National Mussel Watch Monitoring of the California Coast in 2010

CEC Pilot Program: A collaborative effort between NOAA and California

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NOAA National Status and Trends Mussel Watch Program

- Historic data, years 1986-2009
- California collaboration initiated in 2007
  - SCCWRP and SWRCB
- By 2009 a total of 71 sites along CA coastline
  - Bays
  - Open coast with discharges
  - ASBS
- Resident mussels
- Historically, 150 contaminants monitored

1986-2009 Historic Data - Summary

- DDTs, PCBs, and Butyltins have generally decreasing at many stations
  - Consistent with the implementation of pollution controls
- No clear trend for Total PAHs
  - Highest recent concentrations in SF Bay after oil spill
- Mussel tissue pollutant concentrations vary depending on site conditions:
  - Enclosed bays generally have higher concentrations
  - Most ASBS have low concentrations of contaminants, except those near large watershed sources

Mussel Watch Pilot Study: Contaminants of Emerging Concern (CECs) - 2010

Mussel Watch CEC Pilot Study

- Pioneering study to inform future monitoring efforts on what CECs should be targeted
- To expand the relevance and utility of the National Status and Trends Mussel Watch program to regional, state and local stakeholders
- NOAA applied all its analytical resources toward CA mussel watch, with a focus on CECs
- Collaborators: NOAA, SCCWRP, SWRCB, SFEI, USGS

Mussel Watch Pilot Study Design

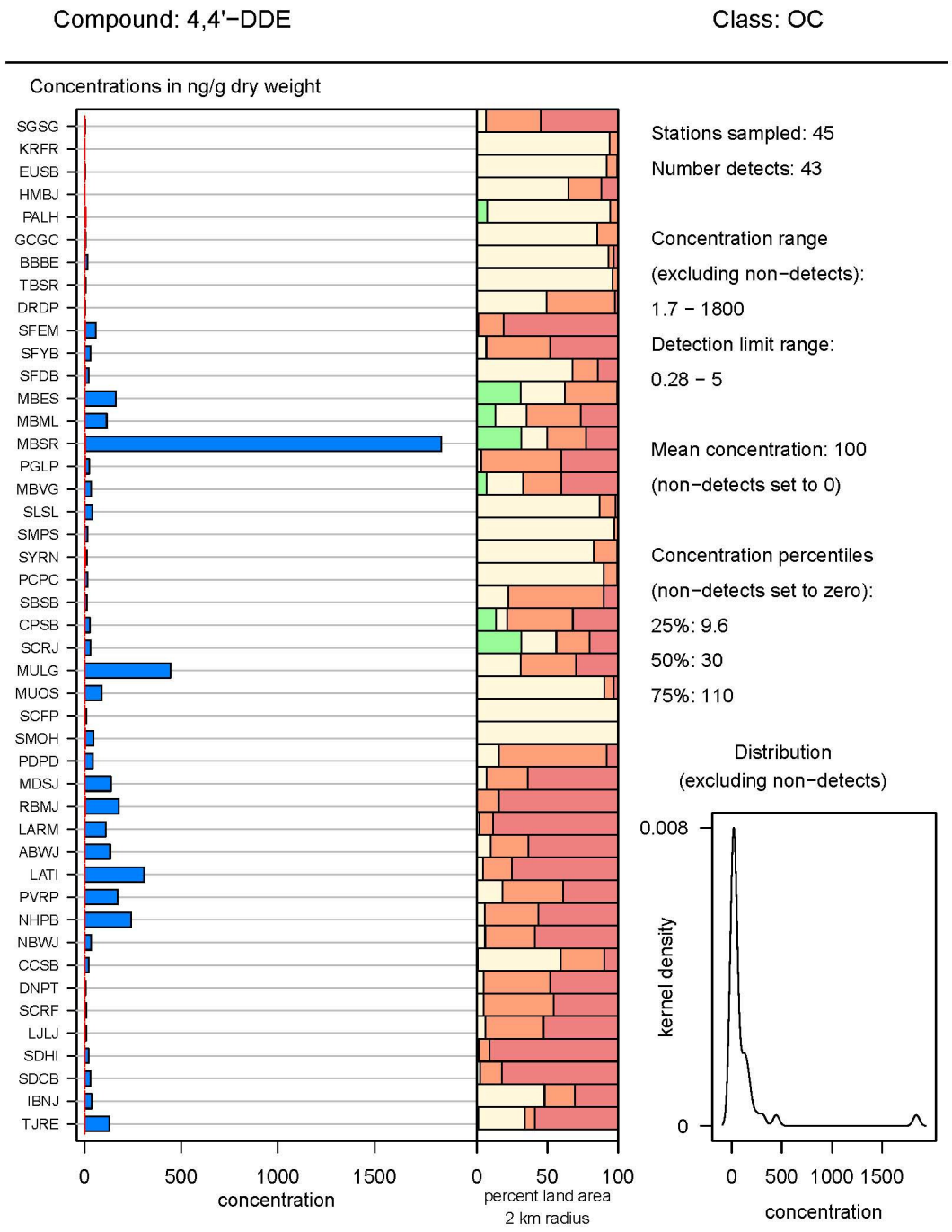
- Resident mussels were sampled Dec. 2009 – May 2010
- Many new analytes selected (CECs)
  - Contaminant concentrations were assessed according to different land uses and proximity to sources
- Traditional pollutants were also analyzed at certain sites to maintain time series

Some bad news on DDE ☹

Salinas River Mouth

Mugu Lagoon (Calleguas Creek)

