The Sediment Quality Triad Index

An Indicator for Puget Sound and a Baseline (1997 – 2003) Update

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I. Findings

- The Sediment Quality Triad Index (SQTI) has been revised for 8 sediment monitoring regions, 5 strata, and Puget Sound-wide.
- Revision was based on a reexamination of chemistry, bioassay, and benthic infaunal community data collected from 1997-2003:
  - ~ 62% of Puget Sound has high quality sediments.
  - ~ 37% of Puget Sound has intermediate quality sediments.
  - <1% of Puget Sound has degraded sediments.
- These baseline values will be compared with recently collected sediment quality data to determine changes over time.
- The SQTI has been identified by the Puget Sound Partnership as a potential indicator of sediment quality for Puget Sound.
- The SQTI can also be used as an ***effectiveness monitoring tool***, providing an indication of the effectiveness of collective source control and cleanup efforts at the 1) urban embayment, (2) stratum, (3) region, and (4) Puget Sound-wide scale.

II. PSAMP's Sediment Quality Triad Index

The **Sediment Quality Triad Index** was developed by PSAMP's Sediment Monitoring team as a weight-of-evidence indicator to characterize the spatial extent of degraded sediment quality in Puget Sound.

Chemistry, **Bioassay**, and **Benthic Invertebrate Community** data are combined to classify the overall quality of the sediments.

1997-2003 PSAMP sediment data were recently re-examined. As a result, 6 chemicals with inconsistently reported data were excluded from the SQTI, only 2 of 5 bioassays were included, and some benthic infaunal community classifications (affected vs. unaffected) were changed.

Four categories of sediment quality were created to characterize sediment in each monitoring station, region, stratum, and embayment with the SQTI:

Sediment Quality Triad Index Categories

- **High Quality** – No degradation detected in any of three test parameters.
- **Intermediate/High Quality** – Degradation detected in one of three test parameters.
- **Intermediate/Degraded Quality** – Degradation detected in two of three test parameters.
- **Degraded Quality** – Degradation detected in all three test parameters.

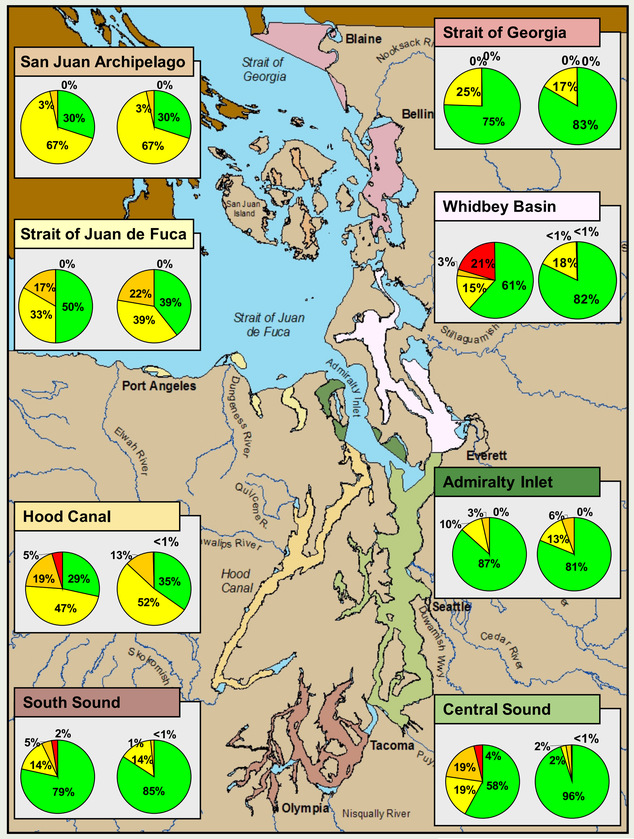

Figure 1. Sediment Quality Triad Index in eight Puget Sound monitoring regions. Percent of stations (left pie chart) and percent of area (right pie chart) representing each index category are depicted for each region.

III. Evaluation of Sediment Quality in Regions

The spatial extent of sediment quality in eight Puget Sound study regions was calculated as both percent of stations in each category and percent of area affected within each region (**Figure 1**):

- **HIGH QUALITY** - The majority of stations and percent area from the Strait of Georgia, Whidbey Basin, Admiralty Inlet, Central Sound , and South Sound regions were of high quality.
- **INTERMEDIATE** - The largest percentages of intermediate quality samples and areas were in the San Juan Archipelago, Strait of Juan de Fuca, and Hood Canal regions.
- **DEGRADED** - Most degraded samples were collected in the Whidbey Basin, Central Sound, South Sound, and Hood Canal regions, and were identified primarily from Everett Harbor, Elliott and Commencement Bays, Budd Inlet, and Port Gamble.

