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Assessing the threat of toxic contaminants to early marine survival of Chinook salmon in the Salish Sea

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Speaker

Sandra M. O'Neill, James E. West, Gina Maria Ylitalo, Andrea J. Carey, Laurie A. Niewolny, Jennifer Lanksbury, and Lyndal L. Johnson

Assessing the threat of toxic contamination to early marine survival of Chinook salmon in the Salish Sea

Sandie O'Neill¹, James West¹, Gina Ylitalo², Andrea Carey¹, Laurie Niewolny¹, Jennifer Lanksbury¹, and Lyndal Johnson²



¹Washington Department of Fish & Wildlife

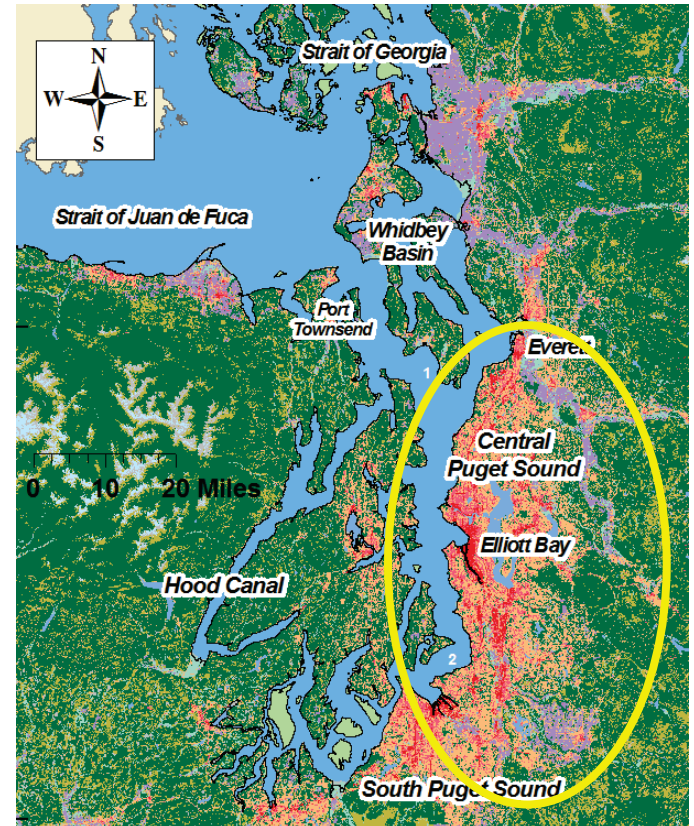
²Northwest Fisheries Science Center



Urbanization Impacts on Salmon



- habitat loss and modification
- increased input of toxics
- reduced habitat quality
- central Puget Sound most threatened



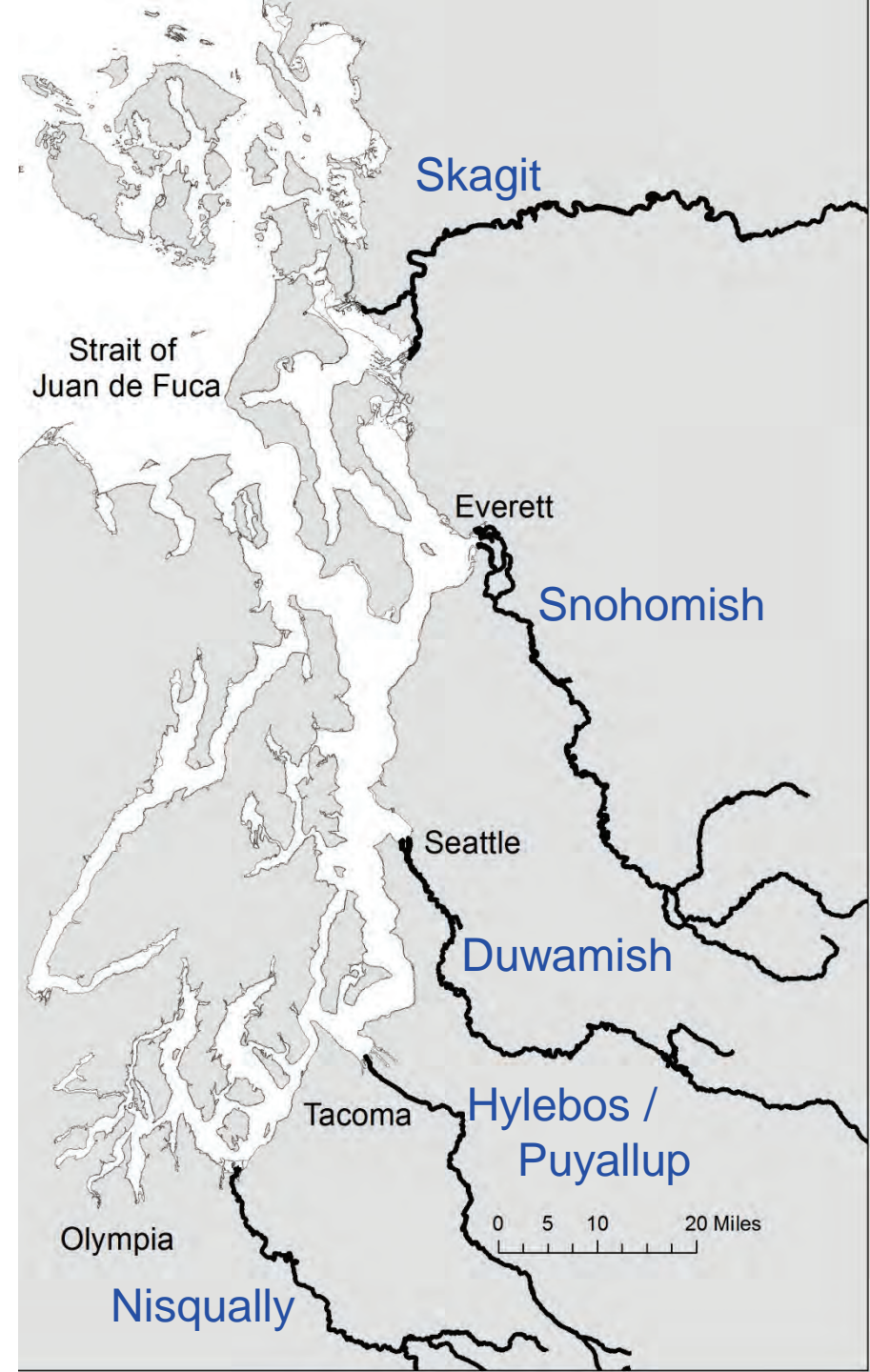
Study Objectives



- Quantify contaminant levels in out-migrant Puget Sound Chinook salmon.
- Evaluate potential effects on marine survival.
- Determine “sources” of contaminant inputs
 - freshwater habitat?
 - marine habitat?
 - freshwater and marine?