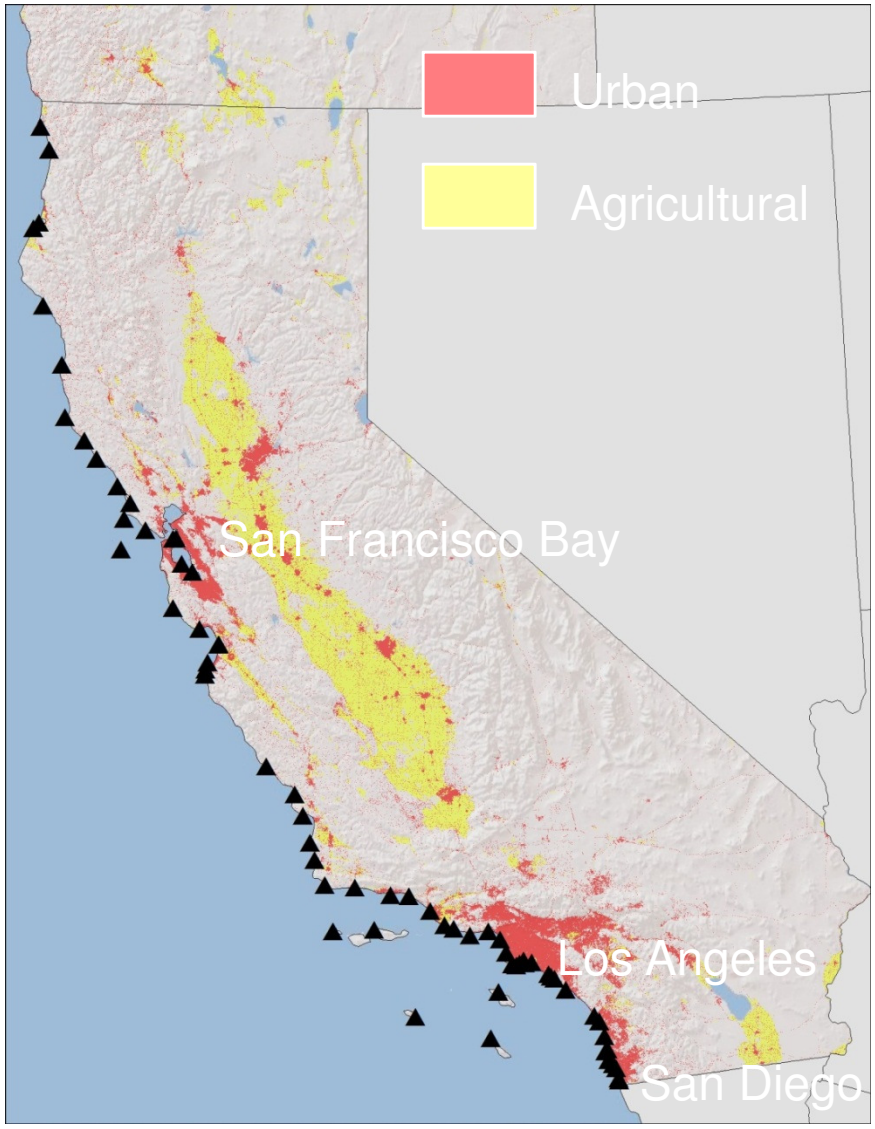
Royal Palms PV Peninsula



CEC Analytes

Class	Abbreviation	Number of Compounds
Alkylphenols	AP	4
Pharmaceuticals and Personal Care Products	PPCP	88
Polybrominated Diphenyl Ethers	PBDE	26
Current Use Pesticides	CUP	27
Other Flame Retardants	OFR	9
Perfluorinated Compounds	PFC	12
Single walled carbon nanotubes	SWNT	

Station Categorization



Land Use	Stations
Urban	14
Mixed Devel.	16
Low Devel.	30
Agricultural	8

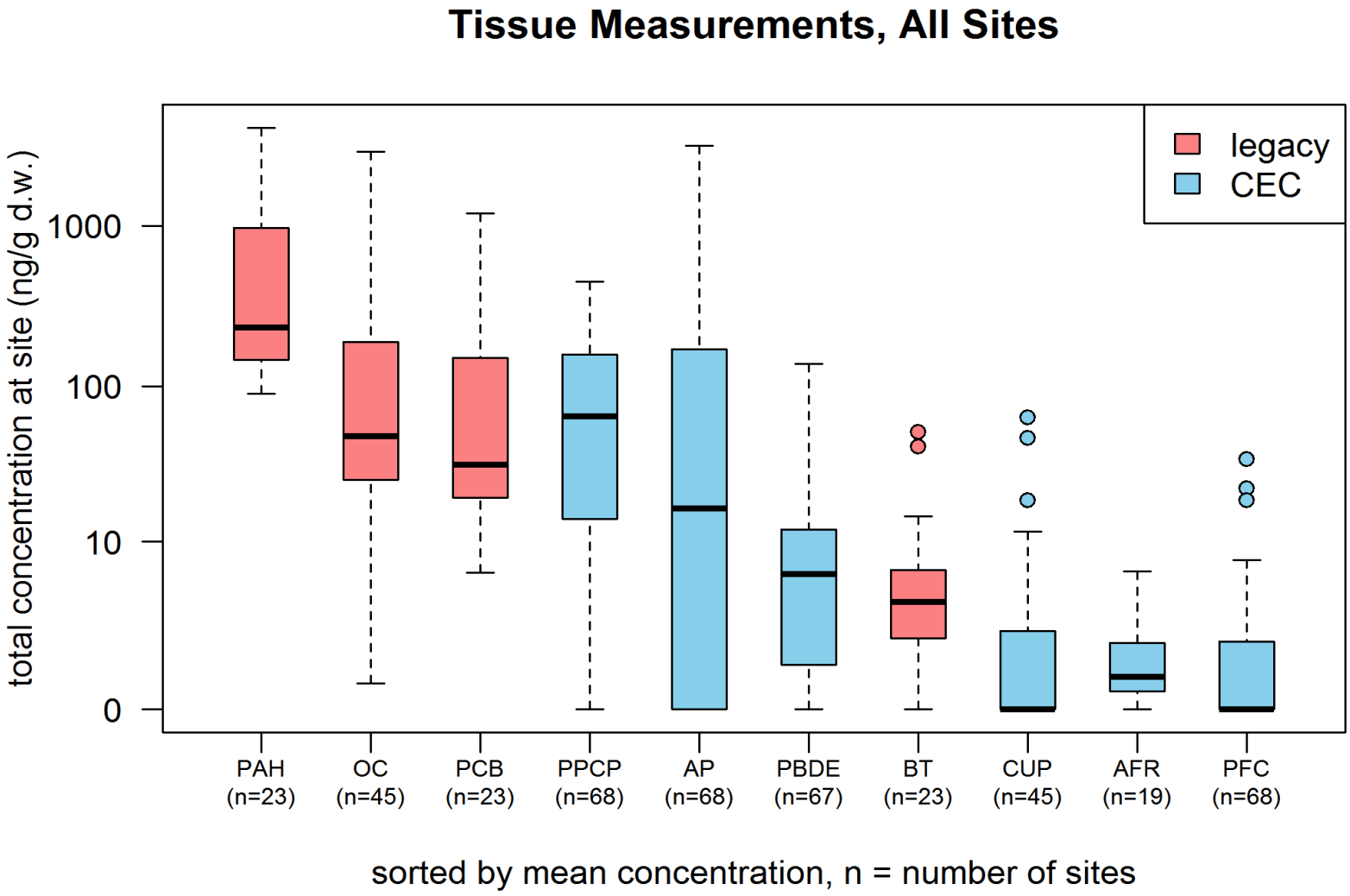
(mutually exclusive)

