Alaska Coastal EMAP

• Background and Setting
  - Physical Environment
  - Existing studies/research
  - Human Use, Industry, Regulations
• Southcentral Alaska 2002
  - Survey/site locations and setting
  - Survey methods/team
  - Deviations/Additions to EMAP QAPP
  - Challenges for applying EMAP Protocols to survey area
  - DRAFT summary data
• Southeast Alaska 2004
• Future of EMAP in Alaska
Alaskan Provinces

- Columbian (Southeast Alaska)
- Alaskan (Southcentral Alaska)
- Aleutian (Aleutian Chain)
- Bering (Western Alaska)
- Arctic (North Slope)
Alaska Coastal EMAP: Physical Setting
Need for Alaska EMAP NCA

• Most studies targeted to specific issues, resource questions (OCSEAP, other MMS studies, EPA, RCACs, NPRB, EVOSTC)

• No probability-based survey designs across coastal environment

• Sediment Quality Triad approach needed to better interpret Alaskan sediment data (e.g. metal inputs)

• Need “context” for interpreting other, focused studies (e.g. EVOS oil spill, natural source rock, coal, seep, background PAH fingerprints)

• State of Alaska assessments targeted to known or suspected impaired waterbodies.
Impaired Waters in Alaska

Number of listed waters per hydrologic unit:
- 1 to 2
- 3 to 5
- 6 or more

Under the Clean Water Act, states are required to list all bodies of water that fail to meet minimum water quality standards. These standards were established to protect environmental and human health. The number of impaired waters in Alaska has increased since 1996 from 51 to 58, while many polluted waters remain unlisted due to lack of monitoring.

This map depicts 58 impaired waters listed by the Alaska Department of Environmental Conservation (ADEC). An additional 16 water bodies shown here are of specific concern to ADEC due to past pollution. Clean-up and monitoring efforts for these waters are planned.

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(907) 266-7173
Alaska
Alaskan Province
Coastal 2001 Design

Legend
- Base Locations
- Intensive Locations
- Stream Class
  - < 150 sq km
  - 150 = 1000 sq km
  - > 1000 sq km
- Land
- Water

Prepared by:
US EPA
U.S. Geological Survey

Data Source:
Surface Sampling Units - Modified USGS 1/100,000 DLG's
Random Sample Locations and Hexagons generated using
CSISO H.S.C. Software.

Scale:
1:6,000,000

Unimak Bight
Stepovak Bay
Shellkof Strait
Cook Inlet
Prince William Sound
Icy Bay
Stevenson Entrance

2001-5-008
GOA Circulation

From Weingartner, GLOBEC
EXXON VALDEZ
Oil Spill-
MARCH 1989
“...create better tools for better air and water quality decisions.”

“...devise and manage a comprehensive program of monitoring environmental impacts of [oil industry] operations... in the Cook Inlet region.”

Maximize expertise and resources
Small Boat Operations for Nearshore Stations
• Conductivity
• Temperature
• Pressure
• Fluorometry
• Dissolved Oxygen
• Optical Backscatter
Discrete Water Quality Sample Parameters

- Total Suspended Solids
- Extinction Coefficient (Secchi Depth)
- Nutrients
- Chlorophyll-a
- pH
Benthic Sediments: Chemistry Samples

Sediment Toxicity
(Ampelisca abdida survival)

