



# Regional Assessment of Sediment Contamination from Marshes to the Continental Shelf: Results of the Western Component of the US EPA National Coastal Assessment

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## **Western Coastal Component, National Coastal Assessment, Environmental Monitoring and Assessment Program**



### **Sampling Program (CONUS only):**

<b>1999</b>	<b>Small estuaries of WA, OR, CA</b>
<b>2000</b>	<b>Large estuaries of WA, OR, CA</b>
<b>2001</b>	<b>OR estuaries</b>
<b>2002</b>	<b>Estuarine tidelands of WA, OR, CA</b>
<b>2003</b>	<b>Continental shelf of WA, OR, CA</b>
<b>2004</b>	<b>Estuaries of WA, OR, CA</b>
<b>2005-6</b>	<b>Resurvey estuaries of WA, OR, CA</b>



# National Coastal Assessment Western Partners



State of Oregon  
Department of  
Environmental  
Quality



WASHINGTON STATE  
DEPARTMENT OF  
ECOLOGY



Southern California Coastal  
Water Research Project

Channel Islands  
National Marine Sanctuary



USGS  
Biological Resources



GULF OF THE FARALLONES NATIONAL MARINE SANCTUARY



An ocean wilderness beyond the Golden Gate



Olympic Coast National Marine Sanctuary



# Sediment Analyses – NCA West

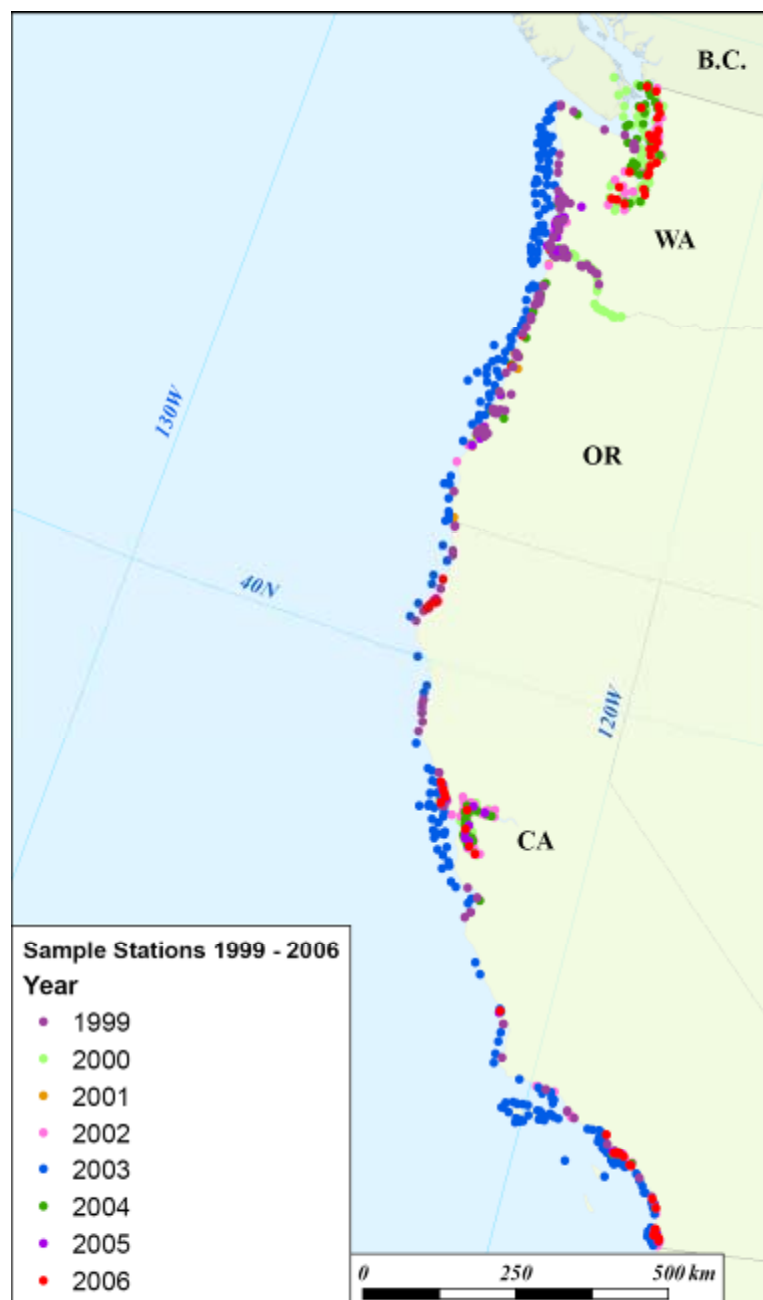
Polyaromatic Hydrocarbons (PAHs)	PCB Congeners (Congener Number and Compound)	DDT and Other Chlorinated Pesticides	Metals and Misc.
<u>Low Molecular Weight PAHs</u> 1-methylnaphthalene 1-methylphenanthrene 2-methylnaphthalene 2,6-dimethylnaphthalene 2,3,5-trimethylnaphthalene Acenaphthene Acenaphthylene Anthracene Biphenyl Fluorene Naphthalene	8: 2,4'-dichlorobiphenyl 18: 2,2',5-trichlorobiphenyl 28: 2,4,4'-trichlorobiphenyl 44: 2,2',3,5'-tetrachlorobiphenyl 52: 2,2',5,5'-tetrachlorobiphenyl 66: 2,3',4,4'-tetrachlorobiphenyl 77: 3,3',4,4'-tetrachlorobiphenyl 101: 2,2',4,5,5'-pentachlorobiphenyl 105: 2,3,3',4,4'-pentachlorobiphenyl 110: 2,3,3',4',6-pentachlorobiphenyl 118: 2,3',4,4',5-pentachlorobiphenyl 126: 3,3',4,4',5-pentachlorobiphenyl 128: 2,2',3,3',4,4'-hexachlorobiphenyl 138: 2,2',3,4,4',5'-hexachlorobiphenyl 153: 2,2',4,4',5,5'-hexachlorobiphenyl 170: 2,2',3,3',4,4',5-heptachlorobiphenyl 180: 2,2',3,4,4',5,5'-heptachlorobiphenyl 187: 2,2',3,4',5,5',6-heptachlorobiphenyl 195: 2,2',3,3',4,4',5,6-octachlorobiphenyl 206: 2,2',3,3',4,4',5,5',6-nonachlorobiphenyl 209: 2,2'3,3',4,4',5,5',6,6'-decachlorobiphenyl	<u>DDTs</u> 2,4'-DDD 4,4'-DDD 2,4'-DDE 4,4'-DDE 2,4'-DDT 4,4'-DDT  <u>Cyclopentadienes</u> Aldrin Dieldrin Endrin  <u>Chlordanes</u> Alpha-Chlordane Heptachlor Heptachlor Epoxide Trans-Nonachlor  <u>Others</u> Endosulfan I Endosulfan II Endosulfan Sulfate Hexachlorobenzene Lindane (gamma-BHC) Mirex Toxaphene	<u>Metals</u> Aluminum Antimony Arsenic Cadmium Chromium Copper Iron Lead Manganese Mercury Nickel Selenium Silver Tin Zinc  <u>Miscellaneous</u> Total Organic Carbon



