Health of Puget Sound

Regional Research at PNNL's Marine Sciences Laboratory

Pacific Northwest NATIONAL LABORATORY

Proudly Operated by Battelle *Since 1965*

Background –
For over 20 years, staff at the Pacific Northwest National Laboratory's Marine Sciences Laboratory (MSL) have been helping federal and state agencies and stakeholders understand how development and climate change influence the ecosystem functions and health of the Puget Sound. Our researchers have helped build scientific understanding of the features and processes within the Puget Sound environment, and have developed and deployed tools to guide effective restoration of valued ecosystems to enhance the services the ecosystems provide. Recent MSL projects described below have improved the "Science of the Sound" and guided restoration of the function of some of its resources.

Puget Sound Dissolved Oxygen Modeling Study: Improvement and Application of Puget Sound Hydrodynamic Biogeochemical Model for Climate Change and Future Loading Scenarios
Description: Tasked by the U.S. EPA, under a Washington State Department of Ecology contract, MSL developed a hydrodynamic and biogeochemical model of Puget Sound, conducted sensitivity tests, computed flushing characteristics of the Puget Sound basins, and then applied the model to future climate (Y2020, 2050, and 2090) and population growth scenarios.
Dimensions: $650 K
Impact: Ecology and EPA have adopted this model as their tool for assessment and management of water quality in the coastal waters of Puget Sound.

Sustainable Coastal Habitat Restoration in the Pacific Northwest: Modeling and Managing the Effects, Feedbacks, and Risks Associated with Climate Change
Description: This EPA-funded project was collaboration with Western Washington University and the Skagit River System Cooperative to address the implications of future sea level rise and other climate change impacts on estuarine rearing habitat for juvenile Chinook salmon. MSL used a hydrodynamic model of the Skagit River and Padilla Bay system of Puget Sound to estimate the effect of decreased river flows on estuarine salinity and to assess potential effects on estuarine vegetation composition and primary production.
Dimension: $330 K
Impact: The hydrodynamic and transport model developed through this project helped identify key features of circulation and transport in the system that will change in response to climate-driven flow and tidal conditions.

Alternative Approaches to Environmental Compliance: Watershed-Scale Contamination Mass Balance
Description: MSL is working closely with the Puget Sound Naval Shipyard in partnership with the U.S. EPA, Washington Department of Ecology, the Suquamish Tribe, Kitsap County, Kitsap County Health District, the City of Bremerton, and other local stakeholders to develop a watershed-based assessment of stream and storm water pollution runoff in the Sinclair -Dyes Inlet watershed of Puget Sound. MSL is providing watershed-scale assessments and unique field collection methods of ambient and source-specific waters, sediment, and biota. A chemical mass balance model is under development to predict stormwater contaminant concentrations as a function of sub-basin land-use and land-cover with a focus on the sub-basins of Sinclair/Dyes Inlet and comparison to Puget Sound region.
Dimensions: $1.31 M
Impact: This project provides the Navy with data to support alternative approaches to meeting environmental compliance based on coupling of modeling and measurement research that puts contaminant loading data into perspective within the surrounding watershed, determines thresholds for impairment to beneficial uses, and identifies the best monitoring methods to directly link contaminants with impairments to the beneficial uses of the marine water resources in the region.

Modeling of Skagit Bay for Rawlins Road / Fir Island Restoration Study

Description: Over the past 150 years, development in the Skagit River delta has resulted in significant losses of wildlife habitat, particularly from the construction of dikes. The objective of this project, funded by NOAA, was to evaluate the feasibility of increasing the productivity of habitat, expanding migratory opportunity for fish, and restoring landscape ecological processes by modifying these historic dikes and hydraulic and hydrologic features with minimum impact on current land use. To support this assessment, MSL developed and applied a three-dimensional tidal circulation model of the Skagit River delta and assessed the feasibility of proposed estuarine restoration alternatives.

Dimensions: $120 K

Impact: Results showed that restoring brackish conditions through localized small scale measures is not as effective as a large-scale network of freshwater distributary channels and helped guide selection of optimum alternatives.

Reconstructing Trends in Hypoxia Using Multiple Paleoecological Indicators Recorded in Sediment Cores from Puget Sound

Description: This project, funded by NOAA, was conducted in collaboration with the University of Washington, Texas A&M University, Bryn Athyns College, and USGS to determined natural and post-urbanization signatures of hypoxia in Hood Canal, a sub-basin of Puget Sound, and the main basin of Puget Sound. A historical sediment reconstruction was conducted of redox-sensitive metals, organic matter inputs, and other paleoecological indicators over the last several hundred years.

Dimensions: $517 K

Impact: This project identified the past influence of climatic hypoxia oscillations in Puget Sound, including Hood Canal. Resource managers can use this information to identify the management actions necessary to support beneficial uses in Hood Canal. This includes managing expectations of the public if climatic factors and geomorphology are the dominant drivers of hypoxia and subsequent fish kills in Hood Canal. This was the first study in Puget Sound to identify the potential importance of climatic variability on the development of hypoxia and also evaluate the watershed-scale indicators as they changed through the period of urbanization. Several seminal papers were published that reconstruct multiple proxies of ecosystem state and how they changed during urbanization.

WSDOT Marine Biology Programs

Description: The primary focus of this multi-year, multi-task program was on the assessment and mitigation of impacts of ferry terminal development and ferry operations on eelgrass and other nearshore habitats. Tasks included studies of habitat enhancement, benthic resources, fish behavior, culvert designs, eelgrass growth requirements, effects of sound on fish behavior, innovative dock designs, and shoreline protection.

Dimensions: $3 M

Impact: WSDOT used the resulting principles, methods, and science findings to redesign terminals and ferry boat operations to minimize and avoid impacts on eelgrass. This program received the "Environmental Excellence Award" from the Federal Highway Administration, which recognizes excellence in environmental science that supports “a safe, efficient, and effective transportation system that fits harmoniously within our natural environment, our neighborhoods, and our communities.” Staff applied a variety of tools, including underwater videography, hydroacoustics, development of specialized sensors, and mapping technologies on these studies.

About Pacific Northwest National Laboratory

The Pacific Northwest National Laboratory, located in southeastern Washington State, is a U.S. Department of Energy Office of Science laboratory that solves complex problems in energy, national security, and the environment, and advances scientific frontiers in the chemical, biological, materials, environmental, and computational sciences. PNNL currently has approximately 4,900 staff members, a business volume of more than $1.1 billion, and has been managed by Ohio-based Battelle since 1965.

For more information about the science you see here, please contact:

Charlie Brandt
Pacific Northwest National Laboratory
Marine Sciences Laboratory
1529 West Sequim Bay Road
Sequim, WA 98382
Charles.Brandt@pnnl.gov