Archive Chemistry

Grain Size

Archive Grain Size

POPs

PAHs and aliphatics

Metals

TOC
### Polynuclear Aromatic Hydrocarbons

<table>
<thead>
<tr>
<th>Compound</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>Naphthalene</td>
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<tr>
<td>C1-C4 Naphthalene</td>
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<tr>
<td>Biphenyl</td>
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<tr>
<td>Acenaphthylene</td>
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<tr>
<td>Fluorene</td>
<td>101</td>
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<tr>
<td>C1-C3 Fluorene</td>
<td>105</td>
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<tr>
<td>Phenanthrene</td>
<td>110/77</td>
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<tr>
<td>Anthracene</td>
<td>118</td>
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<tr>
<td>C1-C4 Phenanthrene/Anthracene</td>
<td>126</td>
</tr>
<tr>
<td>Dibenzothiophene</td>
<td>128</td>
</tr>
<tr>
<td>C1-C3 Dibenzothiophene</td>
<td>138</td>
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<tr>
<td>Fluoranthene</td>
<td>153</td>
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<tr>
<td>Pyrene</td>
<td>170</td>
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<tr>
<td>C1 Fluoranthene/Pyrene</td>
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<tr>
<td>Benzo(a)anthracene</td>
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<tr>
<td>Chrysene</td>
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<tr>
<td>C1-C4 Chrysenes</td>
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<tr>
<td>Benz(a)anthracene</td>
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<tr>
<td>Benzo(a)pyrene</td>
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<tr>
<td>Biphenyl</td>
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<tr>
<td>Chrysene</td>
<td></td>
</tr>
<tr>
<td>Benzo(b)fluoranthene</td>
<td></td>
</tr>
<tr>
<td>Benzo(k)fluoranthene</td>
<td></td>
</tr>
<tr>
<td>Benzo(e)pyrene</td>
<td></td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td></td>
</tr>
<tr>
<td>Perylene</td>
<td></td>
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<tr>
<td>Indeno(1,2,3-c,d)pyrene</td>
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</tr>
<tr>
<td>Dibzneo(a,h)anthracene</td>
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<tr>
<td>Benzo(g,h,i)perylene</td>
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<tr>
<td>Total PAH</td>
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</tbody>
</table>

### Aliphatic Hydrocarbons

- n-C_{10} - n-C_{34}
- Pristane
- Phytane

### 21 PCB Congeners

<table>
<thead>
<tr>
<th>Congener</th>
<th>Quantity</th>
</tr>
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<tbody>
<tr>
<td>2,4'-dichlorobiphenyl</td>
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<tr>
<td>2,2',5-trichlorobiphenyl</td>
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<tr>
<td>2,4',4'-trichlorobiphenyl</td>
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<tr>
<td>2,2',3,3'-tetrachlorobiphenyl</td>
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<tr>
<td>2,2',5,5'-tetrachlorobiphenyl</td>
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</tr>
<tr>
<td>2,3',4,4'-tetrachlorobiphenyl</td>
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<tr>
<td>2,2',4,5,5'-pentachlorobiphenyl</td>
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<tr>
<td>2,3',3',4,4'-pentachlorobiphenyl</td>
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</tr>
<tr>
<td>2,3',3',4,6-pentachlorobiphenyl</td>
<td></td>
</tr>
<tr>
<td>3,3',4,4'-tetrachlorobiphenyl</td>
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<tr>
<td>2,3',3',4,4',5-pentachlorobiphenyl</td>
<td></td>
</tr>
<tr>
<td>2,2',3,3',4,4',4',hexachlorobiphenyl</td>
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</tr>
<tr>
<td>2,2',3,3',4,4',5,5',pentachlorobiphenyl</td>
<td></td>
</tr>
<tr>
<td>2,2',3,3',4,4',6-heptachlorobiphenyl</td>
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</tr>
<tr>
<td>2,2',3,3',4,4',5,6-octachlorobiphenyl</td>
<td></td>
</tr>
<tr>
<td>2,2',3,3',4,4',5,5,6-nonachlorobiphenyl</td>
<td></td>
</tr>
<tr>
<td>2,2',3,3',4,4',5,5,6,6'-decachlorobiphenyl</td>
<td></td>
</tr>
</tbody>
</table>

### DDT and metabolites

- 2,4'-DDD
- 4,4'-DDD
- 2,4'-DDE
- 4,4'-DDE
- 2,4'-DDT
- 4,4'-DDT

### Other Chlorinated pesticides

- Aldrin
- Alpha-Chlordane
- Dieldrin
- Endosulfan I
- Endosulfan II
- Endosulfan sulfate
- Endrin
- Heptachlor
- Heptachlor epoxide
- Hexachlorobenzene
- Lindane (gamma-BHC)
- Mirex
- Toxaphene
- Trans-Nonachlor

