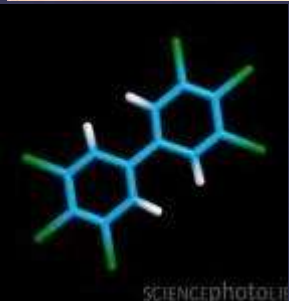
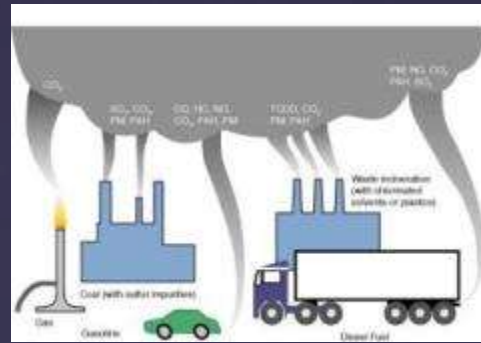


Exploring the interaction between contaminants and biological effects in Columbia River foodwebs

Elena Nilsen and *Jennifer Morace*, USGS





Contaminants from
our everyday lives
affect the ecosystem
we live in

Foodweb Sampling Design

Sediments



- contaminant analyses
- sediment transport modeling

Invertebrates



- contaminant analyses
- community assessment

Passive samplers



- contaminant analyses
- estrogen screen

Largescale Suckers



- contaminant analyses
(organs and whole bodies)
- biomarkers

Osprey



- contaminant analyses
- productivity assessment
- well bird blood analyses