Discharge	Stations
Storm Water	35
POTW Discharge	11

(not mutually exclusive)

Concentration comparison:

PPCPs, APs, and PBDEs have similar concentrations to legacy contaminants



Compound: Cocaine

Class: PPCP

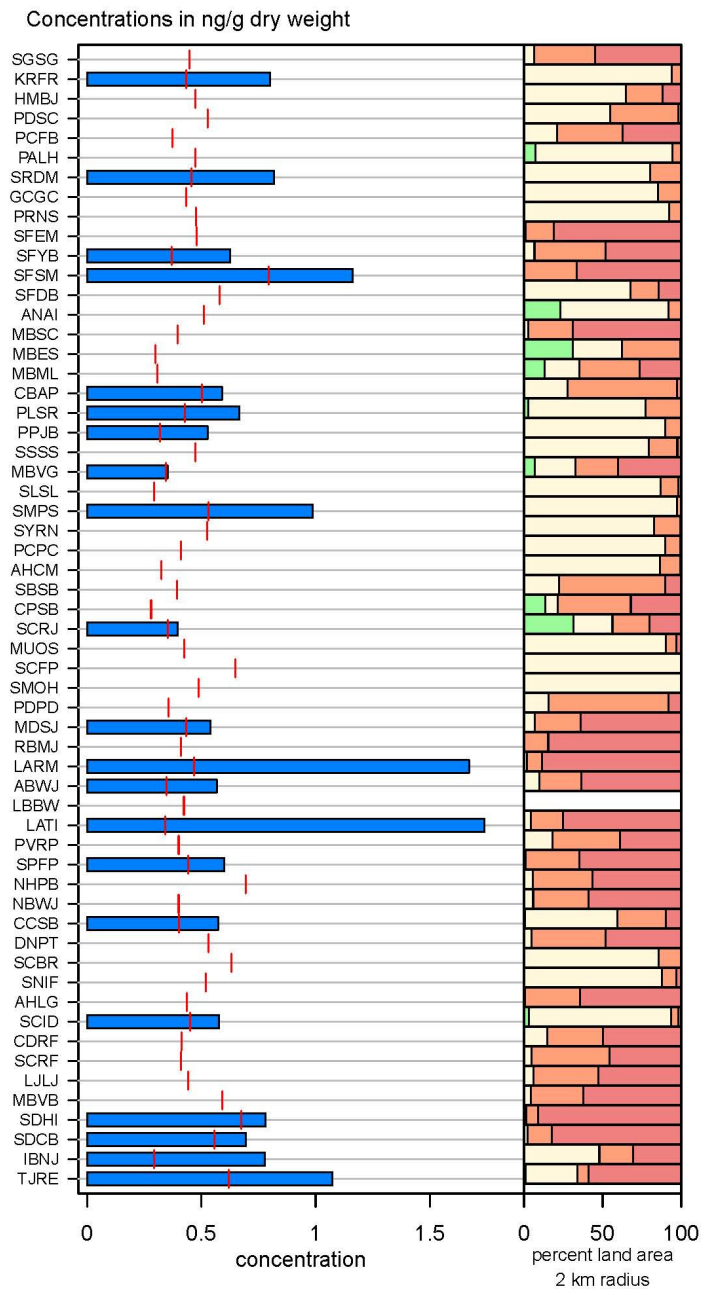
SF Bay S.Mateo

Santa Maria

LA River Mouth

LA Harbor Terminal Island

Tijuana River



Stations sampled: 58

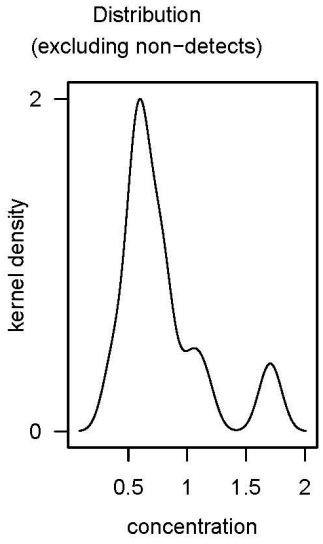
Number detects: 21

Concentration range
(excluding non−detects):
0.35 − 1.7

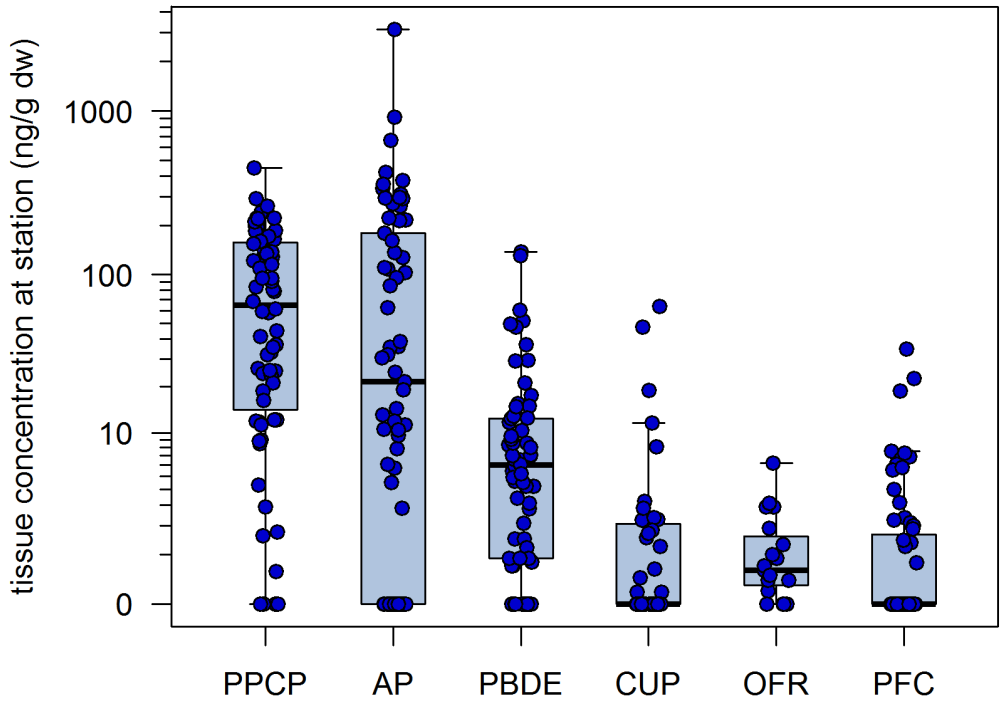
Detection limit range:
0.28 − 0.8

Mean concentration: 0.28
(non−detects set to 0)