### Other Parameters

- Sediment Grain Size (additional size classes)
- Total Organic Carbon
- Butyl tins
- Trace Elements
- Aluminum
- Antimony
- Arsenic
- Cadmium
- Chromium
- Copper
- Iron
- Lead
- Manganese
- Mercury
- Nickel
- Selenium
- Silver
- Tin
- Zinc
Benthic Sediments: Infaunal Samples

>1.0 mm; 1.0 > archived > 0.5 mm
Bottom Trawls - Fish species, counts, lengths, pathology; Invertebrate species and counts
Eastern 400 Deep Stations (29 m footrope); Tri-net otter trawl Nearshore Stations (6 m footrope)
- Secchi depths as low as 0.1 meters
- Sites with the lowest Secchi depths:
  - Every instance of low water clarity corresponded to areas known for high influx of glacial silt
- TSS data showed same trend
Water Column Results: Dissolved Oxygen
SBE 23y sensor on CTD
• All DO values at all depths met AWQS which state that for applicable marine water uses (i.e. Aquaculture, Growth and propagation of aquatic life, Harvesting aquatic life).
• All DO values for all stations and depths were > 6 mg/L and < 13 mg/L.

Water Column Results: pH
Orion Model 250A pH meter; Triode electrode
• Only two stations (at bottom) had pH < 6.5
• Only one station (at surface) had pH > 8.5
• All other pH measurements met AWQS for Aquaculture and Growth and propagation...
• All pH measurements met AWQS for Harvesting...
Inorganic N (NO\textsubscript{2}+NO\textsubscript{3}+NH\textsubscript{4})

- **Surface**: 0.00, 0.40, 0.80, 1.20 mg/L
- **Mid-depth**: 0.00, 0.40, 0.80, 1.20 mg/L
- **Bottom**: 0.00, 0.40, 0.80, 1.20 mg/L
Chlorophyll-a (bottom)

Chlorophyll-a (mid-depth)

Chlorophyll-a (bottom)
Only two stations had amphipod survival that was statistically different than control sediments AND had control-corrected survival less than 80%.

Site AK02-0038 was a relatively shallow site (5m) and had significant amounts of decomposing eelgrass in the sample (6.34% TOC); Site AK02-0005 had highest concentrations of Cr and Ni in study area.
EMAP data
Stress: 0.17
<table>
<thead>
<tr>
<th>Fish Species</th>
<th>Number of Sites</th>
<th>Number of Sites Where Fish Species Caught</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrowtooth flounder</td>
<td>34</td>
<td>Shortfin eelpout 8</td>
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<tr>
<td>Flathead sole</td>
<td>32</td>
<td>Starry flounder 7</td>
</tr>
<tr>
<td>Walleye pollock</td>
<td>26</td>
<td>Pacific tomcod 6</td>
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<tr>
<td>Rex sole</td>
<td>21</td>
<td>Sebastes spp., juvs. 5</td>
</tr>
<tr>
<td>Pacific halibut</td>
<td>20</td>
<td>Snake prickleback 5</td>
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<tr>
<td>Dover sole</td>
<td>19</td>
<td>Wattlel eelpout 5</td>
</tr>
<tr>
<td>Eulachon</td>
<td>19</td>
<td>Bigmouth sculpin 5</td>
</tr>
<tr>
<td>Rock sole</td>
<td>19</td>
<td>Alaska plaice 4</td>
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<tr>
<td>Spinyhead sculpin</td>
<td>19</td>
<td>Pacific staghorn sculpin</td>
</tr>
<tr>
<td>Pacific cod</td>
<td>19</td>
<td>Spiny dogfish 4</td>
</tr>
<tr>
<td>Alaska skate</td>
<td>18</td>
<td>Blackfin sculpin 4</td>
</tr>
<tr>
<td>Longnose skate</td>
<td>18</td>
<td>English sole 3</td>
</tr>
<tr>
<td>Black cod (sablefish)</td>
<td>15</td>
<td>Longsnout prickleback 3</td>
</tr>
<tr>
<td>Sturgeon poacher</td>
<td>12</td>
<td>Monster snailfish 3</td>
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<tr>
<td>Yellowfin sole</td>
<td>12</td>
<td>Pacific sandfish 3</td>
</tr>
<tr>
<td>Pacific ocean perch</td>
<td>12</td>
<td>Sand sole 3</td>
</tr>
<tr>
<td>Yellow Irish lord</td>
<td>11</td>
<td>Showy snailfish 3</td>
</tr>
<tr>
<td>Butter sole</td>
<td>9</td>
<td>Whitespotted greenling</td>
</tr>
<tr>
<td>Great sculpin</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

