BENTHIC INFAUNAL COMMUNITY STRUCTURE IN HOOD CANAL IN RELATION TO SEDIMENT AND WATER QUALITY VARIABLES

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I. Findings

- Sediment grain size, TOC, total abundance, taxa richness, and DO vary geographically throughout Hood Canal, and co-vary with each other..
- Sediment toxicity and chemical contamination in Hood Canal are low and not correlated with the biotic measures
- Grain size, TOC, and DO values all appear to influence infaunal invertebrate community structure.
- Abundances of major taxa groups and indicator species appear to change in association with specific DO levels.
- Numbers of individuals and taxa appear to decrease with decreasing DO levels.
- There appear to be two important inflection points in the DO concentrations (< 6mg/L and <1 mg/L) at which the benthic metrics decrease.

II. Study Design

As part of the Puget Sound Assessment and Monitoring Program (PSAMP), sediment and near-bottom water samples were collected simultaneously from 30 stations along the length of Hood Canal in June, 2004. Sediment samples were analyzed for grain size, total organic carbon (TOC), toxicity, chemical contaminants, and benthic infaunal community composition, while dissolved oxygen (DO) levels were measured for the water samples. Values were mapped to determine patterns of each variable throughout the canal, and analyses conducted to determine the relationships between the measures.

III. Bivariate Relationships

Measures of sediment grain size (as percent fines) and TOC, near-bottom water DO concentrations, and benthic community indices of total abundance and taxa richness co-vary with each other. These relationships are confirmed with correlation analysis (Table 1). Total abundance and taxa richness appear to be positively related to each other and to DO levels at these stations, and inversely related to percent fines and TOC levels in the sediments.

Table 1. Pearson correlation coefficients (rho) and significance levels (p) for 5 variables measured in samples collected from Hood Canal in June, 2004.

	%TOC	% Fines	Total Abund	Taxa Richness
% Fines	0.87 (<0.0001)			
Total Abundance	-0.73 (<0.0001)	-0.72 (<0.0001)		
Taxa Richness	-0.80 (<0.0001)	-0.79 (<0.0001)	0.93 (<0.0001)	
DO	-0.86 (<0.0001)	-0.84 (<0.0001)	0.61 (0.005)	0.74 (<0.0001)

IV. Benthic Community Structure

Five tentatively identified regions of Hood Canal with differing grain size, TOC, and DO measures support differing communities of benthic organisms (Figure 1).

- The northern and central-nearshore regions, with coarser sediments, lower TOC, and higher DO values, support more abundant and diverse infaunal communities with a higher percentage of stress-sensitive species.
- The central-deep, southern, and Dabob Bay stations, with finer sediments, higher TOC, and lower DO values, support less abundant and diverse communities.
- The central-deep region supports a suite of deep-water species.
- The southern and Dabob Bay stations support communities with a higher percentage of stress-tolerant species.

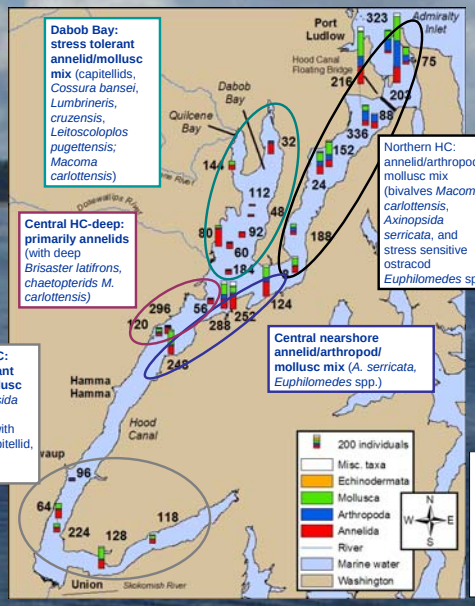

Figure 1. Abundance of major infaunal invertebrate taxa groups measured at 30 PSAMP stations collected from Hood Canal in June, 2004.

V. Patterns in Benthic Indices at Differing DO Levels

Benthic infaunal indices were pooled within five selected ranges of near-bottom water DO concentrations (Figure 2). Patterns varied between indices, but in general, most indices decreased with decreasing ranges of DO. Significant decreases occurred when DO was 10 mg/L or less for total abundance, taxa richness, annelid abundance, and miscellaneous taxa. At 6 mg/L or lower, total abundance, taxa richness, and arthropod, mollusc, and miscellaneous taxa abundance decrease significantly, and echinoderms disappear from the samples. At 1 mg/L or less, total abundance, taxa richness, and annelid, arthropod, and mollusc abundance all decrease significantly, and miscellaneous taxa disappear from the samples. The index data also suggest that arthropod abundance increases when the DO levels range between 10 and >6 mg/L, while mollusc abundance appears to increase slightly between 3 and >1 mg/L.

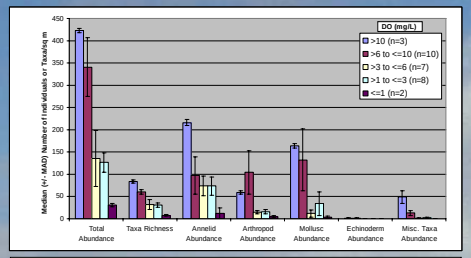

Figure 3. Median (+ Mean Absolute Deviation) benthic index values calculated for 30 PSAMP stations group by near-bottom water dissolved oxygen levels. Samples were collected from Hood Canal in June, 2004.

VI. Species Changes at Differing DO Levels

Abundance patterns were examined for species with differing sensitivity to DO levels. Patterns were apparent as DO concentrations declined (Figure3). Three species, including the ostracods *Euphilomedes carcharodonta* and *E. producta*, and the bivalve *Macoma carlottensis*, increased in numbers when DO levels ranged between 6 and 10 mg/L (Figure 3). When DO values were 6 mg/L or less, the abundance of *M. carlottensis* dropped gradually, while ostracods disappeared. Abundance of *Rhepoxynius boreovariatus* also declined, then disappeared from the samples at 6 mg/L or less. Two numerically dominant bivalves, *Axinopsida serricata* and *Parvilucina tenuisculpta*, decreased dramatically in abundance when DO concentrations dropped from 6-10 mg/L. *Parvilucina tenuisculpta* disappeared from the samples at or below 3 mg/L, while *A. serricata* increase in numbers at 1-3 mg/L, then disappeared at or below 1 mg/L. The polychaete annelids *Pectinaria granulata*, *P. californiensis,* and *Mediomastus sp*. all declined and/or disappeared as DO values decreased.

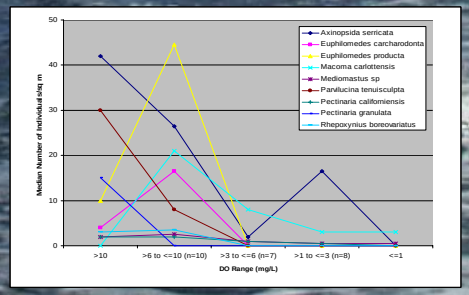

Figure 3. Median number of individuals/m² for 9 indicator species calculated for 30 PSAMP stations grouped by near-bottom water dissolved oxygen levels. Samples were collected from Hood Canal in June, 2004.

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/psamp/index.htm