Concentration percentiles
(non−detects set to zero):
25%: 0
50%: 0
75%: 0.58



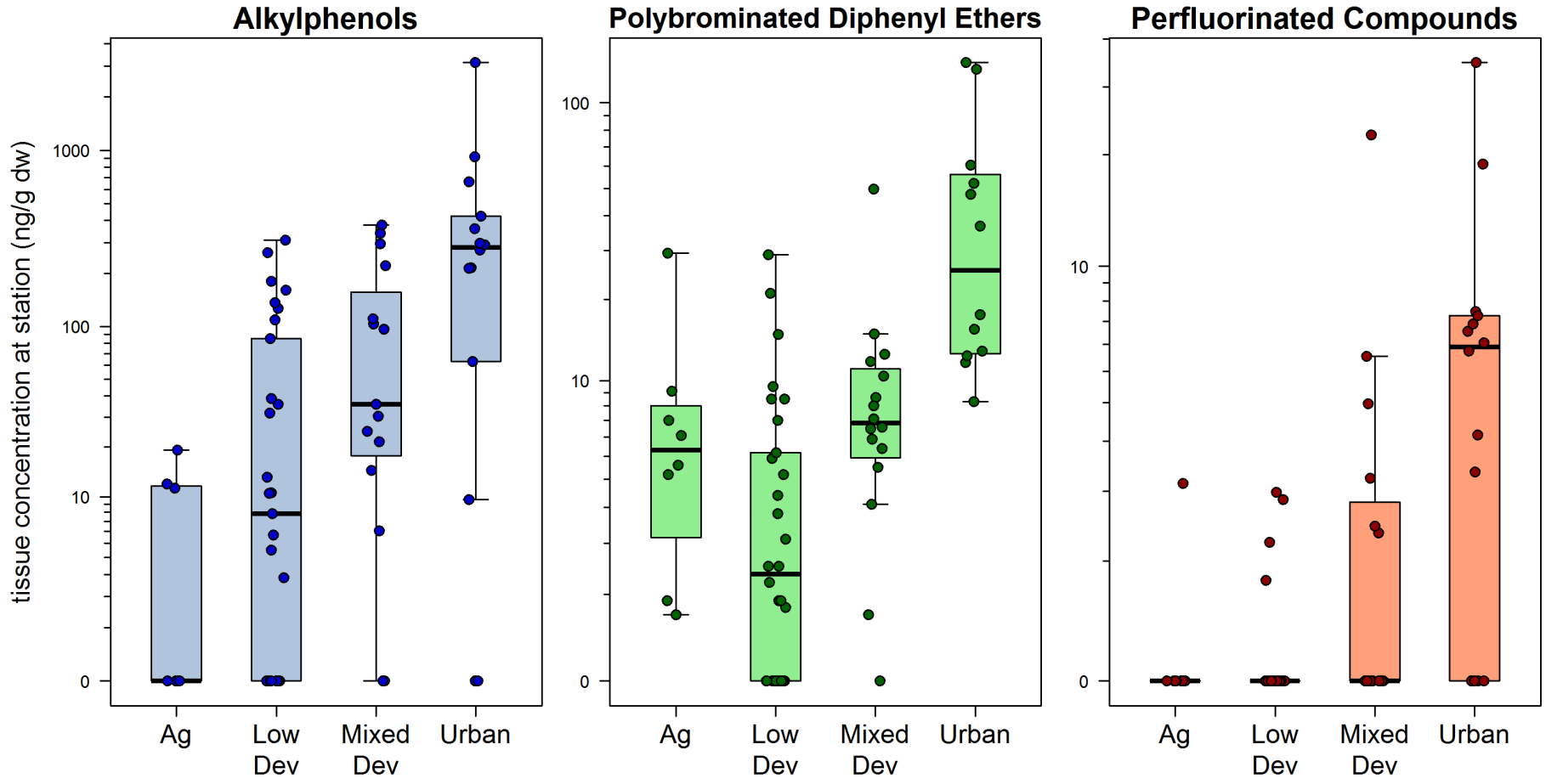
Compound Class Abundance



- CECs detected at 67 of 68 stations
  - San Simeon Point in central CA
- SWNTs not detected
  - measured at 10 urban stations
  - other nanoparticles not measured
