

# Using chemical fingerprints in salmon and whales to infer prey preferences and foraging habitat of SRKWs.

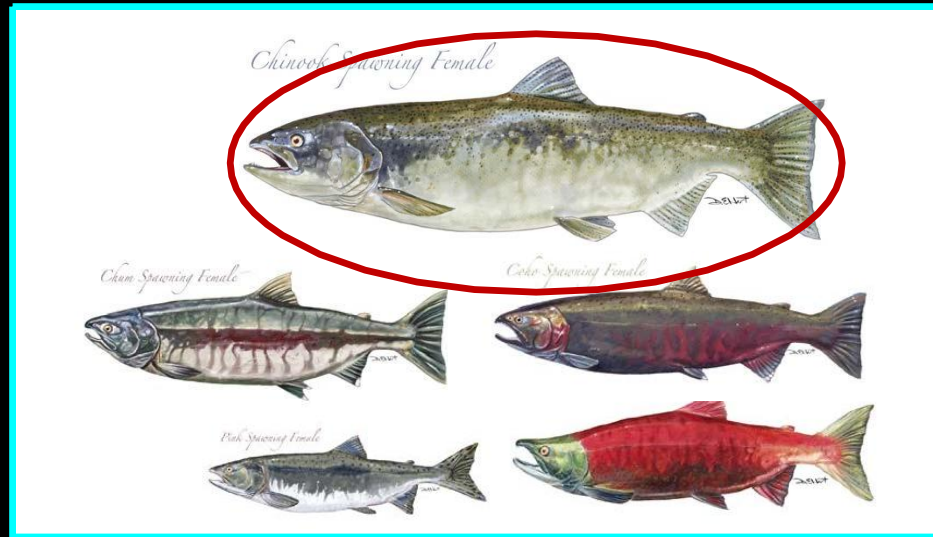
Sandra O'Neill<sup>1</sup>, Gina Ylitalo<sup>1</sup>, David Herman<sup>1</sup> & James West<sup>1</sup>

<sup>1</sup>NOAA Fisheries, Northwest Fisheries Science Center

<sup>2</sup>WA Department Fish and Wildlife



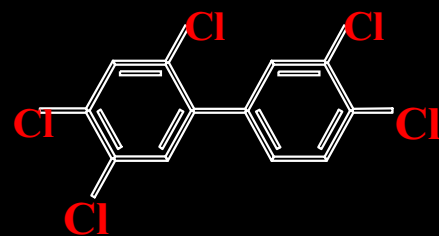
# Contaminants levels in fish are determined by...



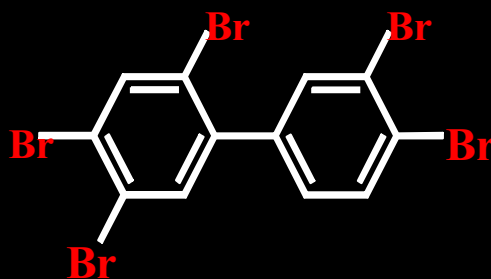
- Where they live
- What they eat
- How long they are exposed
- How fat they are

# Persistent Organic Pollutants (POPs)

- Synthetic, industrial compounds
- Highly toxic
- Resistant to biological degradation
- Accumulate w/ age
- Bio-magnify



Polychlorinated  
Biphenyls (PCBs)

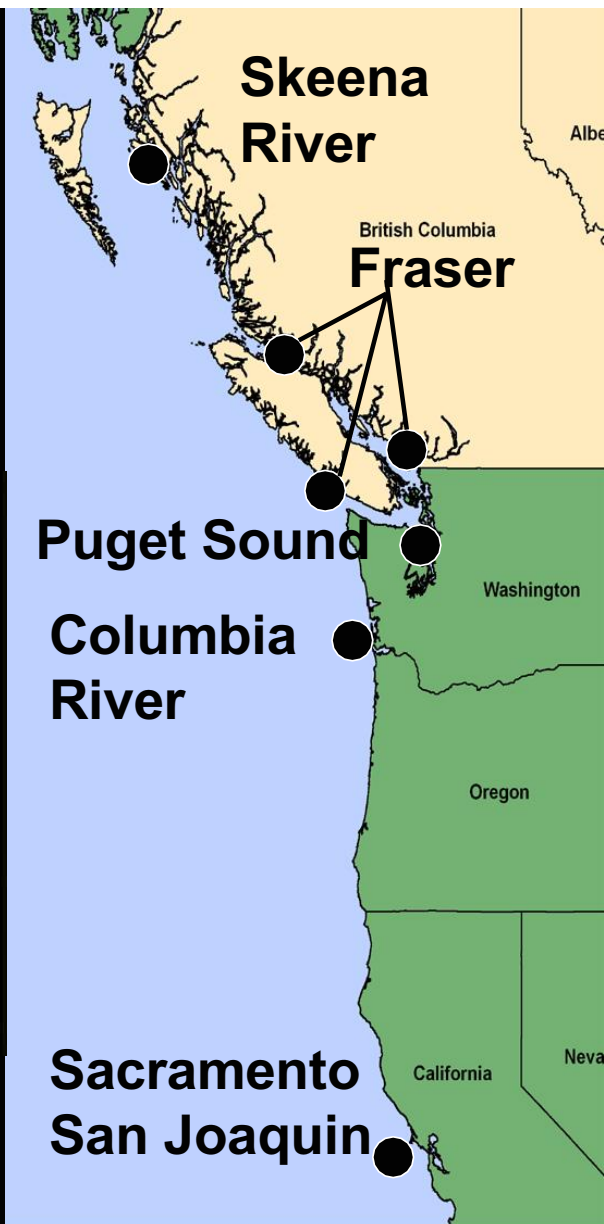


Polybrominated Diphenyl  
Ethers (PBDES)

# How do west coast Chinook salmon populations differ in POP concentrations?



Note: "Fraser" stocks do not include Harrison

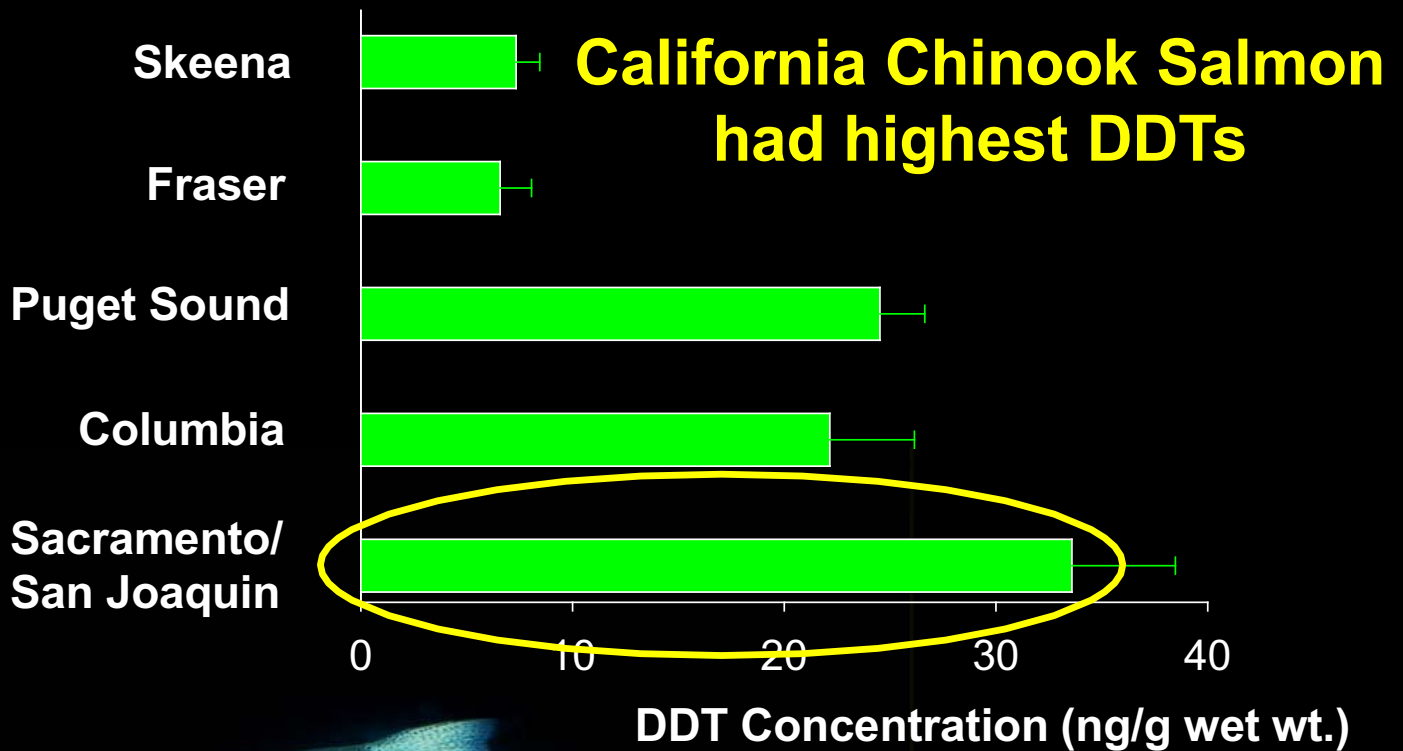


4 classes of contaminants were analyzed  
in 216 whole body salmon samples:

