

Puget Sound Georgia Basin Ecosystem Indicators Report
Technical Background Document
<http://www.epa.gov/region10/psgb/indicators/>

Marine Water Quality

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Marine Water Quality – Characterization of Seawater Density Stratification – as an indicator of how mixed is the water column, how resilient it is to mixing, and how likely water quality vertical gradients (e.g., oxygen depletion, concentration of surface pollutants) will be established.

Data Set Name

Puget Sound and Georgia Basin

Data Type

Indicator Data

SCOPE

1. Geographic Coverage

This indicator covers the marine waters of the Puget Sound and Georgia Basin, as indicated by established latitude and longitude of stations visited by the Washington State Department of Ecology and the Canadian Department of Fisheries and Oceans, Institute of Ocean Sciences in British Columbia, respectively. Station locations for Puget Sound can be viewed at http://www.ecy.wa.gov/programs/eap/mar_wat/mwm_intr.html and for Georgia Basin at http://www-sci.pac.dfo-mpo.gc.ca/osap/projects/straitofgeorgia/default_e.htm

2. Length of Data Series

The underlying data ranges in age from 1998 to 2004.

3. Smallest Geographic Units

Latitude and longitude was determined to thousandth of degree (e.g., 48.xxx N).

RELIABILITY

1. Assumptions and Caveats

Depth, seawater temperature and salinity were measured using a SeaBird Electronics CTD instrument according to manufacturers specification. Seawater density was calculated from temperature and salinity using standard UNESCO equations (Fofonoff, P. and R. C. Millard Jr (1983) Algorithms for computation of fundamental properties of seawater. Unesco Technical Papers in Marine Sciences 44, 53 pp.)

We present the degree of seawater density stratification as an indicator of sensitivity of the marine environment to water quality impacts from human activities. Density stratification means the layering of water according to its density difference, like oil on water.

Stratification intensity is the change in seawater density between near-surface and near-bottom measurements and *stratification persistence* is the frequency of occurrence of strong stratification relative to the total number of samples available at a given location. The intensity of stratification within a marine water column is significant because of the physical barrier it presents with respect to vertical water movement (mixing). Turbulent eddies, driven by winds and tides, cause vertical mixing of phytoplankton, dissolved oxygen, nutrients, pollutants, etc. If, however, the water is stratified, its density increases significantly with depth and the ability of turbulence to accomplish vertical mixing can be greatly decreased.

Thus, stratification can effectively isolate the surface water from the deep water. This can have significant implications for water quality; it can produce zones where dissolved oxygen becomes depleted and causes fish kills, or where nutrients become scarce and thus human additions of nutrients (e.g., sewage input, agricultural and domestic fertilizers) can cause algal growth in excess of the natural system; it can result in the retention of pollutants and contaminants in surface waters, where much of the plankton (including sensitive eggs and larvae) is concentrated, instead of mixing and diluting these out and away from the surface zone.

The persistence and strength of the seawater density stratification can thus be used to indicate the potential sensitivity of an area to human water quality impacts.

2. Quality Assurance Procedures

Temperature and salinity sensors were calibrated annually and data processing procedures were subject to quality assurance standards as described in Newton et al., 2002 and Masson and Cummins, 2004.

3. Data Confidence Limits

The data are representative of the station where measured; the spatial scale of the station's representativeness is not known and is expected to vary over the study area.

COLLECTION INFORMATION

1. Data Methodology

Described in Newton et al., 2002 for Puget Sound stations.

Newton, J.A., S.L. Albertson, K. Van Voorhis, C. Maloy, and E. Siegel. 2002.

Washington State Marine Water Quality in 1998 through 2000. Washington State Department of Ecology, Environmental Assessment Program, Publication #02-03-056, Olympia, WA.

Can be downloaded at <http://www.ecy.wa.gov/biblio/0203056.html>

Described in Masson and Cummins, 2004 for Georgia Basin stations.

(Masson, D., and P.F. Cummins, 2004. Observations and modeling of seasonal variability in the Straits of Georgia and Juan de Fuca. J. Mar. Res., 62, 491-516) and also see

http://www-sci.pac.dfo-mpo.gc.ca/osap/projects/straitofgeorgia/default_e.htm

2. Collection Frequency

Data from Washington are collected monthly and were pooled for 1998-2004.

Data from British Columbia are seasonal (4 times a year) and were collected over the period 1999-2004

NOTICE OF PROPRIETARY DATA

Acknowledgement

Data from Washington are public, and are obtained for public use by the State of Washington. Data from British Columbia are public, obtained from the Department of Fisheries and Oceans, Canada.

DATA SOURCES & CONTACTS

Data Sources

Data source for Washington State is the Washington State Department of Ecology.

Date source for British Columbia is the Department of Fisheries and Oceans, Canada.

Contact Name

Contact for raw data for Washington State is Skip Albertson, (360) 407-6676 and salb461@ecy.wa.gov

Contact for raw data for British Columbia is Dr. Diane Masson, (250) 363-6521, MassonD@pac.dfo-mpo.gc.ca