Longview

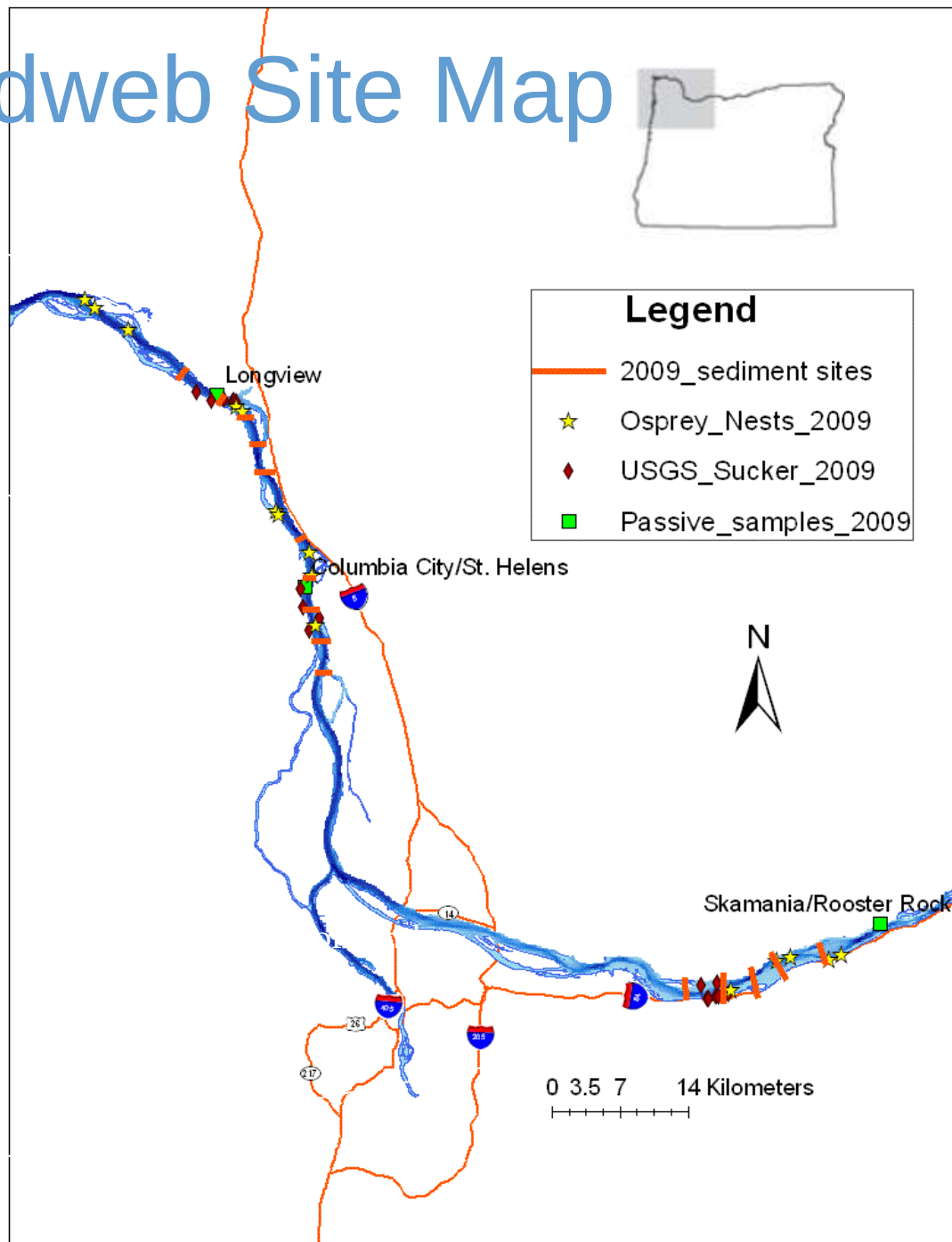


Columbia City



Skamania

Foodweb Site Map



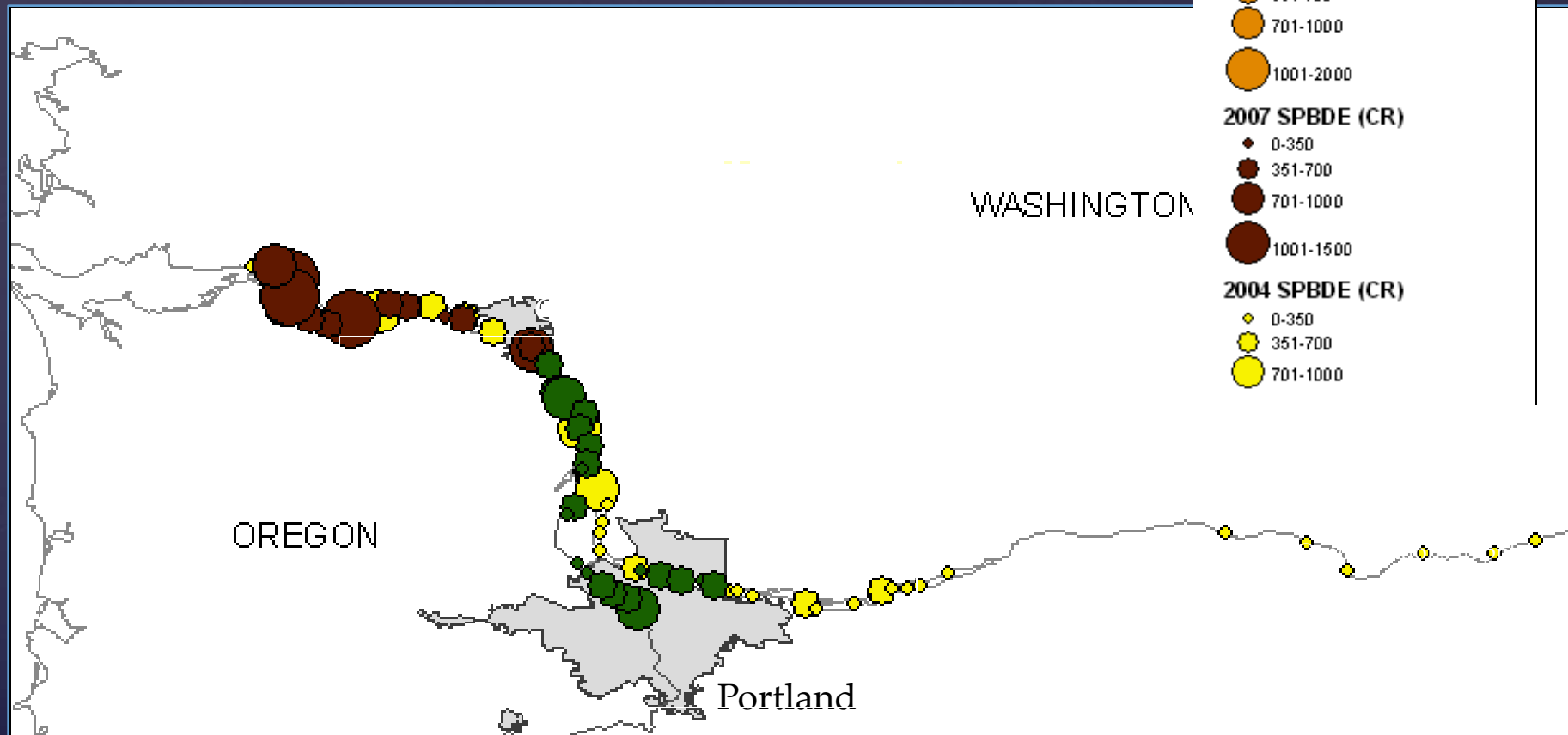
Osprey Eggs and Prey Baskets



Top 4 Prey Items*

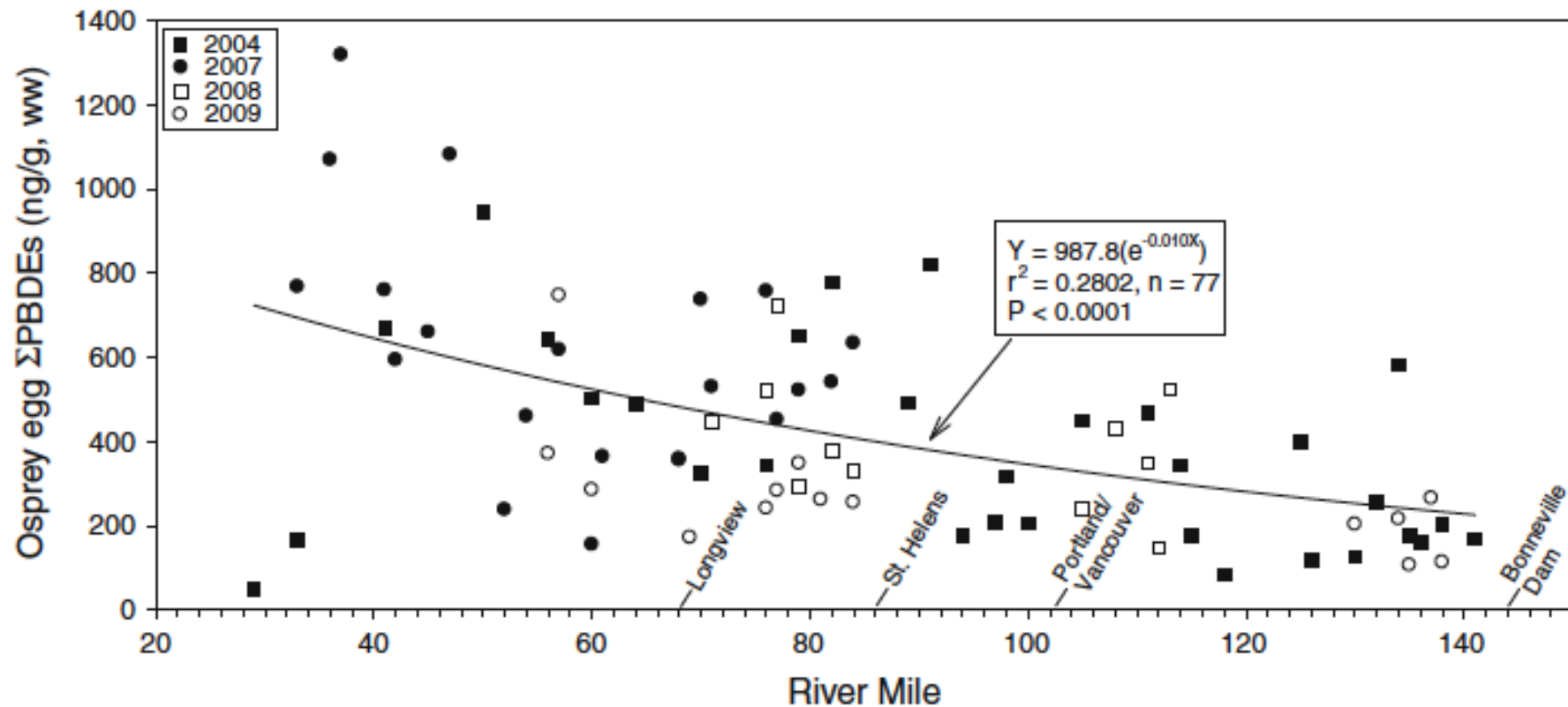
1. Catostomidae (suckers)
2. Cyprinidae (peamouth)
3. Cyprinidae
(northern pikeminnow)
4. Salmonidae (salmon/trout)