**DDTs, HCB, PCBs, PBDEs,**

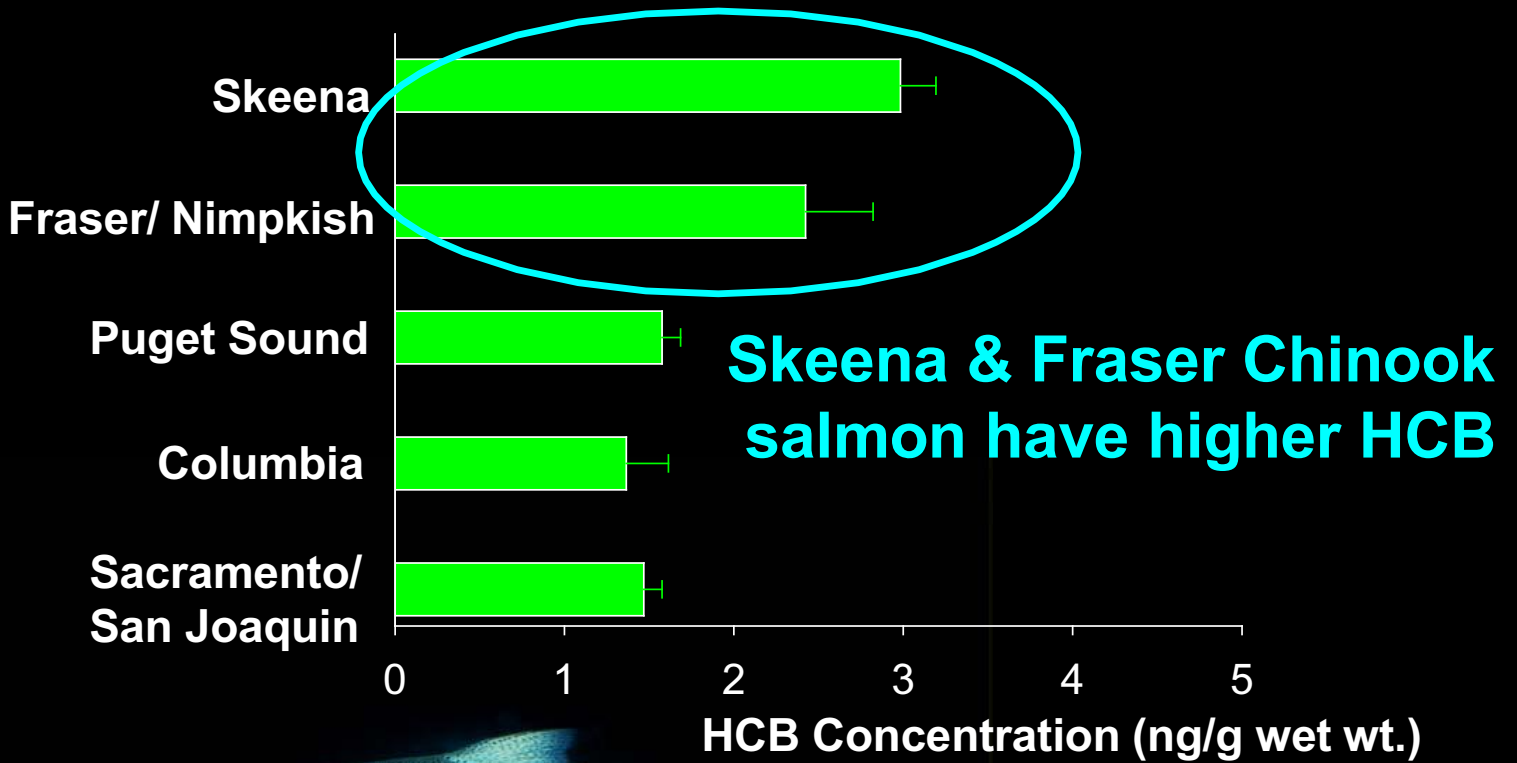


# DDTs in Whole-body Chinook Salmon



**adult fish  
summer/ fall run**

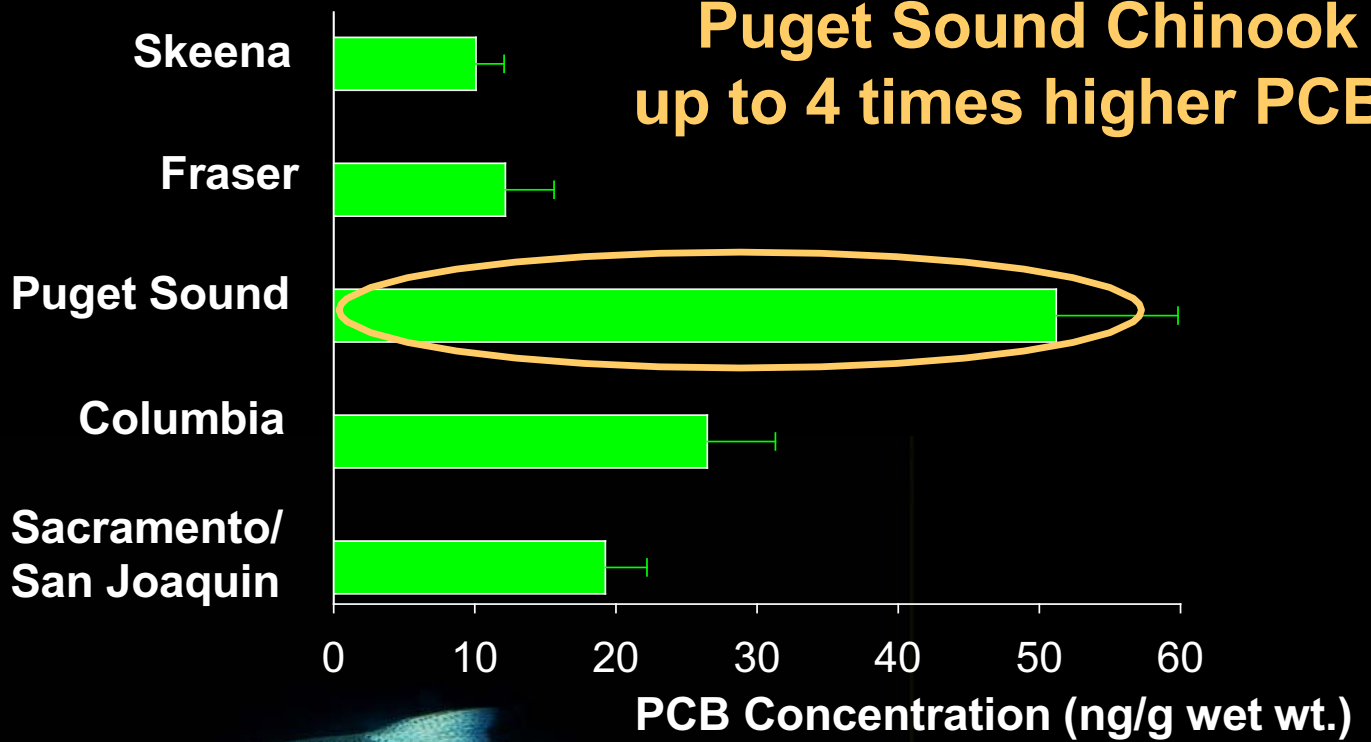
# HCB in Whole-body Chinook Salmon



adult fish  
summer/ fall run

# PCBs in Whole-body Chinook Salmon

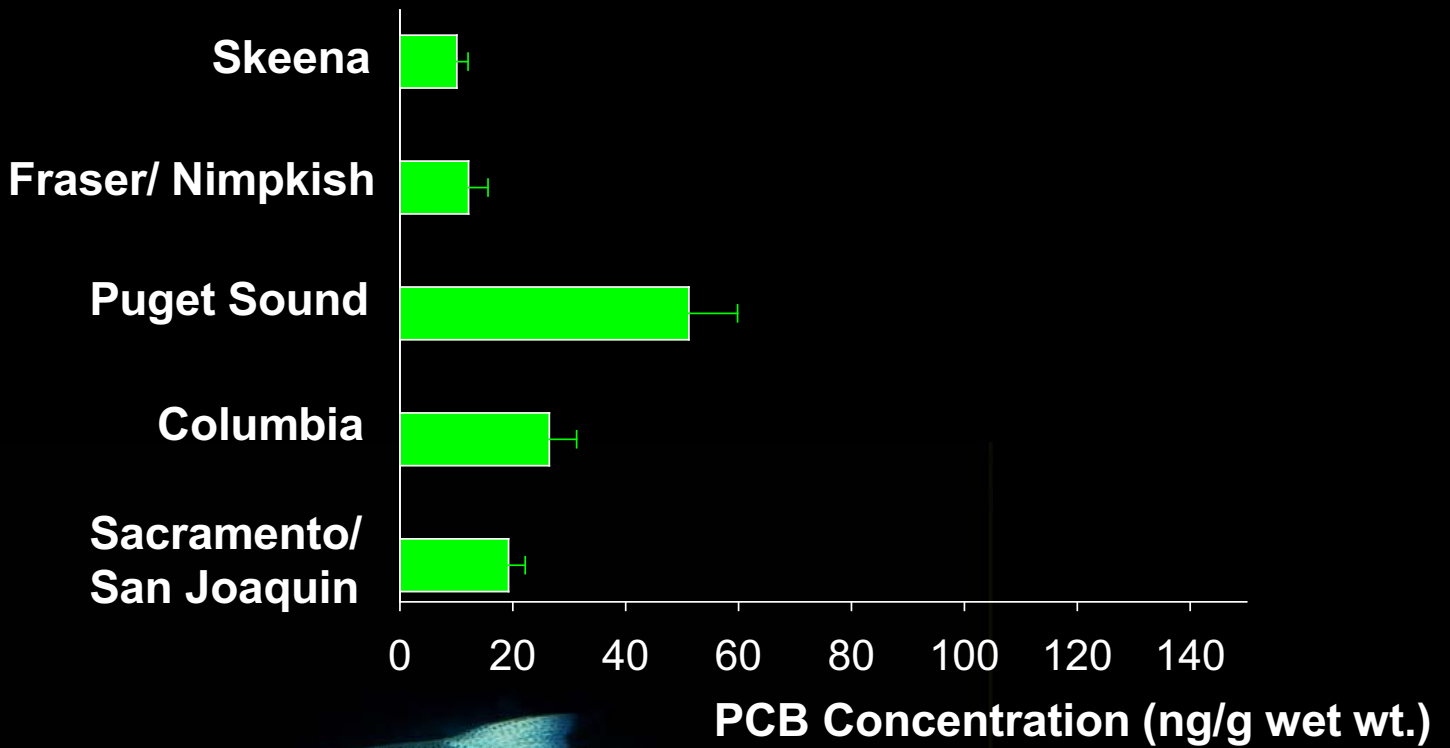
Puget Sound Chinook  
up to 4 times higher PCBs



