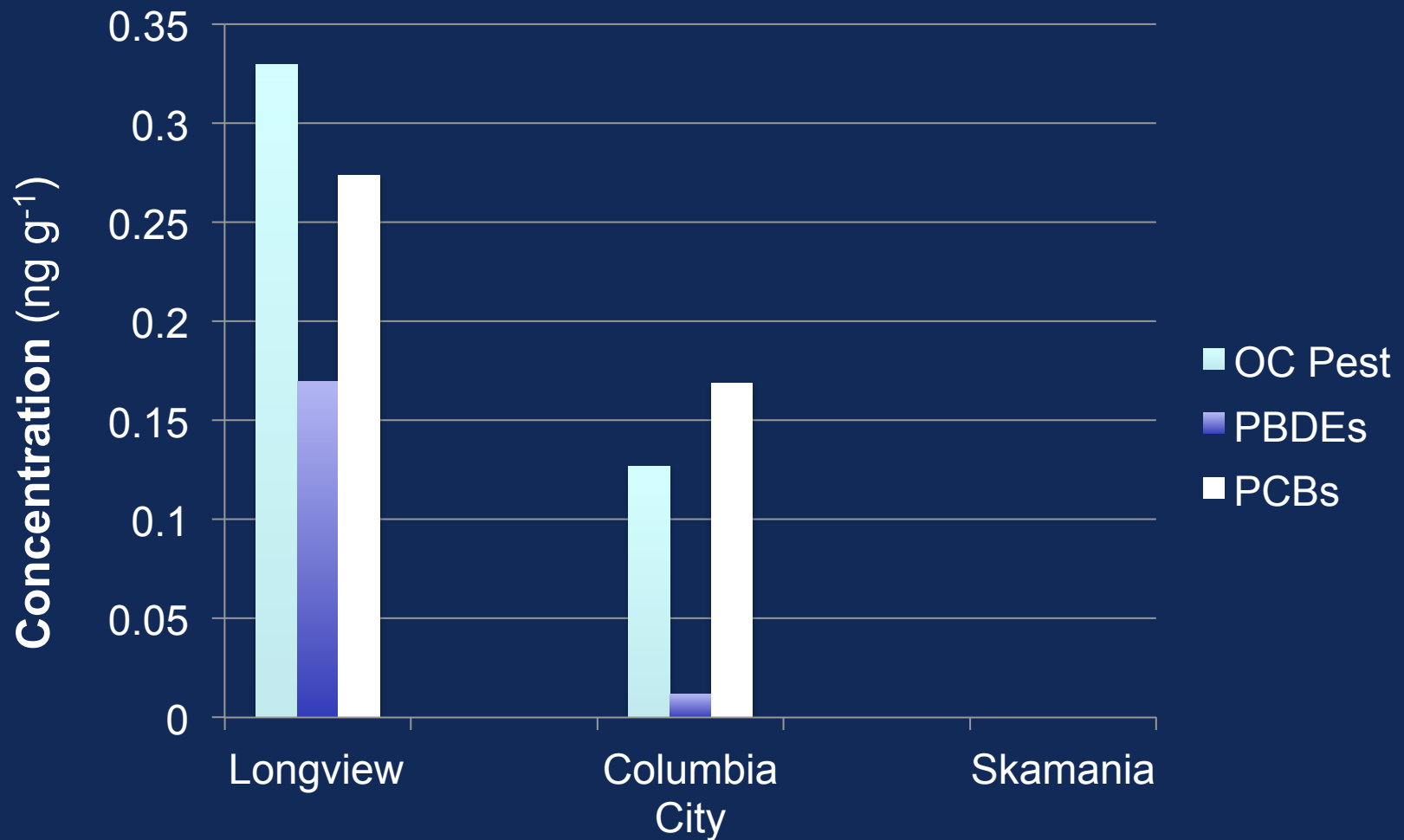
2010



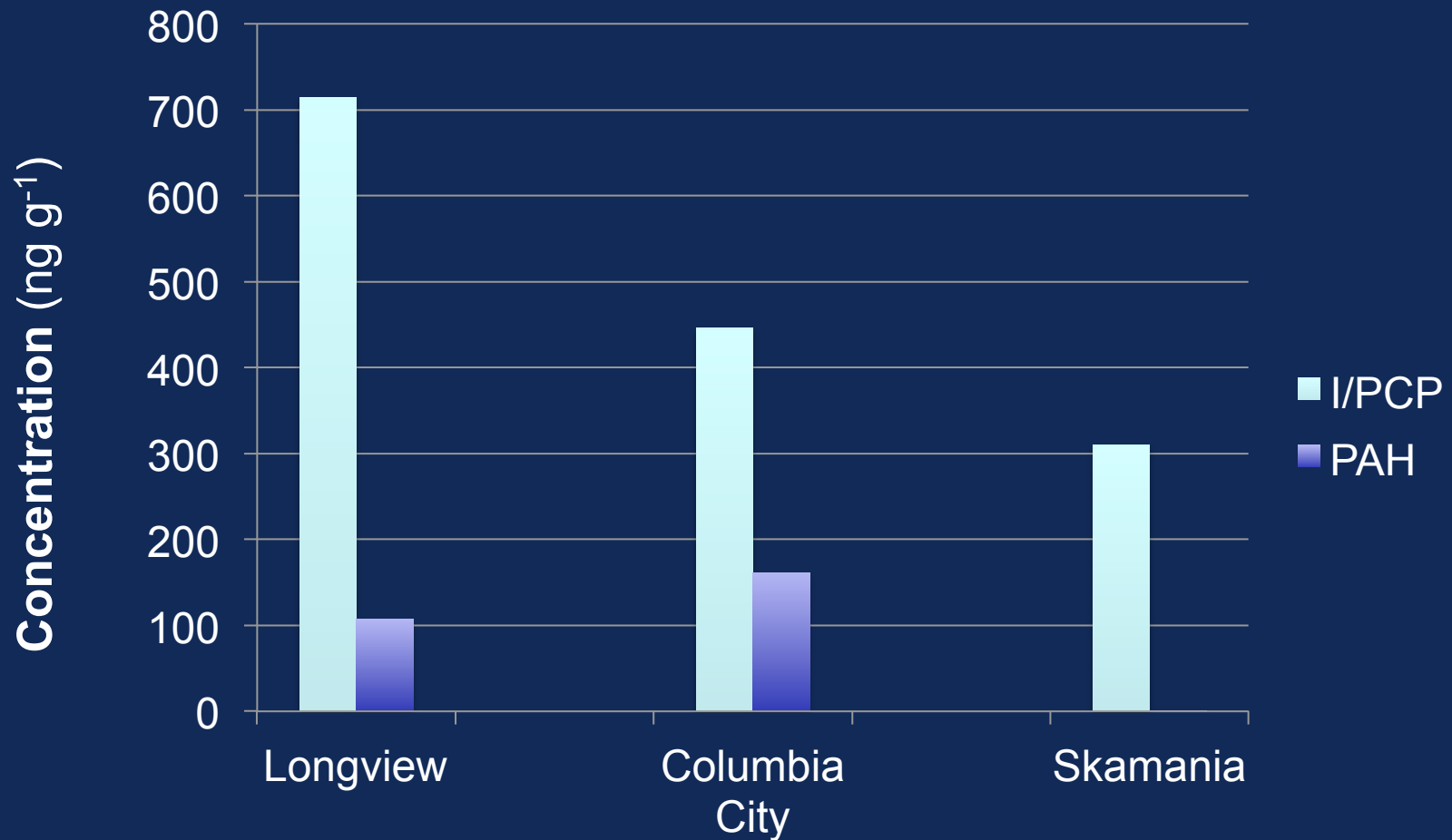
Contaminants in Sediments 2009



Halogenated Contaminants in Sediments 2010



Wastewater Contaminants in Sediments 2010



I/PCP = Industrial/Personal Care Products

Biomarkers of PBDE and EDC Exposure and Effects in Resident Fish

- Androgens (11-ketotestosterone)
- Estrogens (17 β -estradiol)
- Blood vitellogenin
- Gonad size (gonadosomatic index)
- Gonad, kidney, spleen, liver abnormalities (histopathology)
- Condition factor (length: weight)
- Shortening of opercula
- External (skin) parasites
- Gill parasites
- Sperm quality
- Oligonucleotide microarray

