

# Occurrence & Effects of Emerging and Legacy Contaminants:

Columbia River Contaminants and Habitat  
Characterization (ConHab) Project

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# ConHab Team Participants

(2008-2011/12)

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BRD, Western Fisheries Research Center, Cook, WA

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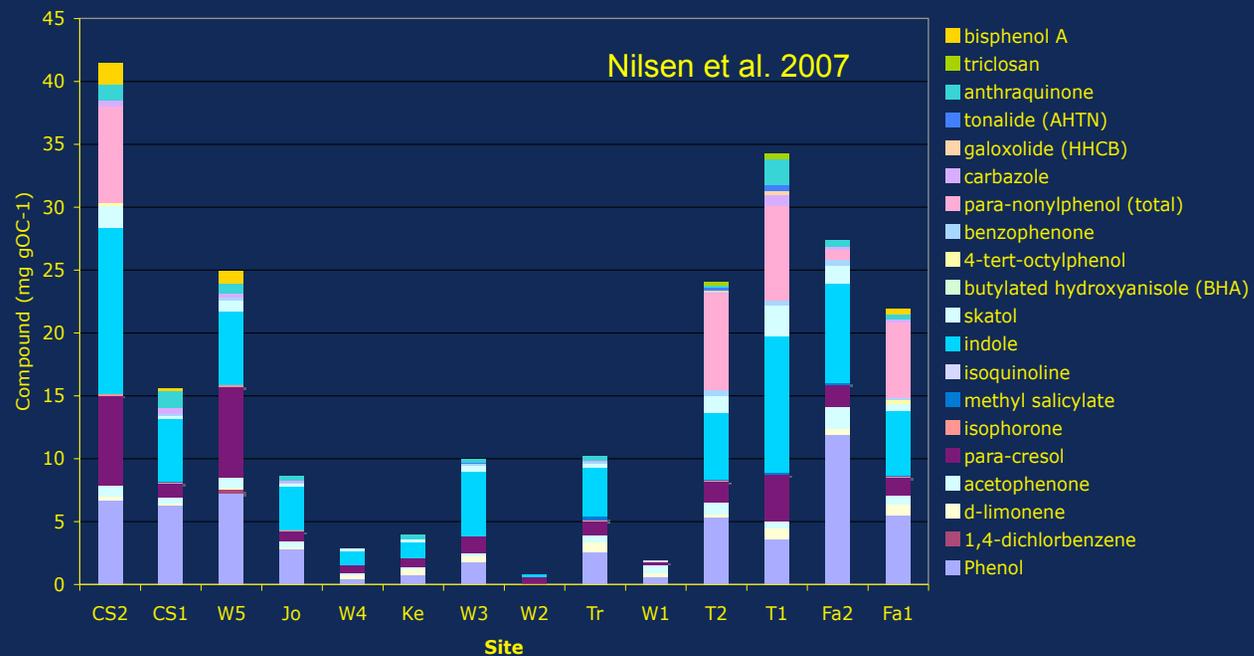
Jennifer Morace, Elena Nilsen, Ian Waite

WRD, Oregon Water Science Center



# Motivation

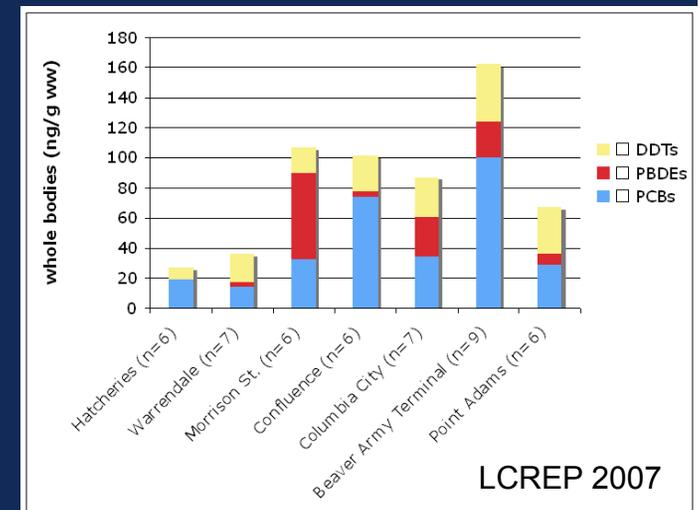
- Forty-nine wastewater indicator contaminants recently detected in CR basin sediments
- Endocrine disrupting compounds (EDCs) detected at 22 of 23 sites sampled





# Motivation

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



# Motivation

## Endocrine Disrupting Compounds (EDCs)

- What they do: mimic or block hormones and disrupt normal function
- Examples of affected wildlife:
  - Fish and piscivorous birds in Great Lakes area
  - Declining alligator population in Lake Apopka, Florida
  - Feminization of males; collapse of lake population of fathead minnow in Ontario, Canada
  - Common carp in Lake Mead, Nevada
  - Intersex largemouth bass in Columbia River Basin



# Motivation

## Endocrine Disrupting Compounds (EDCs)

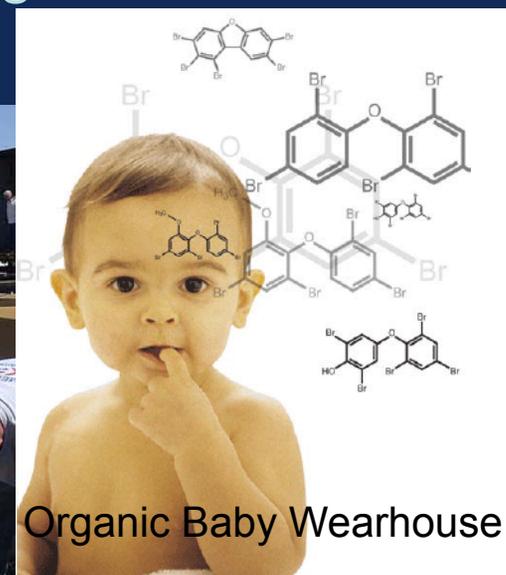
- Affect organism development & population viability
- PBDEs (Kuriyama et al. 2005)
  - Alter thyroid function
  - Reduce sperm counts
  - Delay sperm maturation
- Goal: sample foodweb across sites representing a chemical gradient