adult fish  
summer/ fall run

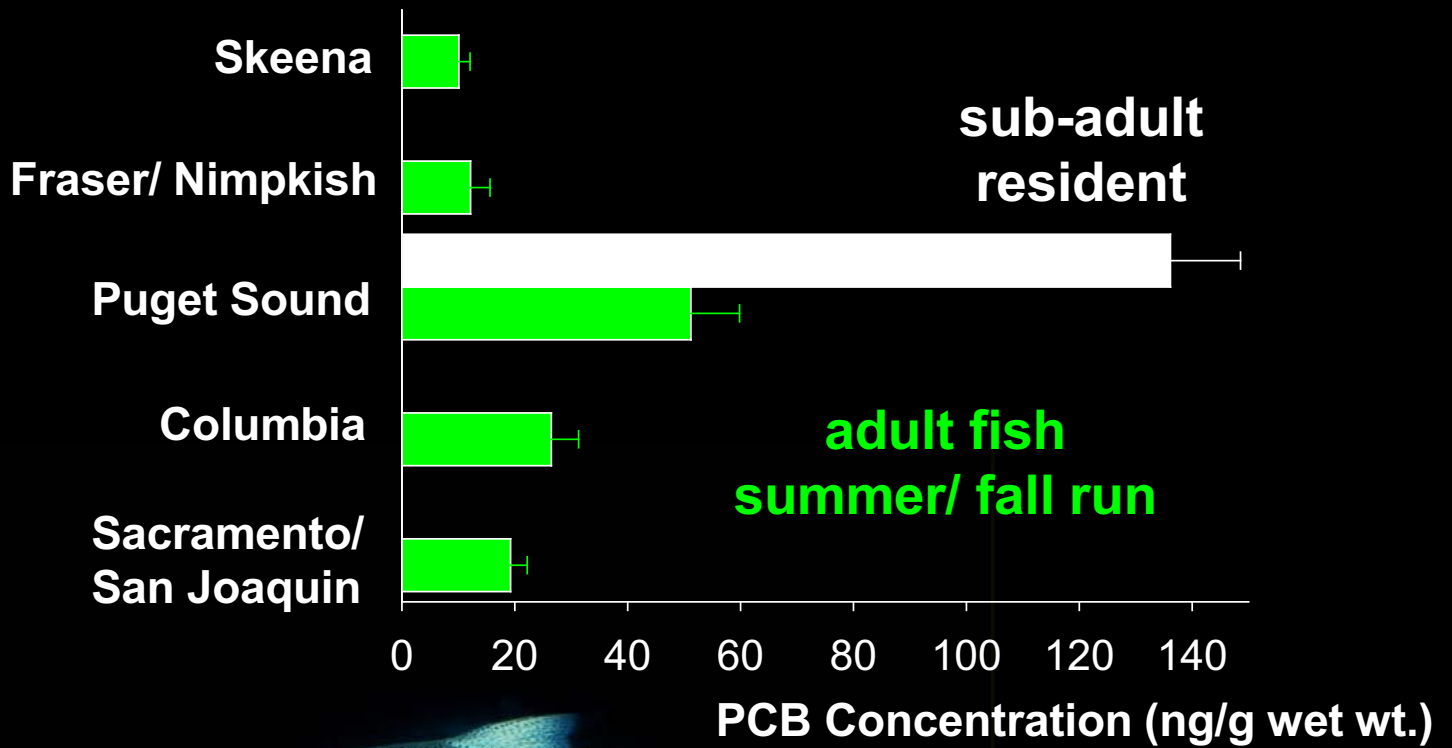


# PCBs in Whole-body Chinook Salmon



**adult fish  
summer/ fall run**

# PCBs in Whole-body Chinook Salmon



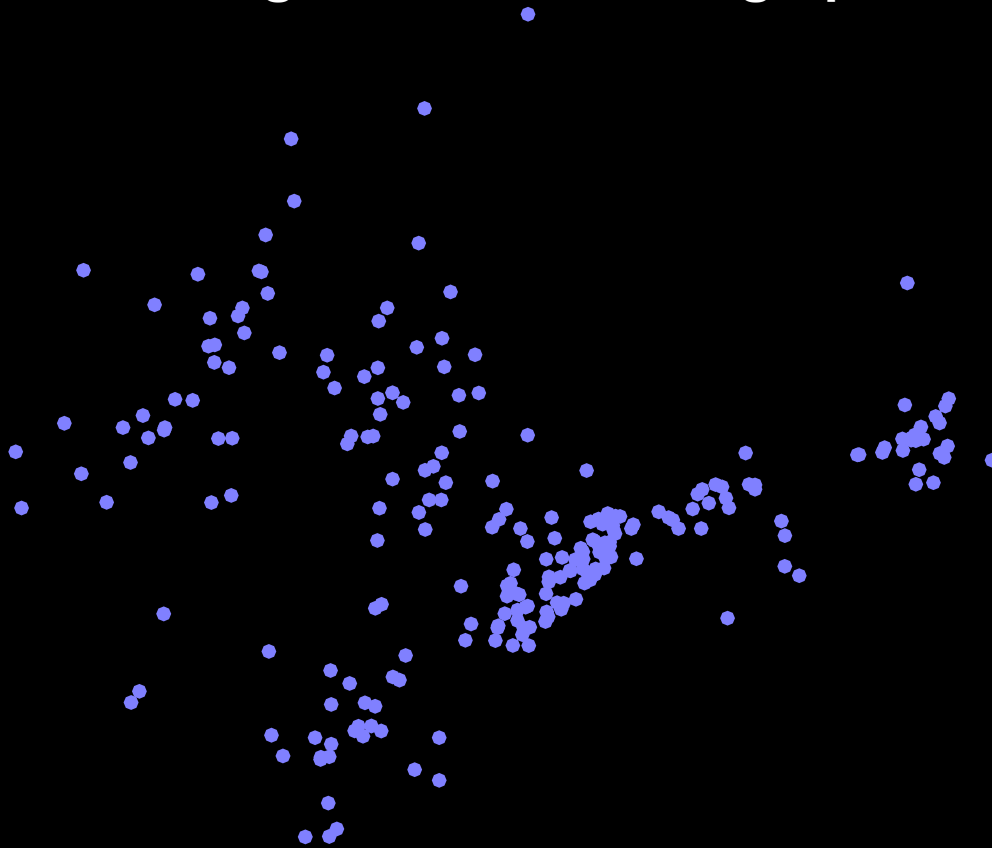
## Salmon have chemical fingerprints

PCBs, PBDEs, DDTs, HCB,

Contaminant patterns vary by Chinook population reflecting difference in their marine distribution.



# Segregation of Chinook Populations Using Contaminant Fingerprint



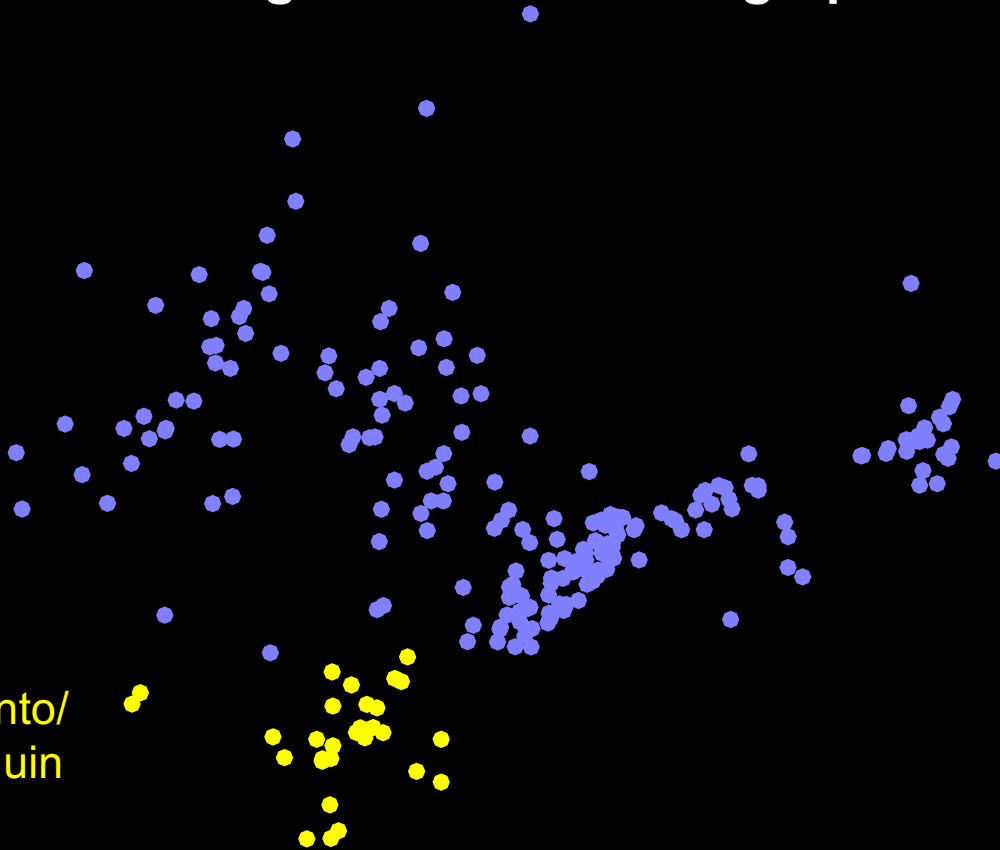
**Multi-dimensional Scaling Plot of Four POPs**

**Stress=0.05**

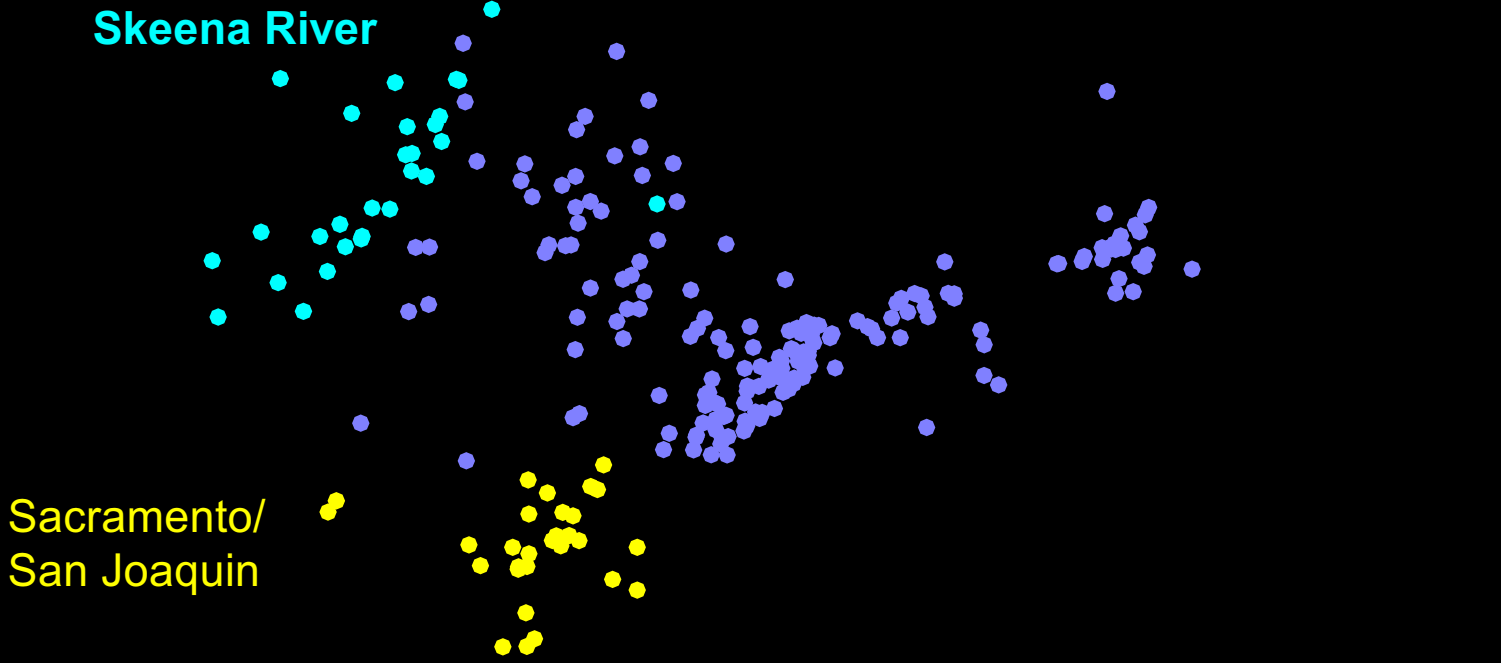
# Segregation of Chinook Populations Using Contaminant Fingerprint