IV. Evaluation of Sediment Quality in Strata

The spatial extent of sediment quality was also calculated for five areas delineated as sediment monitoring strata: harbor, urban, passage, basin, and rural (**Figure 2**).

- **HIGH QUALITY** – High quality sediments were prevalent in the passages and deep basins.
- **INTERMEDIATE** - Intermediate quality sediments were most pervasive in the harbors, followed by the rural and urban embayments.
- **DEGRADED** - The largest percentage of samples with degraded sediment quality was found in the harbor stratum.

Ecologically, the higher degree of degradation in a relatively small percentage of area in the harbor and rural strata may disproportionately affect important fish, shellfish, and aquatic plant species, as these strata include significant areas of critical nearshore habitat for these species.

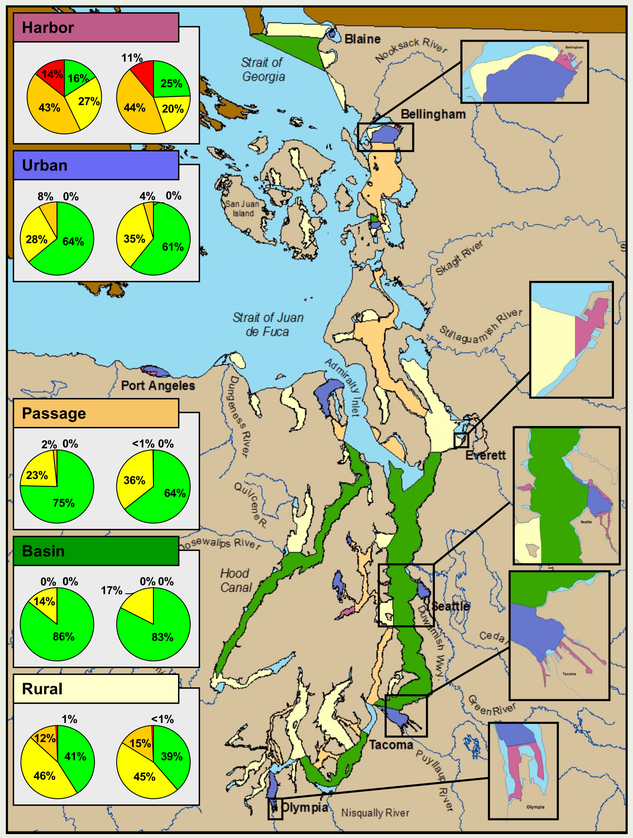

Figure 2. Sediment Quality Triad Index in five Puget Sound monitoring strata. Percent of stations (left pie chart) and percent of area (right pie chart) representing each index category are depicted for each stratum.

Table 1. Sediment Quality Triad Index in the entire Puget Sound study area.

Sediment Quality Index Category	Stations No.	Stations Percent	Area km²	Area Percent
Total Study area	381	100.0	2294.0	100.0
High	200	(52.5)	1431.7	(62.4)
Intermediate/High	120	(31.5)	722.2	(31.5)
Intermediate/Degraded	51	(13.4)	132.1	(5.8)
Degraded	10	(2.6)	8.0	(0.4)

V. Evaluation of Sediment Quality in the Entire Study Area

With the "nested" PSAMP sampling design, the spatial extent of sediment quality was also calculated Puget Sound-wide (**Table 1**).

- **HIGH QUALITY** - High quality sediments were found in 1431.7 km², representing 62% of the study area.
- **INTERMEDIATE** - Sediments with intermediate quality, or a mixture of impaired sediment quality indicators, were distributed over 854 km², or about 37% of the area.
- **DEGRADED** - Sediment from approximately 8 km², or <1% of the Puget Sound study area, were degraded.

VI. The Sediment Quality Triad Index as an Indicator for Puget Sound

The Sediment Quality Triad Index has been identified as a potential indicator of Puget Sound health in the Puget Sound Partnership's 2008 Phase I indicator development report (O'Neill, 2008).

The SQTI provides scientists and managers with a graduated scale of sediment quality categories used to:

- Classify sediment quality at every station sampled in Puget Sound for the PSAMP.
- Determine the spatial extent of sediment quality degradation in Puget Sound sediments at multiple "nested" scales: (1) urban embayment, (2) stratum, (3) region, and (4) Puget Sound-wide.
- Measure change in sediment quality over time at multiple "nested" scales: (1) urban embayment, (2) stratum, (3) region, and (4) Puget Sound-wide.

The SQTI can also be used as an *effectiveness monitoring tool*, with changes in the spatial extent of sediment quality in a given area over time serving as an indication of the effectiveness of collective source control and cleanup efforts established for that area.

General information and all data generated during this survey can be accessed from Ecology's Marine Sediment Monitoring website: www.ecy.wa.gov/programs/eap/mar_sed/msm_intr.htm. This poster was prepared for the 2009 Puget Sound/Georgia Basin Conference, Seattle, Washington.