

# **Extent and Magnitude of Sediment Contamination in Southern California by Two Chemicals of Emerging Concern**

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**[www.SCCWRP.org](http://www.SCCWRP.org)**

# Southern California Bight

**Stream Order**

- SO2
- SO3
- SO4+

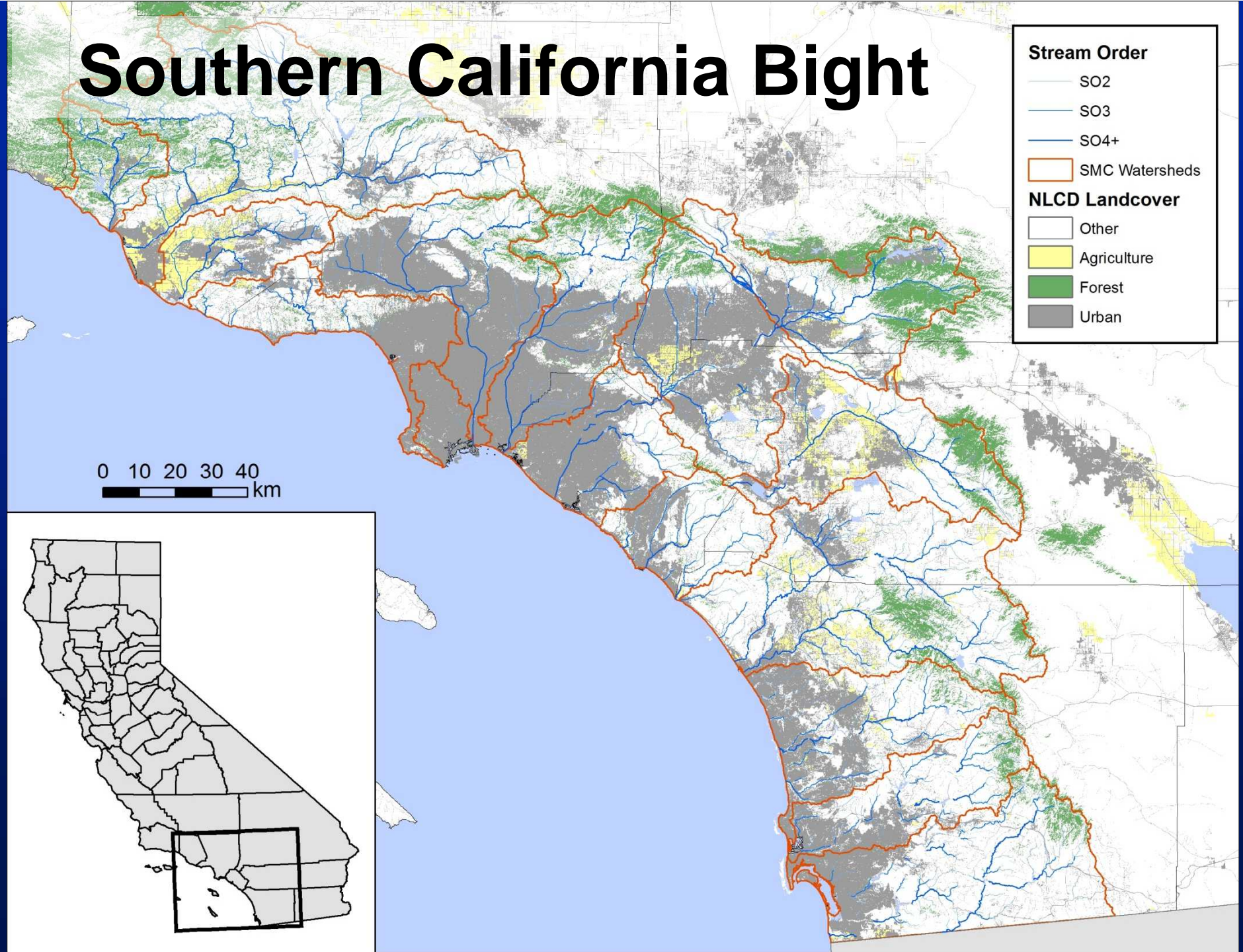
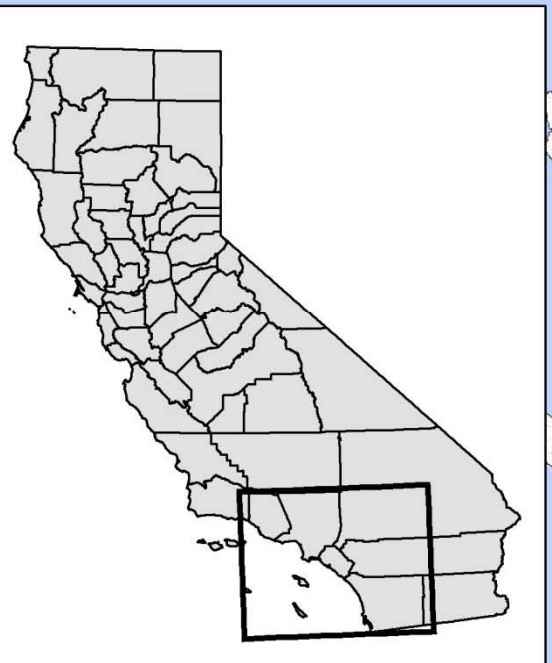
**SMC Watersheds**

