Ocean Acidification in Washington State

From Knowledge to Action

Washington State Blue Ribbon Panel on Ocean Acidification

Photos (left to right): Neil Banas, Minette Layne, Benjamin Drummond

What is Ocean Acidification?

A prolonged reduction in seawater pH, driven by increasing levels of carbon dioxide (CO_2) in seawater.

Principal cause at the global scale:

CO_2 emissions from human activities

Photo: Oran Viriyincy

Ocean Acidification is Occurring Rapidly

- Approximately 25% of the CO_2 generated by human activities since the mid-1700s has been absorbed by the oceans.
- Ocean acidity has increased 30% since the start of the industrial age.
- Ocean acidity is projected to increase 100-150% percent by 2100.
- Current rate of acidification is nearly 10x faster than any period over the past 50 million years.

Washington is Particularly Vulnerable to Acidification

Ocean acidification is appearing in Washington decades *sooner* than anticipated.

A combination of regional factors can exacerbate acidification caused by global CO_2 emissions:

- Coastal upwelling of CO_2-rich waters
- Runoff of nutrients and organic carbon from land
- Decay of organic matter in subsurface waters
- Emissions of acidifying gasses (NO_X and SO_X)

Washington Coast; Photo: Russ McMillan

Implications for Calcifiers

Slower growth and higher mortality for shell-forming organisms *(calcifiers)*

- Calcium carbonate, a mineral used to make shells and other hard body parts, dissolves more easily as acidity increases.
- More than 30% of Puget Sound's marine species are calcifiers. Ex: oysters, crabs, geoducks, sea stars, plankton

Photo: Jon Rowley

Implications for Marine Food Webs & Ecosystems Services

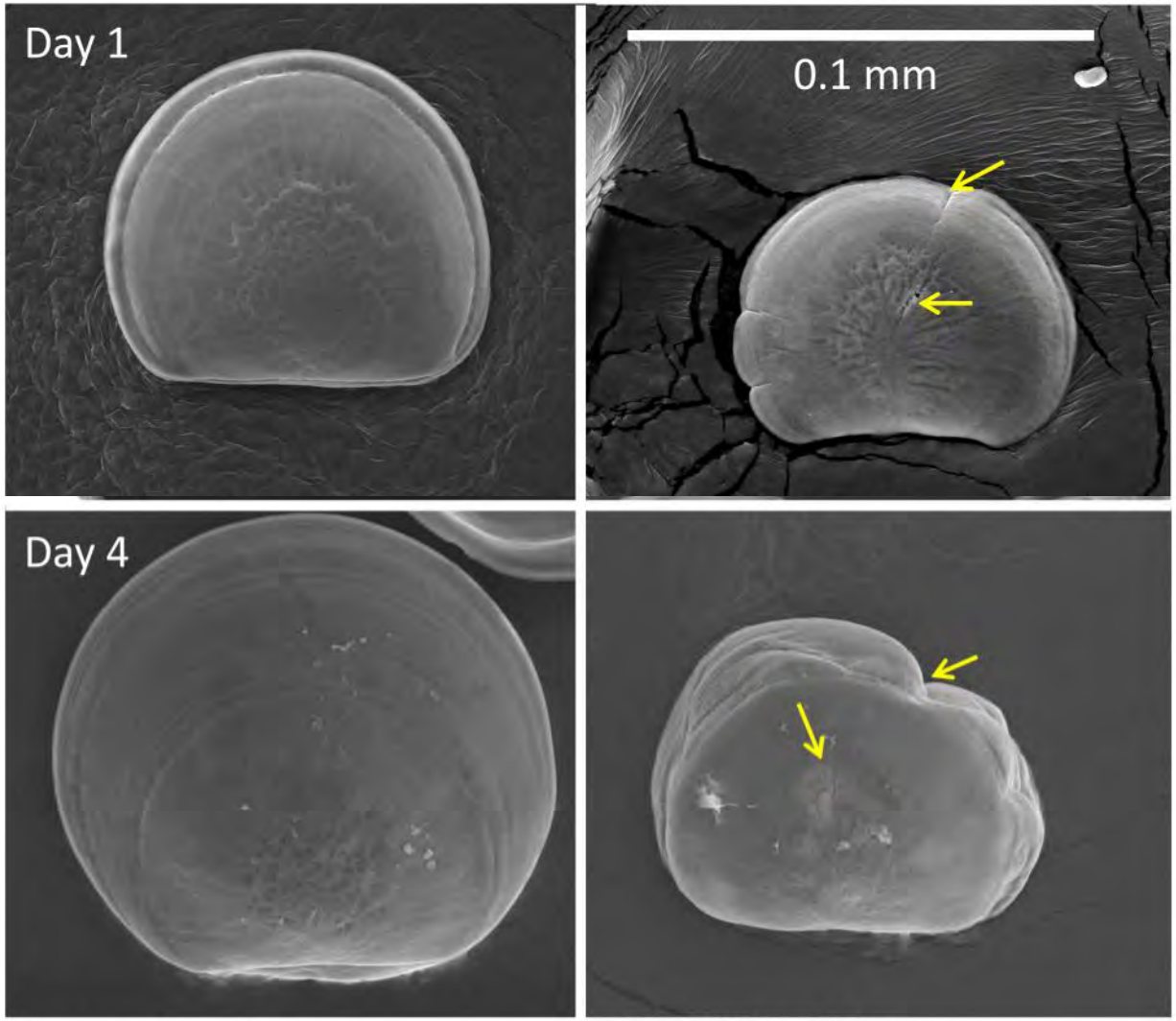
Many life processes are sensitive to changes in pH. Impacts include:

