

Puget Sound Marine Benthic Index and Graphical Causal Model

Overview

The Puget Sound Partnership has funded a project to develop two new tools to help us understand how human disturbance affects life at the bottom of Puget Sound: a **Marine Benthic Index** and a **graphical causal model**.



Collage of Puget Sound benthic invertebrates; photos by Gustav Paulay, Florida Museum of Natural History

Benthic Invertebrates as Indicators of Ecosystem Health

Invertebrates that live in the sediment, or benthos, are key components of the Puget Sound ecosystem. Many species provide important services such as nutrient processing, food for other species (including humans), and modifying the sea floor. Because benthic invertebrates live in, and sometimes consume, sediments, they are continually exposed to stressors such as contaminated sediments, excessive nutrient input, ocean acidification, and low dissolved oxygen in the water. And they have relatively short lifespans, which means the community structure and function may change in response to stressors within a year.

Ecosystems are complex adaptive systems whose response to specific changes and levels of environmental factors are difficult to predict. This means that monitoring environmental factors alone, such as water quality and those driven by climate change, is insufficient to predict the effects of the ecological health of the system. As such, indicators of benthic invertebrate community health serve as measures of ecosystem health, especially as climate change modifies the ecosystem. The indicators can help answer questions such as:

- What is the current condition of the benthic habitat and the associated invertebrate assemblages?
- How has benthic community condition changed over time in response to disturbances such as habitat alteration, changes to food sources, and inputs of carbon, nitrogen, and priority pollutants to the system?

Uses of the Marine Benthic Index and Graphical Causal Model

The sediment **Marine Benthic Index** will be a Marine Water Vital Sign indicator, calculated from Puget Sound Ecosystem Monitoring Program (PSEMP) sediment monitoring data. The Marine Benthic Index will be used to assess and communicate status and trends of benthic invertebrate community health at multiple spatial scales, such as bay-wide and Puget Sound-wide. The **graphical causal model** will be a "what-if" tool, used to assess strengths of relationships between environmental stressors and benthic community responses. The model will be used also to test hypotheses of causation, including predicted effects of management actions.

Project Roles

Funder: Puget Sound Partnership, as part of the Monitoring to Accelerate Recovery program

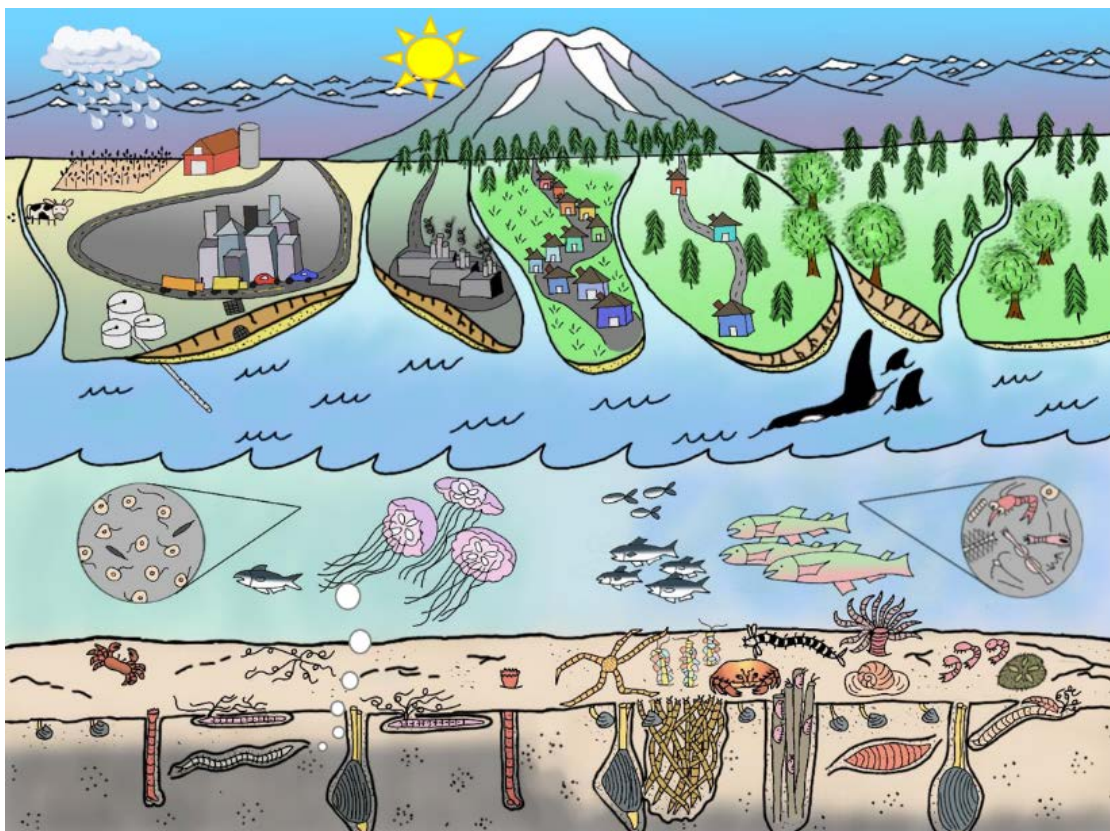
Project Lead: Valerie Partridge, Washington State Department of Ecology Marine Monitoring Unit

Statistical Development and R Coding: Dr. Donald Schoolmaster Jr., US Geological Survey Wetland and Aquatic Research Center

Technical Advisory Group: Interested members of Puget Sound Partnership Science Team, PSEMP workgroups, Tribes, other members of science and monitoring communities

Project Timeline

January-March 2022	Write Quality Assurance Project Plan
April-June 2022	Develop initial index (USGS)
July-October 2022	Validate Marine Benthic Index (benthic invertebrate experts)
August 2022 - February 2023	Develop graphical causal model (USGS)
March-May 2023 -	Write reports



[Conceptual model of benthic invertebrate communities in relation to human and natural pressures.](#)

Illustration drawn by Maggie Dutch, digitally colored by Grace McKenney.

Contact information

Valerie Partridge
valerie.partridge@ecy.wa.gov

ADA accessibility

To request an ADA accommodation, contact Ecology by phone at 360-407-6831 or email ecyadacoordinator@ecy.wa.gov, or visit <https://ecology.wa.gov/accessibility>. For Relay Service or TTY call 711 or 877-833-6341.