- SMC Watersheds

**NLCD Landcover**

- Other
- Agriculture
- Forest
- Urban

0 10 20 30 40 km



# 20 Years of So Cal Regional Monitoring

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- **Integrated, collaborative programs between dischargers, regulators, and citizen monitors**
- **Over a dozen habitats**
  - **Hundreds of sites, scores of indicators**
- **What is the extent and magnitude of environmental impact?**

# Regional Monitoring Is a Terrific Platform For Special Studies

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- **Constituents of Emerging Concern (CECs) are a perfect example**
- **Provides foundational information for managers**
  - How big of a problem is it?
  - Are spatial patterns indicative of sources?
- **Technical expertise can be coalesced**
  - Cost leveraging, technology transfer

# CECs Come In Many Flavors

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- **Pharmaceuticals**
- **Endocrine disruptors**
- **Personal care products**
- **Industrial chemicals**
- **Current use pesticides**

# Poly-Brominated Diphenyl Ethers (PBDEs)

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- **Flame retardant used in consumer products**
  - plastics, foam, textiles
- **Persistent and bioaccumulative**
  - Mix of congeners
- **Southern California has observed relatively high concentrations in biota**
  - Mussels
  - Pinnipeds

# Top 10 Nationwide Mussel Watch PBDE Concentrations

State	General Location	Specific Location	Concentration (ppb ww)
CA	Anaheim Bay	West Jetty	8202
NY	Hudson River	Governor's Island	2189
NY	Hudson River	Battery Park	1946
NY	Hudson River	Shore Road	1550
NY	Hudson River	Fort Wadsworth	1287
NY	Hudson/Raritan Estuary	Lower Bay	1191
CA	San Francisco Bay	Dumbarton Bridge	900
NY	Hudson/Raritan Estuary	Jamaica Bay	899
CA	Marina Del Rey	South Jetty	855
CA	Imperial Beach	North Jetty	846

(Kimbrough *et al*, 2009)