- Increased mortality among some species of pteropods (a type of plankton).
- Impacts on the nervous system of some fish.
- Potential loss of habitat due to impacts on coral reefs.
- Potential loss of water quality benefits provided by shellfish, which filter particles from marine waters.

Pteropod

Photo: Russ Hopcroft

Pacific oyster larvae spawned in favorable (left) and unfavorable (right) seawater conditions



ΩAragonite = 1.64
pCO2 = 403 ppm
pH (total) = 8.00

ΩAragonite = 0.47
pCO2 = 1418 ppm
pH (total) = 7.49

Figure source: Elizabeth Brunner and George Waldbusser, Oregon State University

What's at Stake for Washington's Economy?

The most productive commercial shellfish industry on the West Coast

- Washington's shellfish industry generates $270 million annually, and directly and indirectly supports 3,200 jobs.
- Annual sales of farmed shellfish from Washington account for almost 85% of U.S. West Coast sales (including Alaska).

Photos: Benjamin Drummond (left and right); Bryan Penttila (center)

What's at Stake for Washington's Economy? (cont'd)

Valuable wild and recreational fisheries

- Impacts to marine food webs could affect Washington's seafood industry, which generates over 42,000 jobs in Washington and contributes at least $1.7 billion to gross state product.

- Recreational oyster and clam harvesters contribute more than $27 million annually to coastal economies.

Photos (left to right): Washington Association of Conservation Districts, US Dept. Agriculture, City of Seattle

What’s at Stake for Washington’s Tribes?

Continued identity and cultural survival of Washington’s coastal tribes

- Washington tribes depend upon shellfish for food, income, and connection to their cultural heritage.

Photos: Northwest Indian Fisheries Commission

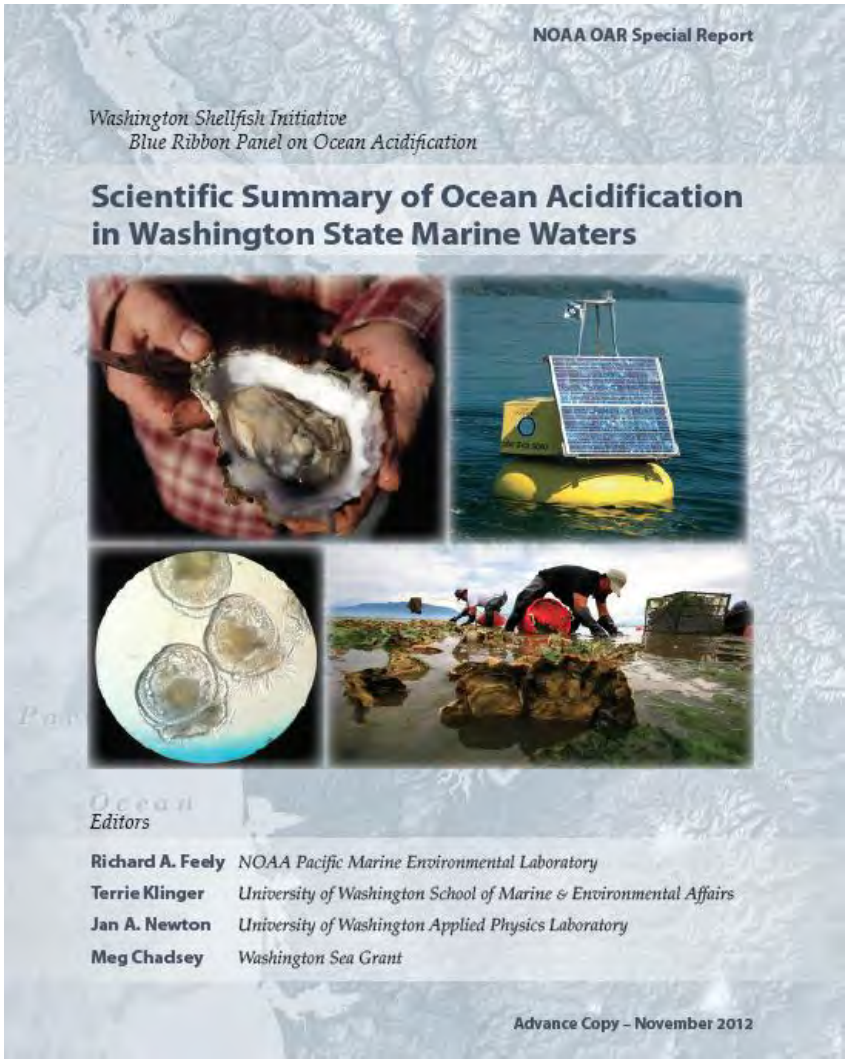
Developing the Response: The Blue Ribbon Panel on Ocean Acidification

