Urgent, Continued Action Needed to Address Changing Ocean Conditions and Impacts

Washington's culture, traditions and economies are strongly connected to its ocean and estuaries. We gravitate to the more than 3,000 miles of marine shoreline to walk the beach, dig for razor clams, eat freshly harvested fish, crab and oysters, watch for orcas and birds, and marvel at the yearly return of salmon.

But our waters are in trouble. More than 10 years ago, oyster hatcheries in the Pacific Northwest experienced mass mortalities of their baby bivalves. Scientists worked with shellfish growers to determine the cause: ocean acidification. Corrosive waters meant these oysters couldn't build and maintain their shells.

Washington's shellfish growers, scientists, and government and community leaders chose to confront the challenge. Together we're working to understand how ocean acidification is harming our state and how we can help those who are harmed while we work on making our ocean healthy again.

While our marine waters are changing due to ocean acidification, warming and loss of oxygen, new science indicates the damage to our ocean and coasts may be happening faster and more broadly than previously understood, largely due to climate change. This means we must act faster.

> *"The changes we are seeing in the ocean are scary. They threaten the fish, clams and crabs that are central to who we are as Quinault people.*
>
> *– Ed Johnstone, fisheries policy lead Quinault Indian Nation*

Washingtonians are seeing first-hand how climate change is harming our ocean and coasts: increasing acidification, rising water temperatures, lower oxygen levels and more intense toxic algal blooms.

Ocean acidification's effects on marine species are made worse by other climate impacts and stressors such as low oxygen and warming ocean temperatures. Local and human sources of nutrient pollution, such as from septic systems, wastewater treatment plants and agriculture runoff, are major contributors to ocean acidification in areas of Puget Sound.

These changes undermine the health of our marine environment, threaten jobs and may fundamentally alter socially and culturally important resources and traditions of tribes and other coastal communities.

Pteropods are a key component of the marine food web. Under acidified conditions, they struggle to build and maintain their shells. Today approximately half the pteropods in our coastal waters show signs of the severe impacts of corrosive waters. Researchers project that by 2050, as much as 70% of pteropods may be negatively affected by corrosive conditions. [Bednarsek et al., 2014]

Photo credit: Nina Bednarsek

> *Our industry is treating the water in our hatcheries to adapt to today's conditions. As ocean acidification worsens, it will impact shellfish in the ocean where such solutions won't work. We need to act now to address the source of the problem.*
>
> *– Bill Dewey, Taylor Shellfish*

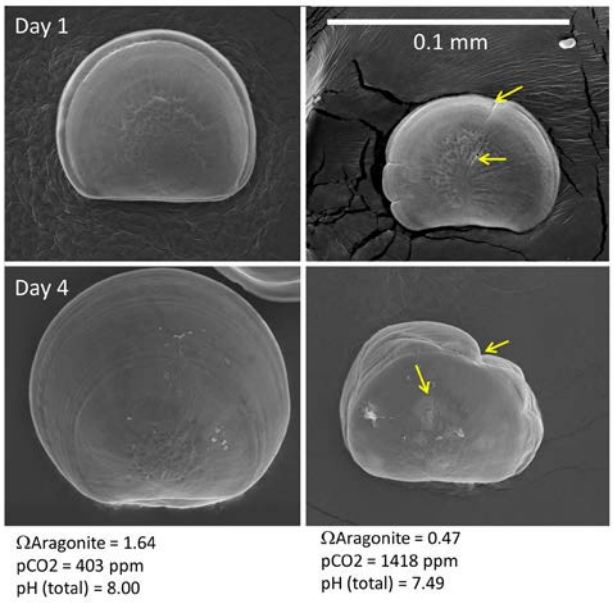


Photo credit: Elizabeth Brunner/George Waldbusser Oregon State University

Pacific oyster larvae collected from the same spawn raised by the Taylor Shellfish Hatchery in natural waters of Dabob Bay, Wash., in favorable and unfavorable carbonate chemistry. Under more acidified conditions (right column), development of larvae is impaired by defective shells. Arrows show both defects (creases) and evidence of dissolution on shell (light patches on shell).

HEALTH OF MARINE ENVIRONMENT

Changing ocean conditions are already affecting species such as oysters, Dungeness crab and salmon, and some of the smaller species that fish and whales rely on for food, like krill and pteropods. These effects will jump dramatically in the coming years if we fail to act soon.

Lab studies show that in acidified waters, salmon have a harder time detecting predators and that harmful algal blooms produce more toxins. And fewer salmon mean that Southern Resident orcas go unfed and nets for commercial and personal consumption come up empty.