# Pyrethroid Pesticides

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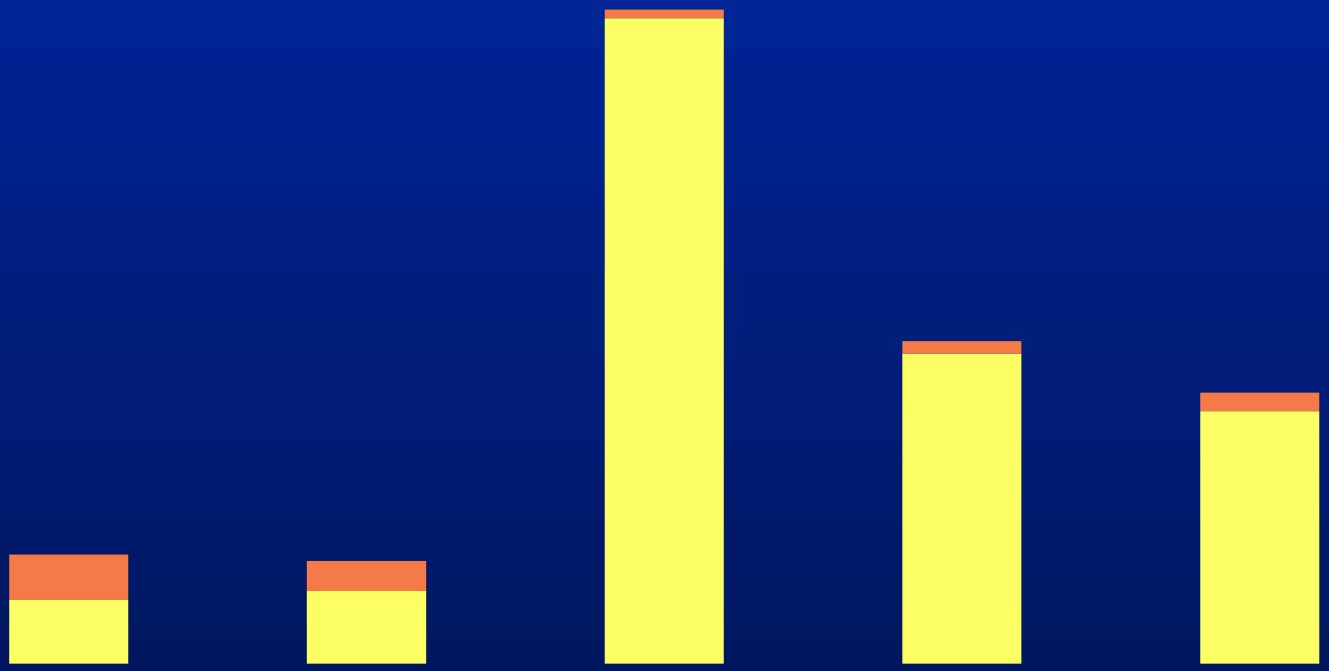
- **Over 1,000 tons/yr applied in So Cal coastal counties**
  - More than 90% is residential use
- **Acutely toxic to arthropods**
  - Significant toxicity observed in marine amphipods at 1 to 10 ng/g sediment
- **So Cal has separate wastewater and stormwater conveyance systems**
  - Urban runoff receives no treatment



# So Cal Pyrethroid Pesticide Use By County

(Active ingredient, Calif Dept Pesticide Regulation)

1999-2008 Total amount  
(Pounds)