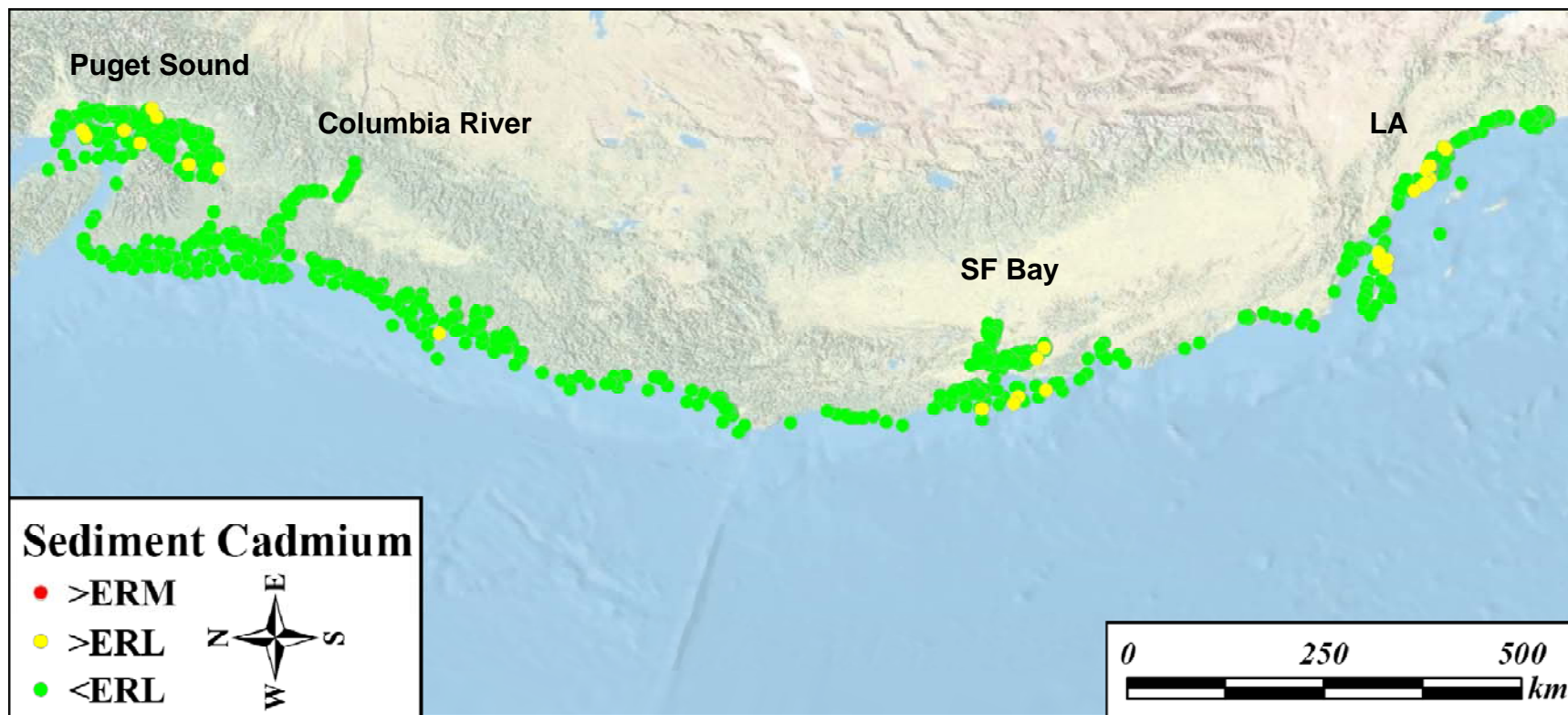


## NCA – West 1999 - 2006

Survey Year	Number of Sediment Contaminant Sample Sites
1999	190
2000	158
2001	33
2002	215
2003	288
2004	137
2005	79
2006	<u>87</u>
	1187



