COASTAL EMAP IN WASHINGTON STATE: ESTUARIES, INTERTIDAL, AND OFFSHORE

Valerie A. Partridge
and Sarah L. Wilson

Washington State Department of Ecology
Washington Coastal EMAP
Funding, Design, and Training Provided by

Kevin Summers
Office of Research & Development
National Health and Environmental Effects Research Laboratory
Gulf Ecology Division; Gulf Breeze, FL

Walt Nelson
Office of Research & Development
Pacific Coastal Ecology Branch; Newport, OR
West Coast EMAP Partners

- EPA Office of Research and Development
- EPA Regions 9, 10
- NOAA National Ocean Service
- NOAA Fisheries
- NOAA National Marine Sanctuary Program
- US Geological Survey
- Others
- Alaska Dept. of Environ. Conservation
- Moss Landing Marine Laboratories
- Oregon Dept. of Environmental Quality
- San Francisco Estuary Institute
- Southern Calif. Coastal Water Research Project
- Univ. of Hawaii
- Wash. Dept. of Ecology
- Overview of West Coast EMAP Design
- Results - Washington Coastal EMAP 1999
- Preliminary comparison WA sediment chemistry by habitat type
- Integration into existing WA state monitoring programs
West Coast EMAP

- Pilot Study
- Integrated, comprehensive monitoring
- Compatible design
- National Coastal Condition Report, 305(b) Report
West Coast EMAP

Sampling Plan

- 1999 – small estuaries
- 2000 – large estuaries
- 2001 – intensification studies (none in WA)
- 2002 – intertidal
- 2003 – offshore (continental shelf)
West Coast EMAP Indicators

- Biotic condition
  - benthic infauna, fish communities

- Abiotic/pollutant exposure condition
  - contaminants, D.O., toxicity

- General habitat condition
  - water quality, sediment characteristics
Habitat Condition – Water Column:

- Water column generally well-mixed; a few strongly stratified
- Water clarity mostly good (high transmissivity & low $k_d$) or moderate
- Water generally N-limited; a few P-limited
- DO generally $>6$ mg/L
  - no severe hypoxia ($<2$ mg/L)
  - a few moderate hypoxia ($<5$ mg/L) at bottom
Habitat Condition - Sediment:

- % Fines tends to be low
- TOC low overall
WA 1999 Results
Small Coastal Estuaries

Abiotic/Pollution Exposure Condition – Sediment Chemistry:

- Metals generally low; a few exceed ERL for As, Cd, Cr, Cu
- PCBs: generally non-detected
- DDT, pesticides: generally non-detected
- PAHs: generally low – all below ERL except...
WA 1999 Results
Small Coastal Estuaries

Abiotic/Pollution Exposure Condition – Sediment Chemistry:

• PAHs: ‘tar ball’ at Station 50 (lab rep #4)

Concentration in Lab Rep 4 Compared to Average Lab Reps 1-3

<table>
<thead>
<tr>
<th>Compound</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acenaphthylene</td>
<td>&lt;10x</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>&lt;50x</td>
</tr>
<tr>
<td>Benzo(b)fluoranthene</td>
<td>&lt;150x</td>
</tr>
<tr>
<td>Benzo(g,h,i)perylene</td>
<td>450x-700x</td>
</tr>
<tr>
<td>Benzo(k)fluoranthene</td>
<td>&lt;10x</td>
</tr>
<tr>
<td>Dibenz(a,h)anthracene</td>
<td>&lt;10x</td>
</tr>
<tr>
<td>Indeno(1,2,3-c,d)pyrene</td>
<td>&lt;10x</td>
</tr>
<tr>
<td>Anthracene</td>
<td>&lt;10x</td>
</tr>
<tr>
<td>Benz(a)anthracene</td>
<td>&lt;50x</td>
</tr>
<tr>
<td>Chrysene</td>
<td>&lt;50x</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>&lt;10x</td>
</tr>
<tr>
<td>Fluorene</td>
<td>&lt;50x</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>&lt;50x</td>
</tr>
<tr>
<td>Pyrene</td>
<td>&lt;50x</td>
</tr>
<tr>
<td>2-Methylnaphthalene</td>
<td>&lt;50x</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>&lt;50x</td>
</tr>
<tr>
<td>Anthracene</td>
<td>&lt;50x</td>
</tr>
<tr>
<td>Fluorene</td>
<td>&lt;50x</td>
</tr>
</tbody>
</table>