Chemical & Engineering News



NOAA



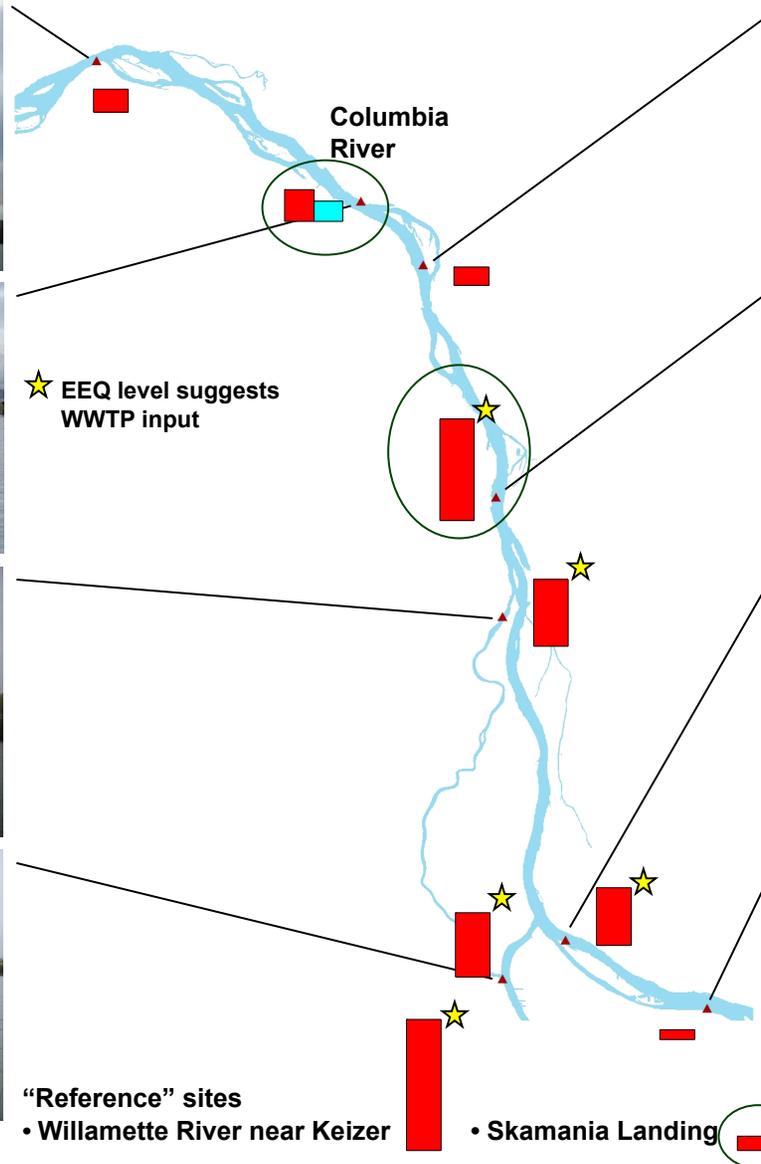
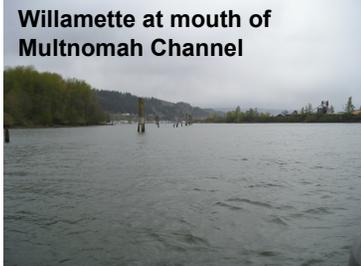
Organic Baby Wearhouse