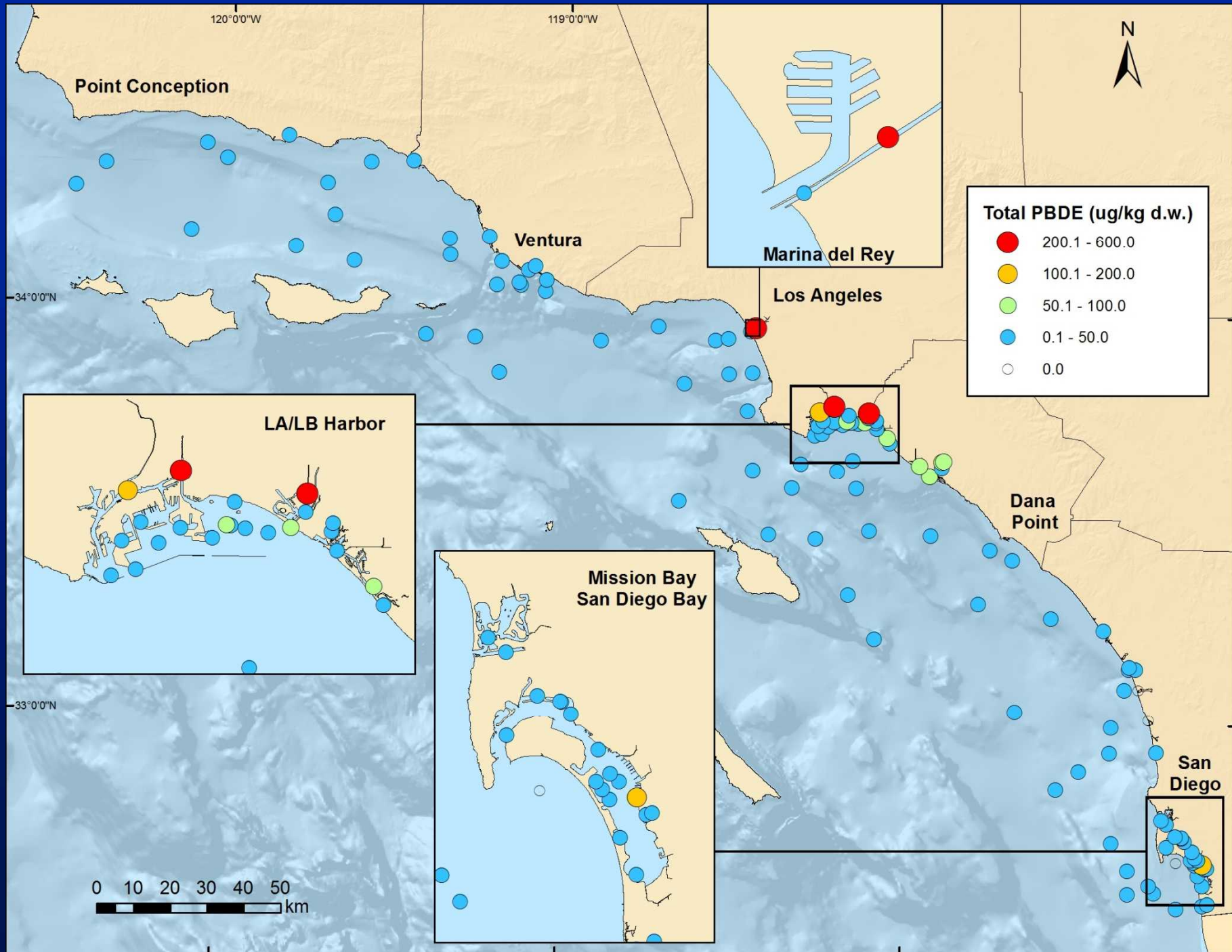
■ Agricultural ■ Nonagricultural

# Methods Summary

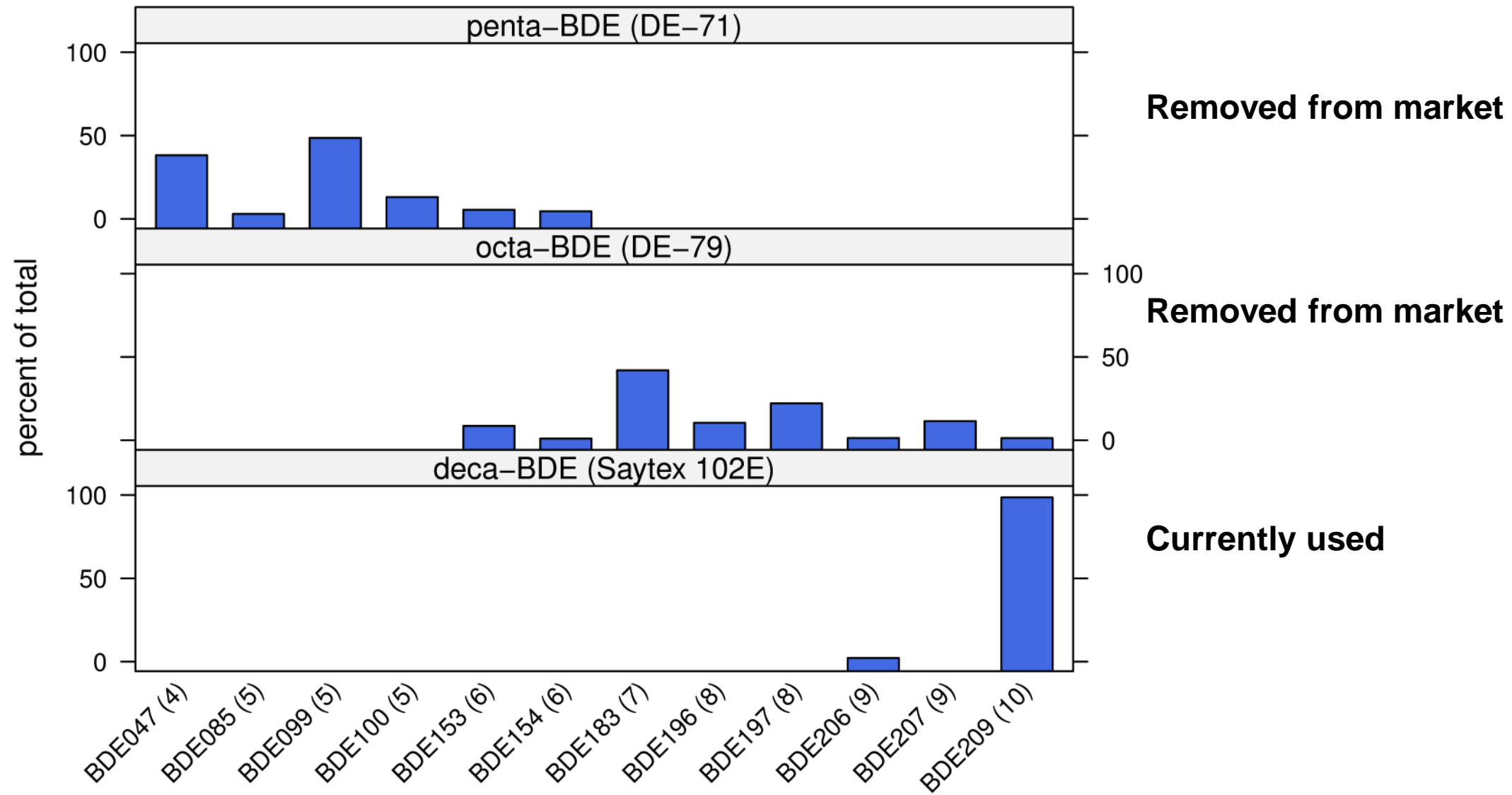
- **Probability based design**
  - Enables unbiased estimates of extent and magnitude
- **Surface sediments from Offshore and Embayment habitats**
  - Estuaries, marinas, ports, open bays
- **13 PBDE congeners**
  - 121 sites
- **8 pyrethroid pesticides**
  - 155 sites