## Sediment Metals – NCA West



ERL = 1.2  $\mu\text{g/g}$   
Median = 0.15  $\mu\text{g/g}$

ERM = 9.6  $\mu\text{g/g}$   
85th % = 0.49  $\mu\text{g/g}$

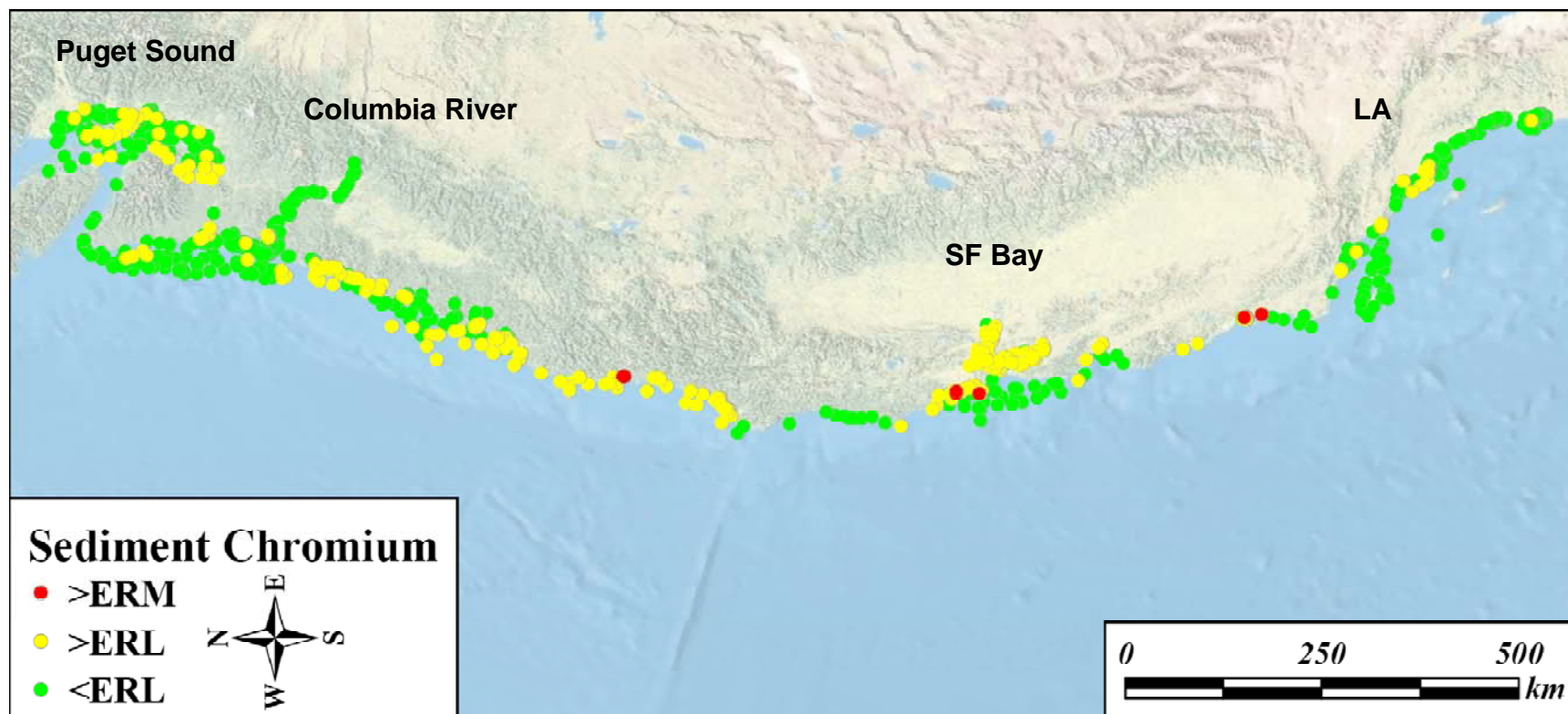


	NOAA Mussel Watch*	EPA NCA
<b>Sites</b>	280 – US mainland 98 sites – WA, OR, CA	1187 sites – WA, OR, CA
<b>Design</b>	Non-random sites, resample	Random sites, no site resample
<b>Sediment Cd 85<sup>th</sup> Percentile</b>	Nationally - 0.50 µg/g Data from 1996-1997	Regionally - 0.49 µg/g Data from 1997-2006
<b>Highest Conc. Site</b>	Nationally – Palos Verdes Shelf	Regionally – Palos Verdes Shelf
<b>High Cd Conc.</b>	3.2 µg/g	4.85 µg/g

\* D.A. Apeti et al. / Marine Pollution Bulletin 58 (2009) 1016–1024

## Sediment Metals – NCA West

Sands in the Northwest have been mined for chromium; the naturally high levels make ERL/ERM unreliable as indicator for west coast