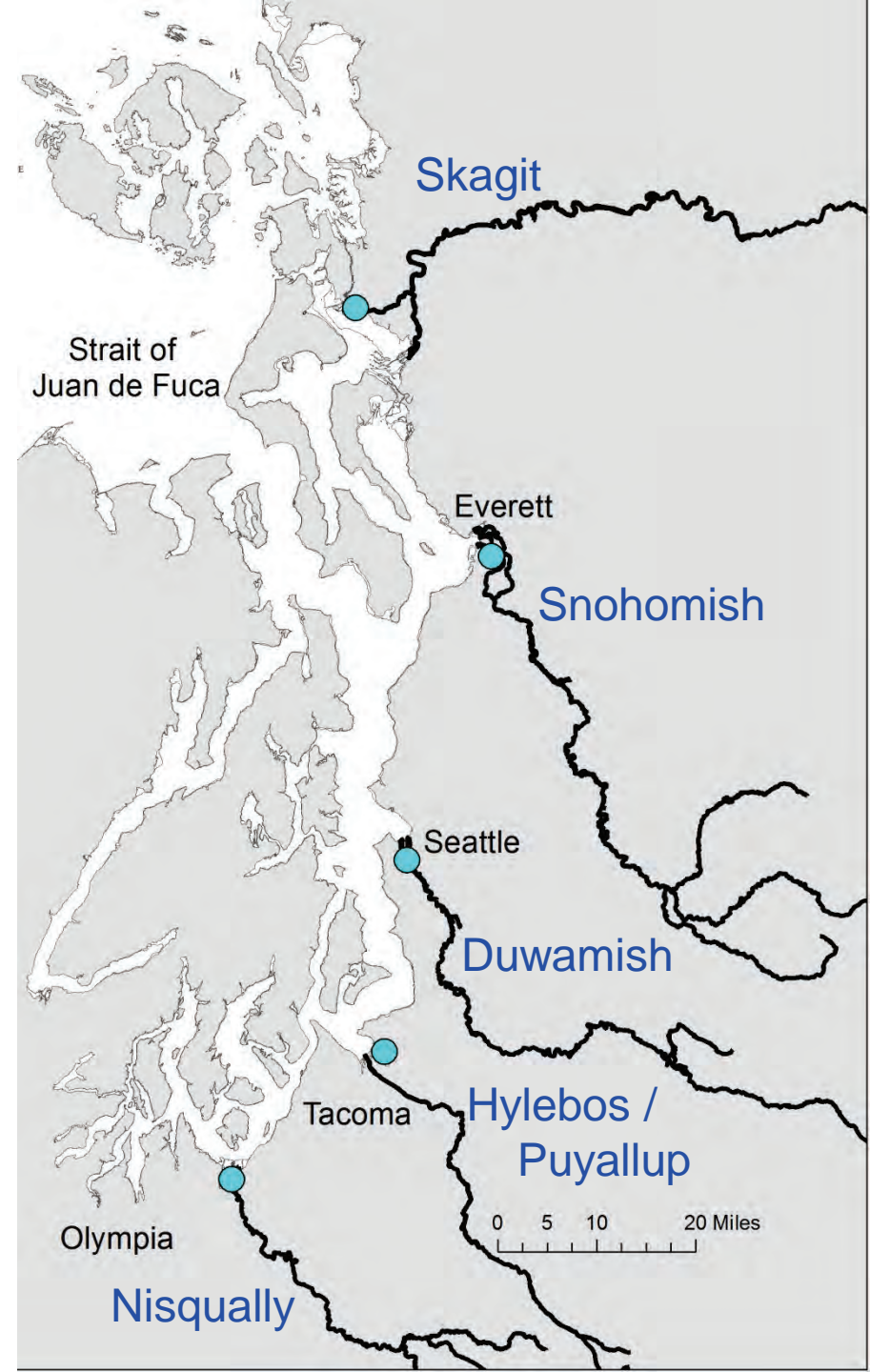
Sampling Design

- 5 major river/estuary systems



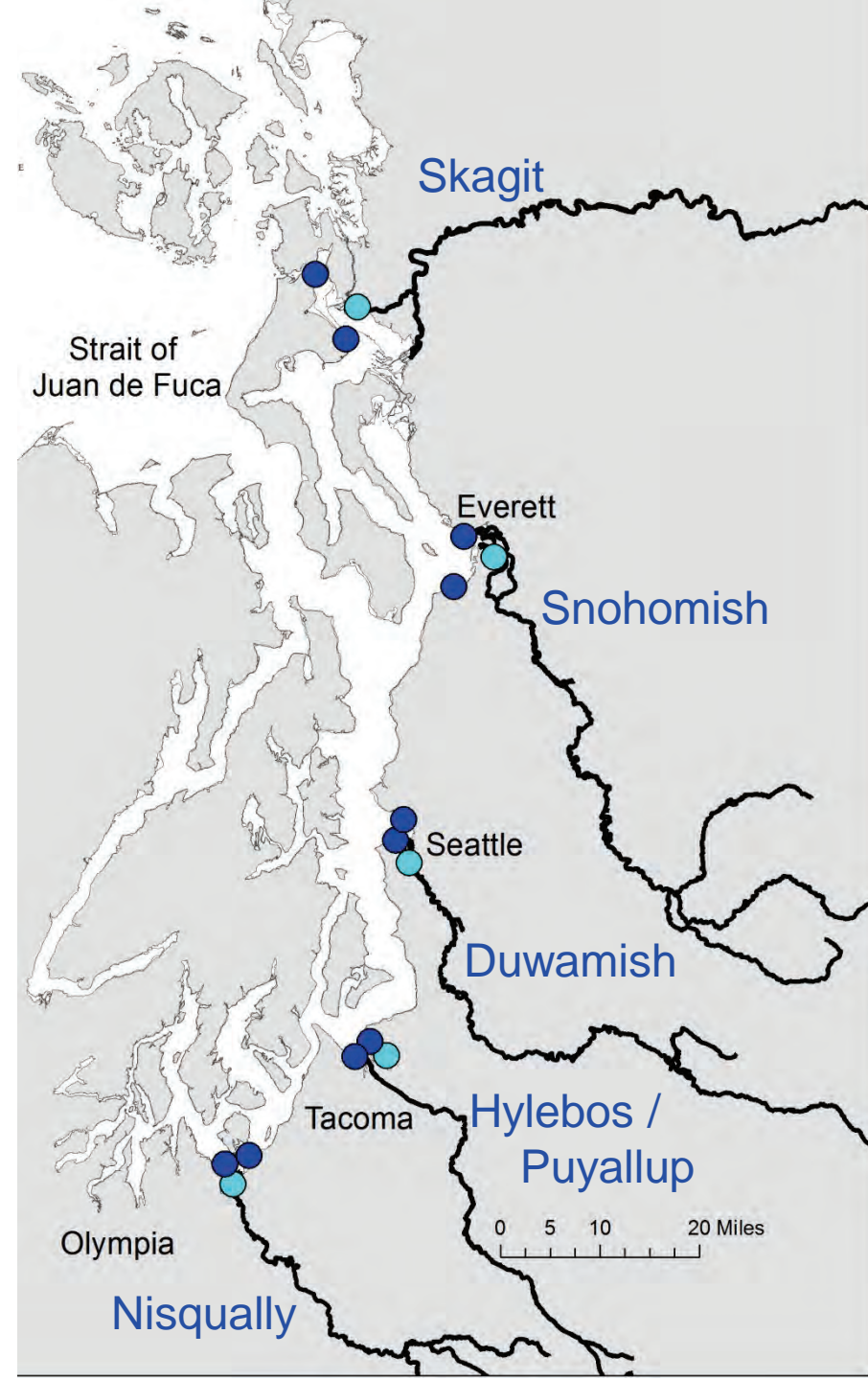
Sampling Design

- 5 major river/estuary systems
 - lower river (May)