PBDEs in Osprey Eggs



C. Henny and B. Grove

PBDEs in Osprey Eggs



Henny et al., 2011
Ecotoxicology 20: 682-97

Foodweb Sampling - Fish

Largescale Suckers



Mobile Lab



Foodweb Sampling - Fish



❖ Per Site

- ❖ 17 males, 10 females

❖ Biomarkers

- ❖ Condition factors, blood, thyroid, liver section, gonad

❖ Sperm analyses

- ❖ Gonad

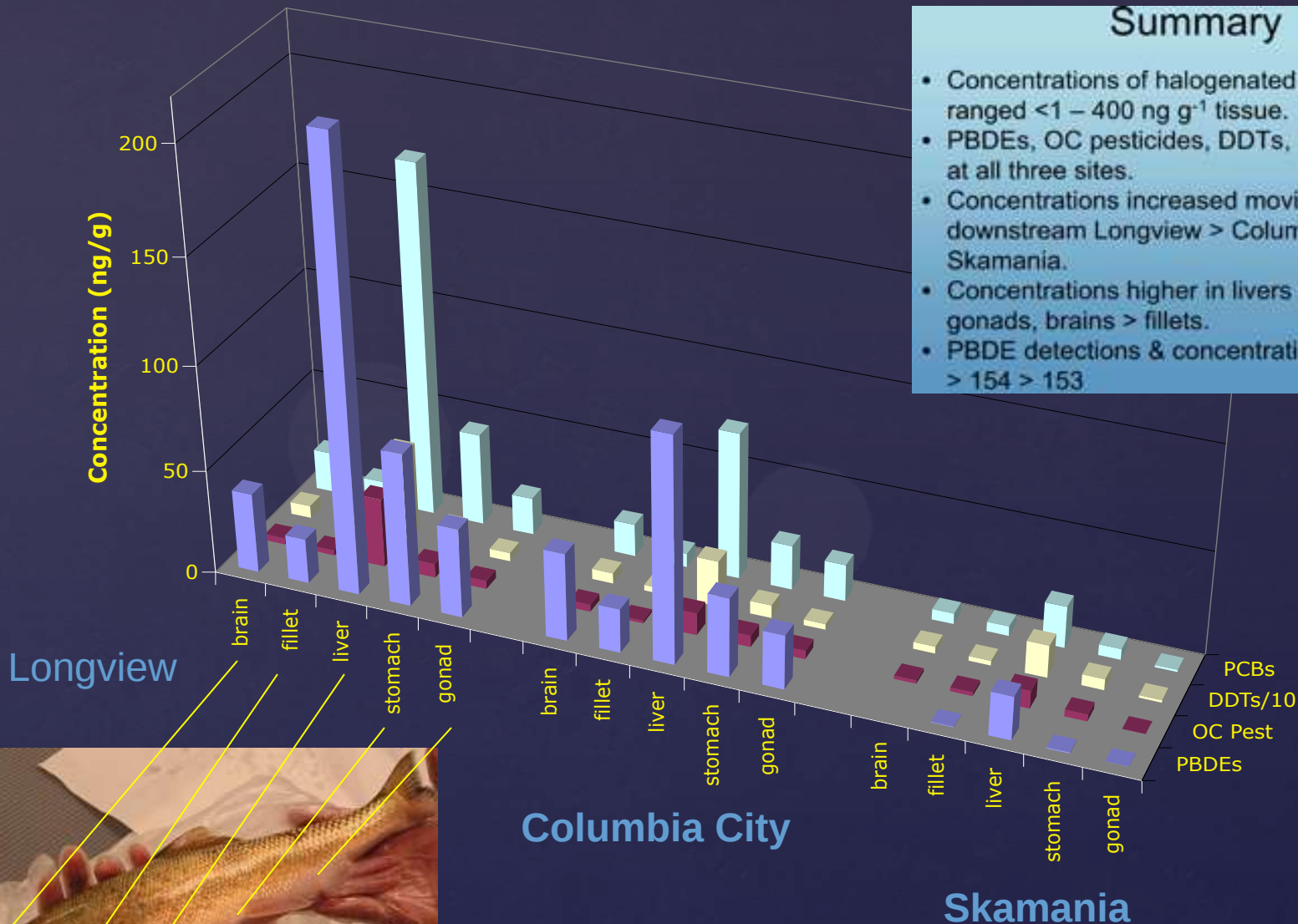
❖ Gene microarray

- ❖ Liver section

❖ Contaminants

- ❖ Gonad, liver, stomach, brain, fillet 2009
- ❖ Individual livers 2010

Contaminants in Fish Tissues 2009



Biomarkers Show Fish More Stressed Downstream Compared to Upstream

- 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 macrochelyus*)

Torres et al., 2014
Christiansen et al., 2014
Jenkins et al., 2014



Foodweb Sampling – Sediments/Invertebrates

Sediments



❖ Sediments

- ❖ PBDEs, AWI, pesticides, pharmaceuticals, etc.
- ❖ Organic carbon, grain size for model