# Area Map



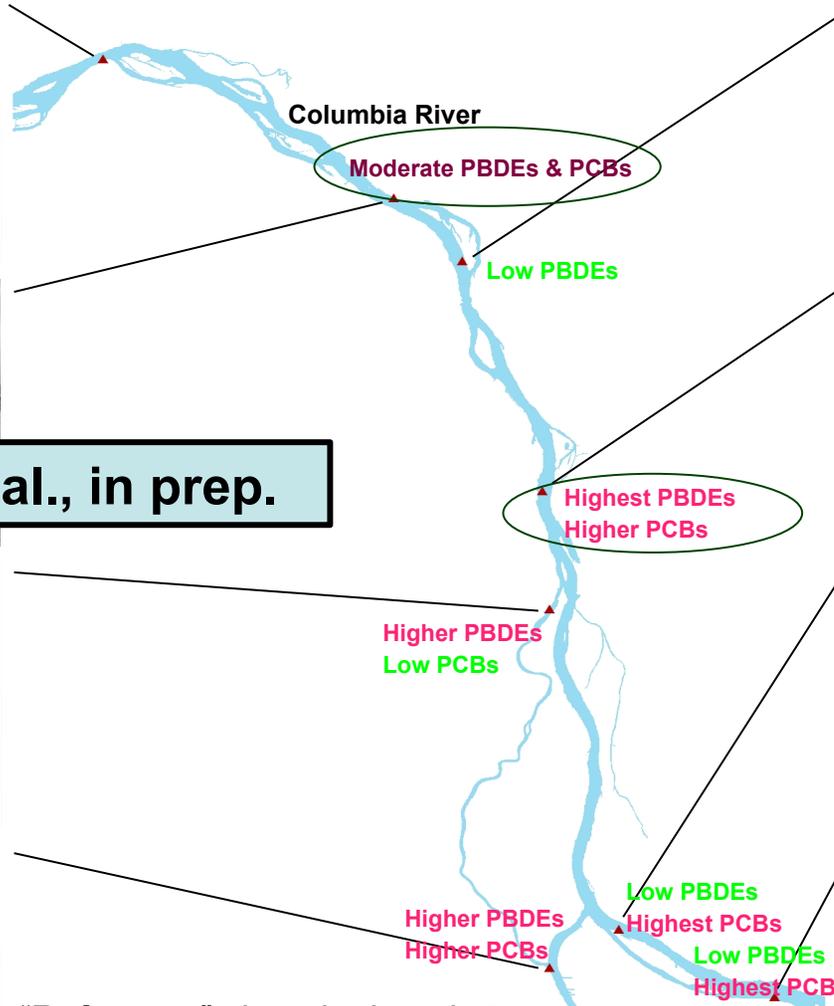
# Estrogenicity (YES) Passive Samplers

## Spring 2008



# PBDEs and PCBs Passive Samplers

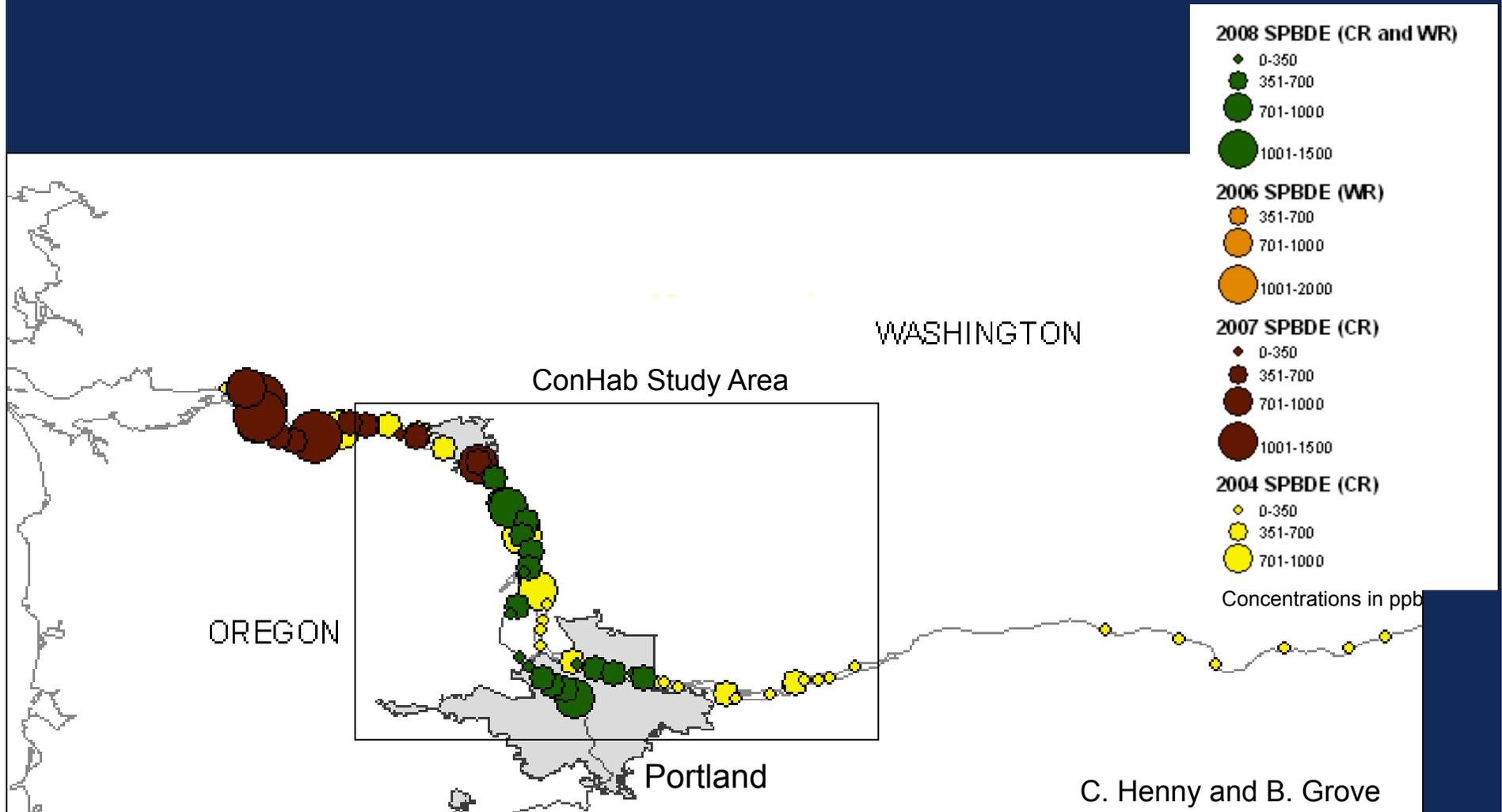
## Spring 2008



**Alvarez et al., in prep.**

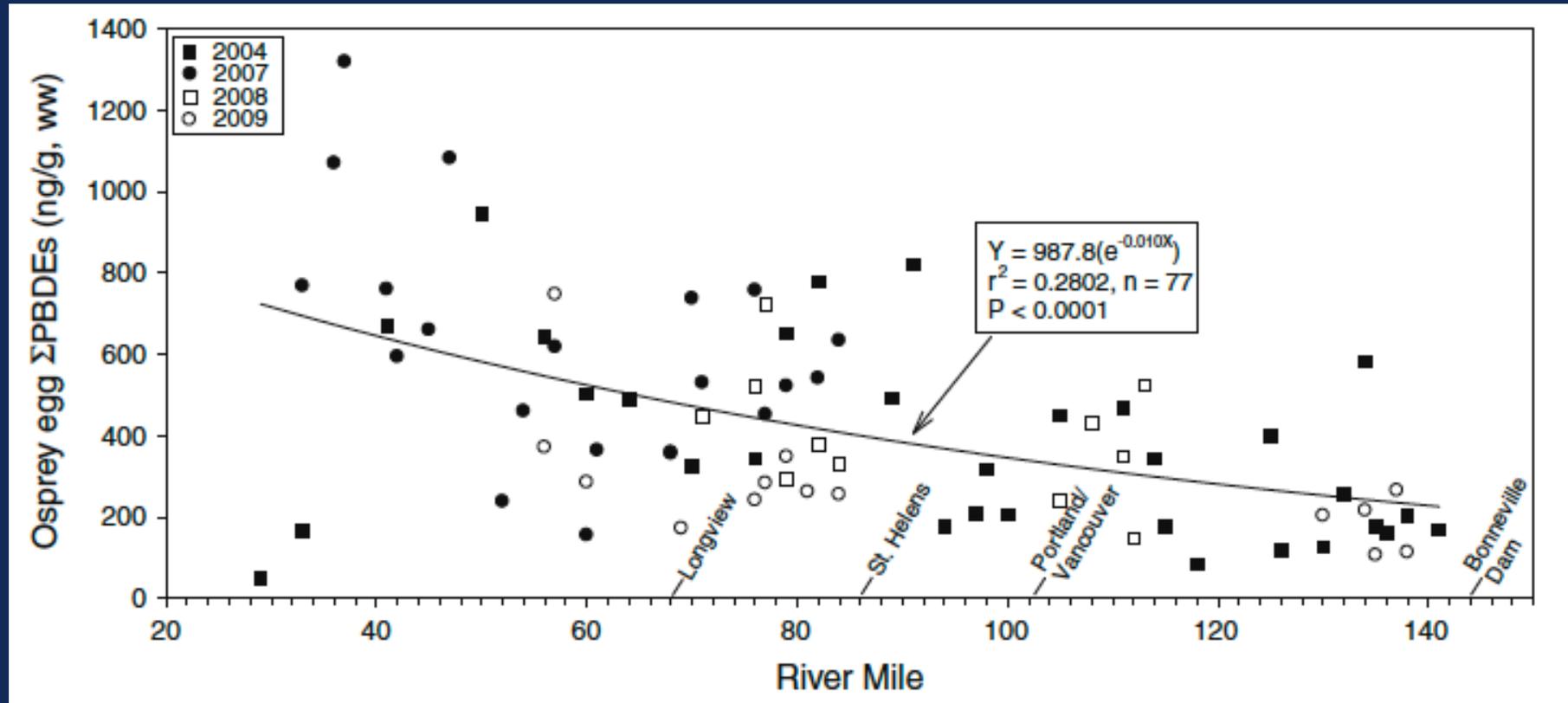
- “Reference” sites deployed at
- Willamette River near Keizer **Higher PBDEs, Low PCBs**