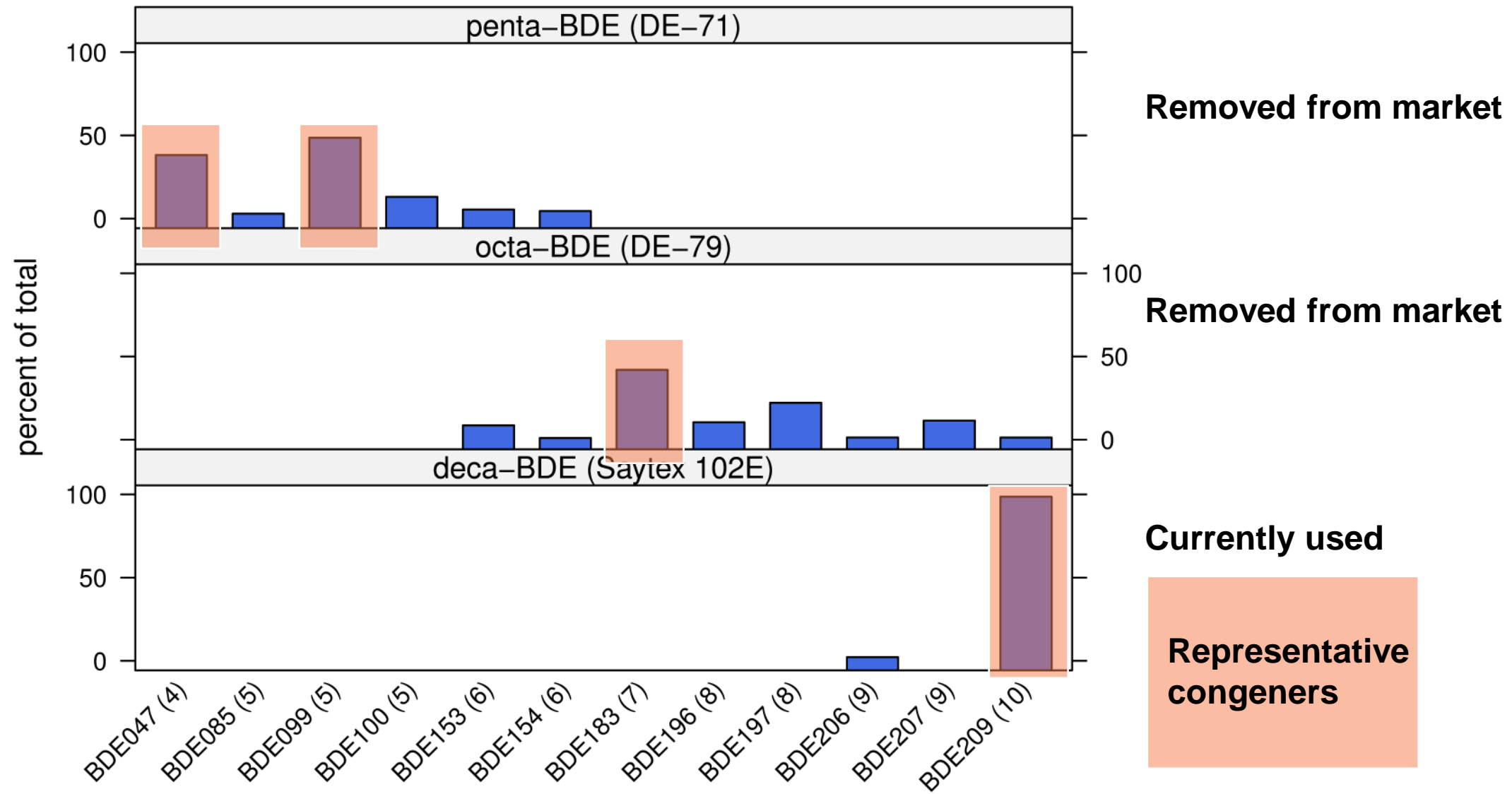
# Flame Retardants (PBDEs) In the Southern California Bight