- Concentrations similar to those observed in other coastal bivalve surveys
  - PPCP bivalve data not available

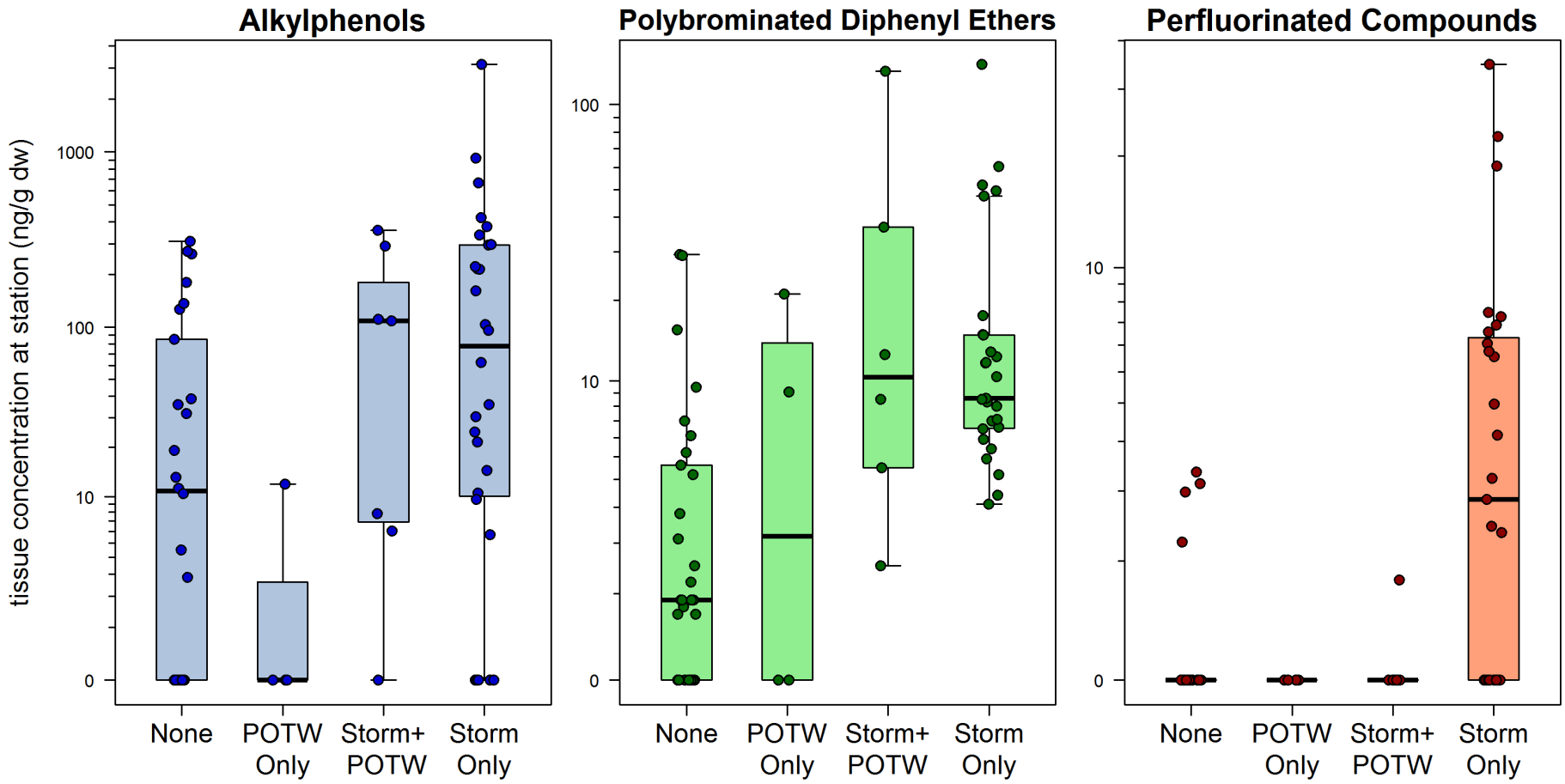
Urban Influence

- APs, PBDEs, and PFCs are used in a wide variety of industrial and consumer products
- Five stations with the highest median concentrations were located at the mouths of urban embayments or waterways