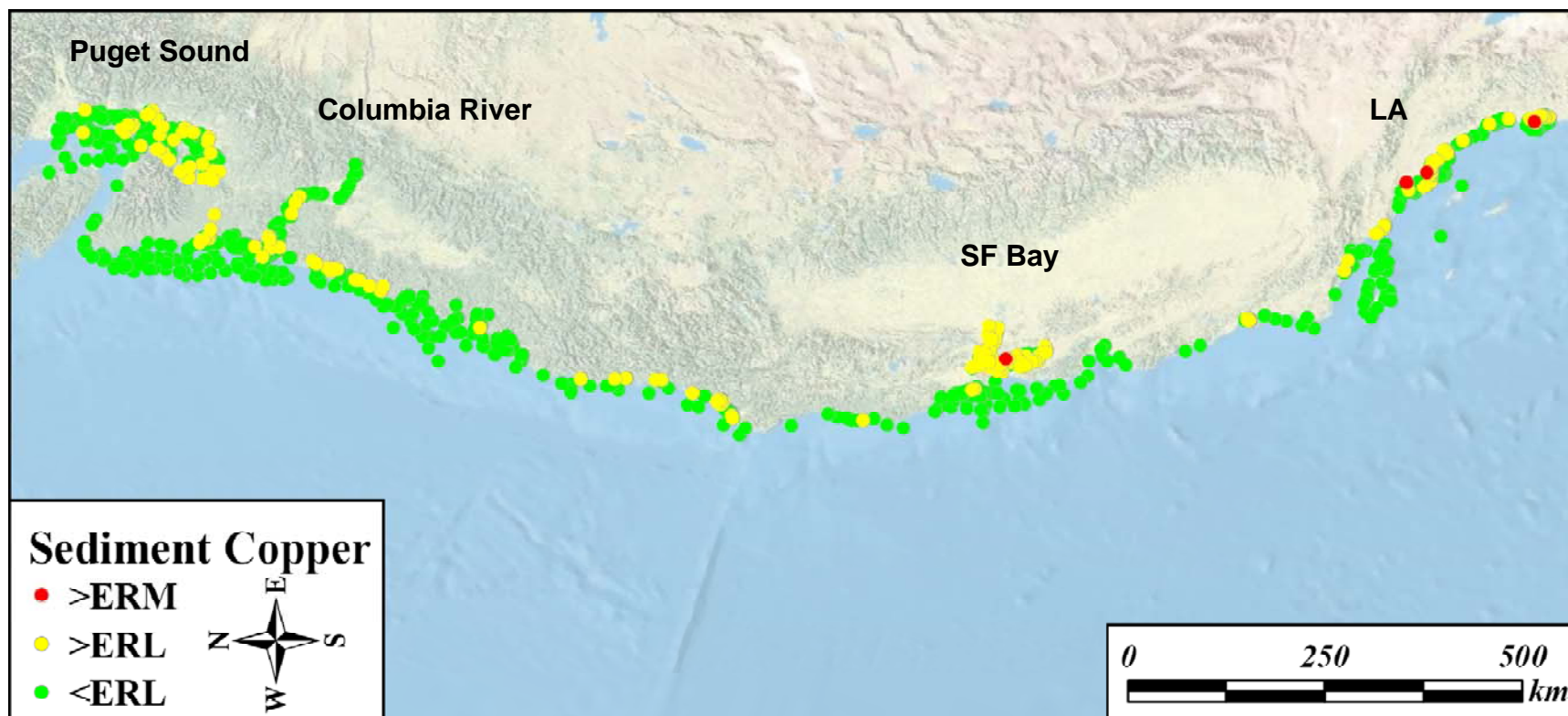


ERL = 81  $\mu\text{g/g}$   
Median = 60.3  $\mu\text{g/g}$

ERM = 370  $\mu\text{g/g}$   
85th % = 140  $\mu\text{g/g}$



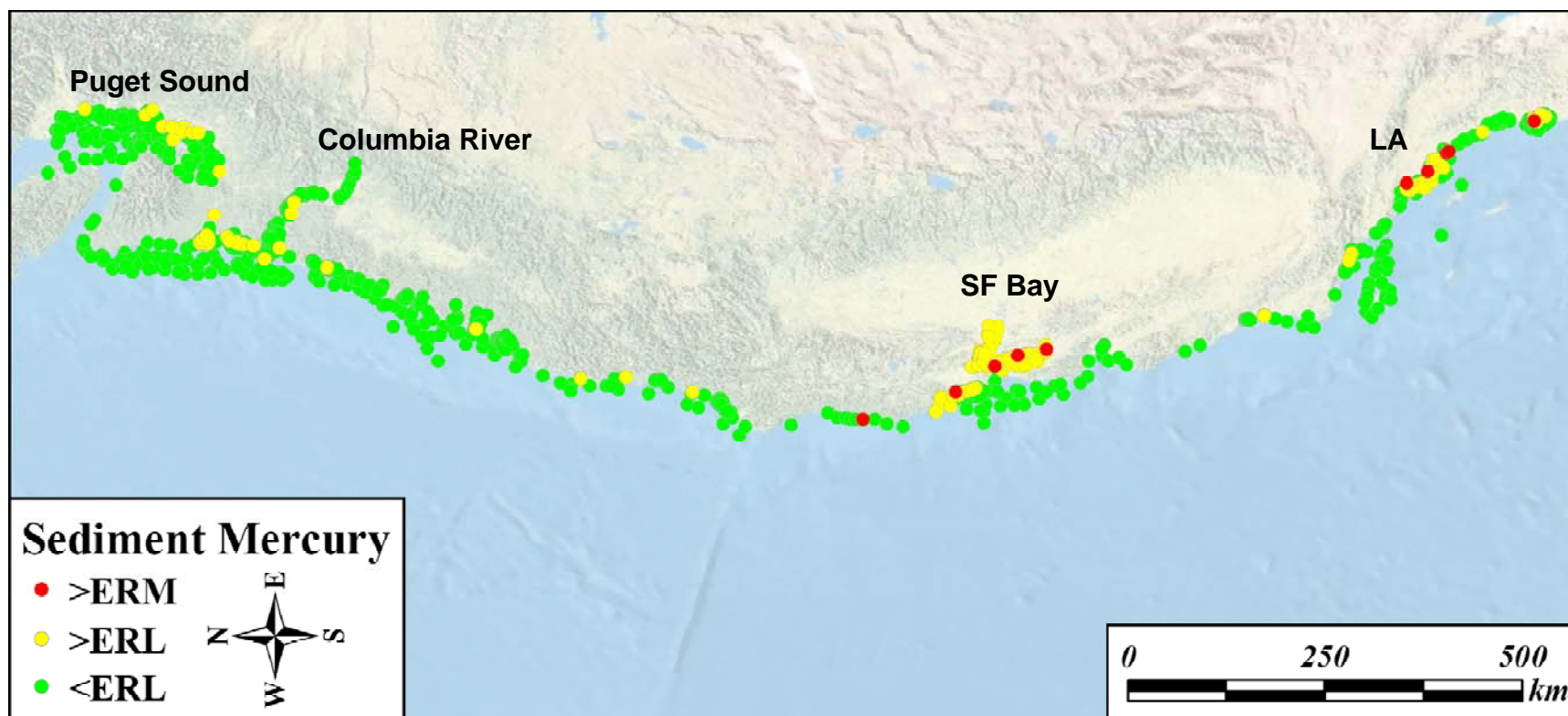
## Sediment Metals – NCA West



ERL = 34  $\mu\text{g/g}$   
Median = 16  $\mu\text{g/g}$

ERM = 270  $\mu\text{g/g}$   
85th % = 44.2  $\mu\text{g/g}$

## Sediment Metals – NCA West

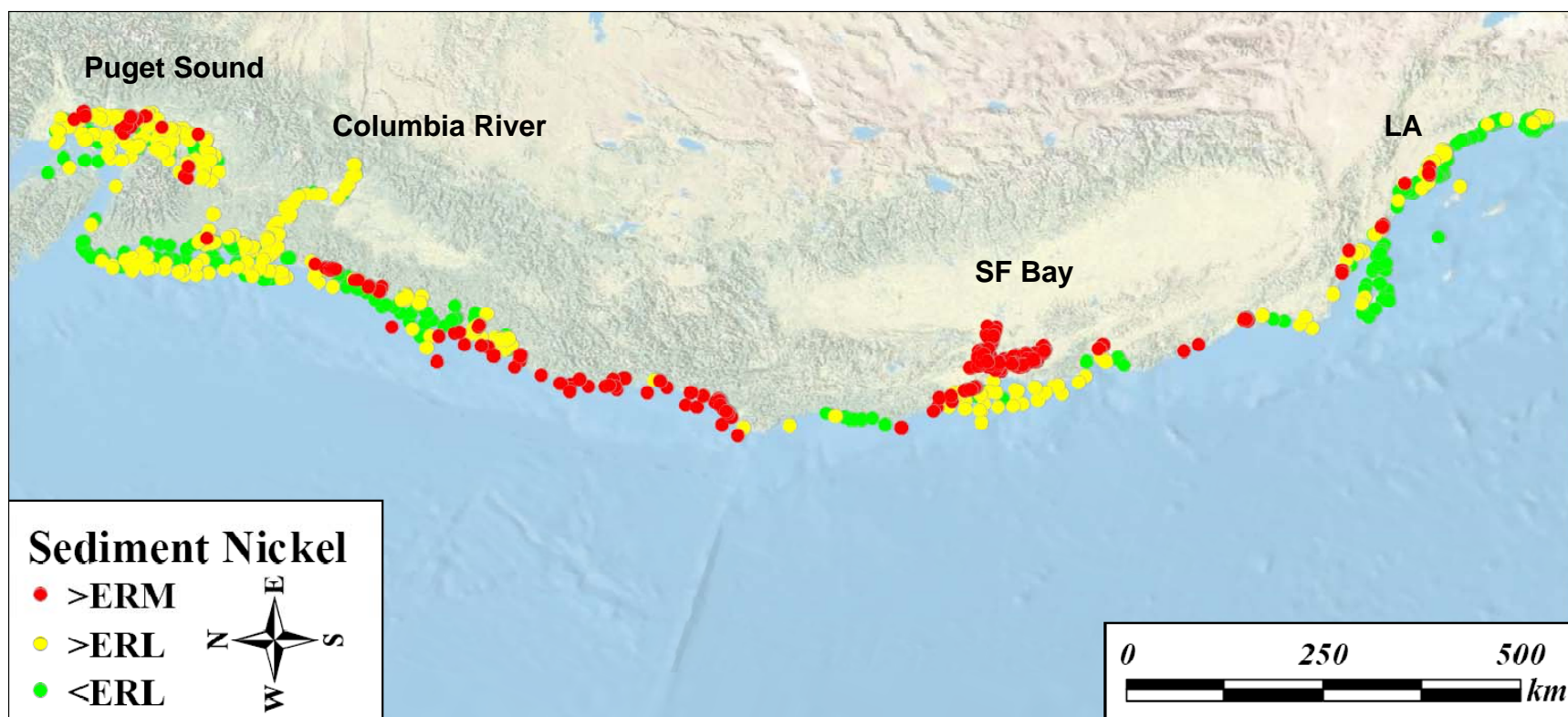


ERL = 0.15  $\mu\text{g/g}$   
Median = 0.04  $\mu\text{g/g}$

ERM = 0.71  $\mu\text{g/g}$   
85th % = 0.16  $\mu\text{g/g}$

## Sediment Metals – NCA West

Nickel ERL/ERM is unreliable as indicator for west coast  
and was not used in NCCRs