Largescale Suckers
(*Catostomus macrochelys*)

Torres et al., in prep.
Christiansen et al., submitted
Jenkins et al., in prep.



Biomarkers Show Fish More Stressed Downstream Compared to Upstream

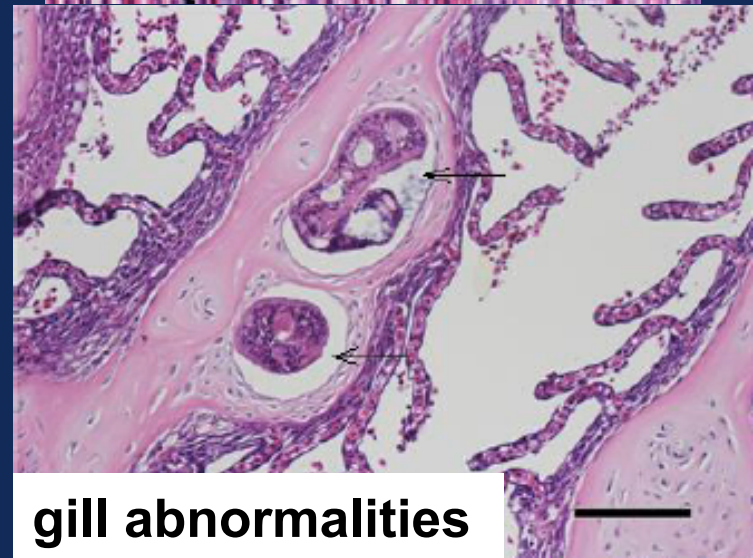
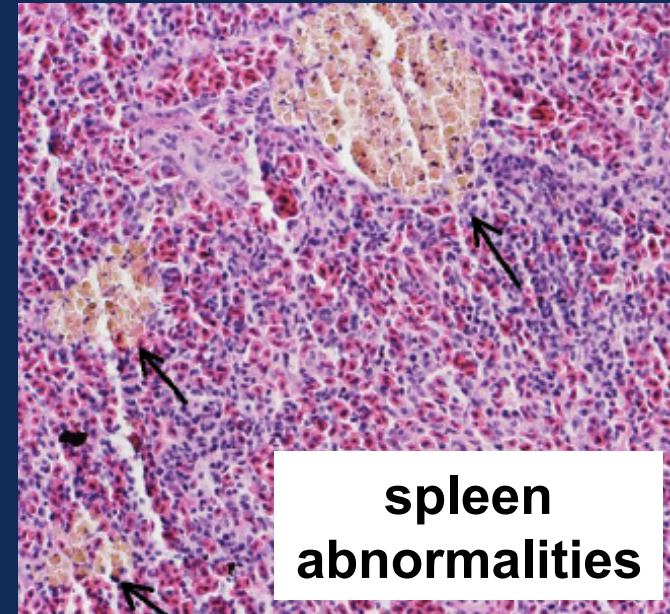
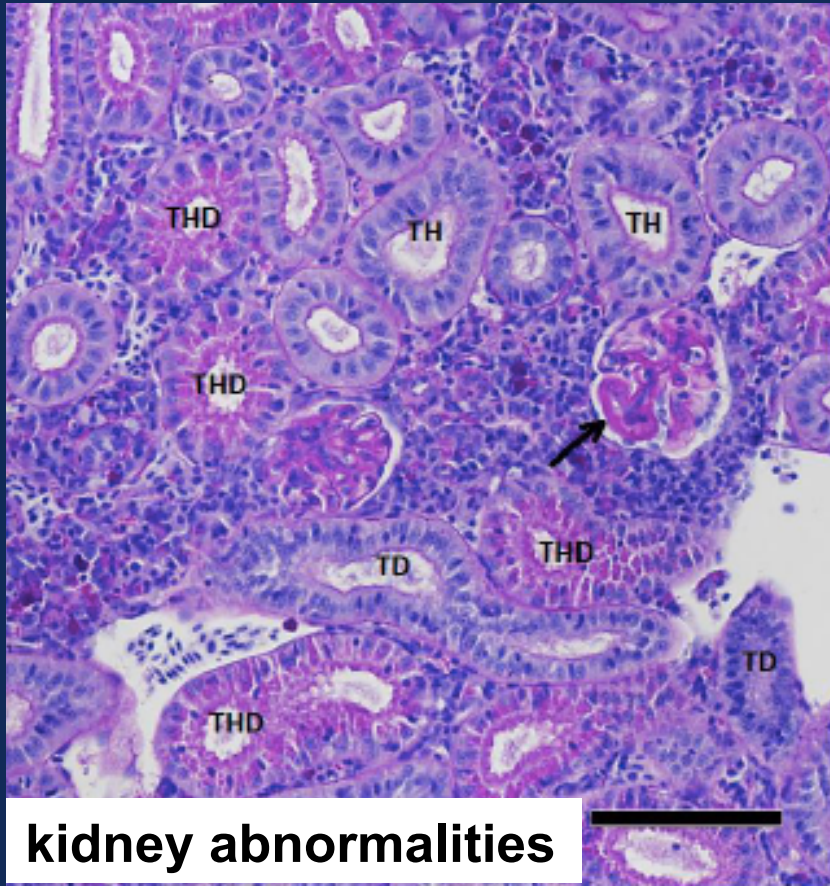
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Biomarkers Show Fish More Stressed Downstream Compared to Upstream