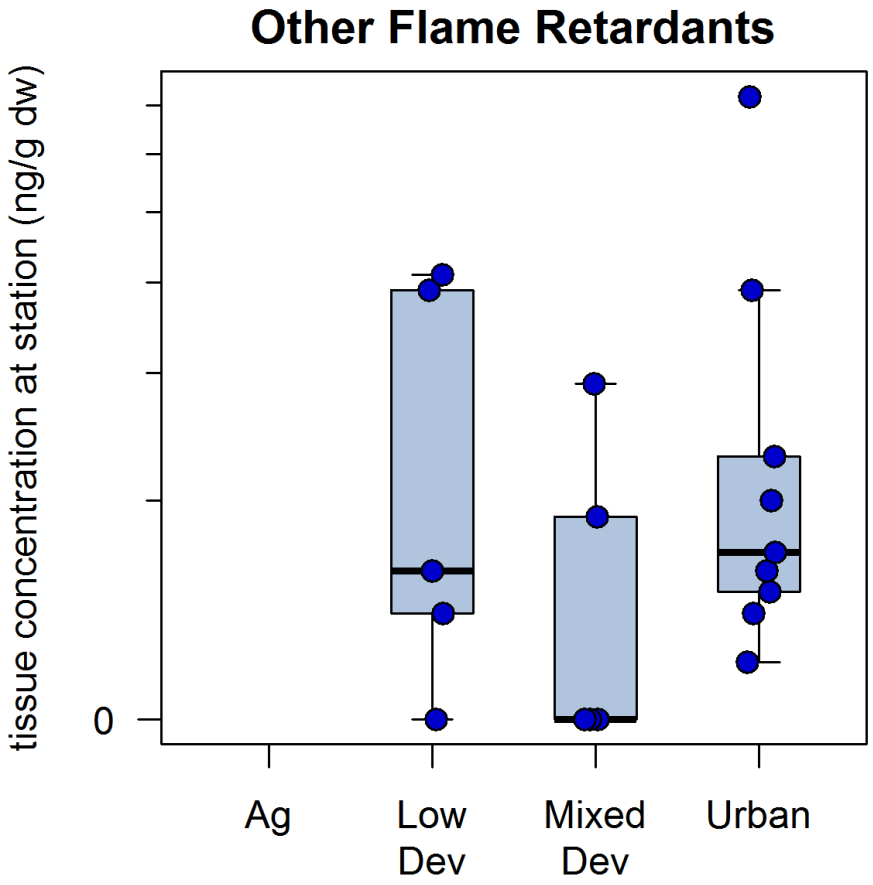


Storm Water Influence

- Higher concentrations at stations receiving storm water, indicating this is a source of these contaminants to coastal waters
- ASBS were used as a proxy for no sources (i.e. “None”)



Other Flame Retardants

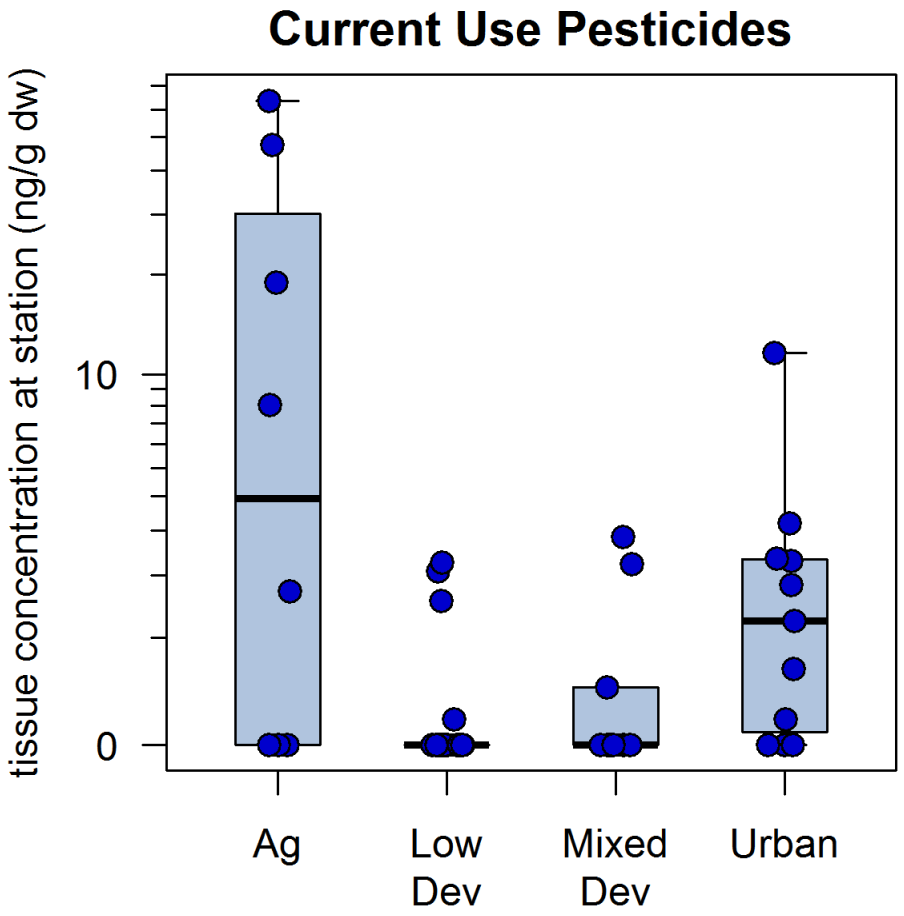


- Measured at subset of 20 stations
- Expected to have urban sources, but lower statistical power