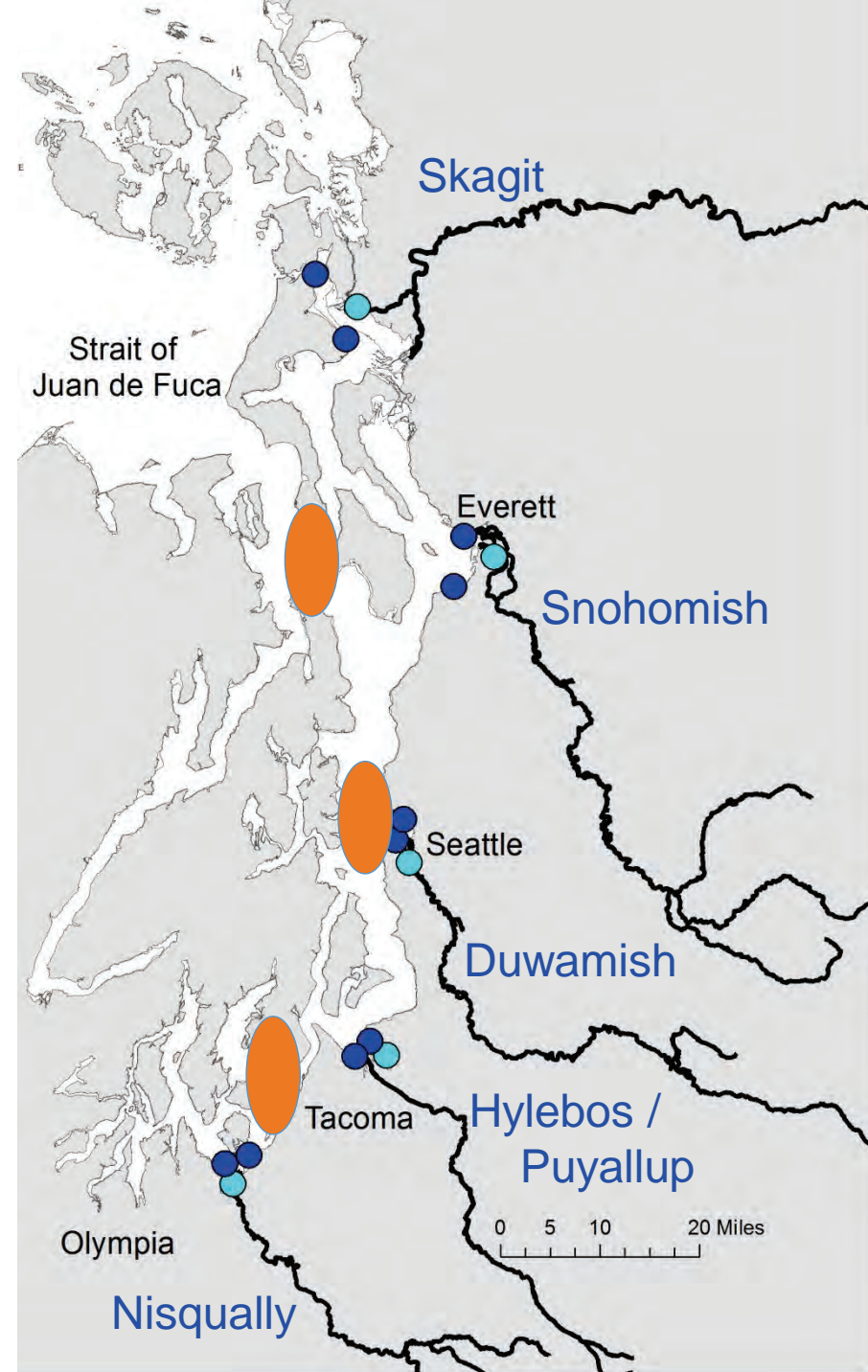
Sampling Design

- 5 major river/estuary systems
 - lower river (May)
 - marine estuary (June)



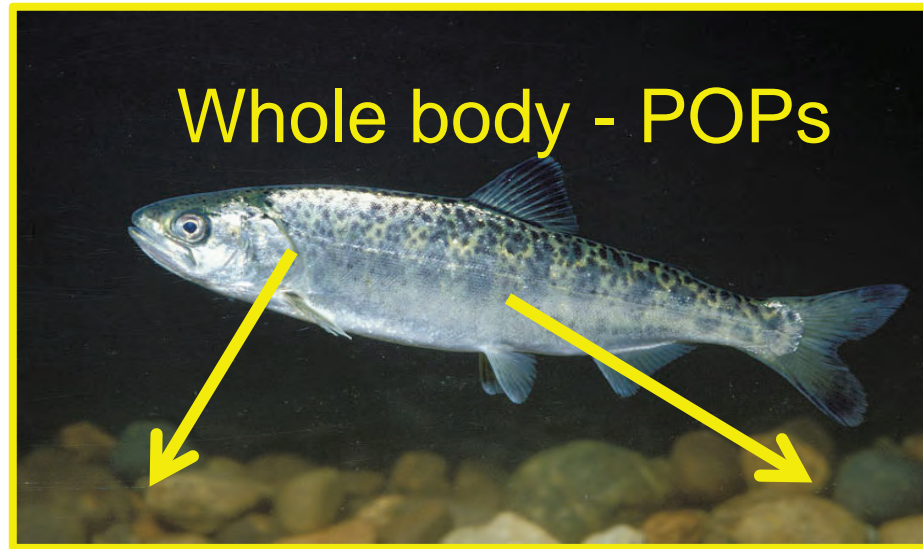
Sampling Design

- 5 major river/estuary systems
 - lower **river** (May)
 - **marine estuary** (June)
- 3 **marine basins**
 - Admiralty Inlet (July)
 - Central Sound (July, Sept.)
 - South Sound (July, Sept.)



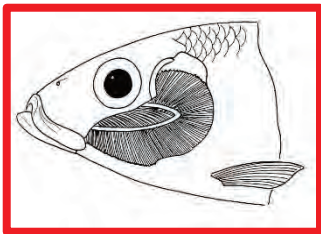
Methods: contaminants measured

480 fish combined into 67 composite samples



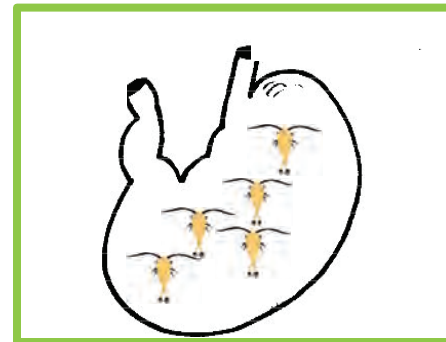
Total PCBs
 Σ_{11} PBDEs
 Σ_6 DDTs,
HCB
 Σ_8 Chlordanes
 Σ_3 HCHs