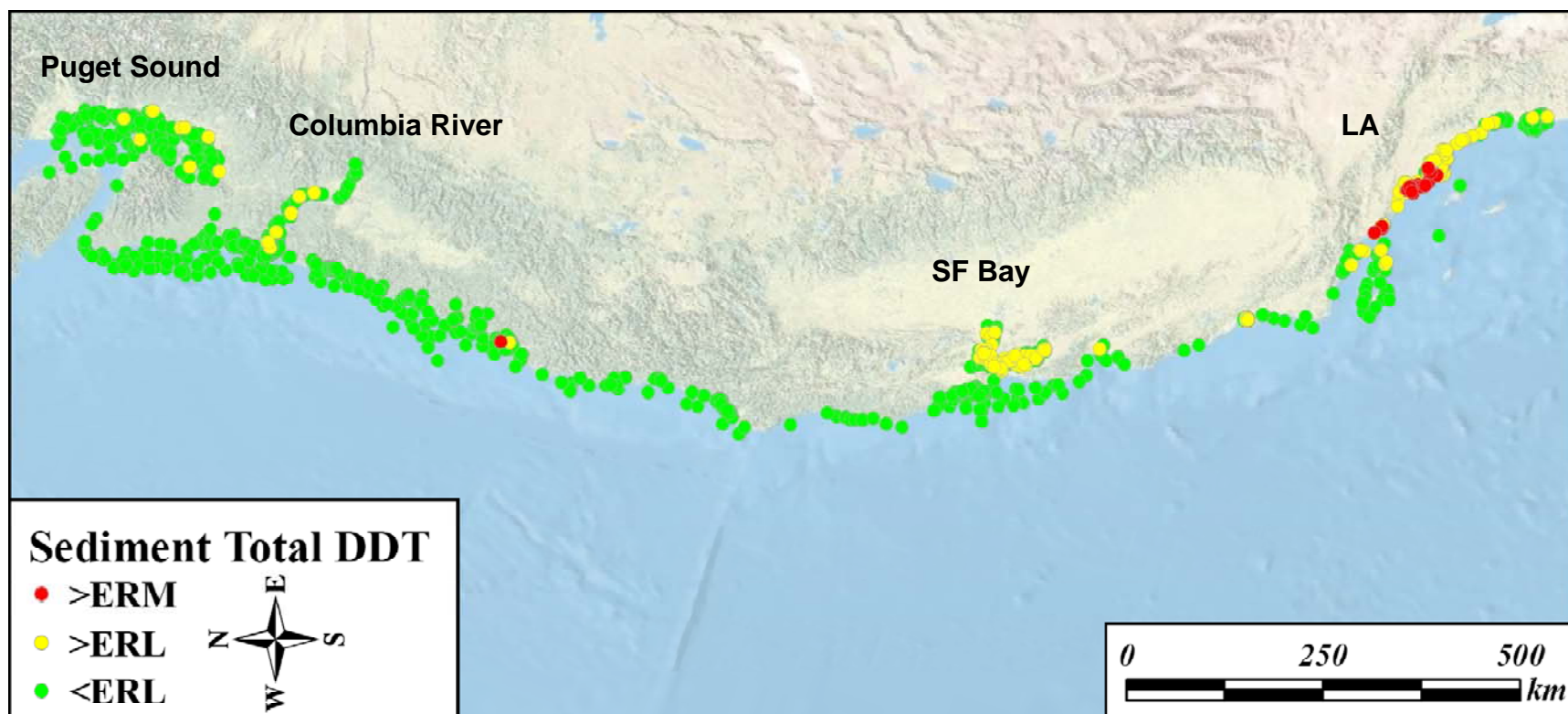


ERL = 20.9  $\mu\text{g/g}$   
Median = 27.1  $\mu\text{g/g}$

ERM = 51.6  $\mu\text{g/g}$   
85th % = 88.3  $\mu\text{g/g}$



## Sediment Pesticides – NCA West

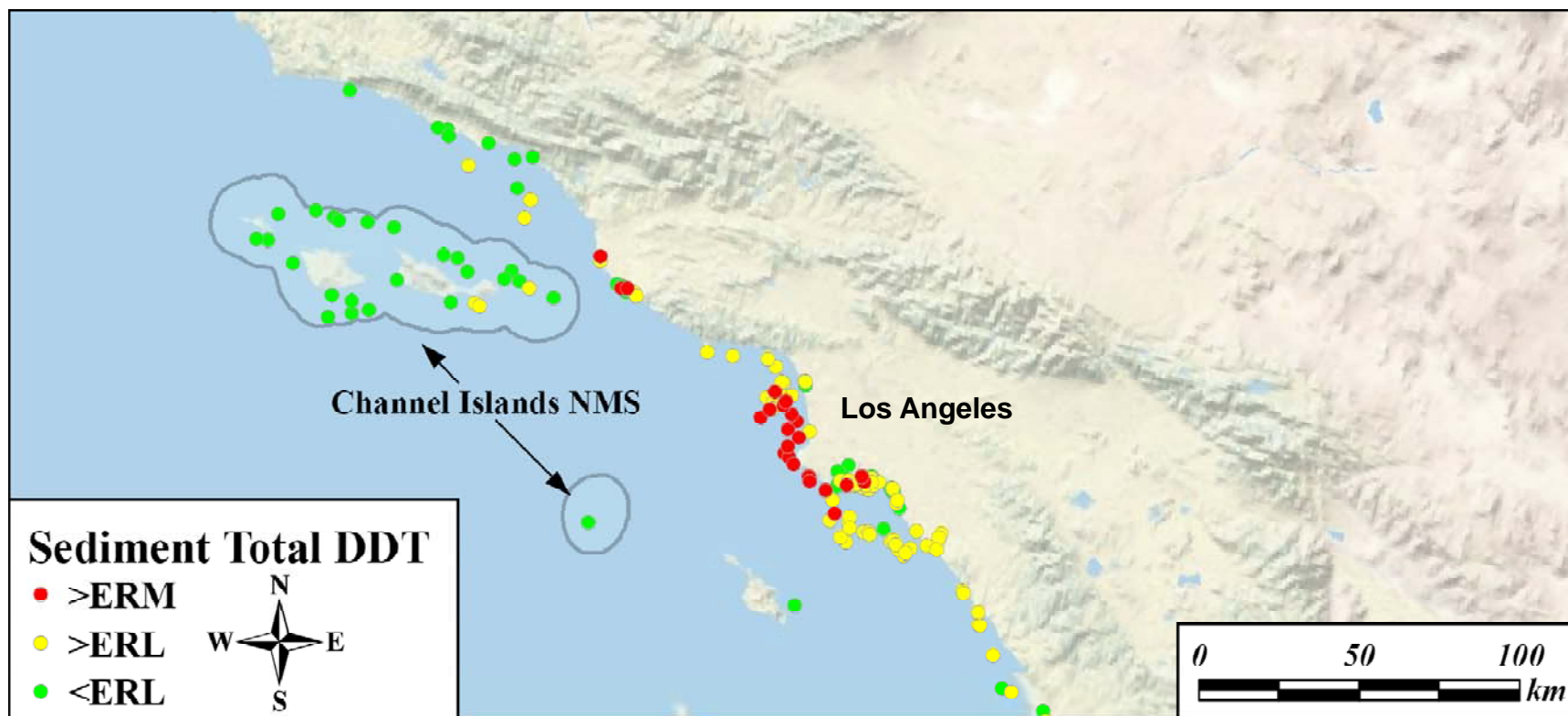


ERL = 1.58 ng/g  
Median = 0 ng/g

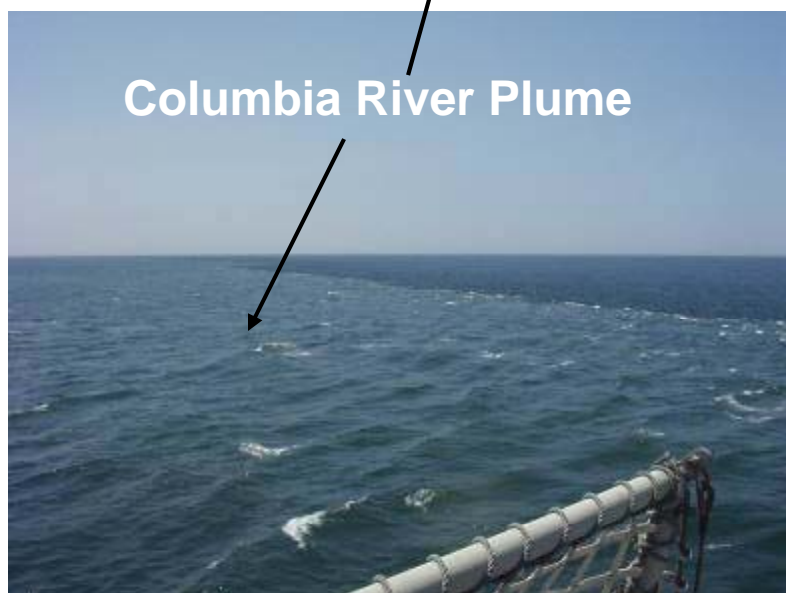