Sacramento/  
San Joaquin

Multi-dimensional Scaling Plot of Four POPs Stress=0.05



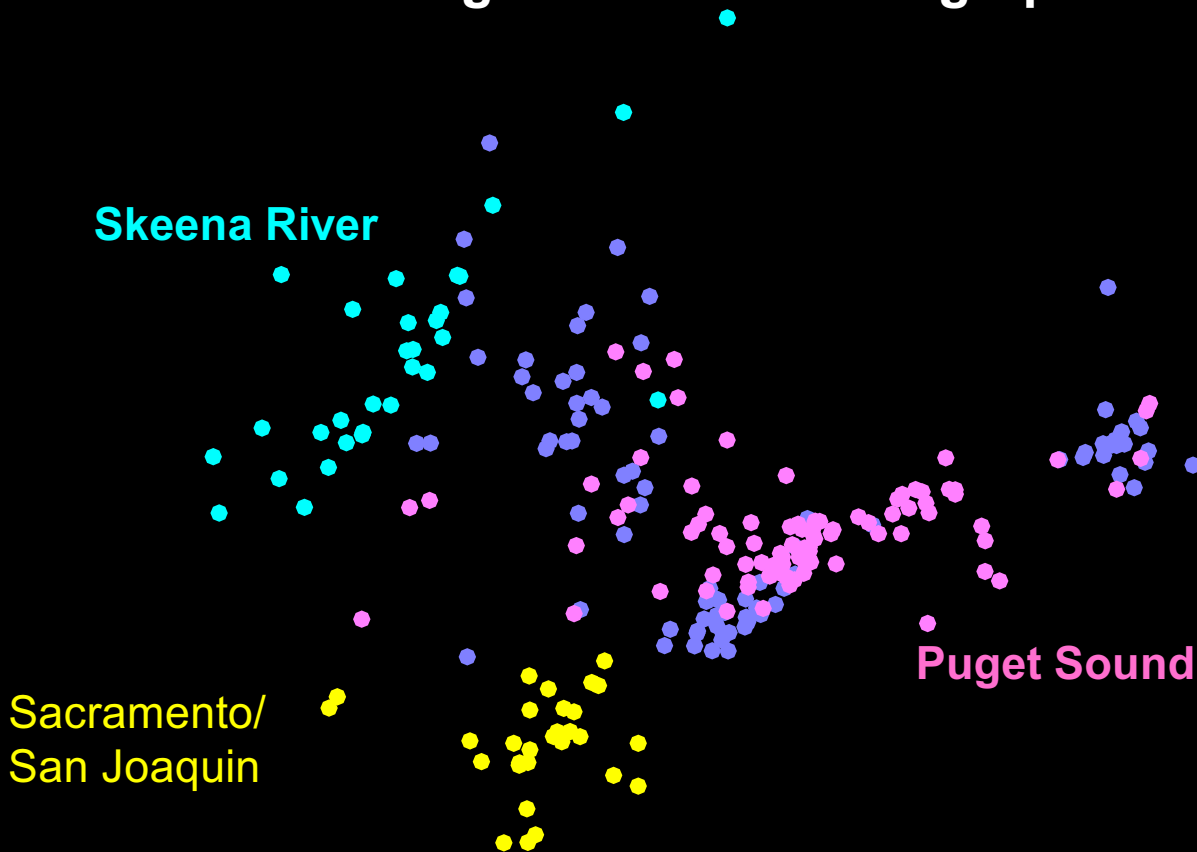
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Multi-dimensional Scaling Plot of Four POPs

Stress=0.05

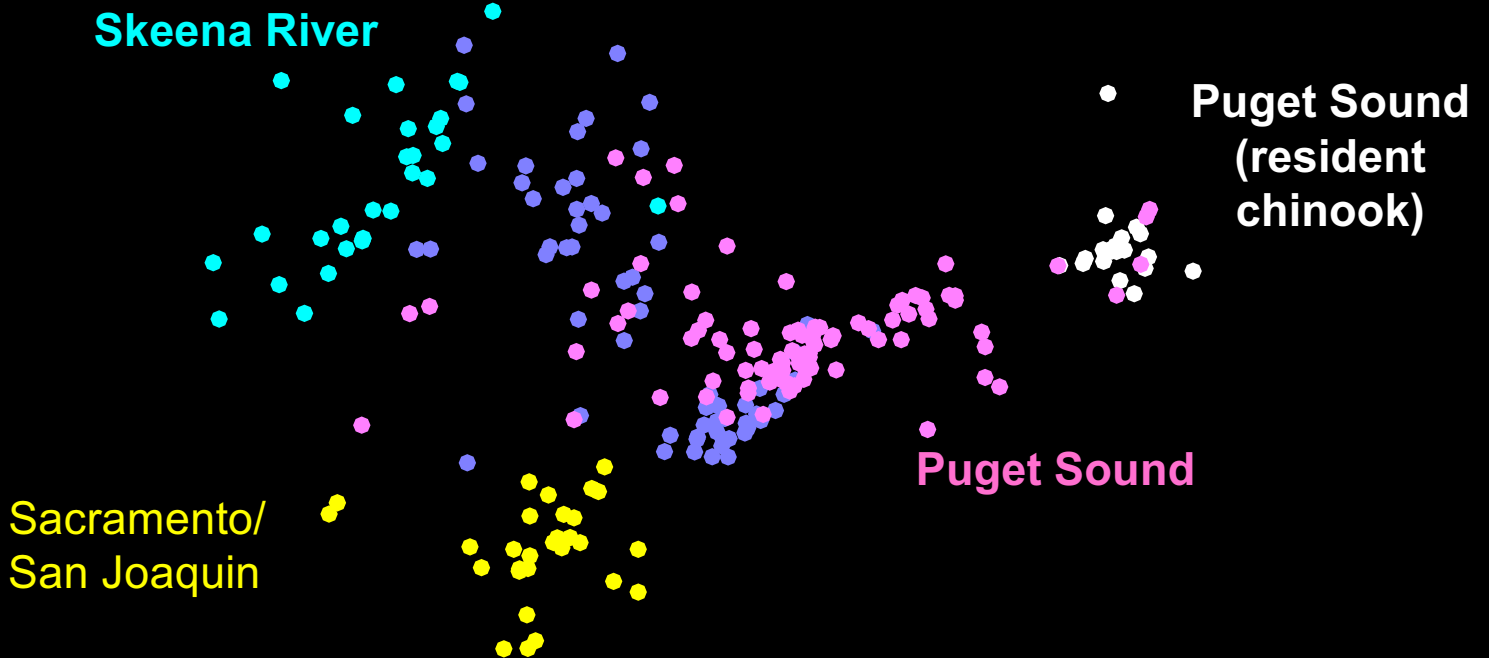
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**Multi-dimensional Scaling Plot of Four POPs**