  - Skamania Landing **Low PBDEs, Low PCBs**

# PBDEs in Osprey Eggs



# PBDEs in Osprey Eggs

Henny et al., 2011\*



Longview



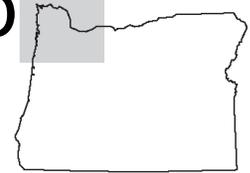
Columbia City



Skamania

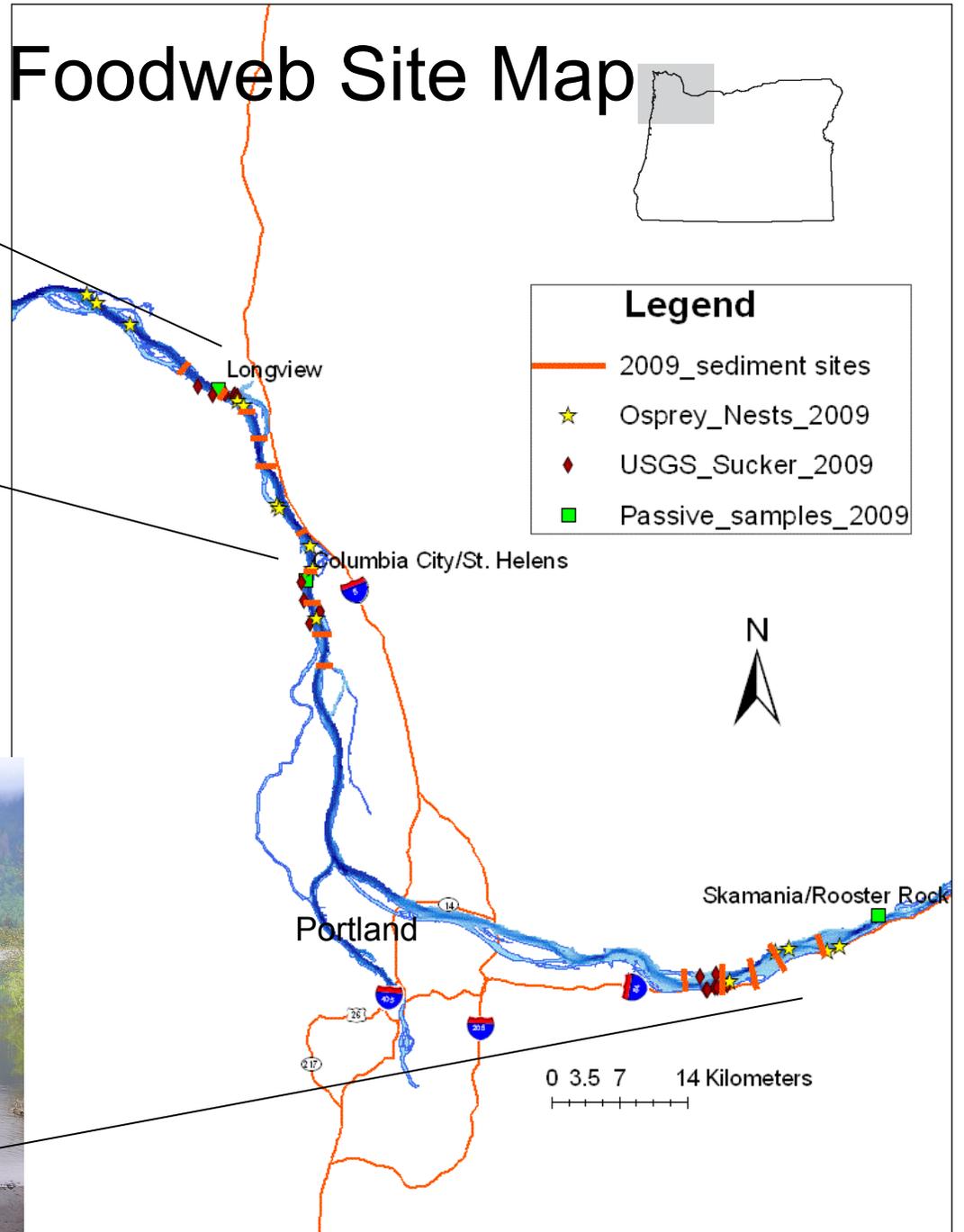


# Foodweb Site Map



**Legend**

-  2009\_sediment sites
-  Osprey\_Nests\_2009
-  USGS\_Sucker\_2009
-  Passive\_samples\_2009