# PBDE Congeners in Commercial Mixtures



# PBDE Congeners in Commercial Mixtures

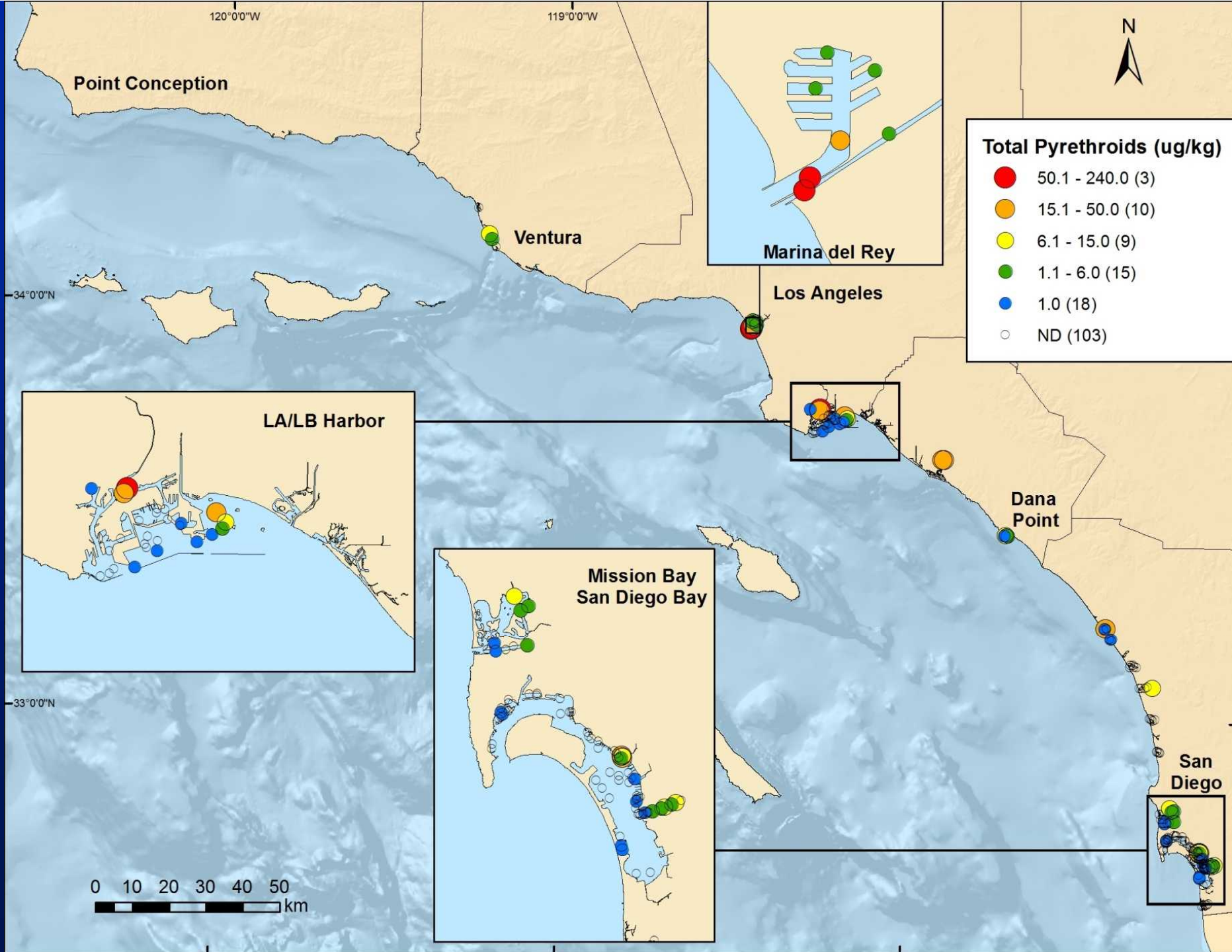


# PBDE Congener Concentration By Habitat

Area Weighted Geomean ( $\pm$  95%CI), ug/dry kg

BDE Congener	Embayment	Offshore
047	0.43 (0.14)	0.18 (0.07)
099	0.44 (0.15)	0.17 (0.08)
183	0.08 (0.03)	0.02 (0.03)
209	9.0 (4.8)	0.6 (0.3)
Total 13 Congeners	12 (4)	2.0 (0.4)

# Pyrethroid Pesticides In the Southern California Bight



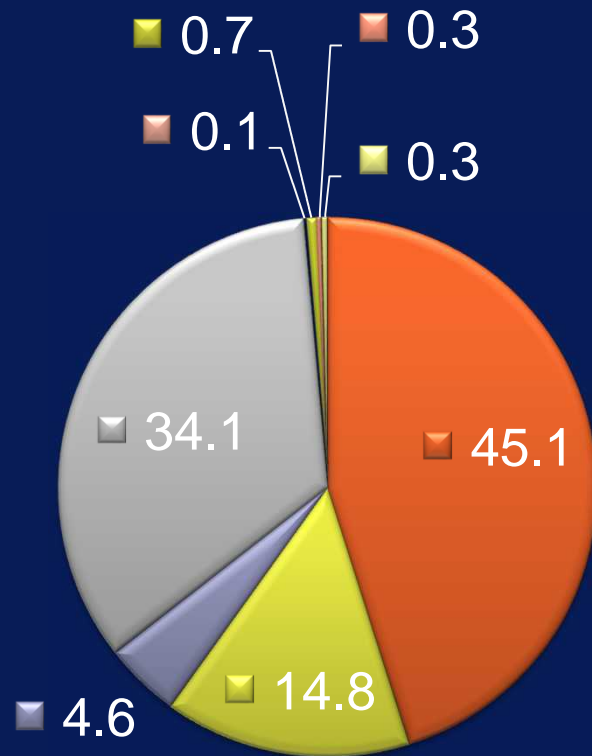
# Pyrethroid Extent, Magnitude and Accumulation

