

Monitoring ocean acidification in our waters is critical to developing tools that allow marine industries to take action against ocean acidification. To advance Washington State Blue Ribbon Panel Action 7.1.1., the Washington State Legislature provided \$625,000 to the Washington Ocean Acidification Center (WOAC) in the 2013-2015 biennium to establish an ocean acidification monitoring network that measures trends in local water quality conditions and impacts to marine life. Of this amount, \$150,000 was explicitly allocated to monitoring at shellfish sites (see Shellfish information sheet) as part of the larger network.

What have monitoring efforts looked like?

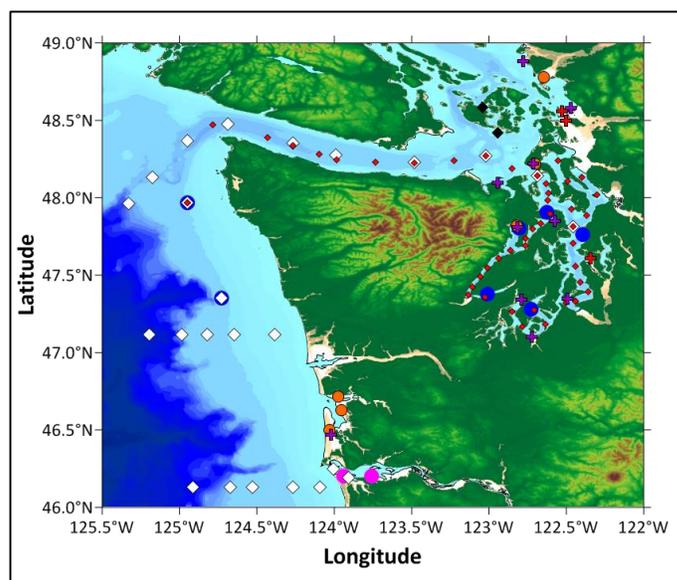
Using these funds, WOAC brought together diverse partners to create an integrated monitoring network for ocean acidification in the marine waters of the Washington coast and Puget Sound. Unlike other monitoring efforts, this network uniquely focuses on marine species as well as the chemical and physical properties of seawater in our estuarine, nearshore, and offshore environments. Funds were also used to support three monitoring buoys, monitoring cruises, and the deployment of high-quality pH sensors within the existing monitoring array. The network monitoring strategy focuses on high-priority plankton species as well as chemical and physical conditions such as pH, pCO₂, total alkalinity, dissolved inorganic carbon, oxygen, nutrients, chlorophyll, salinity, and temperature.

How has the state investment been leveraged?

The monitoring network includes a diverse array of federal, tribal, state, and local partners. WOAC's monitoring network plan includes strategic investments for integrated monitoring, and the network allows WOAC to leverage partners' experience, data, research assets, and several million dollars of investment.

Continued monitoring of ocean acidification is needed in 2015-17

Additional funds are needed in the 2015-2017 biennium to sustain integrated monitoring for ocean acidification in Washington's waters. Sustained monitoring will allow us to better understand where and how often corrosive water conditions are most severe, which species and marine industries will be most affected, and how we might mitigate the most harmful consequences. Monitoring plays a critical role in protecting our coastal economy in Washington.



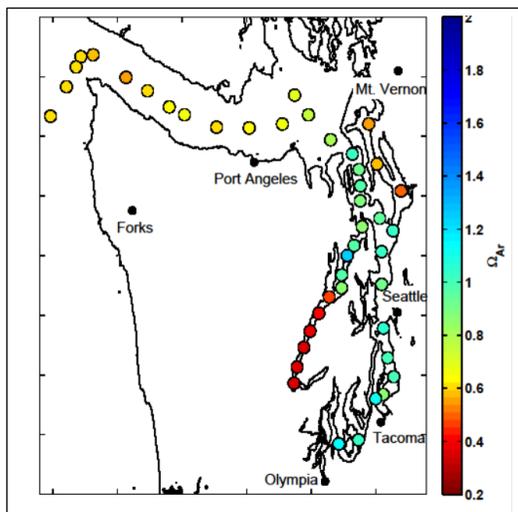
Monitoring sites of the WOAC monitoring network

In the figure above, white, red, and black diamonds are ship cruise stations; blue dots are OA buoys (or soon to be), pink dots are OA moorings; orange dots are shellfish grower sites, and crosses are nearshore monitoring stations, including those of WA DNR (purple).