# 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

# Biomarkers of PBDE and EDC exposure and effects in resident fish

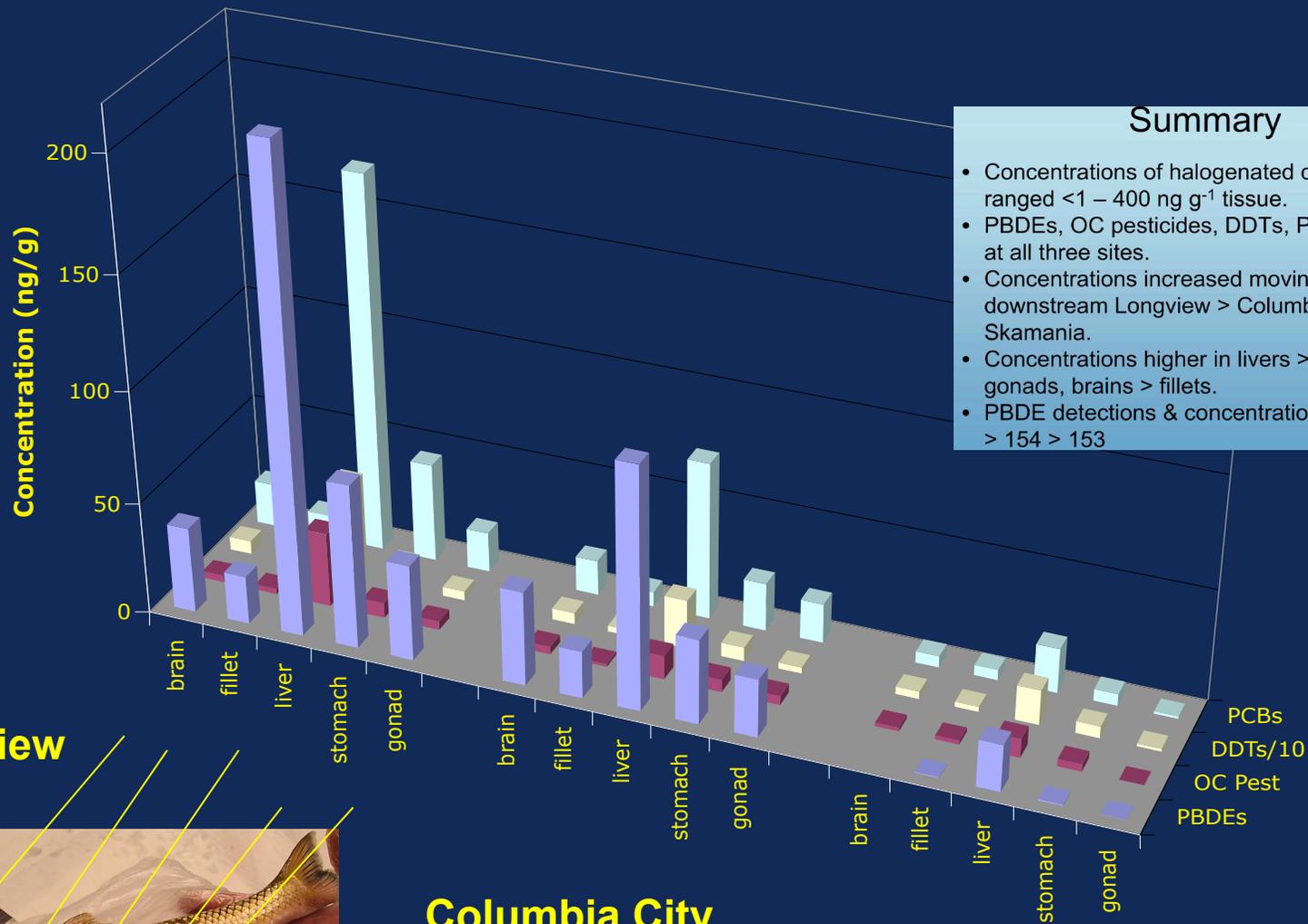
- Androgens (11-ketotestosterone)
- Estrogens (17 $\beta$ -estradiol)
- Blood vitellogenin
- Gonad size (gonadosomatic index)
- Gonad abnormalities (histopathology)
- Sperm quality
- oligonucleotide microarray development
- Condition factor (length: weight relationship)

**Largescale Suckers**  
(*Catostomus macrochelyus*)

Torres et al., in prep.  
Mesa et al., in prep.  
Jenkins et al., in prep.