JOBS & LIVELIHOOD

Changing ocean conditions have real economic consequences. Employing more than 15,000 people in fishing, aquaculture and seafood processing — and generating billions in wages and revenue — Washington is ranked No. 1 of all coastal states for the largest living marine resources sector.

Yet harmful algal blooms can shut down shellfish harvest to protect public health. In 2015, a toxic bloom triggered by warmer ocean temperatures cost our coastal communities an estimated $97.5 million in lost crab landings and $40 million in tourism spending.

TRIBAL & CULTURAL IMPLICATIONS

Salmon, shellfish and other marine resources have been the foundation for many tribes in the Northwest for thousands of years, serving not just as food, but as the cornerstone of cultures, traditions and spirituality. These resources were so important that many area tribes signed treaties with the United States to reserve their right to continue to fish and hunt. Tribal economies have also developed around sustainable harvest of

fish and shellfish. The potential loss of marine resources due to changing ocean conditions would be devastating to the well-being of many tribes.

WE NEED TO ACT QUICKLY TO TURN THE TIDE

Ocean acidification is worsening quickly and at a faster pace. Globally, the ocean already has 30% more acidity than in preindustrial times and is projected to have 100–150% more acidity by 2100 if we do not alter our carbon dioxide emissions. [Gattuso et al., 2015]

Due to Washington's location and oceanographic conditions, our state will experience ocean acidification faster and to a greater degree than many other places. These changes are occurring even more rapidly in Puget Sound waters than along our coast. This makes Washington's marine resources and communities especially vulnerable to ocean acidification repercussions.

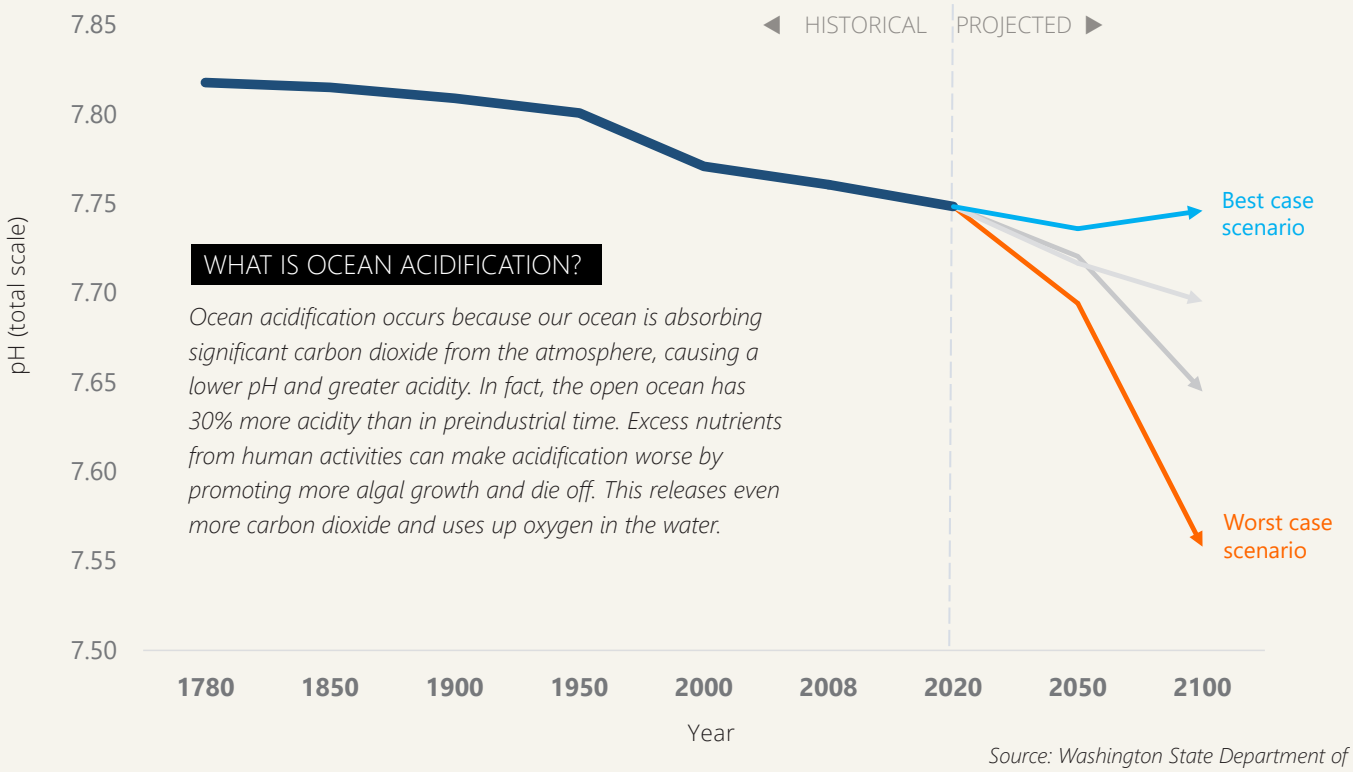
On a smaller scale, various marine species have different thresholds for coping with ocean acidification. By 2050, models indicate that the corrosive water conditions in parts of Puget Sound will exceed the thresholds for some species much or most of the time.