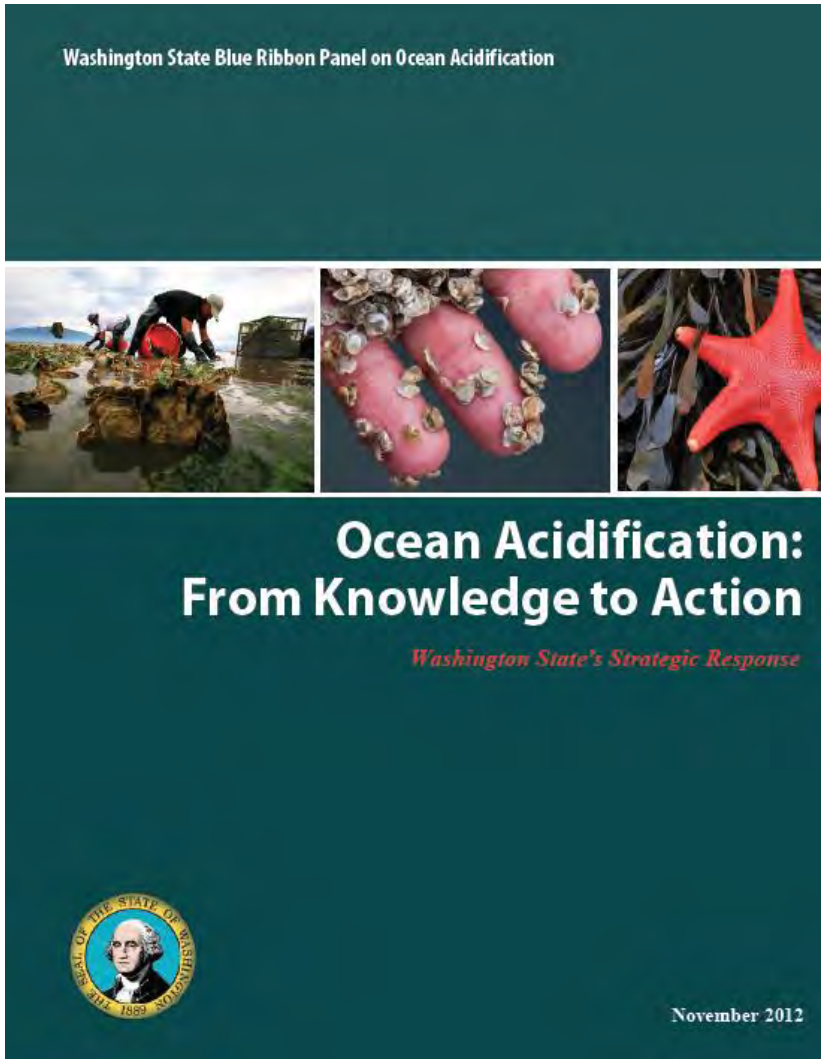
- Convened by Governor Christine Gregoire in February 2012.
- A first-of-a-kind comprehensive state-level effort to address ocean acidification.
- Charged with reviewing the best available science, and producing a set of recommendations to guide Washington's response.
- Scientists, decision makers, industry stakeholders, tribal representatives, and conservation community representatives worked together to produce a comprehensive set of recommendations.

Gov. Gregoire and Bill Dewey of Taylor Shellfish Company discuss growing and harvesting techniques for oysters in the tide flats in Samish Bay.