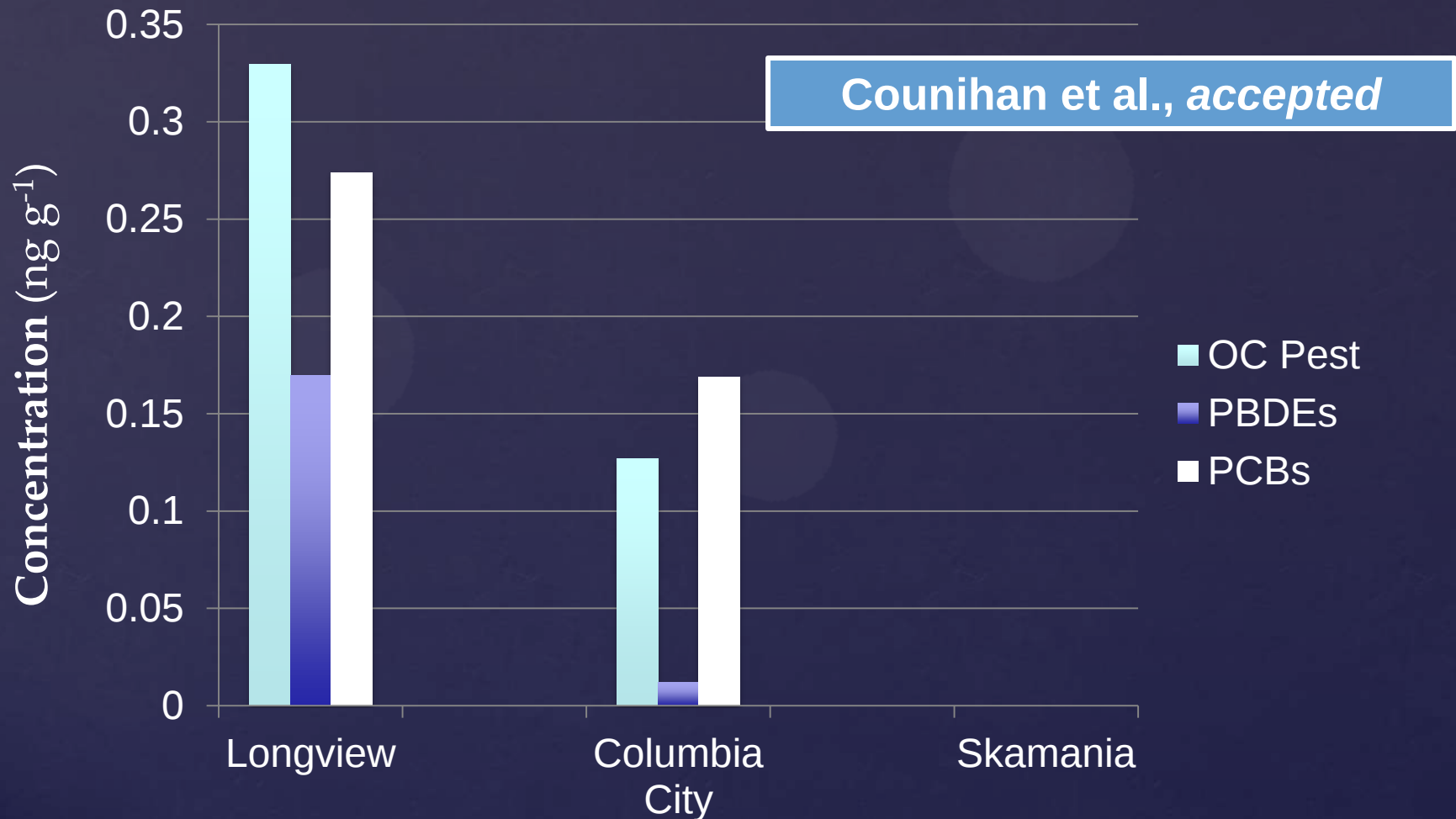
Invertebrates



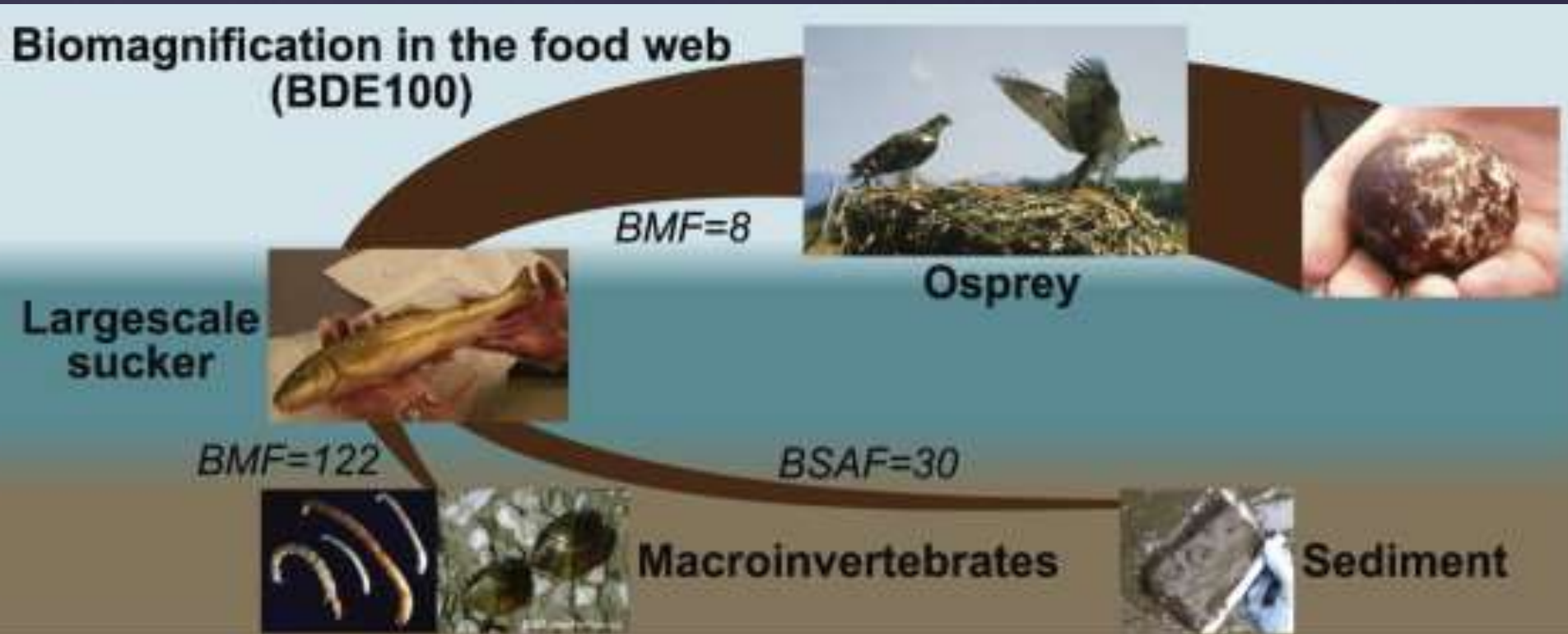
❖ Invertebrates

- ❖ Contaminants
- ❖ Community assessment

Halogenated Contaminants in Depositional Sediments 2010*



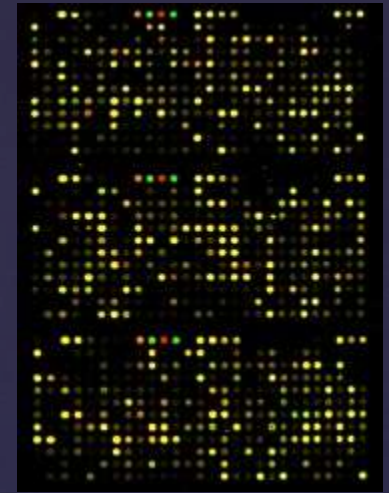
Biomagnification in the food web



Science of the Total Environment, v. 484, pp. 319-389

Special Section: Foodweb Transfer, Sediment Transport, and Biological Effects of Emerging and Legacy Organic Contaminants in the Lower Columbia River, Oregon and Washington, USA