Gills - Metals



Zinc
Cadmium
Copper
Lead
Nickel

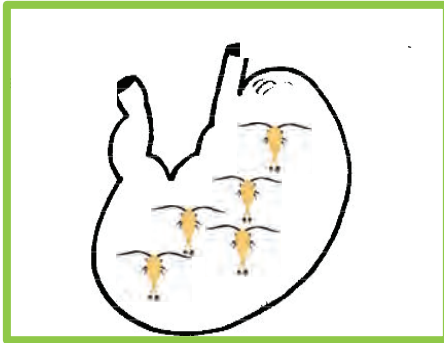
Gut Contents- PAHs



Σ_{37} PAHs

Results

Gut Contents- PAHs



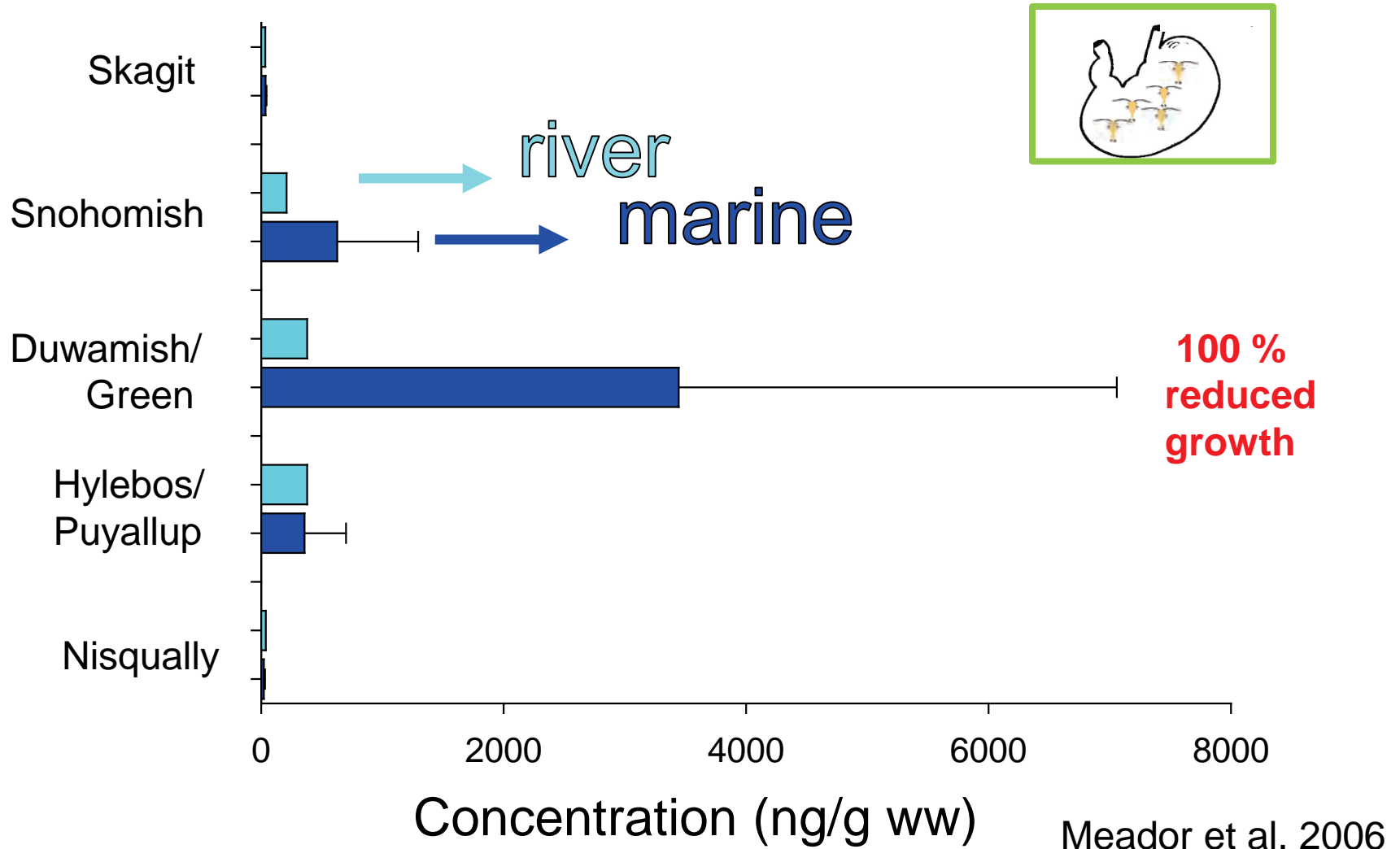
Whole body - POPs



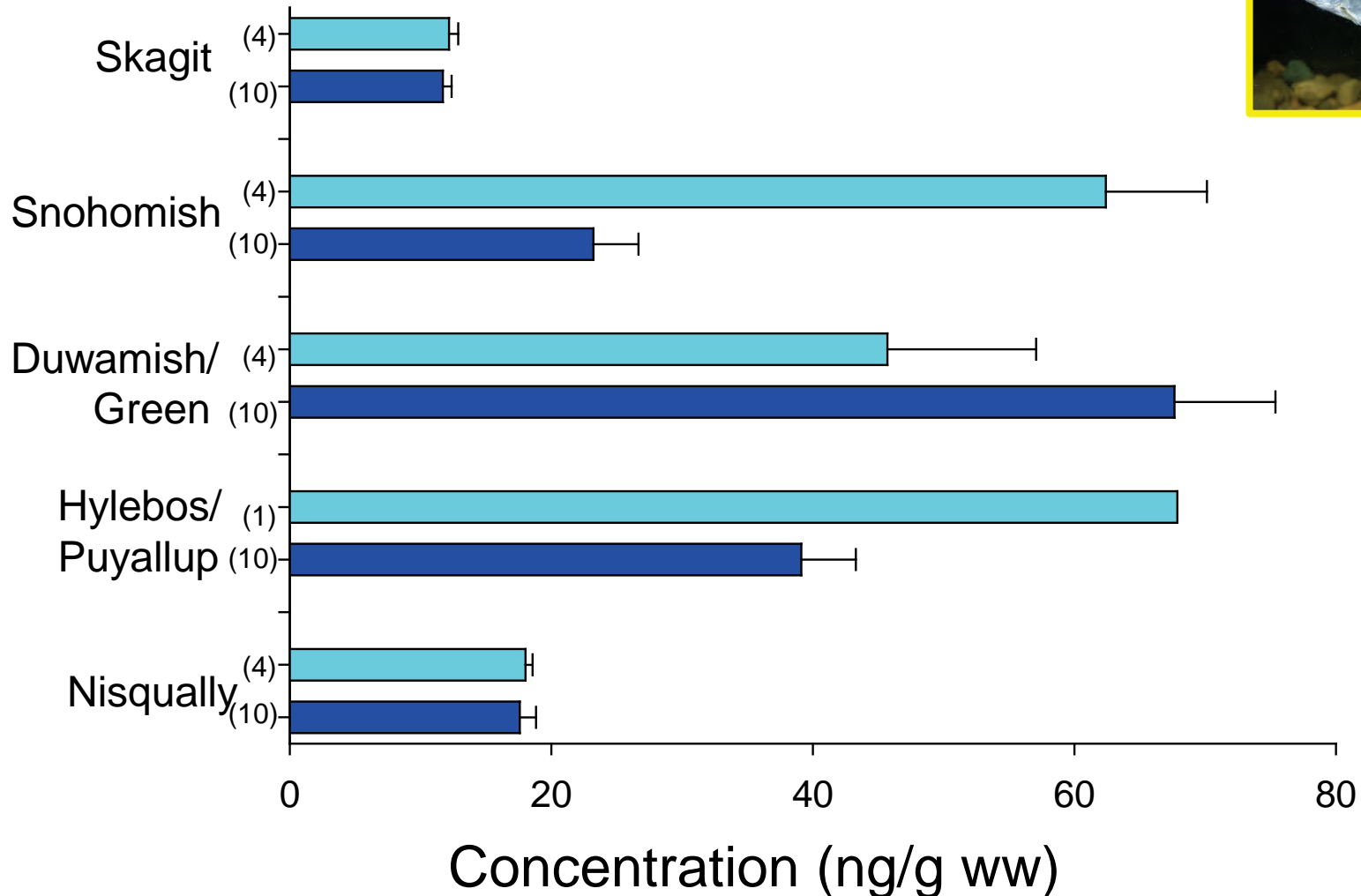
How contaminated are out-migrant Chinook salmon?

Are the levels high enough to impact fish health and survival?

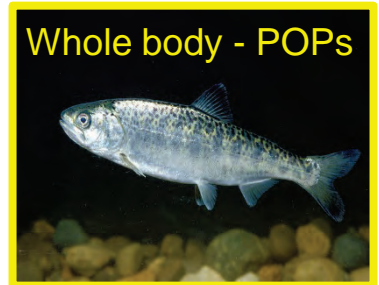
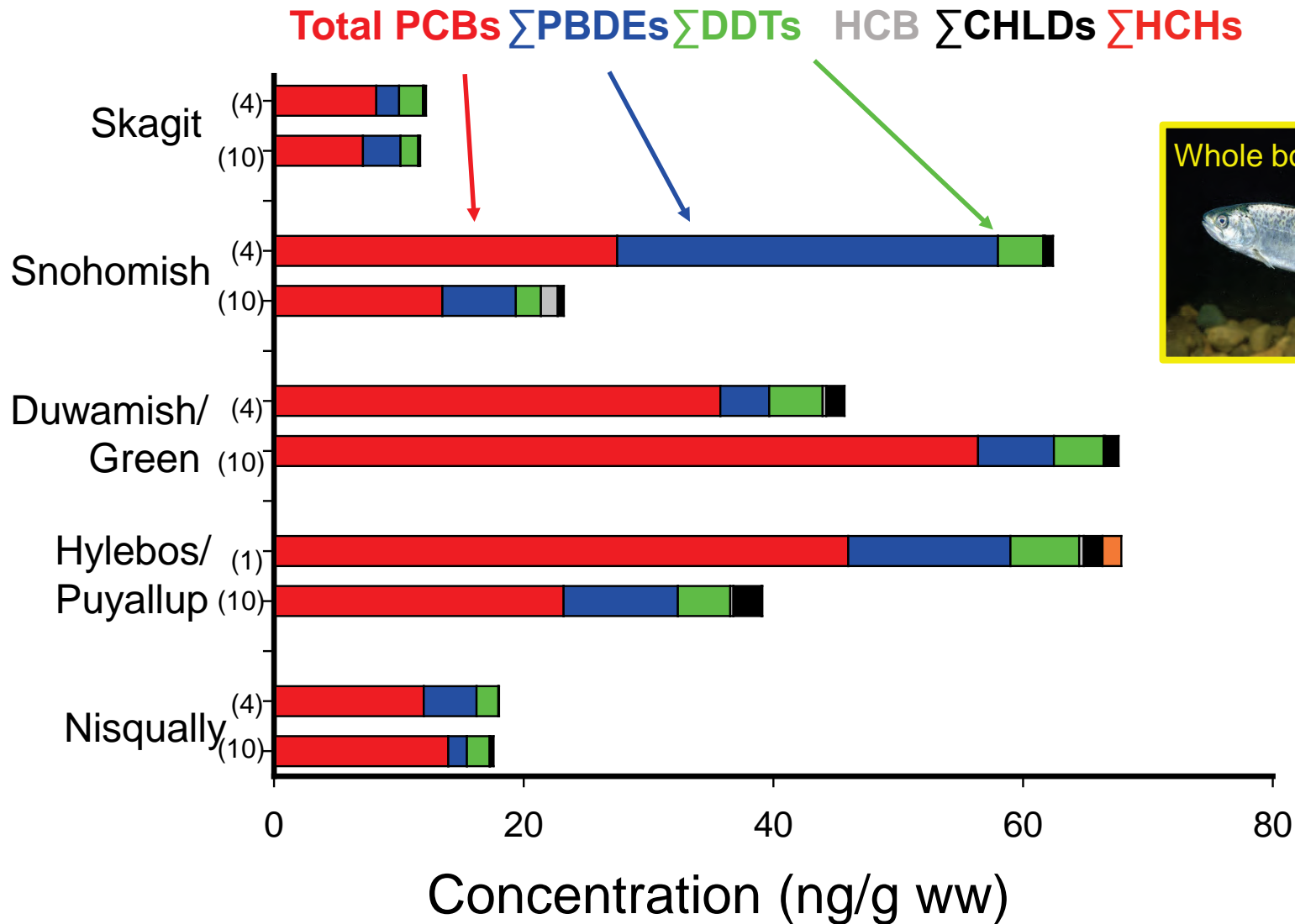
Σ_{37} Polycyclic Aromatic Hydrocarbons (PAHs)