- Main compounds
  - **HBCD, gamma**
  - **HBCD, alpha**
  - **HBCD, beta**

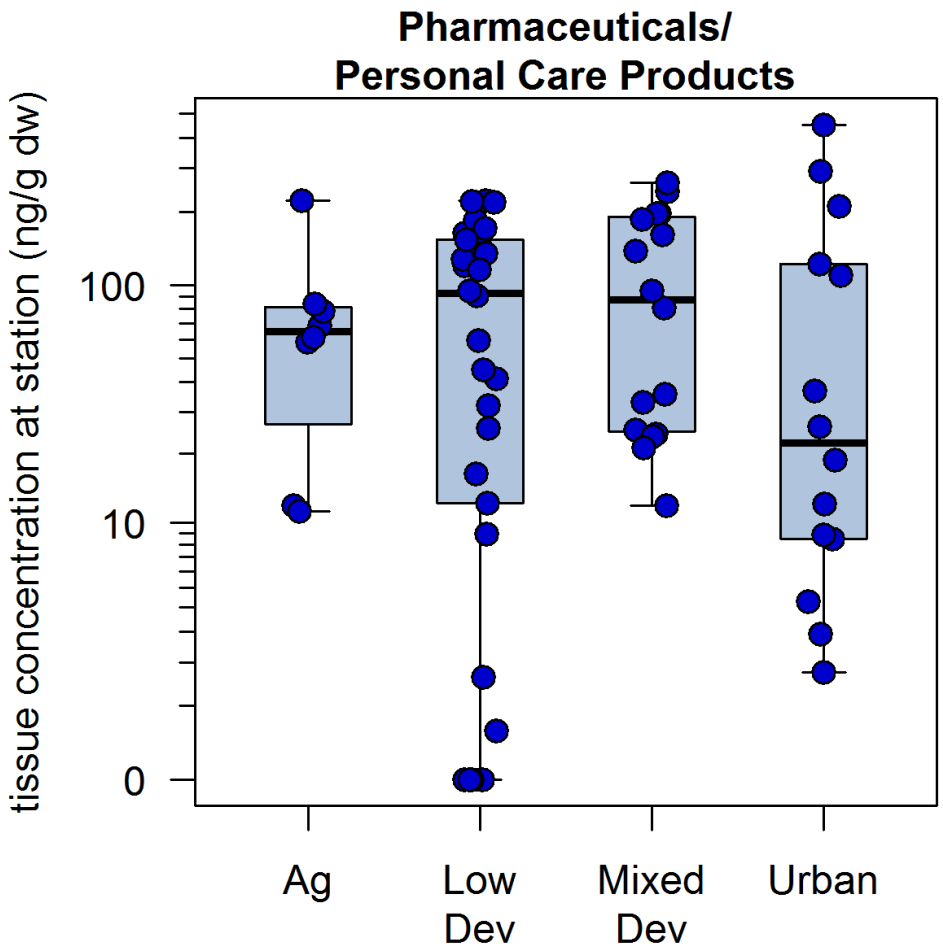
- Other measured compounds
  - Alternative FRs: **BTBPE**, TBB, TBPH
  - Chlorinated Phosphates: TCPP, TDCPP, TCEP

Agricultural Influence



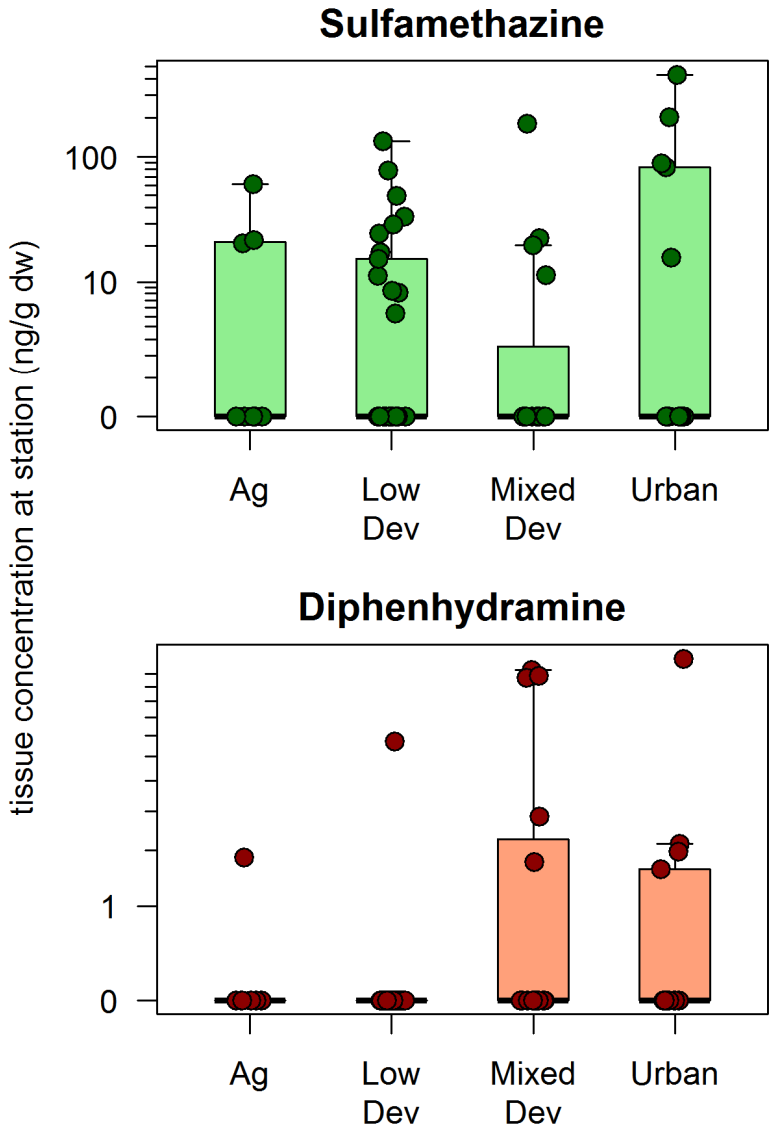
- CUPs have higher concentrations at the agricultural stations
  - but not statistically significant
  - measured at 45 stations
- Main compounds
  - **Chlorpyrifos** (organophosphate insecticide)
  - **Dacthal** (a herbicide)
    - Known to have agricultural sources within California
  - **Chlorpyrifos** is also used to treat urban structures

PPCP Spatial Distribution



- As a class PPCPs had similar concentrations across the land use categories
- Main compounds were antibiotics
  - **Methylprednisolone**
  - **Lomefloxacin**
  - **Sulfamethazine**
- Varying sources?