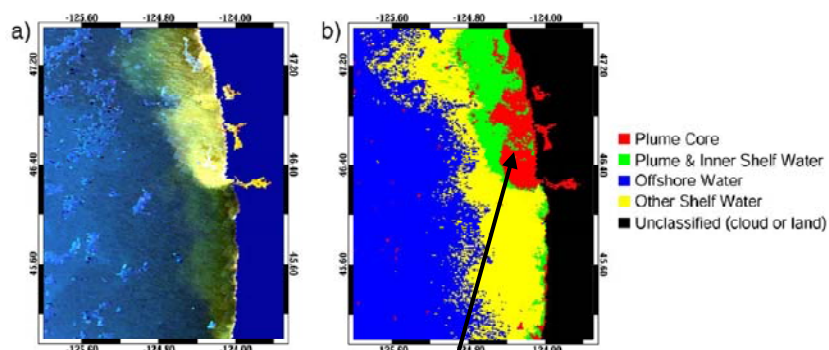
ERM = 46.1 ng/g  
85th % = 1.2 ng/g



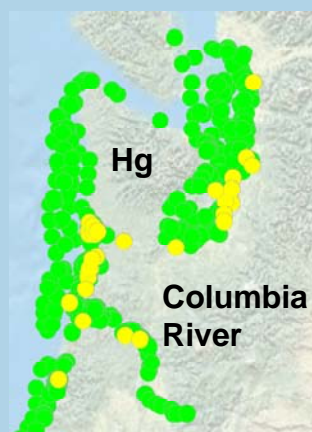
## Sediment Pesticides – NCA West



# Sediment Pesticides – NCA West



DDT may be a  
tracer for  
Columbia River  
plume sediments

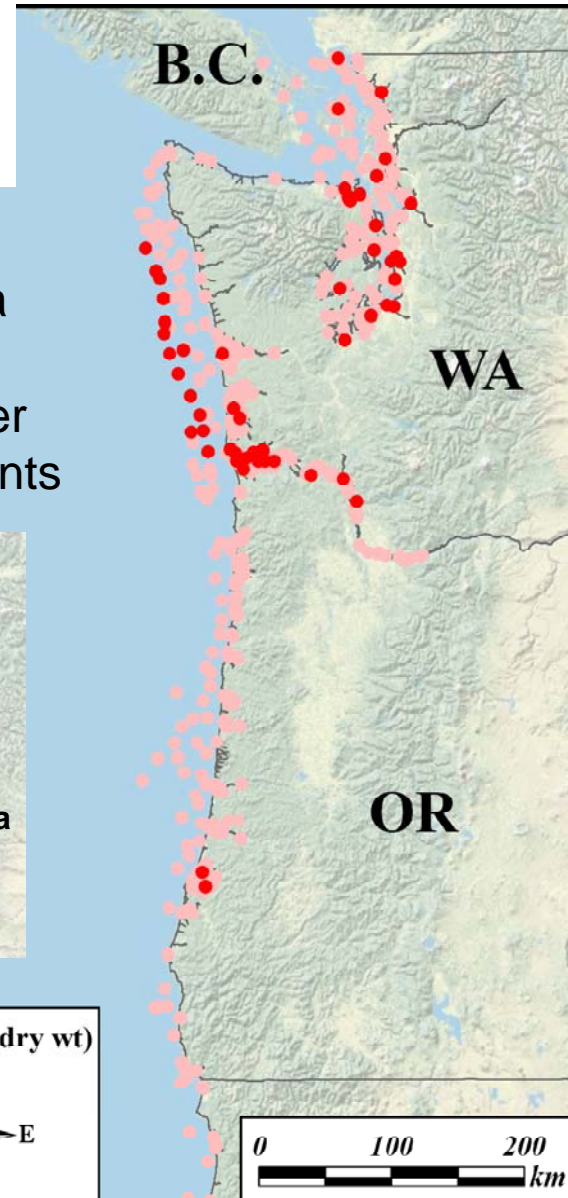


Sediment Total DDT (ng/g dry wt)

