

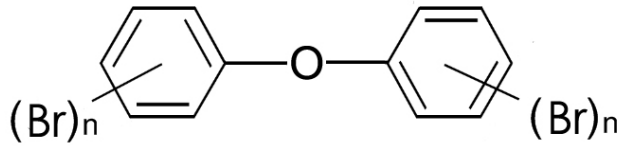
Emerging and Legacy Contaminants in the Foodweb:

Columbia River Contaminants and Habitat
Characterization (ConHab) Project

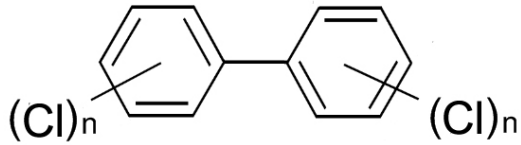
Elena Nilsen
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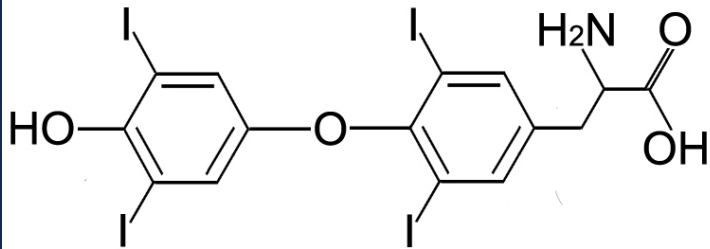
Motivation PBDEs and EDCs



Polybrominated diphenyl ethers (PBDE)



Polychlorinated biphenyls (PCB)



Thyroxine (T4)

- Affect organism development & population viability
- PBDEs (Kuriyama et al. 2005)
 - Hyperthyroidism in cats (Mensching et al. 2012)
 - Alter thyroid function and reduce sperm counts in humans (Kuriyama et al. 2005)
 - Similarity to T4 structure may underlie PBDE and PCBs toxicity
 - Thyroxine important for fish mitochondrial function