Gene Expression Microarray

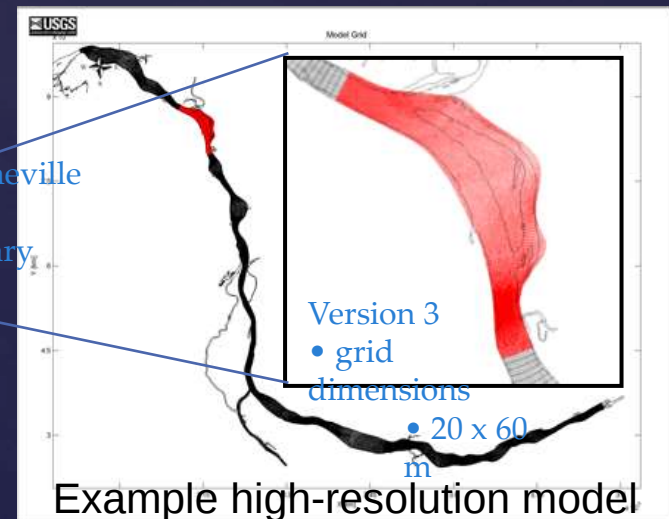
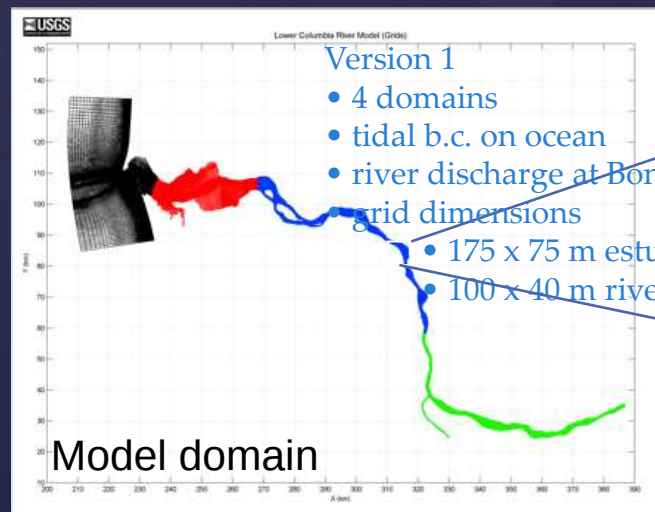


- ❖ 18 genes with expression patterns that correlated with hepatic tissue levels of **multiple contaminants**
- ❖ additional 58 genes that correlated with levels of **individual contaminants**
- ❖ a range of **biological processes**, including metabolism, cell communication, transport, development, and neurological system processes
- ❖ a variety of **molecular functions** such as binding, catalytic activity, enzyme regulator activity, receptor activity, and transcription regulator activity

Hydrodynamic Models

- ❖ **Hydrodynamic models** were developed in order to predict sedimentation characteristics of the river channel. These predictions were used to inform the **design** of sediment contaminant surveys.
- ❖ These predictions demonstrate that contaminant concentrations and detections vary with the **hydrological processes** of the Columbia River, forming the **basis** for further studies.

Elias and
Gelfenbaum, 2009



Where do we go from here?

- ❖ Contaminant and biomarker results support the hypothesis that contaminants in the environment both correlate to **bioaccumulation** and cause **genetic and reproductive impacts** within the foodweb.
- ❖ Contaminants of concern could be assessed and monitored as part of current and future **river restoration programs** to *strengthen* those efforts in the Columbia River and other large aquatic ecosystems.



- ❖ ConHab website
<http://or.water.usgs.gov/proj/Conhab/>
- ❖ Science of the Total Environment,
v. 484, pp. 319-389



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