Σ Persistent Organic Pollutants

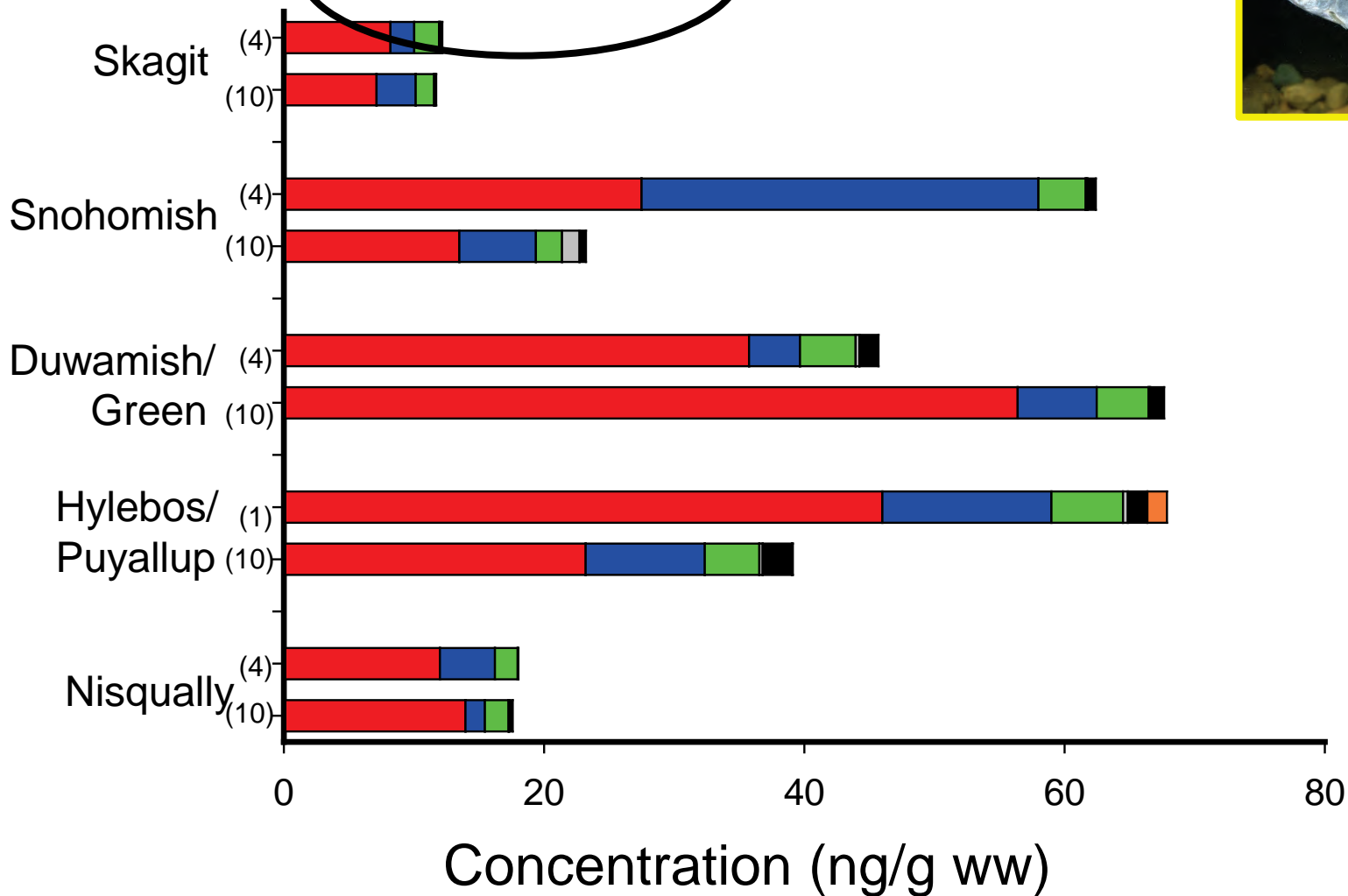


Σ Persistent Organic Pollutants

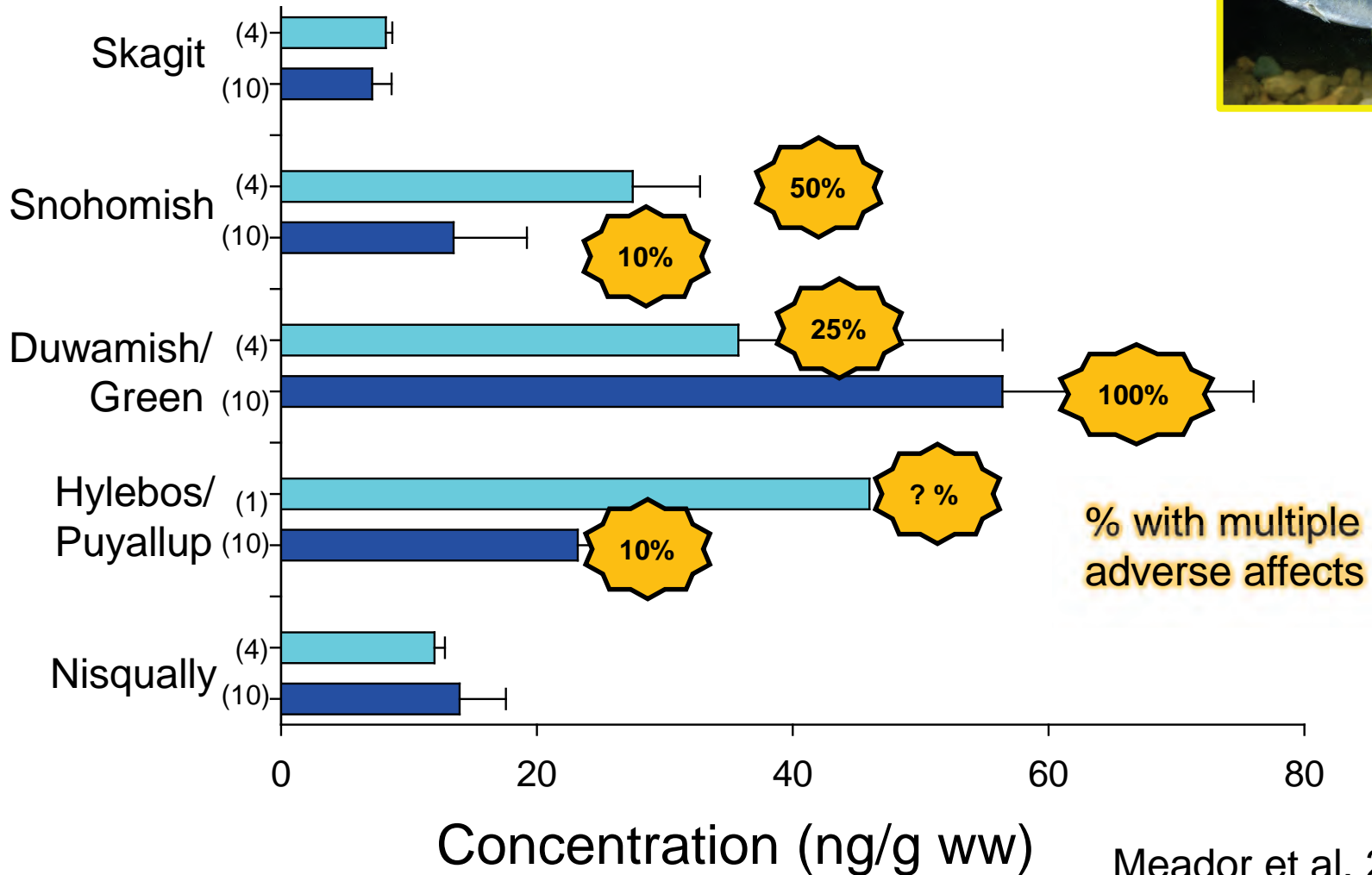
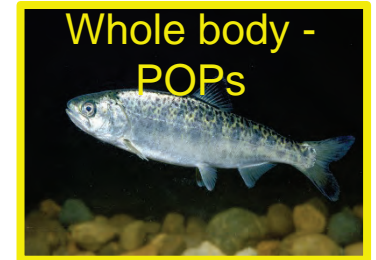