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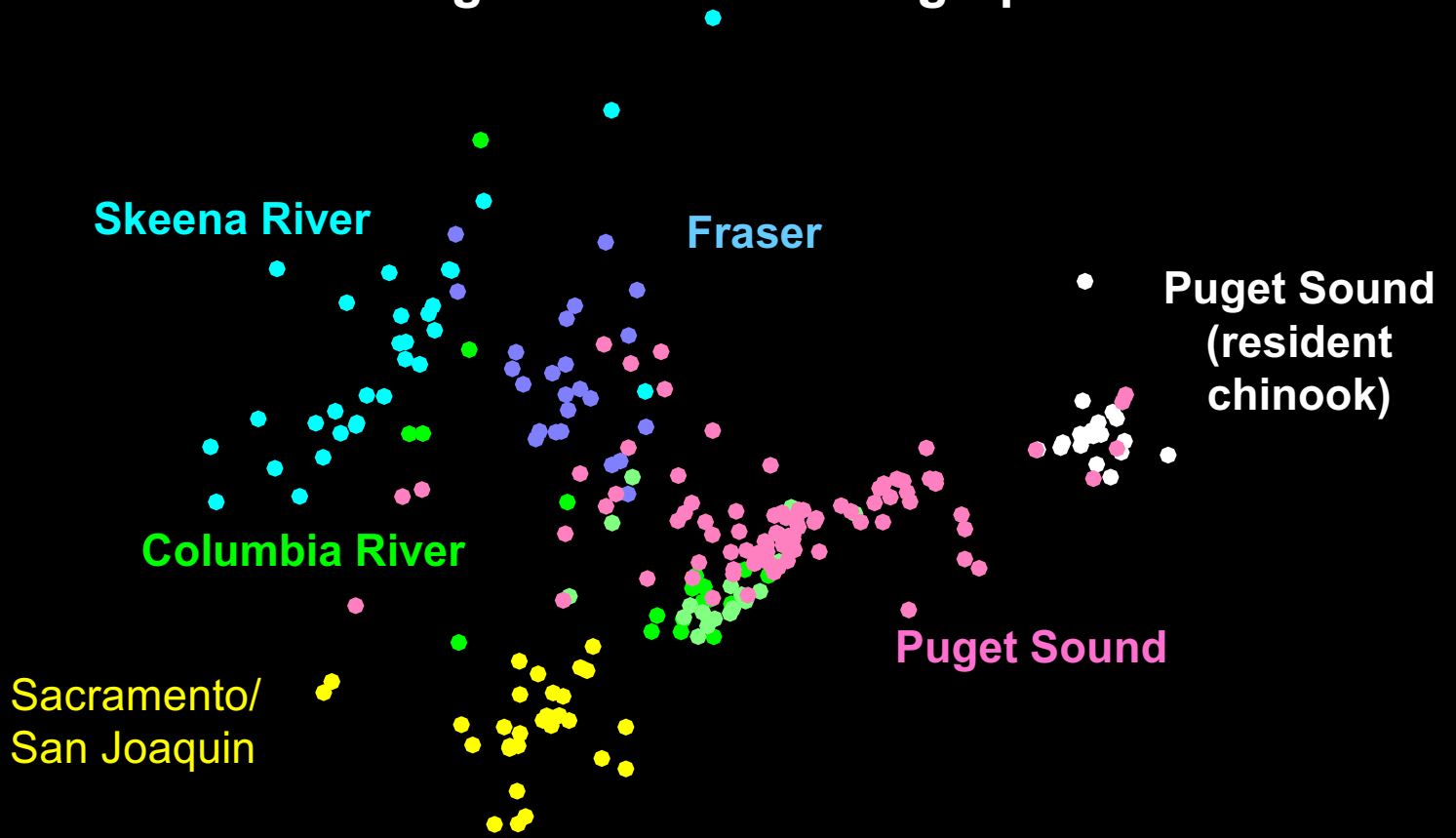