Individual PPCP Spatial Distribution



- Sulfamethazine
  - antibiotic
  - used in both livestock and human medicine
  - possible non-urban and urban sources
- Diphenhydramine
  - antihistamine
  - human use only
  - urban sources

Mussel Tissue Conclusions

- PBDEs, APs and PPCPs most frequently detected.
- Urban land use stations generally had higher concentrations for PFCs, APs and PBDEs.
- CECs had the highest concentrations at stations influenced by storm water discharges.
- PPCPs were present in all land uses, including agriculture.
  - Occurrence of veterinary drugs unexpected.
- CUPs highest at agricultural areas, followed by urban.
- Provides data to inform the design of more comprehensive coastal water quality monitoring.

Future Monitoring Methods - Passive Samplers

Bivalves

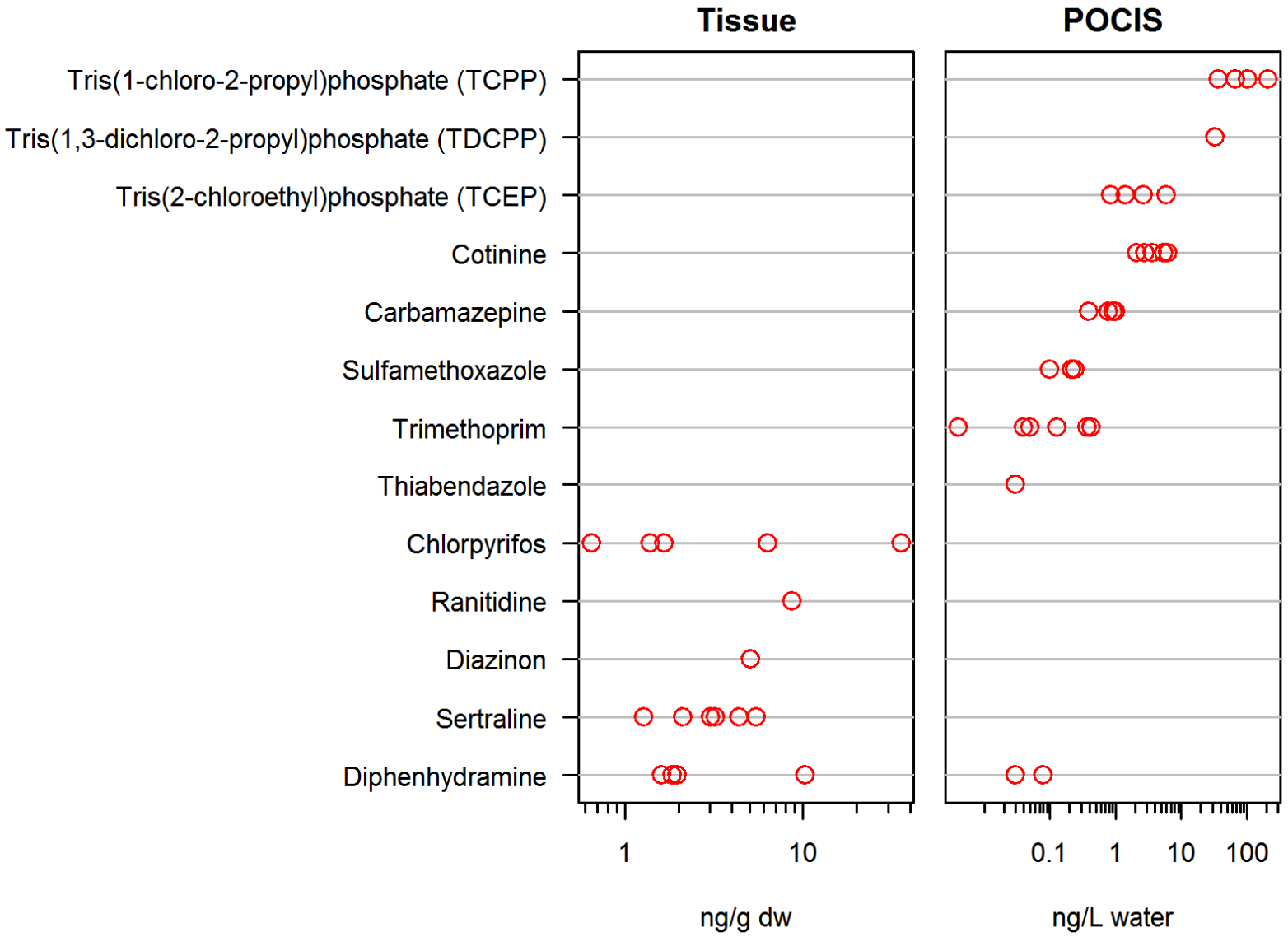
- significant logistics/regulations/cost
- resident mussels habitat limited
- transplants cannot be deployed in all conditions

PS Mechanism of Operation

- diffusion transports contaminants to a sorbent material
- mimics the exposure of aquatic organisms
- different sorbent materials target various chemical classes

Accumulation in Mussels vs. POCIS

POCIS: Polar organic chemical integrative samplers



Want to learn more?

- Special Issue of Marine Pollution Bulletin is being developed to publish all this data.