Σ All Persistent Organic Pollutants

Total PCBs
ΣPBDEs
ΣDDTs
HCB
ΣCHLDe
ΣHCH

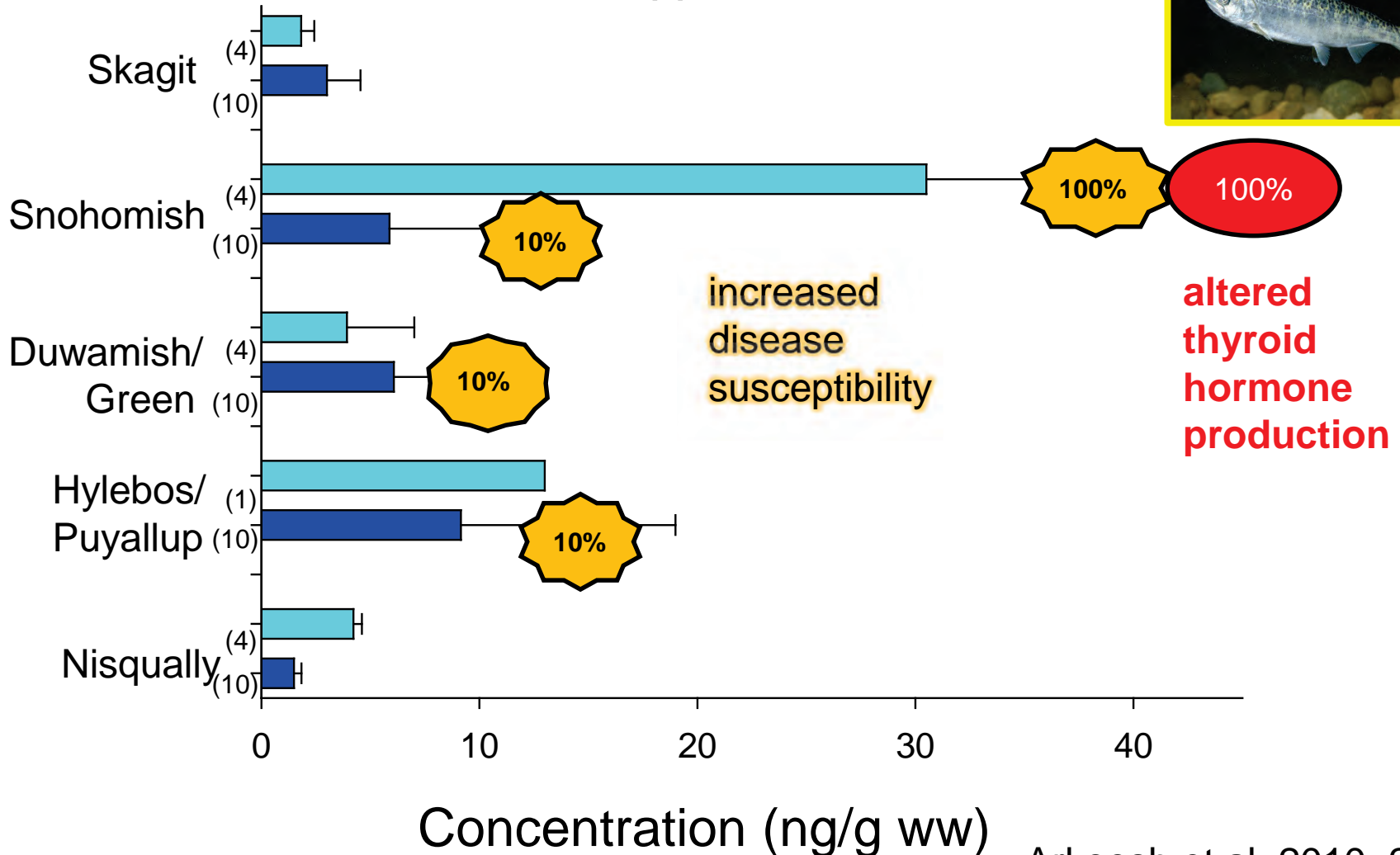


Total Polychlorinated Biphenyls (PCBs)



Meador et al. 2002.

Σ_{11} Polybrominated diphenyl ethers (Σ_{11} PBDEs)



Results

What are the “sources” of contaminant inputs?