Multi-dimensional Scaling Plot of Four POPs

Stress=0.05

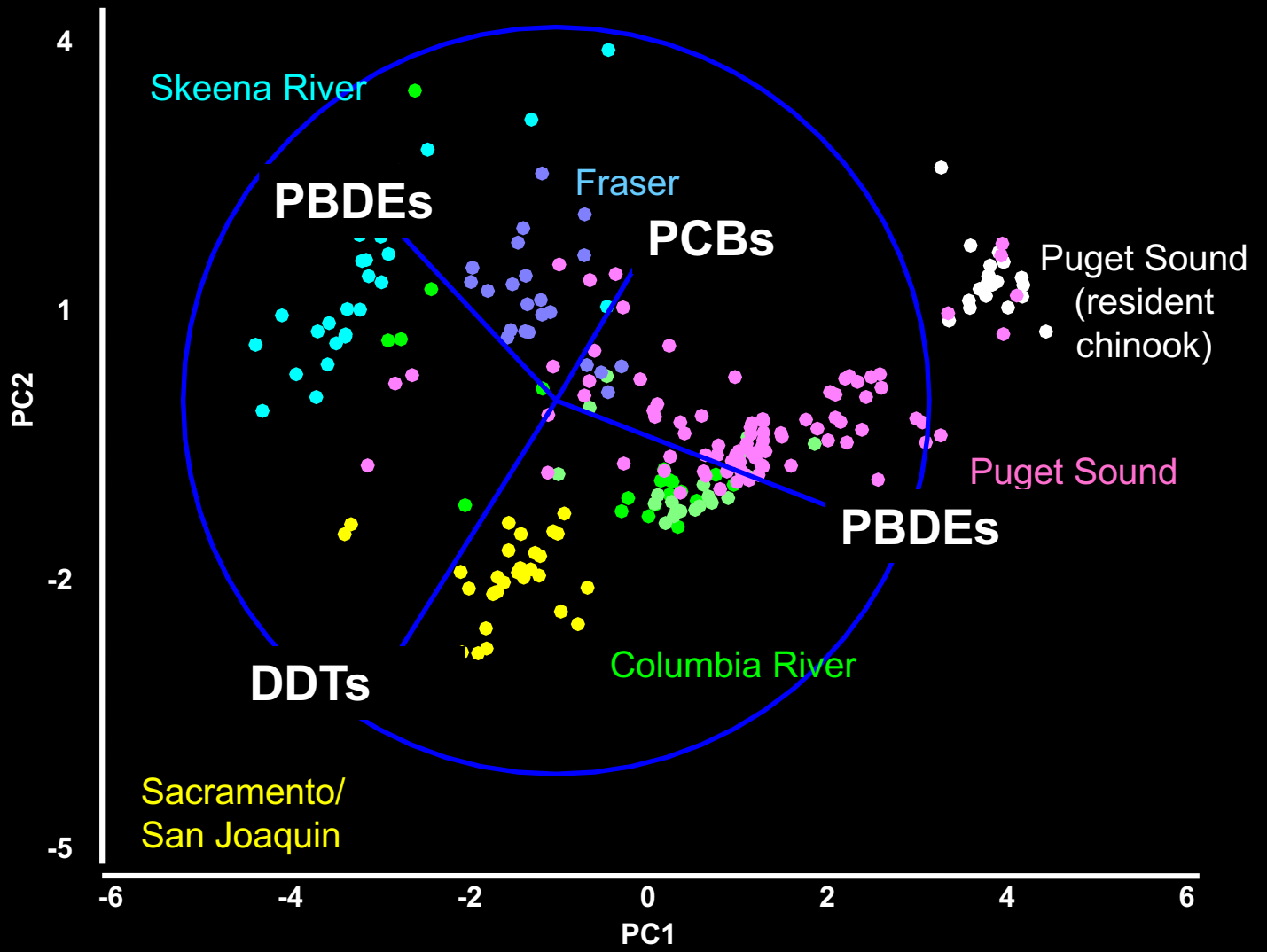


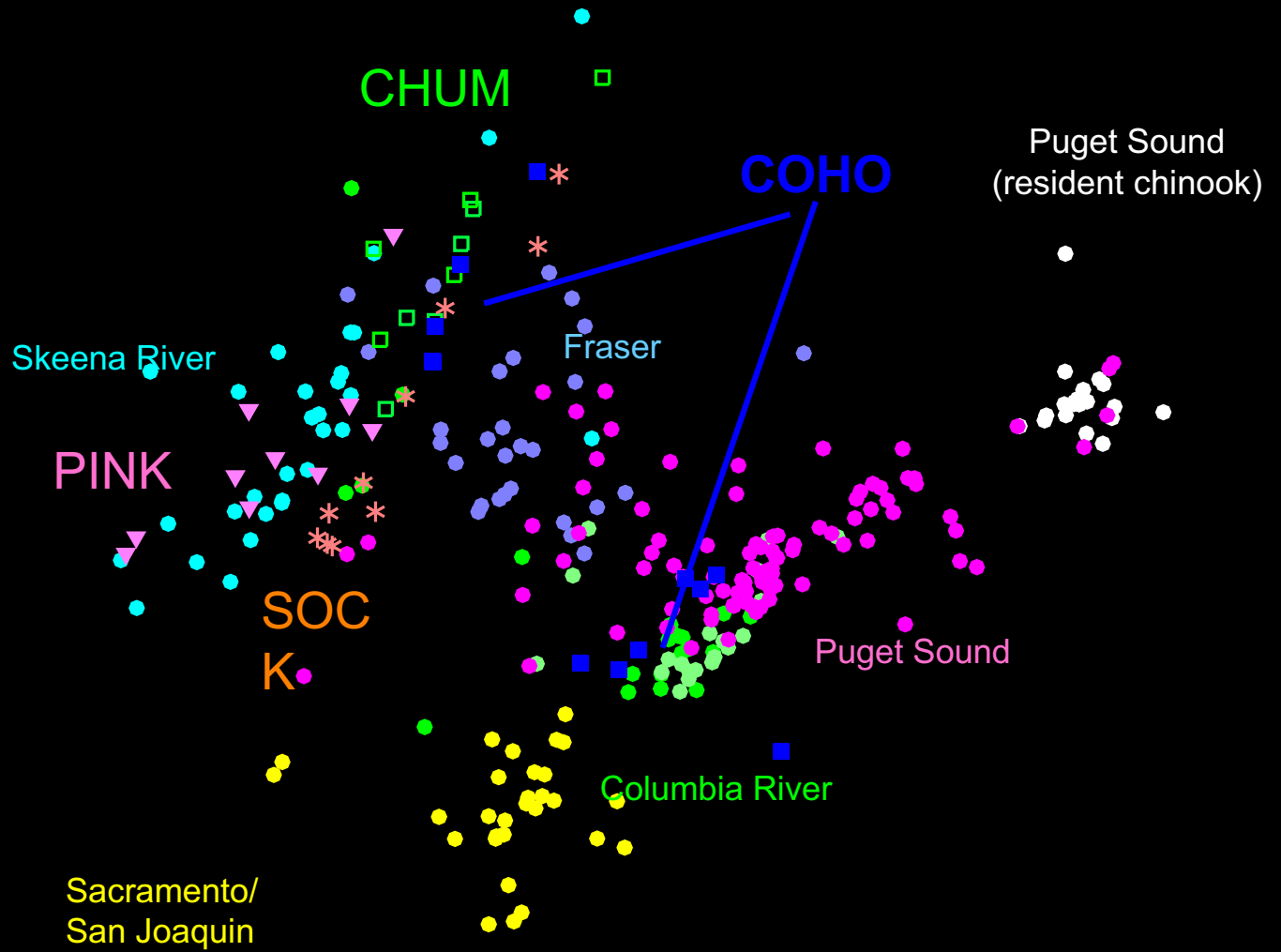
# Segregation of Chinook Populations Using Contaminant Fingerprint

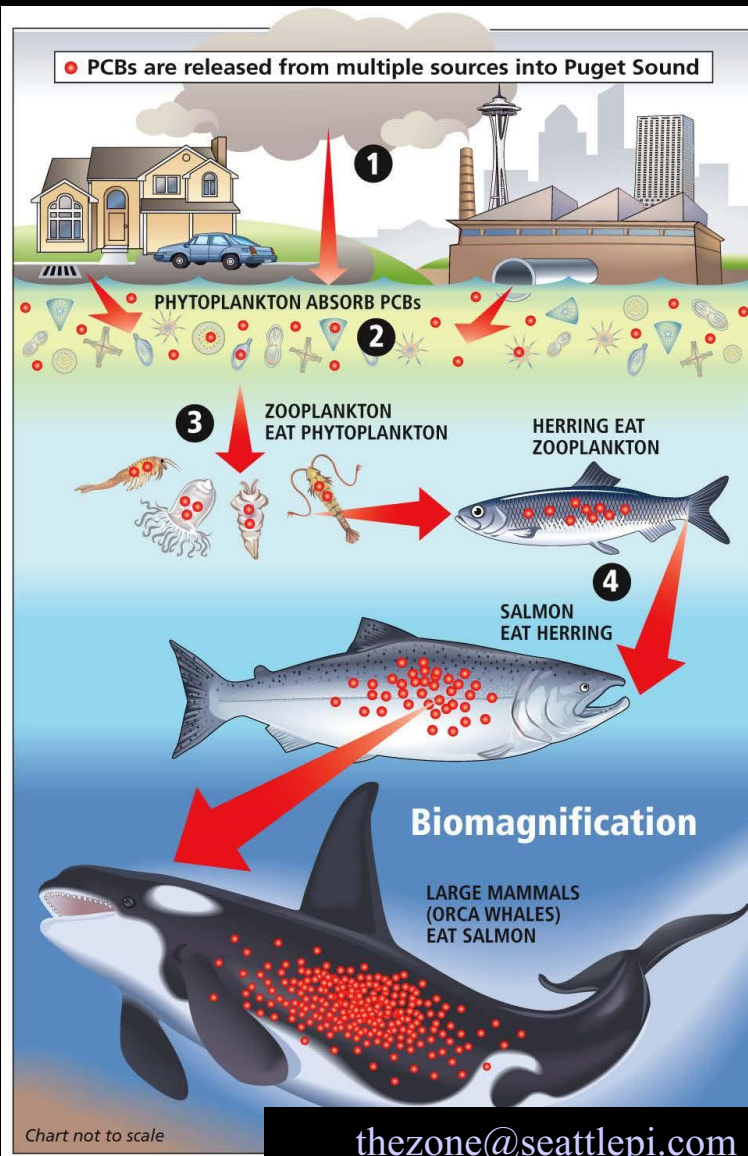