Red species were original priority target species based on historical NMFS data on geographic range and abundance.

Occurred at only one site:
- Blackfin eelpout, Blacktip poacher,
- Cottiidae, juvs., Dusky rockfish,
- Greenling, (unspecified), Kelp greenling
- Longnose eelpout, Plain sculpin,
- Rock greenling, Roughback sculpin,
- Searcher, Slender eelblenny,
- Smooth lumpsucker,
- Sockeye salmon (smolt),
- Spinycheek starsnout, Threaded sculpin
- Variegated snailfish, Yelloweye rockfish
- Wolf-eel
# Fish Samples for Tissue Chemistry Analyses

<table>
<thead>
<tr>
<th>Species</th>
<th>Scientific Name</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrowtooth flounder</td>
<td>Atheresthes stomias</td>
<td>28</td>
</tr>
<tr>
<td>Yellowfin Sole</td>
<td>Limanda aspera</td>
<td>8</td>
</tr>
<tr>
<td>Flathead sole</td>
<td>Hippoglossoides elassodon</td>
<td>24</td>
</tr>
<tr>
<td>Rock Sole</td>
<td>Pleuronectes bilineatus</td>
<td>11</td>
</tr>
<tr>
<td>Pacific Tom Cod</td>
<td>Microgadus proximus</td>
<td>3</td>
</tr>
<tr>
<td>Pacific Cod</td>
<td>Gadus macrocephalus</td>
<td>2</td>
</tr>
<tr>
<td>Starry Flounder</td>
<td>Platichthys stellatus</td>
<td>2</td>
</tr>
<tr>
<td>Walleye pollock</td>
<td>Theragra chalcogramma</td>
<td>3</td>
</tr>
<tr>
<td>Butter Sole</td>
<td>Isopsetta isolepis</td>
<td>2</td>
</tr>
<tr>
<td>Rex sole</td>
<td>Glyptocephalus zachirus</td>
<td>7</td>
</tr>
<tr>
<td>Pacific halibut</td>
<td>Hippoglossus stenolepis</td>
<td>1</td>
</tr>
<tr>
<td>Dover sole</td>
<td>Microstomus pacificus</td>
<td>2</td>
</tr>
<tr>
<td>Eulachon</td>
<td>Thaleichthys pacificus</td>
<td>2</td>
</tr>
<tr>
<td>Pacific Sandfish</td>
<td>Trichodon trichodon</td>
<td>1</td>
</tr>
</tbody>
</table>

Initial analyses for one species per site; oversampled in the field and later raised funds to analyze archived fish tissue samples.
**4-4' - DDE**

**Hexachlorobenzene**

**Total PCB**

**Trans-Nonachlor**

**% Lipids**

*POP detects Fish Tissue*
Deviations from EMAP protocols

• No PAR sensor
• pH for discrete water samples; no profile
• Trawl times reduced
• Two different trawl sizes (deep and shallow stations)
• Shipping/storing times - logistical limitations
• Numerous sites sampled outside of EMAP protocols for distance away from “target” location
Substrate/
rocky or uneven
Bathymetry
(Steep)
Interferences
Alaskan Provinces

- Columbian (Southeast Alaska)
- Alaskan (Southcentral Alaska)
- Aleutian (Aleutian Chain)
- Bering (Western Alaska)
- Arctic (North Slope)