Snohomish System

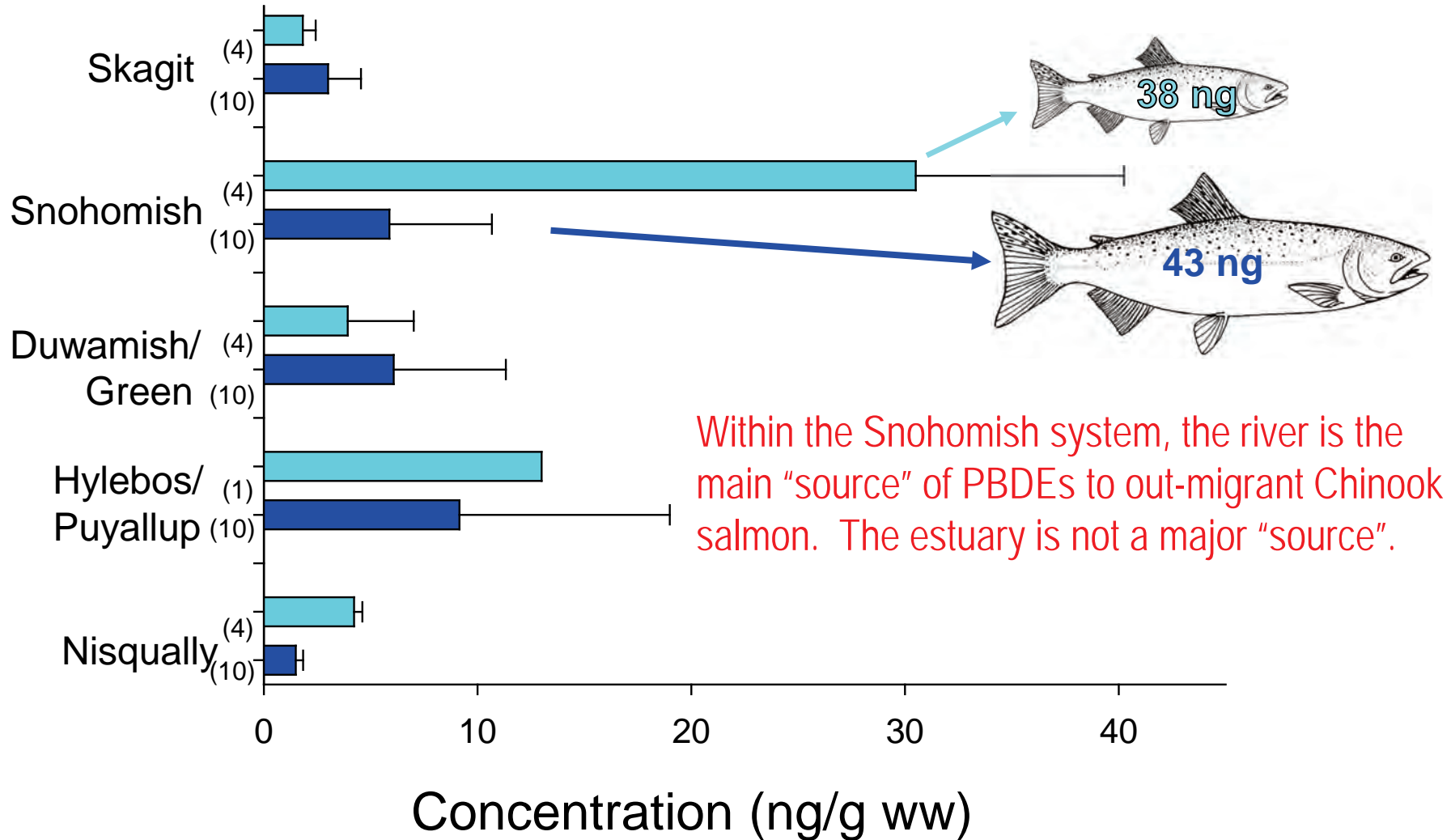


river



marine nearshore

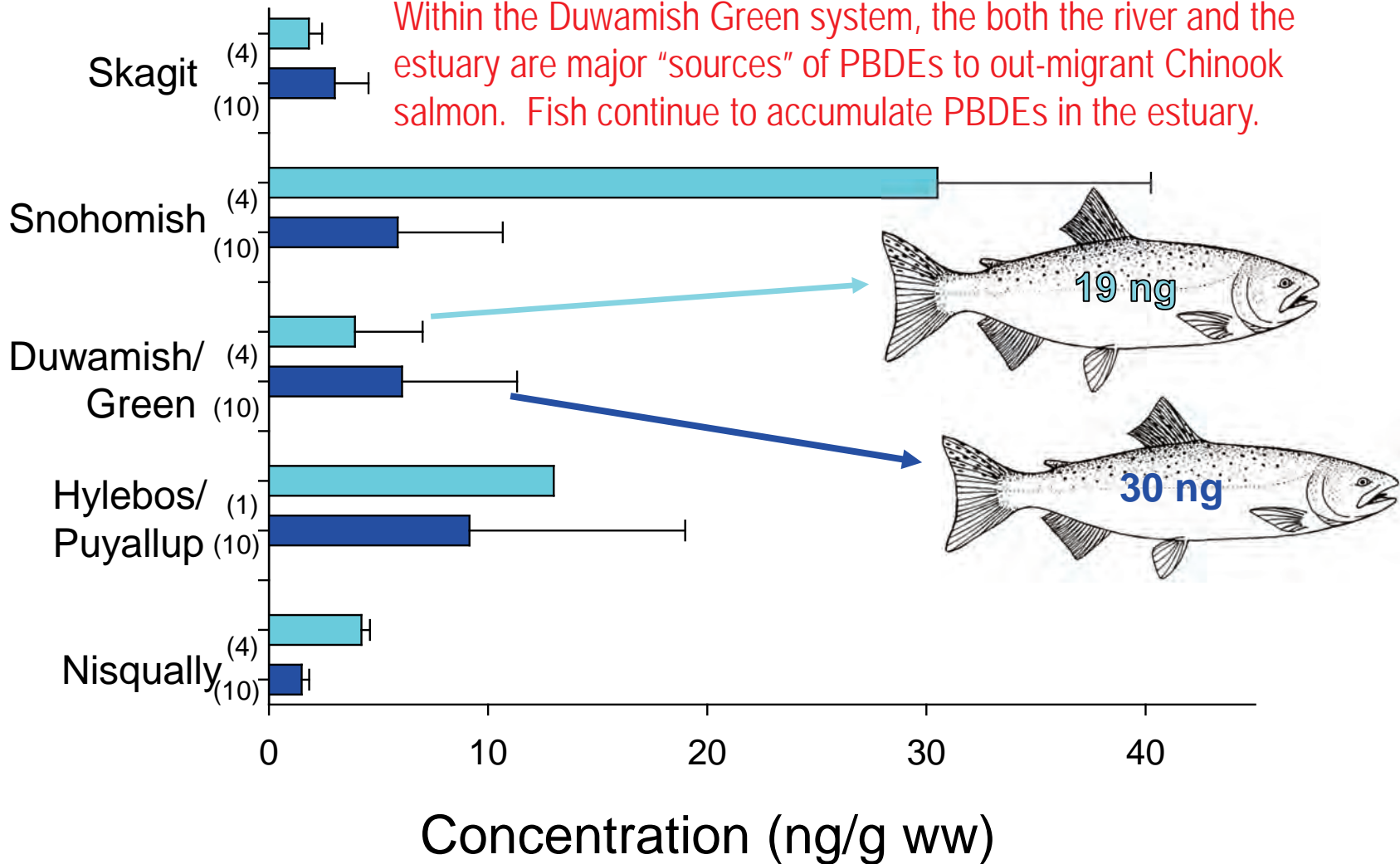
Σ_{11} PBDEs



Σ_{11} PBDEs



Within the Duwamish Green system, the both the river and the estuary are major "sources" of PBDEs to out-migrant Chinook salmon. Fish continue to accumulate PBDEs in the estuary.



Conclusions

1. Juvenile Chinook salmon migrating through urban river/estuary systems had elevated levels of man-made chemicals (POPs, PAHs), and some metals (lead).
2. POPs and PAH levels in Chinook salmon from urban estuaries are high enough to cause adverse effects, likely affecting marine survival.
3. Focus areas for contaminant clean-up will vary by area
 - a. - Snohomish River in Snohomish System
 - b. - Duwamish River and Elliott Bay in Duwamish/Green System

