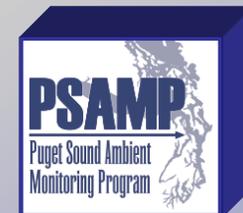




SEDIMENT QUALITY IN HOOD CANAL

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I. Abstract

As part of the Puget Sound Ambient Monitoring Program (PSAMP), the Washington State Department of Ecology conducts annual sediment sampling to assess the condition of marine sediments throughout Puget Sound. During June 2004, sediment was collected from 30 stations in Hood Canal, utilizing a stratified random sampling approach. Sediment samples were analyzed for 118 potentially toxic chemicals, urchin fertilization toxicity, and infaunal community structure. The resulting data were used to identify the distribution of degraded sediments in Hood Canal.

II. Study Design

The quality of recently deposited sediments are quantified using a Sediment Quality Triad, a weight-of-evidence approach that incorporates measures of chemical contamination, toxicity, and benthic infaunal composition. Since 2002, Ecology has followed an annual sampling scheme which rotates through 8 different regions in the greater Puget Sound basin. Sampling locations are selected using a generalized random tessellation stratified multi-density survey design. In 2004, 30 stations were sampled in Hood Canal (Figure 1).

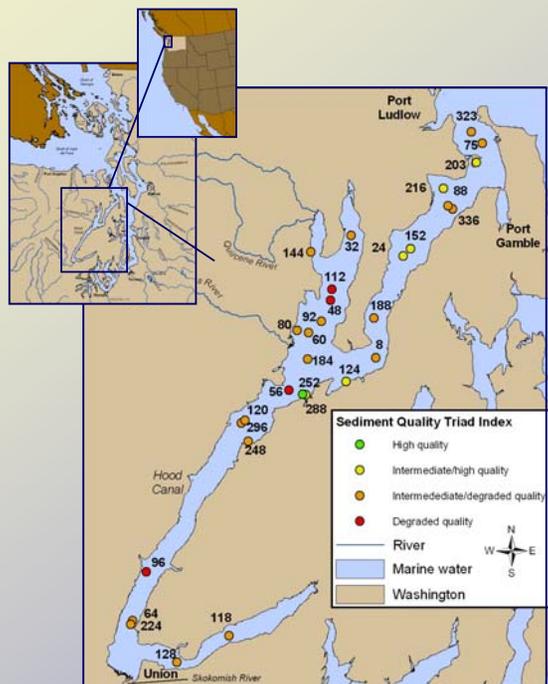


Figure 1. Spatial patterns in Sediment Quality Triad in Hood Canal.

Table 1. Estimated incidence and spatial extent of the Sediment Quality Triad in Hood Canal

Sediment Quality Index category	Incidence No. (%) of stations	Spatial extent km ² (%) of study area
Hood Canal study area	30 (100.0)	294.8 (100.0)
High	1 (3.3)	9.2 (3.1)
Intermediate/high	6 (20.0)	55.4 (18.8)
Chemistry	6 (20.0)	55.4 (18.8)
Toxicity	0 (0.0)	0.0 (0.0)
Infaunal	0 (0.0)	0.0 (0.0)
Intermediate/degraded	19 (63.3)	189.3 (64.2)
Chemistry/toxicity	0 (0.0)	0.0 (0.0)
Chemistry/infaunal	18 (60.0)	178.1 (60.4)
Infaunal/toxicity	1 (3.3)	11.2 (3.8)
Degraded	4 (13.3)	40.9 (13.9)

III. Using the Sediment Quality Triad to Determine the Distribution of Degraded Sediments

The Sediment Quality Triad was calculated by identifying samples in which critical values for chemistry, toxicity and infaunal community composition were exceeded. Chemistry results were compared with State Sediment Quality Standards (SQS) and NOAA Effects Range Median (ERM) guidelines; critical toxicity values were exceeded when mean urchin fertilization was <80% in sediment porewater; and the benthos was evaluated by calculating and comparing nine measures of abundance and diversity to median values from the PSAMP historical baseline for Puget Sound (n = 300). Dominant species were also evaluated for presence of indicator species known to be associated with degraded benthic infaunal conditions. The results for sediment chemistry, toxicity, and benthic community composition were then combined and each site allocated into one of four sediment quality 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

IV. Results

The Sediment Quality Triad Index was used to evaluate sediment quality over approximately 294.8 km² of Hood Canal (Table 1). Only one site (288, Stavis Bay), representing 3% of the study area, had high quality sediments. Twenty-five sites, representing 83% of the study area, had intermediate quality sediments. Of these 25 intermediate sites, 6 were of intermediate/high quality and 19 were of intermediate/degraded quality. Intermediate/high quality sediments were found only in the northern portion of Hood Canal. Intermediate/degraded conditions were found throughout the study area. Degraded sediment quality was found in 4 sites located in Dabob Bay and southern Hood Canal. These sites represent 14% of the study area.

The Sediment Quality Triad Index was greatly influenced by chemical values exceeding one or more State Sediment Quality Standards and degraded benthic infaunal composition. Four chemicals, benzoic acid, benzyl alcohol, 2-methylphenol, and phenol, exceeded state standards at 28 of the 30 sites. Phenol concentrations accounted for the majority of these, exceeding SQSs at 25 of the 28 stations. No Effects Range Median guidelines were exceeded. Benthic invertebrate analyses indicate degraded benthic infaunal composition at 23 of 30 sites. Urchin fertilization tests showed toxicity at 5 out of 30 sites.

V. Summary

- ❖ In June 2004 sediments were sampled at 30 sites in Hood Canal.
- ❖ A weight-of-evidence approach that combines chemistry, toxicity, and benthic invertebrate data was used to characterize sediment quality.
- ❖ Only one station had high sediment quality, representing 3% of the study area.
- ❖ Intermediate/high sediment quality was found at 6 sites, representing 19% of the study area.
- ❖ Intermediate/degraded sediment quality was found at 19 sites, representing 64% of the study area.
- ❖ Degraded sediment quality was found at 4 sites, representing 14% of the total study area.

VI. References

- Long, E.R., M. Dutch, S. Aasen, K. Welch, In preparation. Chemical Contamination, Acute Toxicity in Laboratory Tests, and Benthic Impacts in Sediments from Hood Canal, Washington. Washington State Department of Ecology, Olympia, WA.
- Long, E.R., Donald D. Mac Donald, Sherri L. Smith, Fred D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environmental Management 19(1):81-97.
- Washington Dept. of Ecology. 1995. Sediment Management Standards. Chapter 173-204, WAC. Publication No. 96-252. Washington State Department of Ecology, Olympia, WA.

General information and all data generated during this survey can be accessed from Ecology's Marine Sediment Monitoring website:

http://www.ecy.wa.gov/programs/eap/mar_sed/msm_intr.html