

Focus on: Puget Sound Long-term Sediment Quality, 2017-2022



Related information

Marine Sediment Monitoring Team's [collection of interactive story maps](#)¹ describes our sediment monitoring program and findings.

[Marine sediments - Washington State Department of Ecology](#)²

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Puget Sound sediments evaluated

Surface sediments in Puget Sound are sampled annually in April as part of Ecology's Puget Sound Sediment Monitoring Program. Results are published in an interactive story map, which provides a summary of findings. This includes analyses of physical, biogeochemical, and chemical contaminant parameters, as well as the composition of sediment-dwelling invertebrate communities. The data is based on sediment samples collected from 50 Puget Sound-wide monitoring stations between 2017 and 2022.

Summary of findings

Habitat

The Puget Sound study area is shaped by a combination of marine and freshwater influences, creating a diverse network of interconnected habitat types. Sampling locations were delineated into five station types based on geomorphology and anthropogenic use. These include deep depositional basins, semi-enclosed bays, highly urbanized harbors, high-energy passages, and shallow, poorly circulated terminal inlets. Changes in the physical habitat—such as depth, grain size, and biogeochemistry—play a crucial role in shaping benthic community structure and overall ecosystem function.

Depth: Station depths within the study area ranged from 2 to 220 meters.

Grain size: Surface sediments within the study area were primarily composed of silt and sand.

Biogeochemistry: Analysis of elemental and isotopic carbon and nitrogen revealed that the organic matter reaching the sediment originated from both terrestrial and marine sources and tended to accumulate more in certain habitat types.

Chemical contamination

Many of the concentrations of individual chemicals measured were qualified as undetected at or below the reporting limit of the analytical methods. The chemical classes that were most often detected included metals and polycyclic aromatic hydrocarbons. Less frequently detected chemical classes were polybrominated diphenyl ethers (PBDEs), polychlorinated biphenyls (PCBs), and per- and polyfluoroalkyl substances (PFAS).

Exposure to potentially harmful chemicals, as measured with the Sediment Chemistry Index, was minimum or low in the Puget Sound study area. Concentrations of four chemicals were found above (not meeting) the Washington State Sediment Quality Standards, established to protect benthic communities. These included: one metal (Mercury); two polycyclic aromatic hydrocarbons, Indeno(1,2,3-cd)pyrene and Benzo(g,h,i)perylene; and one phthalate (Butylbenzylphthalate).

Different chemical classes displayed distinct spatial patterns of accumulation, with all exhibiting their lowest concentrations in high-energy, non-depositional passage areas.



Benthos

Benthic invertebrates were identified and counted, and multiple community measures were calculated, including the total number of organisms, the number of unique species, and the abundance of each of five major taxonomic groups. Benthic communities were predominantly composed of annelids, followed by mollusks and arthropods. Echinoderms and other miscellaneous taxa were the least common, on average accounting for less than 3% of the total abundance.

The Sediment Benthic Index and the Multivariate AZTI Marine Biotic Index (M-AMBI) both indicated that the area with “adversely affected” benthic communities did not change significantly across the five surveys of Puget Sound. Invertebrate communities showed considerable stability over time, with spatial variations playing a more significant role than temporal changes. However, a subset of the 50 stations was monitored for more than three decades, revealing a decline in benthic health over time.

Distinct benthic communities were identified, each characterized by species composition linked to ecological groups based on their sensitivity to environmental stress. Overall, benthic conditions were poorest in the poorly circulated shallow terminal inlets and improved progressively toward the open waters.

Putting it all together

Three key environmental parameters were found to play a significant role in shaping the Puget Sound benthic invertebrate community: water depth, sediment particle size, and total nitrogen concentration in surface sediments. The highest TN concentrations were found in areas where “adversely affected” benthic communities existed and opportunistic species thrived (generally the shallow, silty terminal inlets). Chemical contaminants in surface sediments did not contribute substantially to the statistical model. A considerable portion of the variability within the benthic community remains linked to parameters that were not measured.

Fifty sampling locations may not accurately represent all the habitats in Puget Sound adequately; limited geographic scope and sampling at a single point annually can miss variations, reducing generalizability. Additional research and collaborations are necessary to improve our understanding of the multiple drivers and pressures that affect Puget Sound.

¹ <https://storymaps.arcgis.com/collections/aaec1a6656ff43e098d209c75ce00244>

² <https://ecology.wa.gov/Water-Shorelines/Puget-Sound/Sound-science/Marine-sediments>