# Contaminants in Fish Tissues 2009



Longview

Columbia City

Skamania

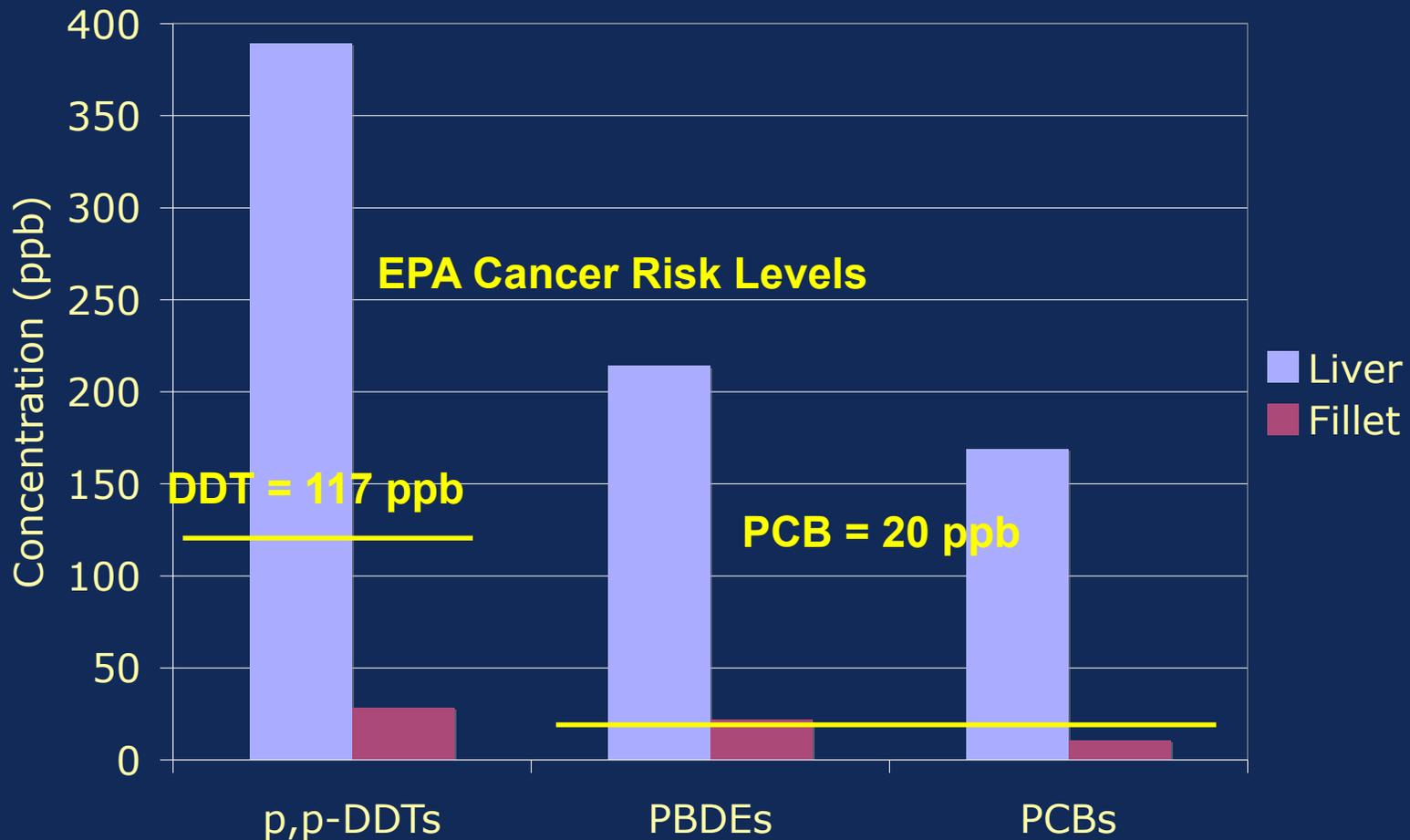
Nilsen et al., in prep.