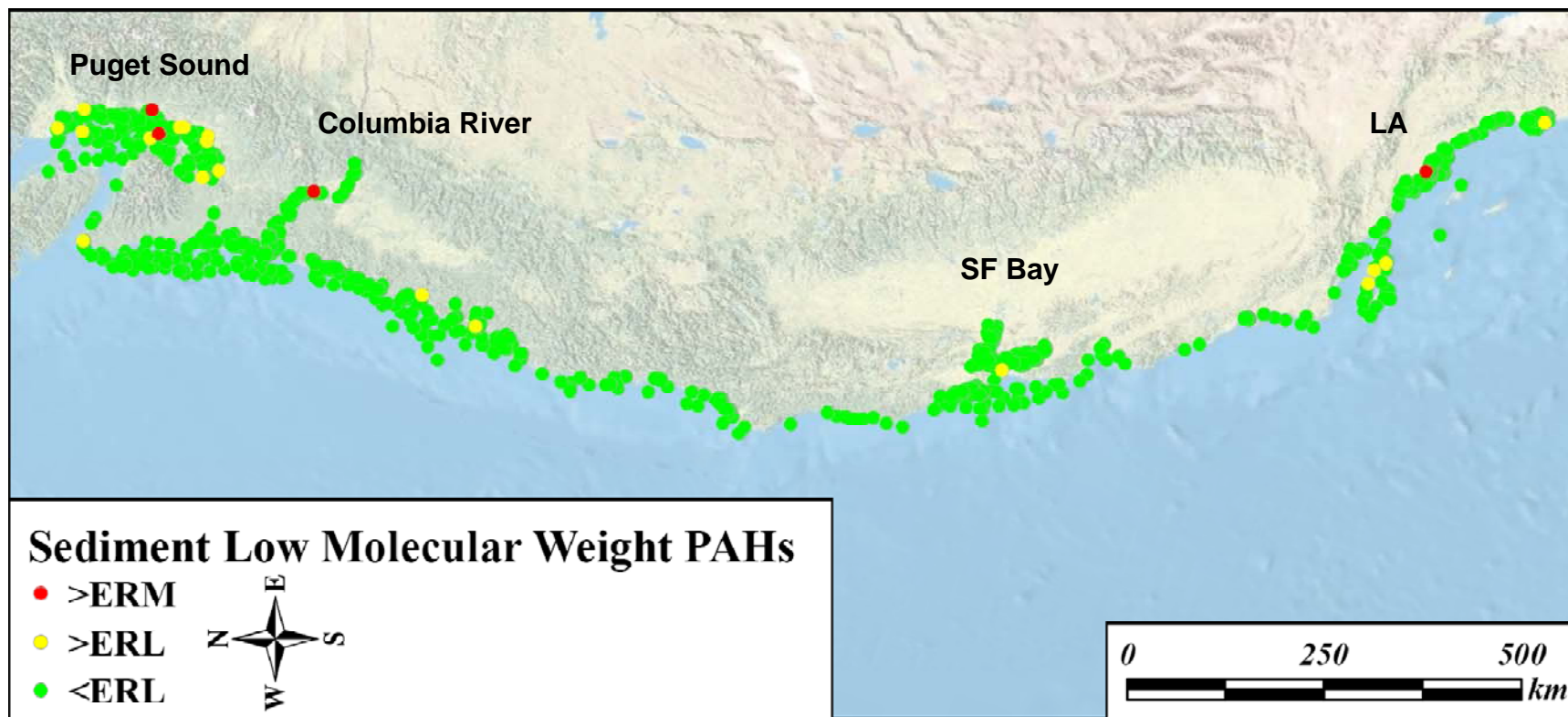
• >0.01  
• ≤0.01



0 100 200  
km



## Sediment Organics – NCA West

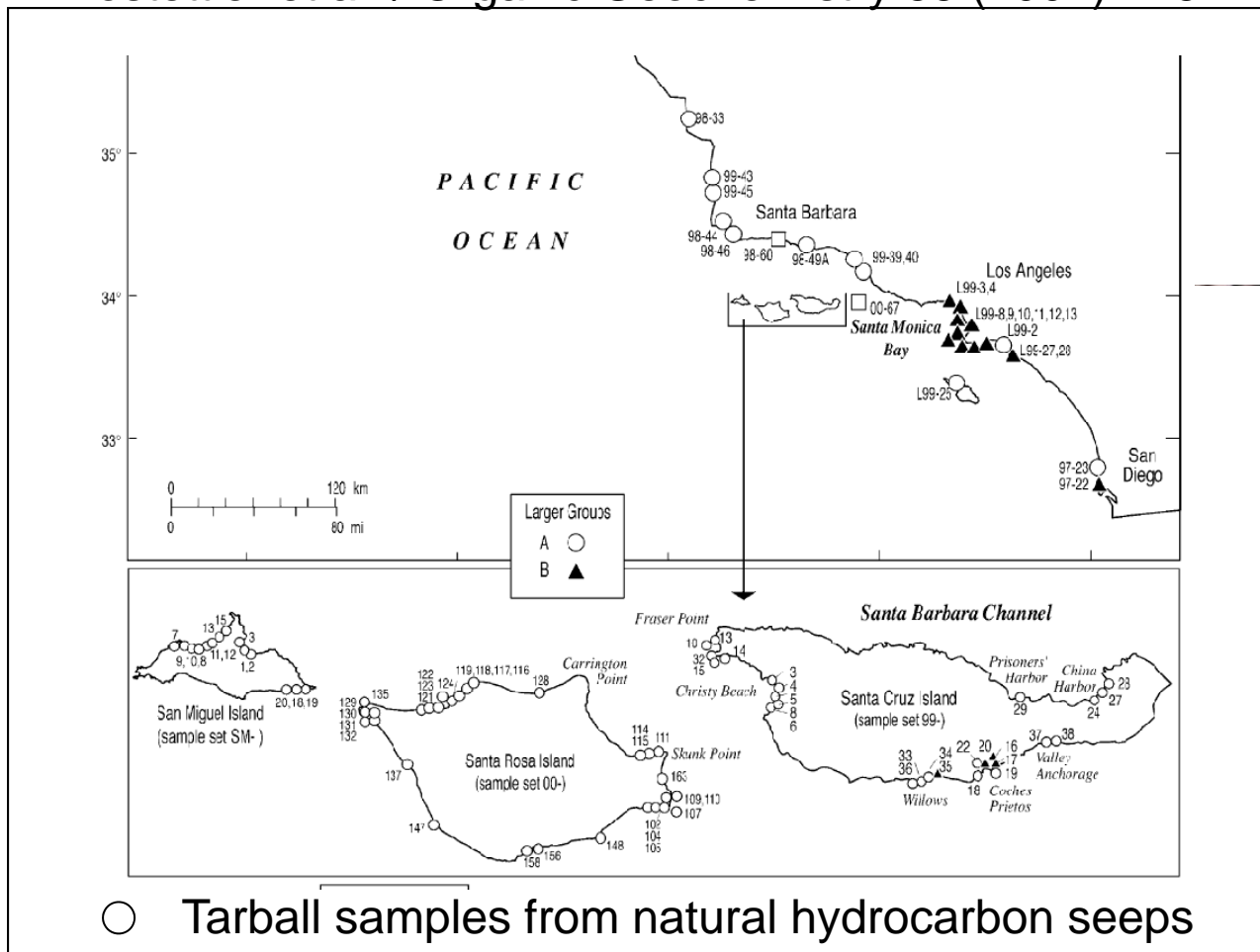


ERL = 552 ng/g  
Median = 6 ng/g

ERM = 3160 ng/g  
85th % = 121.5 ng/g

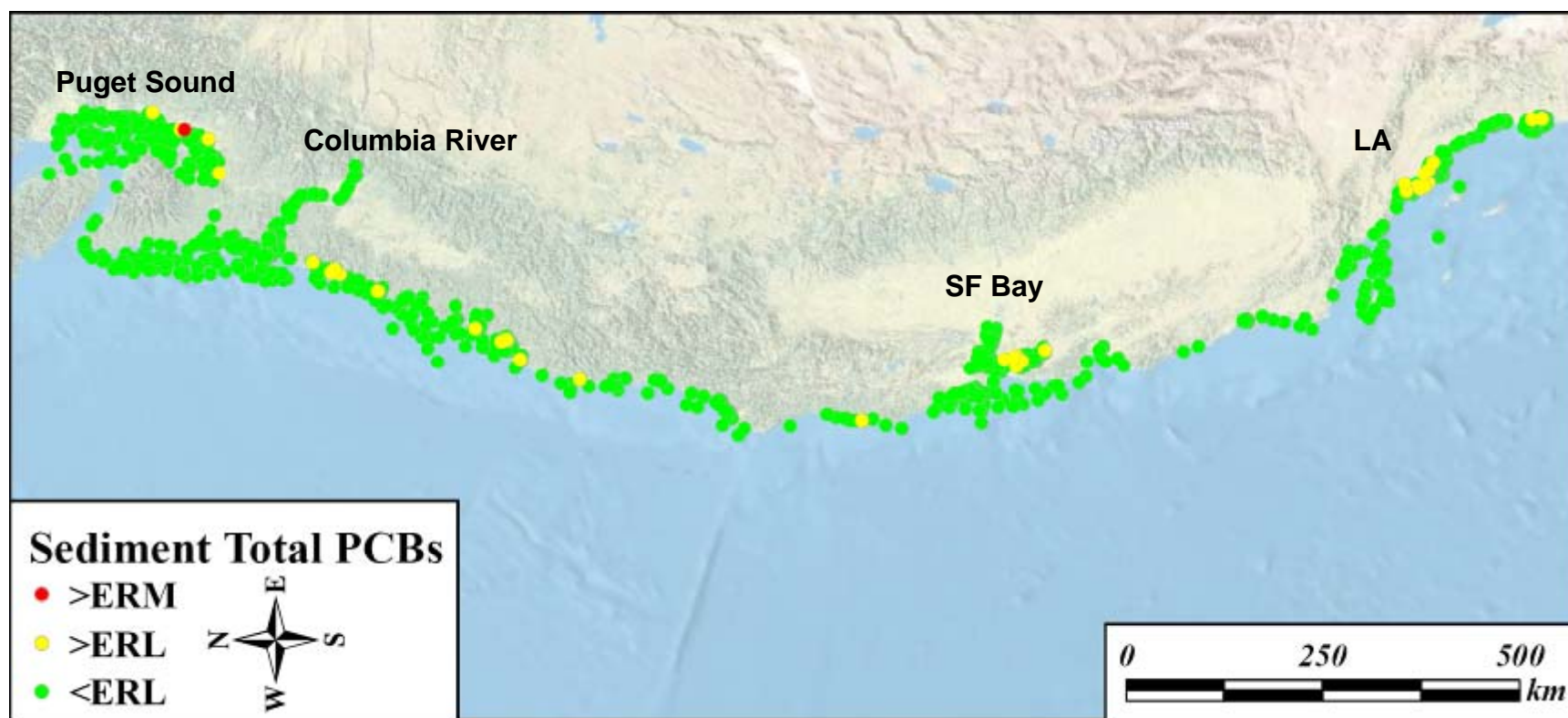
# Low Molecular Weight PAH 2 - methylnaphthalene

F.D. Hostettler et al. / Organic Geochemistry 35 (2004) 725–746





## Sediment Organics – NCA West



ERL = 22.7 ng/g  
Median = 0 ng/g

ERM = 180 ng/g  
85th % = 1.5 ng/g

# Summary

## Sediment Contaminants – NCA West

Number of sites above ERM

Contaminant	No. of Sites
4',4' - DDE	31
Total DDT	24
Individual PAHs	11
Chromium*	10
Mercury	10
Copper	5
Low molecular wt PAHs	4
All other metals (Pb, Zn)	3
Total PCBs	1

\* Low reliability



## Summary

# Sediment Contaminants – NCA West

### Chlorinated Pesticides other than DDT



14 compounds analyzed

14,786 analyses

Percentage of Detects =

2 %





## Summary

# Sediment Contaminants – NCA West

Study	% of Area > 1 ERM	% of Area > 5 ERLs
1999-2000 Estuaries	3	17
2000 Estuary Intertidal	0.3	0.2
2003 Continental Shelf	0.6	0.1
2004, 2005, 2006 Estuaries	0.2	2.7

An integrated area estimate over all studies combined is in process.

Order of magnitude difference in contaminant estimates between 1999-2000 and 2004-2006.

- ? Actual decrease
- ? Differences in sample frames used
- ? Difference in analytical labs





## Conclusions

### Sediment Contaminants – NCA West

Good news –

At regional scale, relatively small areas (<1%) have sediment contaminant levels potentially impacting benthic communities

No new hotspots are apparent - areas with problems are well known, and have monitoring programs in place (Puget Sound, San Francisco Bay, Southern California Bight).

Levels of some contaminants may have decreased, but this finding needs further confirmation.





## Conclusions

### Sediment Contaminants – NCA West

Questions for future monitoring efforts:

Is the use of ERL/ERMs as the reference for the sediment contaminant index optimal?

*some metals problematic due to natural background*

Is continued analysis for most legacy pesticides warranted, at least at West Coast regional scale, given cost and lack of detects?

How best to develop an adaptable sediment contamination index which allows legacy pollutants to be dropped and new ones to be added with backward comparability (think Dow Jones Index)?

Is sediment monitoring the optimal approach for contaminants of concern, or should effort be moved to tissue monitoring?

*bioaccumulation effects may still lead to problems where sediment measures are below levels of concern*