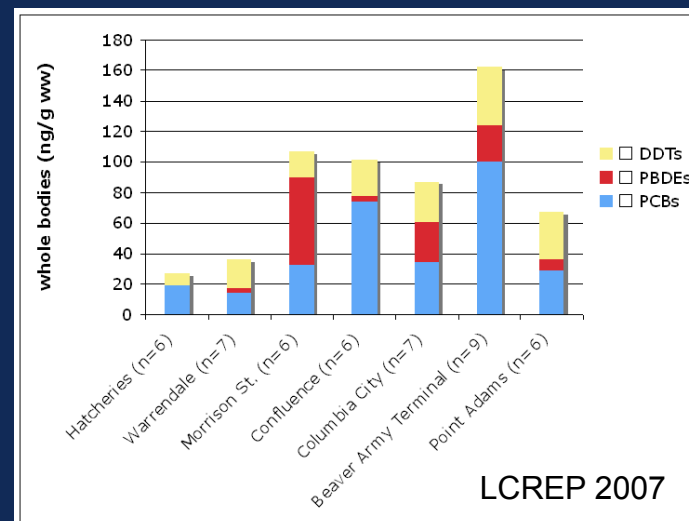




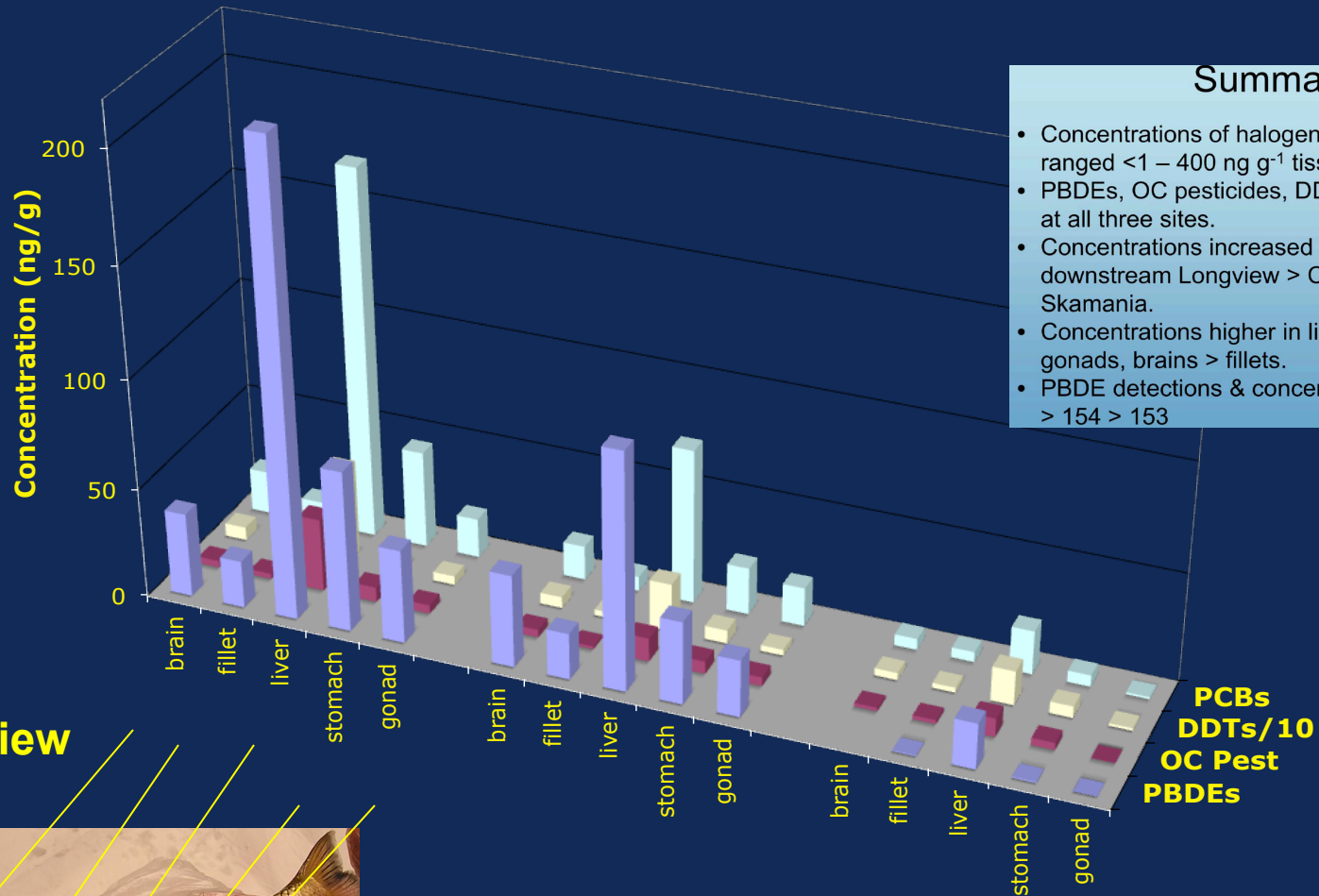
Motivation PBDEs



- 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)
- Goal: sample foodweb across sites representing a chemical gradient



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



Biomagnification PBDE100

Italics = $\mu\text{g Kg}^{-1}$

osprey egg
94



BMF
8

largescale sucker
12



BSAF
19

BMF
48

Sediment
0.65

macro-
invertebrates
0.25



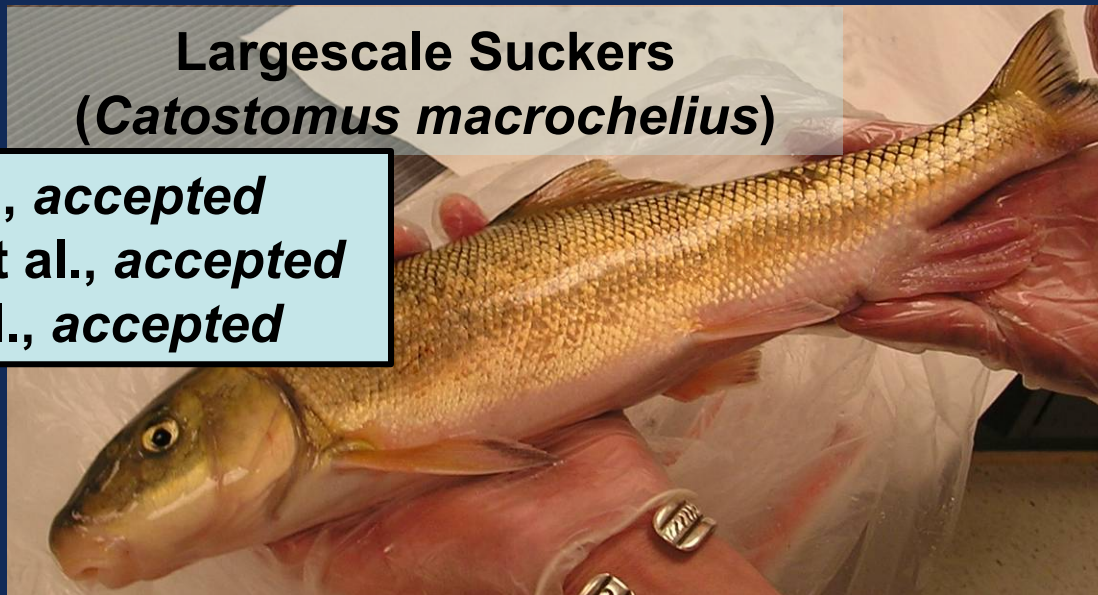
NABS (www.benthos.org)