What you need to know

- \$625,000 provided by State Legislature to establish an ocean acidification monitoring network
- Funds used to assemble a network monitoring impacts to marine species and water quality on the coast and in Puget Sound (\$475,000) and to support monitoring at six existing shellfish grower sites (\$150,000)
- Funds also used to support three research buoys, several monitoring cruises, and improve sensor quality at nearshore, shellfish and basin sites
- Leveraged partnerships and funds with federal, tribal, state, and local entities, including \$800,000 from NOAA and US IOOS

Through these efforts, WOAC leveraged federal investments of over \$800,000 from the National Oceanic and Atmospheric Administration (NOAA) and U.S. Integrated Ocean Observing System (US IOOS). It used ship time funded by the National Science Foundation and the University of Washington. It also uses a real-time data portal provided by Northwest Association of Networked Ocean Observing Systems (NANOOS) funded federally by IOOS.



Corrosiveness of Washington's Waters
Aragonite saturation state in bottom 50 m

What are we learning through

monitoring? Monitoring data show that ocean acidification conditions in Washington waters are highly variable in space and time. We need to understand this variability to develop response strategies that protect natural resources and coastal economies. For example, we now know that surface conditions generally differ from those in deeper waters and that variation in Puget Sound differs from that in outer coastal waters. Moreover, hot spots of exceptionally low pH, high- $p\text{CO}_2$ waters have been detected in Puget Sound. During most of the year, seawater conditions are corrosive to the shells of pteropods – a plankton species that provides food for fish. While pteropod shells collected off the coast have shown signs of corrosion due to ocean acidification, those collected from Whidbey Basin and Southern Hood Canal showed even worse corrosion, resulting in holes in the shells. Continued monitoring is needed to more fully understand this difference.

How will continued monitoring efforts help us in the future?

Washington's shellfish growers are already seeing the effects of ocean acidification on juvenile oysters. Similarly, plankton and pteropods – critical species within the marine food web – are also showing signs of harm due to ocean acidification. Sustained monitoring into the next biennium will allow Washington State to better understand the role of ocean acidification in creating corrosive marine conditions at local and regional scales and to predict future impacts to species of economic importance. Monitoring data will continue to guide Washington's industry, tribes, coastal communities, and resource managers in making sound management decisions to protect our marine ecosystems and the industries that rely on them.

For more information

See the Washington Ocean Acidification Center website:

<http://coenv.washington.edu/research/major-initiatives/ocean-acidification/>

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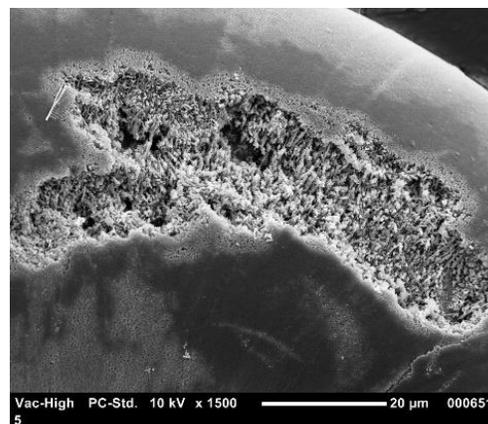
WOAC Monitoring Network Partners leveraging state investments

Federal: Environmental Protection Agency, National Oceanic and Atmospheric Administration, NOAA Pacific Marine Environmental Laboratory, National Science Foundation, NANOOS/US IOOS, Olympic National Park, Padilla Bay National Estuarine Research Reserve, Olympic Coast National Marine Sanctuary

Tribal: Stillaguamish Tribe

State: Washington Department of Natural Resources, Washington Department of Ecology, Western Washington University, Oregon Health and Sciences University

Local: King County, Seattle Aquarium



Whidbey Basin pteropod shell showing evidence of extensive corrosion