Acknowledgments

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Muckleshoot Tribe

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Nisqually Tribe

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NOAA NWFSC

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Sean Sol

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Julann Spromberg

Mary jean Willis

David Baldwin

Josh Chamberlin

Jason Hall

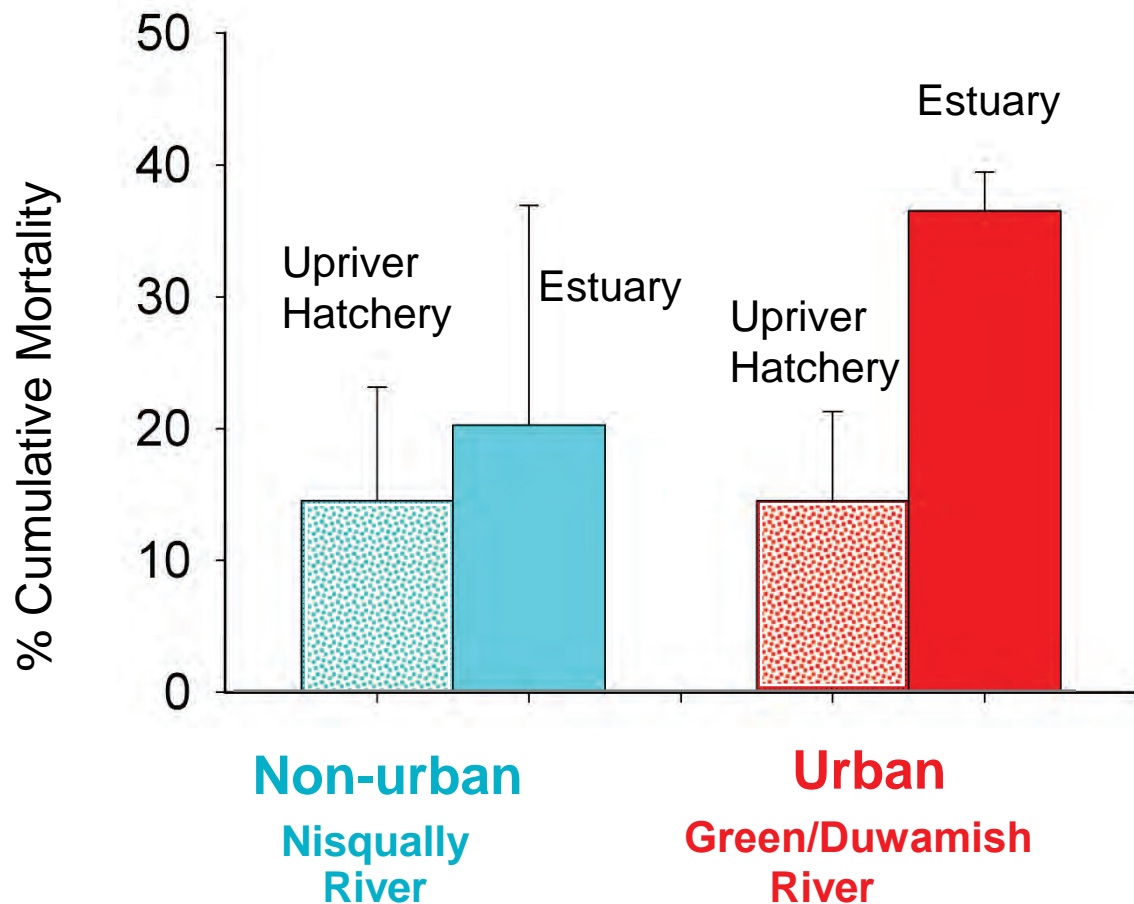
Environmental Chemistry
staff

USFWS

Steve Damm

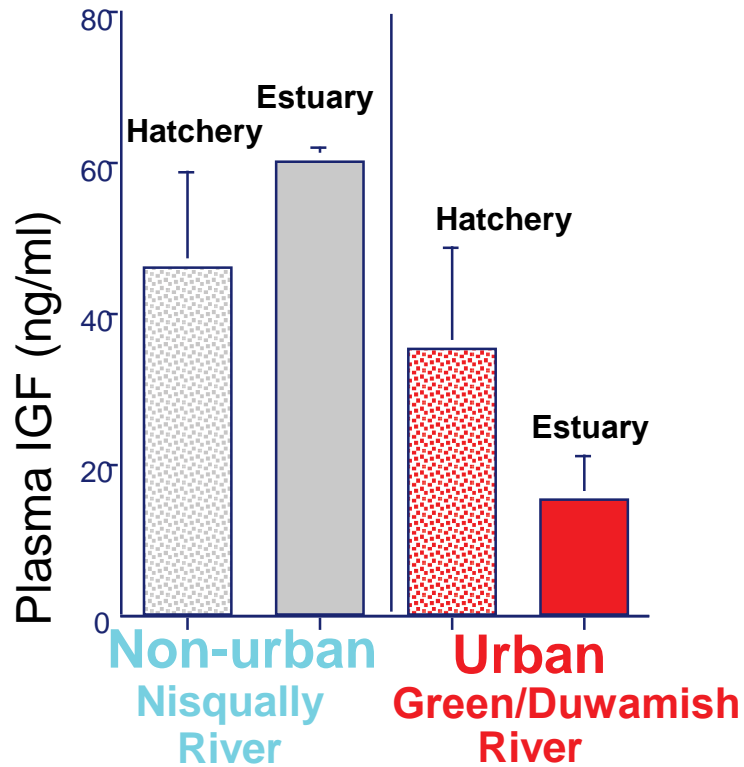


Juvenile Chinook in urban estuaries are more susceptible to mortality from natural pathogens

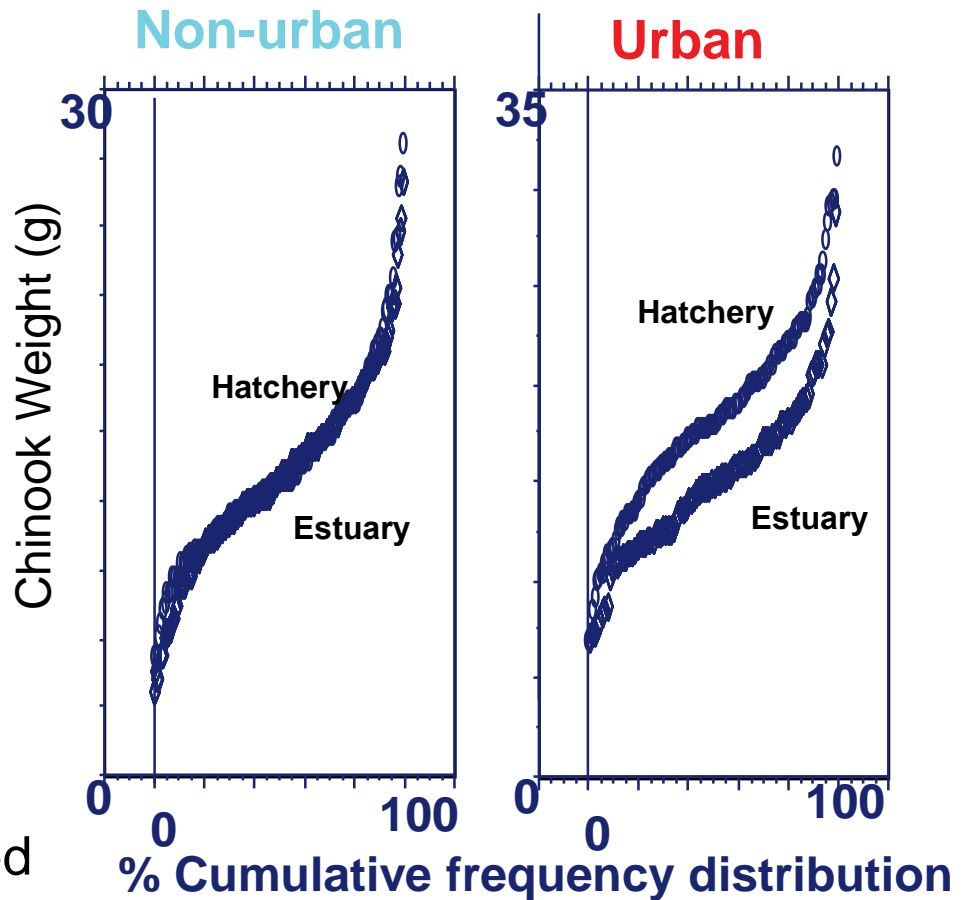


Additional contaminant feeding studies confirms exposure to toxics impairs immuno-competence.

Insulin-like Growth Factor



Subsequent Growth in the Lab



- Follow-up contaminant feeding studies confirm growth is impaired by exposure to toxic chemicals.

POPs levels in salmon are determined by:



Hatcheries

Where they live Freshwater habitat

Marine habitat

- ✓ Puget Sound
- ✓ Pacific Ocean



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Proximity to sources, duration of exposure, residency- migration

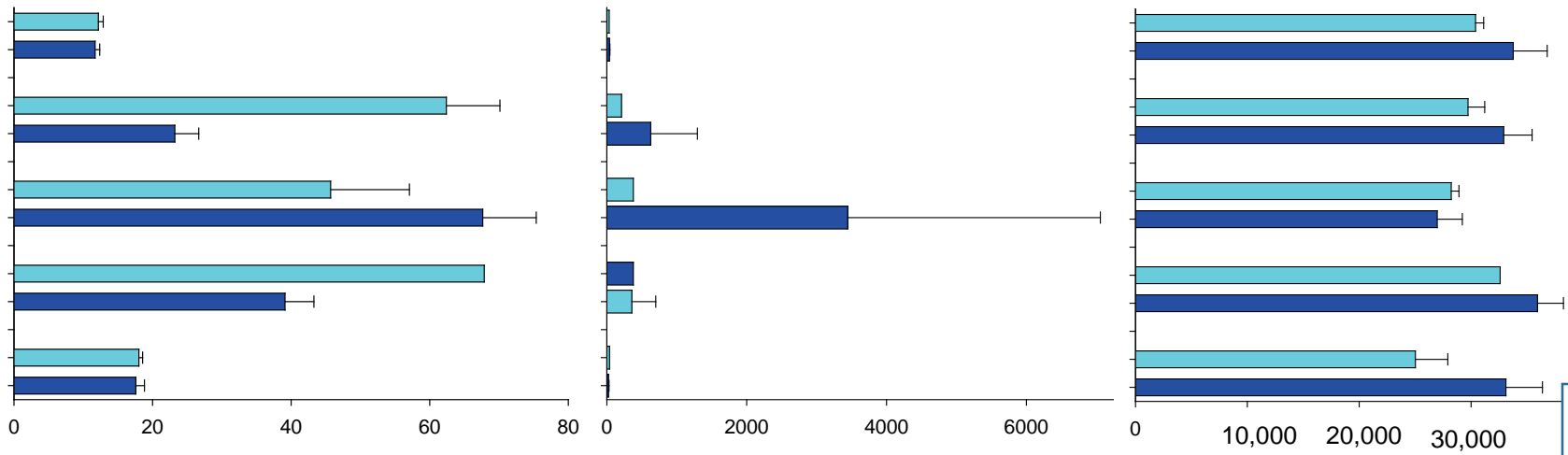
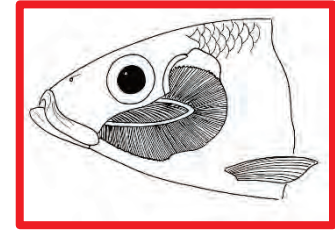
Contaminants in Chinook salmon



Gut Contents- PAHs



Gut Contents- PAHs



Concentration (ng/g ww)

Hypothesis

Exposure to toxic contaminants in Puget Sound reduces the health and productivity of salmon and their food supply.