Embayment Habitat	Percent Area with Detectable Concentrations	Area Wtd Mean Concentration (ug/kg)	Sediment Accumulation (kg/km <sup>2</sup> )
Estuary	49	22	1.64
Marina	65	20	1.50
Open Bay	36	2.3	0.21
Port	16	0.2	0.02
Total Embayments	35	5.2	0.39



# Pyrethroid Components

## Relative Concentration



## Relative Toxicity



- Bifenthrin
- Cyfluthrin
- Cypermethrin
- Permethrin
- Deltamethrin
- Esfenvalerate
- Fenpropathrin
- $\lambda$ -Cyhalothrin

# Toxicity Identification Evaluation

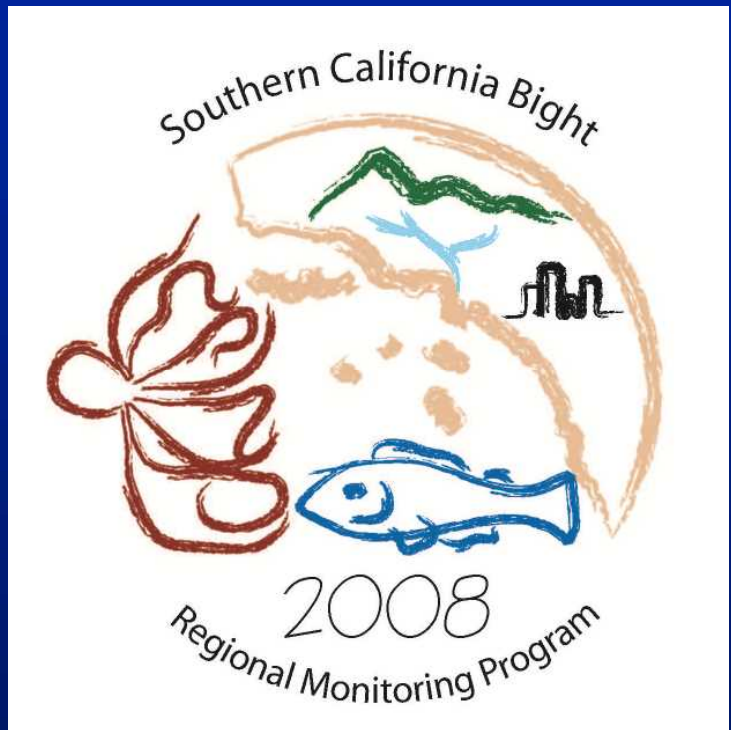
## (Ballona Creek Estuary)

Treatment	Purpose	Pore Water Exposure	Sediment Exposure
EDTA or Cation exchange resin	Complexes metals	Not effective	Not effective
C18 Extraction or Activated carbon	Removes nonpolar organics	Highly effective	Highly effective
Piperonyl Butoxide (PBO)	Metabolic inhibitor Blocks OP pesticide toxicity Enhances pyrethroid pesticide toxicity	Uncertain	Highly effective (increase)
Carboxyl-esterase	Hydrolyzes pyrethroid pesticides making them nontoxic	Highly effective	Highly effective
Temperature Reduction	Enhances pyrethroid pesticide toxicity	Uncertain	Highly effective

# Summary of CEC Results

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- The occurrence of PBDEs and pyrethroid pesticides were widespread in So Cal
- Highest concentrations observed near the mouths of our most urbanized watersheds
  - Suggests a runoff source
- Toxicity identification evaluation indicated pyrethroids were a source of toxicity in estuaries
  - Bioaccumulation of PBDE is sport fish coming up!



**Tip 'o the Hat for  
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