Torres et al., in prep.

Summary

- Fish tissue contaminant concentrations increase moving downstream - gradient of exposure achieved in 2009, 2010
- Gradient less in 2010, although median still similar
- Many of same compounds in passive samplers accumulating in fish tissues, but trends not always same
- Sediment transport model a very useful tool to predict accumulation of fine-grained sediments and contaminants
- With sampling based on model, sediment concentrations follow fish (increasing downstream)
- Median sediment concentrations lower in 2010 than 2009, except wastewater compounds
- Biomarkers show fish more stressed downstream sites relative to upstream (not statistically linked to measured toxics)

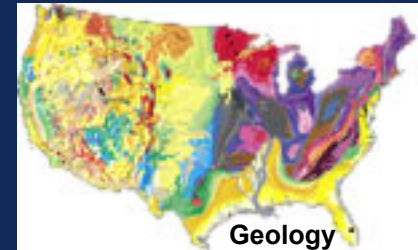
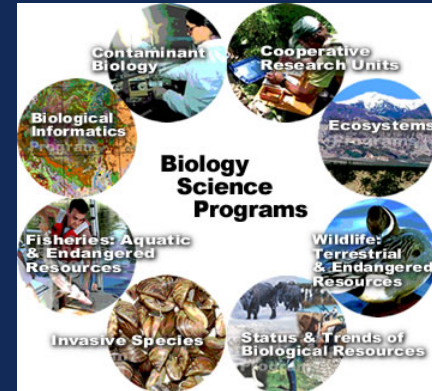
Acknowledgements



**US Army Corps
of Engineers.**



**Lower Columbia
Solutions Group**



**UNIVERSITY
OF
LOUISIANA**
Lafayette™



*American Fisheries Society
Louisiana Chapter*



More Information

Websites:

<http://or.water.usgs.gov/proj/Conhab/> (public)

http://or.water.usgs.gov/preview/uo/internal_htmls/ConHab/
(internal USGS)

Video:

<http://or.water.usgs.gov/proj/Conhab/#video>

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