Photo credit: Washington State Department of Fish and Wildlife

> *There is growing evidence that many (ocean and coastal) ecosystem changes can be avoided only with substantial reductions in the global average atmospheric CO2 concentration.*
>
> *– Fourth National Climate Assessment, 2018*

Projected CO2 Emissions Impacts on pH in the Salish Sea

Average pH_T in the Salish Sea (0-10m)



WHAT IS OCEAN ACIDIFICATION?

Ocean acidification occurs because our ocean is absorbing significant carbon dioxide from the atmosphere, causing a lower pH and greater acidity. In fact, the open ocean has 30% more acidity than in preindustrial time. Excess nutrients from human activities can make acidification worse by promoting more algal growth and die off. This releases even more carbon dioxide and uses up oxygen in the water.

Source: Washington State Department of Ecology.

WE HAVE THE ABILITY TO CHANGE THE COURSE OF OCEAN ACIDIFICATION WITH LOCAL ACTIONS AND LEADERSHIP.

The good news is that if we act now — locally and globally — we can make a difference and alter the course of ocean acidification. The longer we wait to act, though, the less effective our actions will be in halting harms to our marine resources and protecting the communities that rely on them.

Already, Washington is leading the way by implementing a comprehensive set of actions overseen by the Governor's Marine Resources Advisory Council and supported by the state Legislature. Established in 2013, the council maintains a steady, coordinated focus on ocean acidification for Washington. Its members, representing diverse interests, deliver recommendations to the governor and Legislature and seek public and private funding to support those recommendations. It works with and advises the Washington Ocean Acidification Center at the University of Washington and assists with education and outreach activities.

Due to the leadership of the council and other concerned partners, the Legislature has invested nearly $10 million — mostly in significant actionable research — since 2012. This investment has, in turn, spurred $14.5 million in federal and private funding.

This research, monitoring and modeling are guiding decision makers on next steps. For example, this activity has enabled the shellfish industry to adapt its operations by treating hatchery water and timing the transfer of shellfish to growing areas to boost their survival in acidified waters. Researchers are exploring how eelgrass and kelp may improve local water quality and reduce acidification. And inter-jurisdictional partners cooperate to reduce local nutrient sources such as wastewater.

Photo credit: Washington State Department of Fish and Wildlife

As a result of all this work, our state is emerging as a global hub of knowledge, innovation and collaboration on ocean acidification. Collaborating with other states and Canadian provinces on the West Coast, Washington has formed a coalition to lead and take action to mitigate ocean acidification and other climate impacts on our ocean. Today, that consortium numbers 80 members, a powerful sign of the gravity of this work.

WHAT DO WE NEED TO DO

Current scientific evidence indicates that we must do more to address ocean acidification and other climate impacts.

Reduce carbon dioxide emissions further. Washington has recently adopted nation-leading policies to transition to 100% clean electricity by 2045, improve efficiency of buildings and electrify transportation. Yet they still fall short of what science shows will be required to protect our state from the worst impacts. If we fail to reduce emissions quickly enough, our marine waters and ocean will be irreversibly damaged.

Reduce nutrient pollution discharged into marine waters from sewage treatment plants and failing septic systems and runoff from farms and yards. Reducing excess nutrients from human activities can provide additional protection to marine ecosystems while we reduce emissions of greenhouse gases — locally and globally.

Improve local adaptation and resiliency. Actions such as protecting and restoring kelp and eelgrass — and growing more — can improve water quality locally and provide refuge for marine species from acidified and other stressful conditions elsewhere. These habitats may improve the growth and survival of species that are sensitive to ocean acidification.

Support science. Scientific research, monitoring and modeling are necessary to help us answer our remaining questions, inform our decisions and take action. Indeed, science is a foundation for effectively addressing ocean acidification, and the state needs to sustain these critical investments over time.