# Contaminants in Fish Tissues 2009

FDA Action Levels

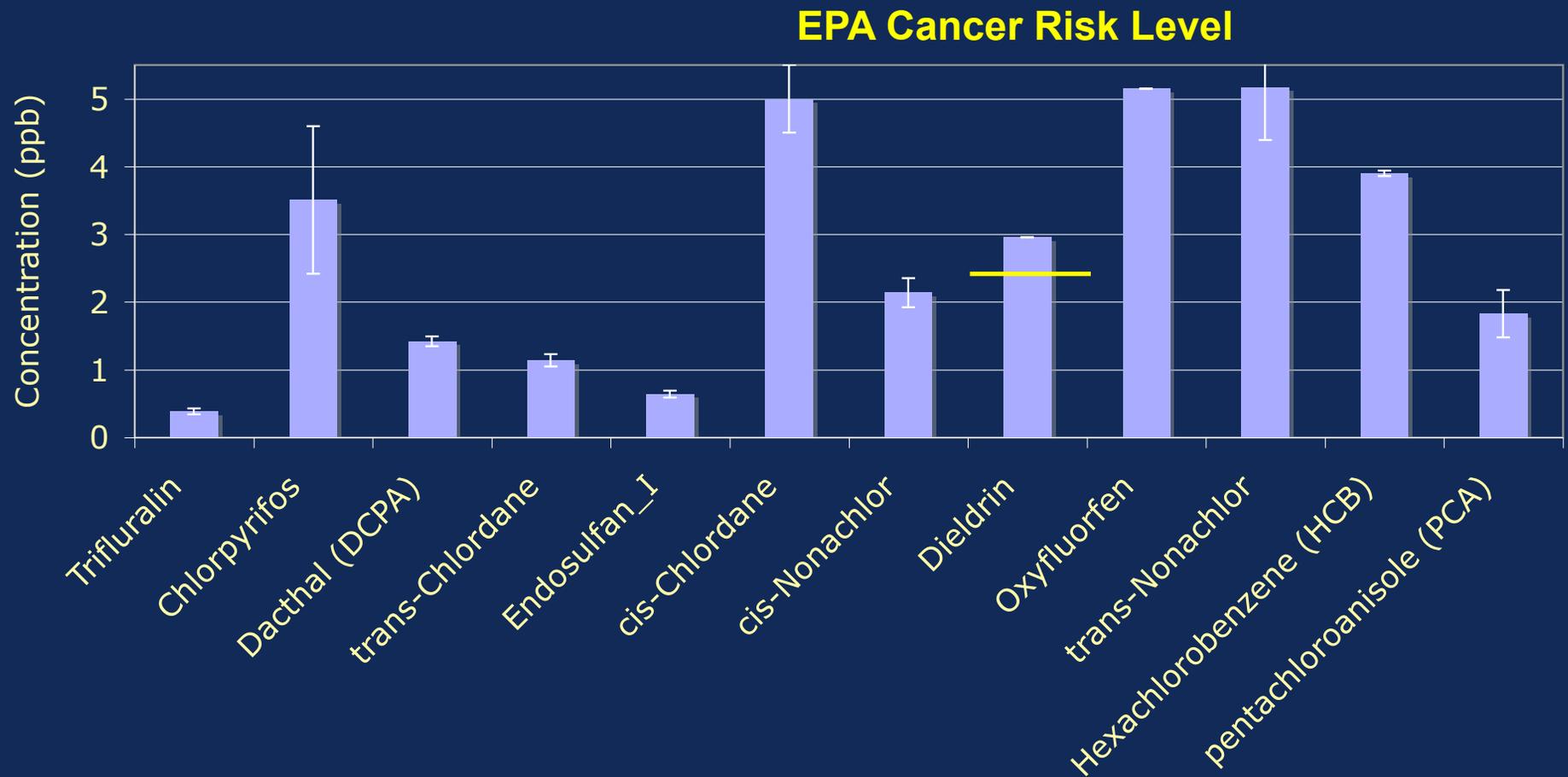
DDT = 5,000 ppb

PCBs = 2,000 ppb

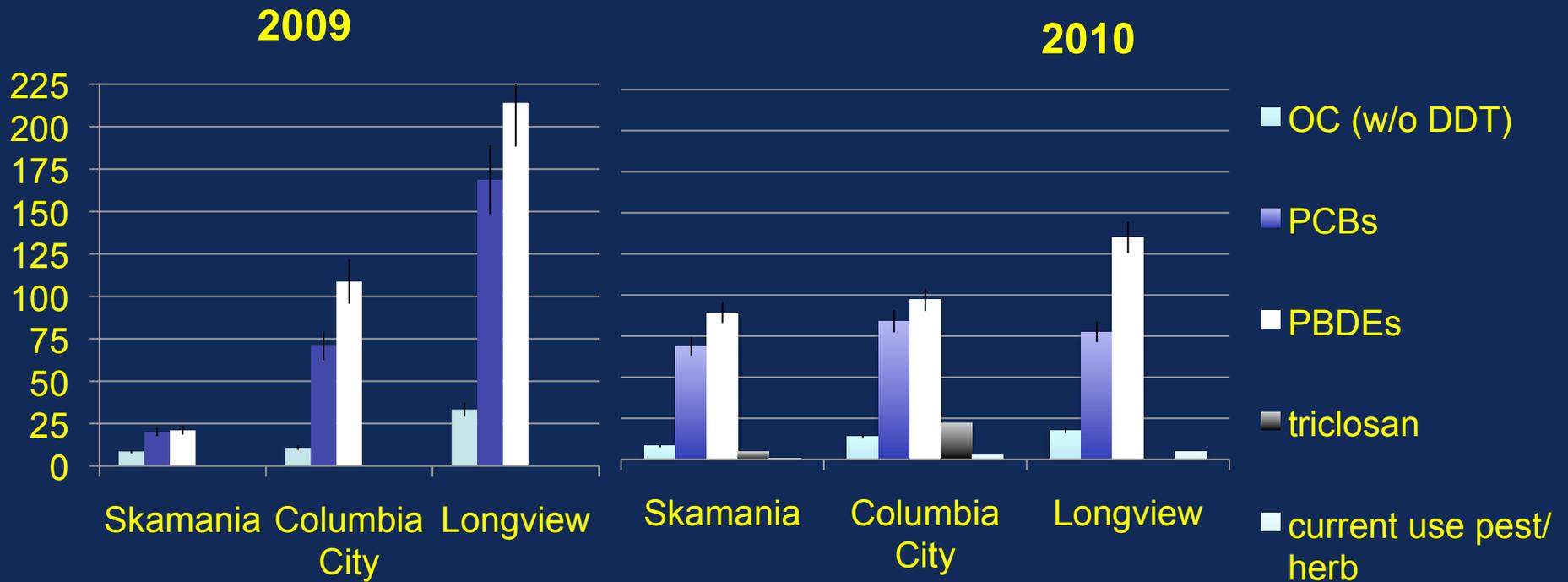


%RSD: DDTs = 15%; PBDEs = 2-12%; PCBs = 2-11%

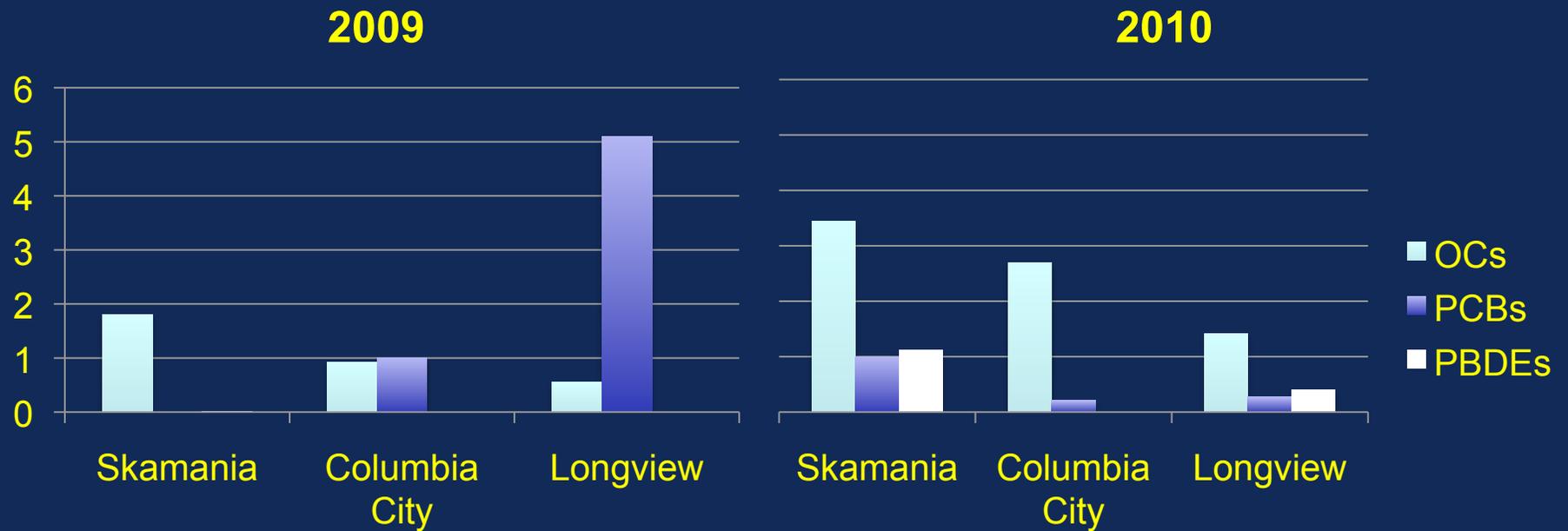
# Contaminants in Fish Livers 2009



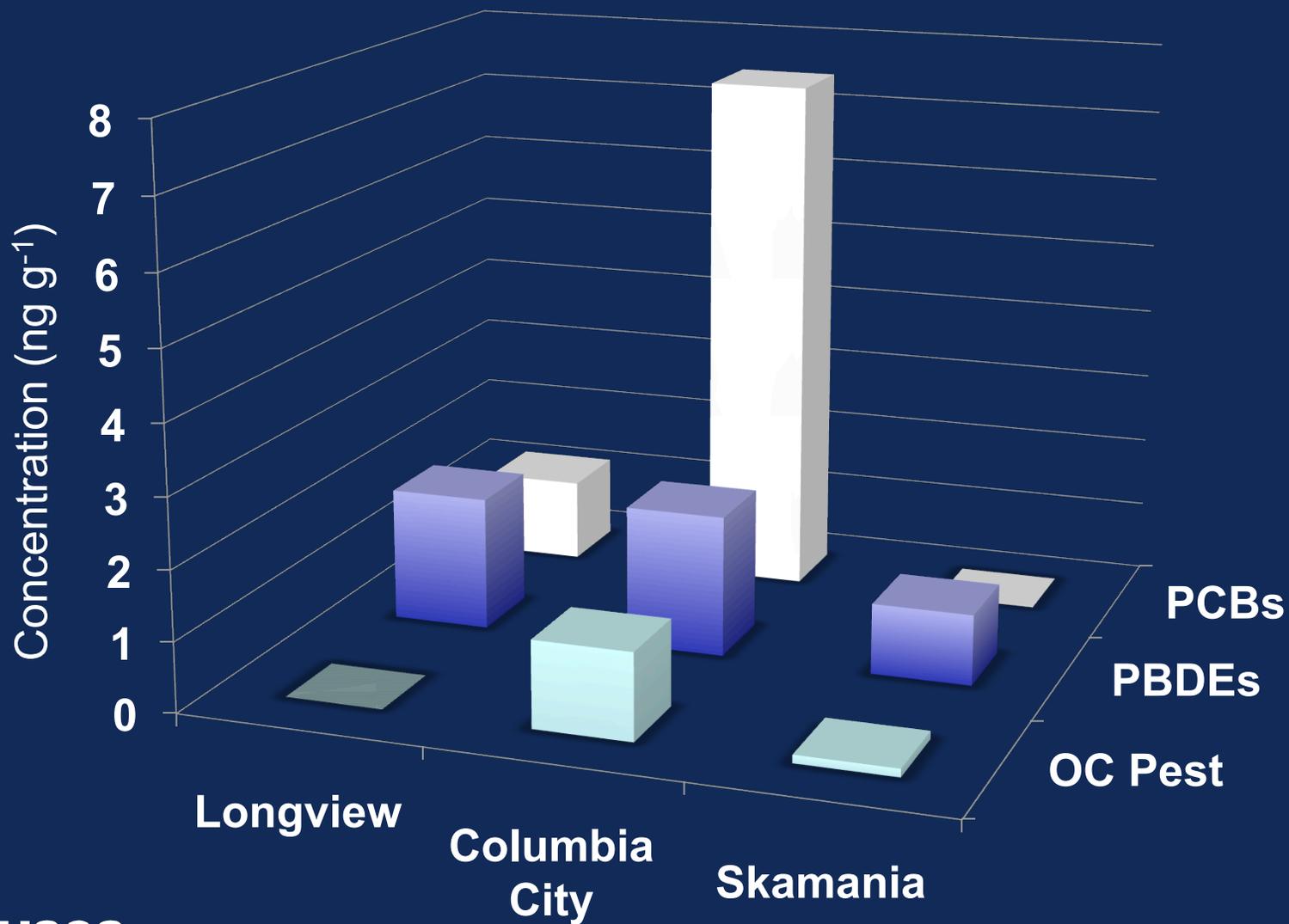
# Contaminants in Fish Livers (ng/g)



# Contaminants in Passive Samplers (ng/L) SPMD & POCIS



# Contaminants in Sediments 2009



# Contaminants in Sediments 2009

Site	Compounds Detected	> Reporting Level	Possible Use
Skamania	Indole		Fragrance
Columbia City	Para-cresol	x	Preservative
	Phenol	x	Disinfectant
	D-limonene	x	Fragrance
	3-methyl-1h-indole (skatol)		Fecal indicator
	Indole		Fragrance