Multi-dimensional Scaling Plot of Four POPs

Stress=0.05







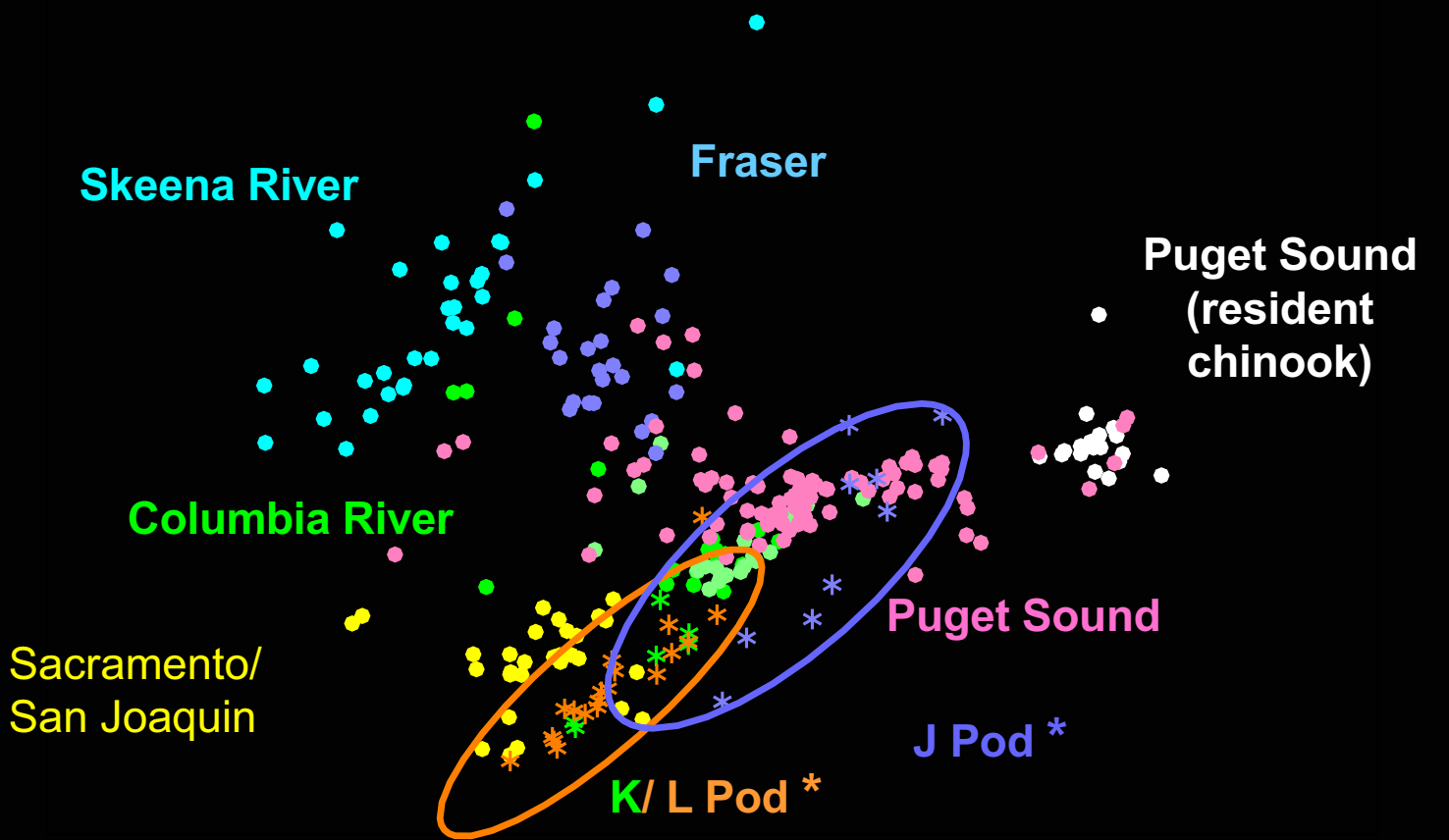
Chinook salmon populations distributed near land-based sources of contaminants have elevated POPs.