WA 1999 Results
Small Coastal Estuaries

Abiotic/Pollution Exposure Condition – Fish Tissue Chemistry:

- Metals generally detected; Hg highly variable
- PCBs: detected in all samples
- DDTs: detected in all samples
- Other pesticides: generally non-detected
WA 1999 Results
Small Coastal Estuaries
Biotic Condition

Benthic Macrofauna:
- 431 Species; top ten = 63.7% [33 exotic (5.7%)]
- Taxa richness (# spp.): 1 – 37, mean 27
- Abundance (# indiv/0.1 sq.m): 3 – 3106, mean 483

Demersal Fish:
- 34 Species; top ten = 93.4%
- Taxa richness (# species/trawl): 1 – 11, mean 3
- Abundance (# fish/trawl): 1 – 336, mean 37
WA Coastal EMAP

Comparison of Sediments

- 1999: Small coastal estuaries
- 2000: Puget Sound
- 2002: Intertidal
- 2003: Offshore
WA Coastal EMAP Preliminary Results
Sediment Grain Size

% Fines

Coastal Estuaries 1999
Puget Sound 2000
Intertidal 2002
Offshore 2003

* outliers

results (all stations combined)

95% CI for median
Estuaries
Coastal Puget Sound Intertidal Offshore

WA Coastal EMAP Preliminary Results
Total Organic Content

Percent

Coastal Estuaries 1999
Puget Sound 2000
Intertidal 2002
Offshore 2003

outliers
results (all stations combined)
95% CI for median
WA Coastal EMAP Preliminary Results
Metals Mean ERM Quotient

Coastal Estuaries 1999
Puget Sound 2000
Intertidal 2002
Offshore 2003

* outliers
results (all stations combined)
95% CI for median
WA Coastal EMAP Preliminary Results
PAH Mean ERM Quotient
including outlier in 1999 at station WA99-0050
WA Coastal EMAP Preliminary Results
PAH Mean ERM Quotient
without outlier in 1999 at station WA99-0050

- 5 outliers
- 0.15-0.91
- 95% CI for median

Results (all stations combined)
EMAP Components Integrated into Existing WA State Monitoring Programs

- Study design
  - probabilistic, random stratified
  - multi-density categories
  - comparability
- CDF tools
- Database design
- Benthic indicator development
- Partnerships and other collaborations
Puget Sound Ambient Monitoring Program (PSAMP)

- Mandated by legislature since 1989
- Administered by Puget Sound Water Quality Action Team (now Puget Sound Action Team)
- Interagency program
  - WA State Depts. of Ecology, Fish and Wildlife, Health, Natural Resources
  - King County Dept. of Natural Resources
  - National Marine Fisheries Service
  - U.S. Environmental Protection Agency
  - U.S. Fish and Wildlife Service
Puget Sound Ambient Monitoring Program (PSAMP)

Multiple components:

- marine water
- fresh water
- marine sediment
- nearshore habitat
- fish
- shellfish
- marine birds
- marine mammals
PSAMP Sediment Component
Revised Sampling Design
Design Assistance and Training Provided by

Tony Olsen
Kevin Summers
Walt Nelson
Henry Lee

Ed Long, retired
Jawed Hameedi
PSAMP SEDIMENT COMPONENT PROGRAM EVOLUTION

PSAMP (historical)
1989-1996
Non-random
Temporal
Characterizes stations only

NOAA NS&T
1997-1999
Probabilistic, random, stratified
Spatial
Characterizes north, central, south regions defining 99 strata with 3 stations ea.

EPA EMAP
2002+
Spatially balanced probabilistic, random, stratified
Spatial, Temporal (CDF calculations)
Characterizes whole sound, 8 regions, 5 strata, int. embayments and focus studies, 30 stations ea.
Challenges for Future

• More multidisciplinary integration
• Decreasing funds mean partnerships increasingly important
• Improved temporal and spatial assessments
Final Thoughts

• Baseline for areas previously not studied
  › before completely developed

• Comparison of coast to Puget Sound
  › Puget Sound more sensitive
  › where majority of WA population lives

• Put Puget Sound in regional context

• Other issues – e.g., orcas