Photo: Puget Sound Partnership

Washington State Panel Reports





http://www.ecy.wa.gov/water/marine/oceanacidification.html

Panel Recommendations

42 recommendations, including 18 *Key Early Actions*, that will:

1. **Address the root cause of acidification by reducing CO_2 emissions**;

Photos: Oran Viriyincy (top); www.TheEnviroonmentalBlog.org (bottom)

Panel Recommendations

42 recommendations, including 18 *Key Early Actions*, that will:

1. Address the root cause of acidification by reducing CO_2 emissions;

2. **Reduce local land-based pollutants that worsen acidification**;

Photos: Wash Dept. of Ecology (top); Kate Boicourt (bottom right); Suvi Geary (bottom left)

Panel Recommendations

42 recommendations, including 18 *Key Early Actions*, that will:

1. Address the root cause of acidification by reducing CO_2 emissions;

2. Reduce local land-based pollutants that worsen acidification;

3. **Foster adaptation and remediation to protect the shellfish industry and marine ecosystems**;

Photos: Benjamin Drummond (top); Bern Harrison (lower right); Jim Culp (lower left)

Panel Recommendations – cont'd

42 recommendations, including 18 *Key Early Actions*, that will:

4. **Increase research and monitoring of acidification in state waters**;

Photos (clockwise from upper left): Wendi Ruef, UW; Michael J. Bok; John Payne, POST Project; Northwest Indian Fisheries Commission

Panel Recommendations – cont'd

42 recommendations, including 18 *Key Early Actions*, that will:

4. Increase research and monitoring of acidification in state waters;

5. **Inform, educate, and engage the public, stakeholders, and decision makers in responding to ocean acidification; and**

Outreach on the beach

Ocean acidification in the classroom

Photos: Jefferson Co. Marine Resource Committee (top); Center for Microbial Oceanography—Research and Education (bottom); Matt Chadsey (inset)

Panel Recommendations – cont'd

42 recommendations, including 18 *Key Early Actions*, that will:

4. Increase research and monitoring of acidification in state waters;

5. Inform, educate, and engage the public, stakeholders, and decision makers in responding to ocean acidification; and

6. **Maintain a sustained and coordinated focus on ocean acidification.**

Photo: Washington Secretary of State

Governor's Response: *Executive Order 12-07*

Directs the Department of Ecology and other cabinet agencies to:

- Implement the recommendations of the Blue Ribbon Panel;
- Advocate for reductions in emissions of carbon dioxide;
- Work with the University of Washington and others to coordinate and conduct scientific investigations and science/policy collaborations;
- Request that the EPA assess water quality criteria relevant to ocean acidification;
- Increase public understanding of ocean acidification and its consequences.

Signing Exec Order 12-07, Nov 27, 2012

Governor's Response: *Proposed Funding*

$3.31 million in proposed 2013-2015 biennial budget to implement the Panel's key early actions.

Funds reallocated from State Toxics Control Account, Aquatic Lands Enhancement Account and Resource Management Cost Account.

Shucked Pacific oyster

Photo: Dan Bennett

Governor's Response:
OA Impacts and Adaptation Center

Establishes a new **Ocean Acidification Impacts and Adaptation Center** at the University of Washington. The Center will:

- Advance the Panel's research and monitoring recommendations;
- Lead and foster ongoing decision-relevant science regarding ocean acidification;
- Enhance and maintain research coordination and collaboration; and
- Engage a range of stakeholders

Shucked Pacific oyster

Photo: Dan Bennett

Conclusions

- Ocean acidification is a well-documented consequence of rising CO_2 emissions
- Ocean acidification results in low pH and other changes that make marine waters more corrosive to shell-forming organisms. Impacts on non-calcifiers have also been observed.
- Ocean acidification is affecting Northwest shellfish and carries potentially significant economic and ecological risks.
- Actions proposed by the Blue Ribbon Panel are a starting point for addressing the near-term and long-term risks of ocean acidification.

Photo: Jon Rowley

"Nowhere on our planet is a local response to ocean acidification more urgently and immediately needed than here in Washington State." --Dr. Jane Lubchenco, Administrator of the National Oceanic and Atmospheric Administration, Nov. 27, 2012

"The cost of responding to ocean acidification may be substantial, but it is still far less than the costs of inaction. Responding to ocean acidification will require a sustained effort – there's no silver bullet solution." -- Bill Ruckelshaus, Blue Ribbon Panel co-chair, Nov. 27, 2012

"Let's get to work. Let's lead the world in addressing this global challenge." -- Governor Gregoire, Nov. 27, 2012

Photo: Northwest Indian Fisheries Commission

For More Information…

Washington Department of Ecology :

http://www.ecy.wa.gov/water/marine/oceanacidification.html

NOAA Pacific Marine Environmental Laboratory:

http://www.pmel.noaa.gov/co2/story/Ocean+Acidification

Photo: Hugh Shipman