POP concentrations in Chinook salmon vary **regionally** with **distinct chemical fingerprints** associated with each population.

**Marine distribution** is the main factor **affecting POP levels** in Chinook salmon.

**What does this mean for SRKW?**

# Segregation of Chinook Populations Using Contaminant Fingerprint



Multi-dimensional Scaling Plot of Four POPs

Stress=0.07

## Fingerprint Summary

- **J Pod** killer whales fingerprint overlap with Puget Sound (Harrison) and Columbia River, suggesting substantial portion of their contaminants originate from those source – a more “**Salish Sea signal**” + **Columbia**
- **K and K Pod** killer whales fingerprint overlap more with Sacramento/ San Joaquin and Columbia River – a more “**California signal**”

# Other factor affecting fingerprints

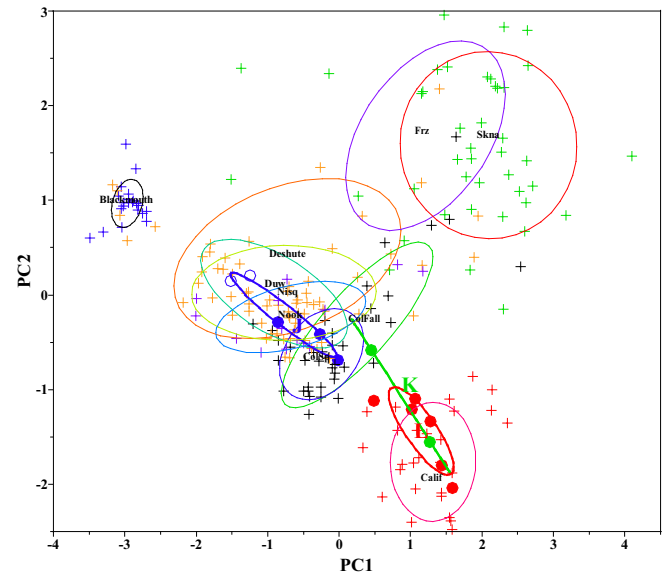
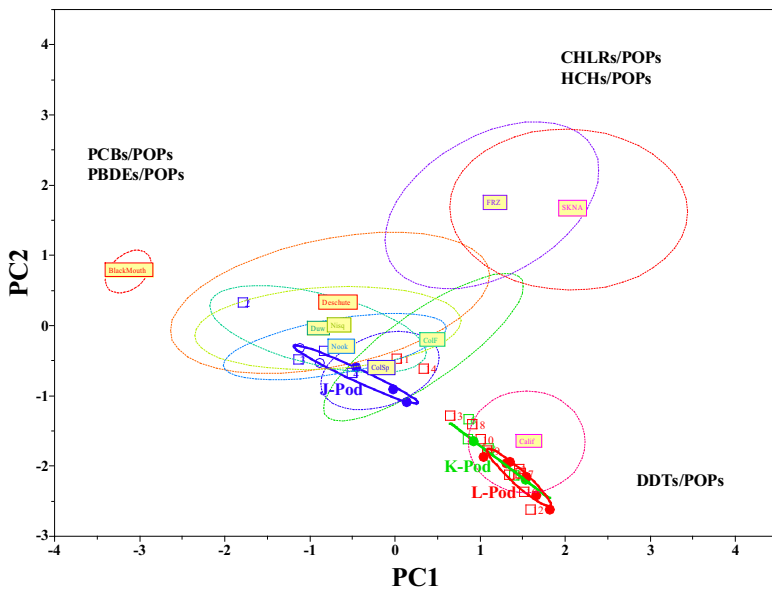


1. Contaminant fingerprints in whales and salmon reflect different time scales.
  - Long-term trends in PBDE alter fingerprints over time
  - BUT, fingerprints with and without PBDEs are similar.
2. Contaminant bioaccumulation factors for individual contaminants differ between whales and fish, altering fingerprints.
  - Preliminary corrections for bioaccumulation factors
    - dampens “California signal” for K and L pods
    - enhances “Salish Sea” signal for J pod
3. Contaminant fingerprints reflect qualitative differences in source of contaminants in diet
  - Quantitative assessment require mass-balance bioconcentration models.

**END**



# Correction for bioaccumulation rates shifts whales' fingerprint toward Columbia River populations

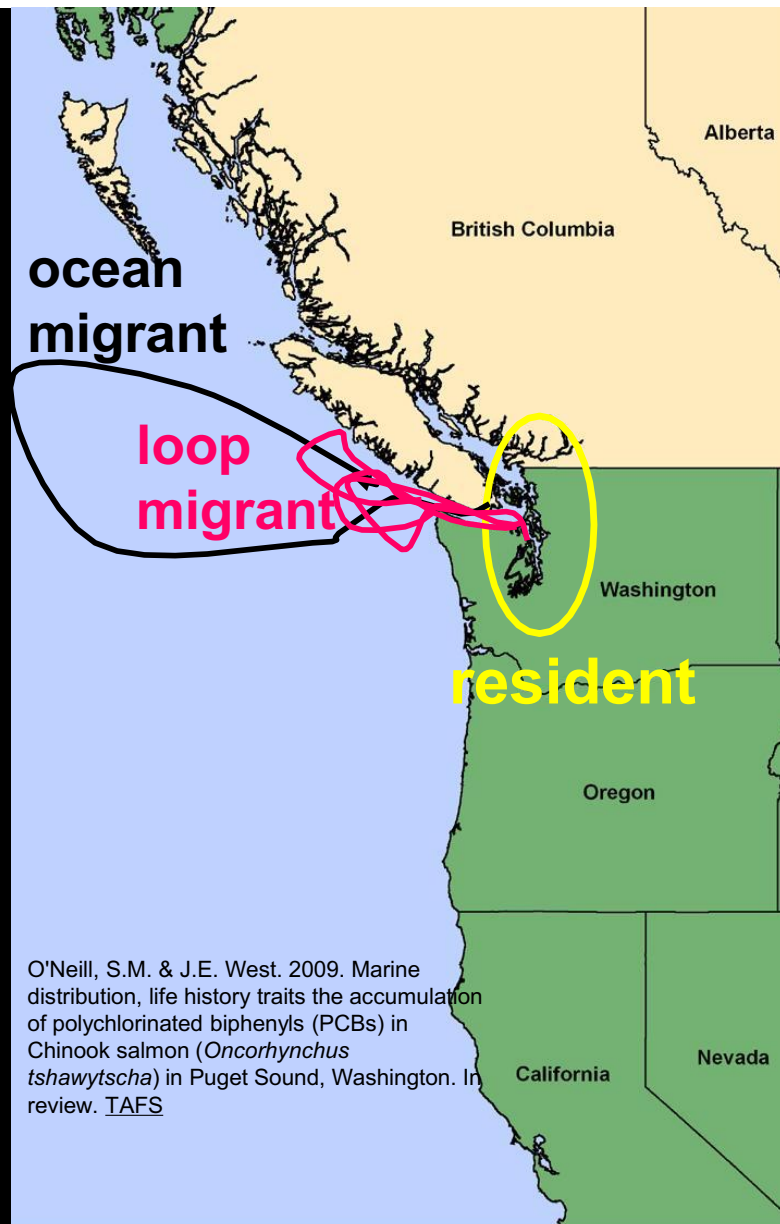


# Migration patterns of Puget Sound Chinook salmon

Percent of recreational and commercial catch of Puget Sound Chinook salmon displaying resident behavior

29 % of sub-yearling smolts

45 % of yearling smolts



# POP Fingerprints

**Chemical Fingerprints of  
Chinook salmon & Pacific  
herring are similar in regions  
where their distribution overlaps**

*Chinook Herring Complex*