Biomarkers of PBDE and EDC Exposure and Effects in Resident Fish

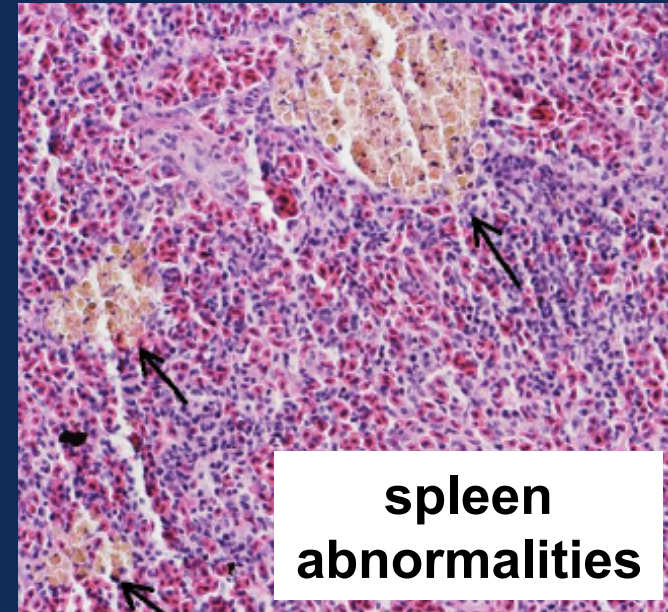
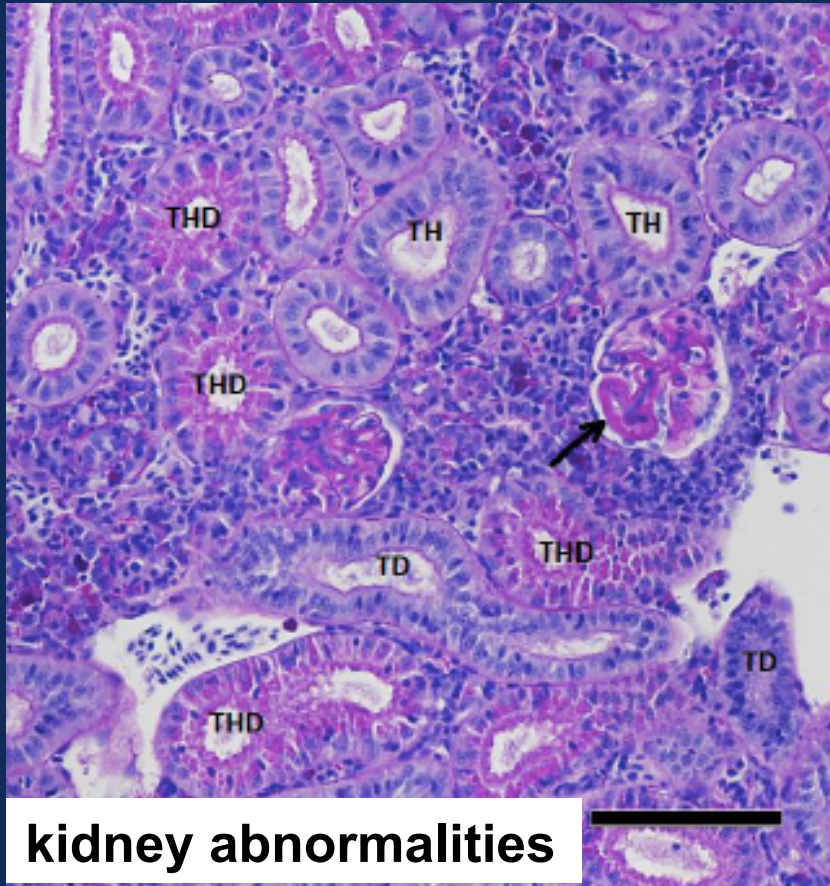
- Androgens (11-ketotestosterone)
- Estrogens (17 β -estradiol)
- Blood vitellogenin
- Gonad size (gonadosomatic index)
- Gonad, kidney, spleen, liver abnormalities (histopathology)
- Condition factor (length: weight)
- Shortening of opercula
- External (skin) parasites
- Gill parasites
- Sperm quality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

**Largescale Suckers
(*Catostomus macrochelys*)**

Torres et al., *accepted*
Christiansen et al., *accepted*
Jenkins et al., *accepted*



Biomarkers Show Fish More Stressed Downstream Compared to Upstream



Sperm Health

Results

- Biomarker that differed among sites:
 - abnormal morphology, viability, mitochondrial membrane potential, live apoptotic cells, total apoptotic cells, ATP content, DNA fragmentation, and percent haploid testicular cells
- Correlations between contaminants (NWQL data) and T4, T3, VTG, sperm motilities
- Sub-lethal effects of xenobiotics impacting endocrine and reproductive axes in male largescale suckers

Summary

- Fish tissue contaminant concentrations increase moving downstream – levels are of concern for subsistence fisher populations based on ALRs
- Bioaccumulation/biomagnification was observed for PBDEs
- Biomarkers show fish more stressed downstream sites relative to upstream (some statistically correlated to measured toxics)
- Gene expression microarray identified 76 genes with expression patterns correlated with hepatic tissue contaminants

Science of the Total Environment Nov. 2013

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- Nilsen EB, Zaugg SD, Alvarez DA, Morace JL, Waite I, Counihan T, et al. Contaminants of legacy and emerging concern in largescale sucker (*Catostomus macrocheilus*) and the foodweb in the lower Columbia River, Oregon and Washington, USA.
- Torres L, Nilsen E, Grove R, Patiño R. Health condition of largescale sucker (*Catostomus macrocheilus*) collected along a contaminant gradient in the Lower Columbia River, Oregon and Washington, USA.