Longview	Phenol	x	Disinfectant
	Bisphenol a		Plasticizer

# Summary

- Fish tissue contaminant concentrations increase moving downstream
- Wastewater compounds higher concentrations at Columbia City in water & sediments (inputs)
- Many of same compounds detected in passive samplers are accumulating in fish tissues, but trends do not necessarily match
- Experimental design making sense - gradient of exposure achieved in 2009, less so in 2010
- Goals of understanding more about biomagnification and health effects on organisms on the horizon

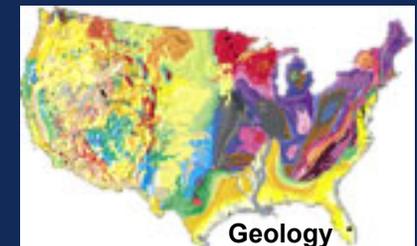
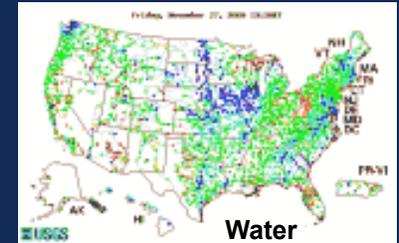
# Acknowledgements



**US Army Corps  
of Engineers.**



Lower Columbia  
Solutions Group



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