Upwelling of Acidified Water: Not Just an Issue for Shellfish Hatcheries on the West Coast of the US.

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Oysters in deep trouble: Is Pacific Ocean's chemistry killing sea life?

Oyster larvae have been dying by the billions. Scientists suspect it’s a sign that carbon dioxide is dramatically affecting the ocean — and if they're right, it could push Washington into the center of the debate about the future of the seas.

By Craig Welch
Seattle Times environment reporter

WILLAPA BAY, Pacific County —

The collapse began rather unspectacularly.

In 2005, when most of the millions of Pacific oysters in this tree-lined estuary failed to reproduce, Washington's shellfish growers largely shrugged it off.

In a region that provides one-sixth of the nation's oysters — the epicenter of the West Coast's $111 million oyster industry — everyone knows nature can be fickle.

But then the failure was repeated in 2006, 2007 and 2008. It spread to an Oregon hatchery that supplies baby oysters to shellfish nurseries from Puget Sound to Los Angeles. Eighty percent of that hatchery's oyster larvae died, too.

Oysters' failure to reproduce will lead workers like Northern Oyster Co.'s Gildardo Mendoza to collect far more of their product from a state "oyster preserve" in Willapa Bay. Pacific oysters haven't successfully reproduced in the wild since 2004.
Effects of increased seawater pCO$_2$ on early development of the oyster *Crassostrea gigas*

Haruko Kurihara*, Shoji Kato, Atsushi Ishimatsu

Institute for East China Sea Research, Nagasaki University, 1551-7 Taimamachi, Nagasaki, 851-2213, Japan

*C. gigas* has trouble mineralizing larval shell at pH 7.4
The Pacific oyster, *Crassostrea gigas*, shows negative correlation to naturally elevated carbon dioxide levels: Implications for near-term ocean acidification effects

Alan Barton, a Burke Hales, b, * George G. Waldbusser, b Chris Langdon, c and Richard A. Feely d

Fig. 5 a. Relationship between retraction states for oysters and (a) proportion of larvae developing to Dohrn stage, (b) number of larvae produced, (c) proportion of mid-growth to Dohrn stage, and (d) relative larval production.
Rapid Progression of Ocean Acidification in the California Current System

Nicolas Gruber,1* Claudine Hauri,1 Zouhair Lachkar,1 Damian Loher,1 Thomas L. Frölicher,2 Gian-Kasper Plattner3

A

Euphotic zone (0-60 m)
What About East Coast Hatcheries?
Biocalcification in the Eastern Oyster (*Crassostrea virginica*) in Relation to Long-term Trends in Chesapeake Bay pH

George G. Waldbusser · Erin P. Voigt · Heather Bergschneider · Mark A. Green · Roger L. Newell

(A) *Crassostrea virginica*

![Graph showing shell area vs. pH treatment](image)

(B) Calculated CaCO$_3$ (μg/shell)

![Graph showing CaCO$_3$ vs. pH treatment](image)

Shellfish Face Uncertain Future in High CO$_2$ World: Influence of Acidification on Oyster Larvae Calcification and Growth in Estuaries

A. Whitman Miller, Amanda C. Reynolds, Cristina Sobrino, Gerhardt F. Riedel
South winds cause N.J. ocean temperatures to plummet, massive plankton bloom

A satellite image shows a bloom of phytoplankton off the New Jersey coast. (NASA)

By Stephen Stirling | The Star-Ledger
Follow on Twitter
on July 10, 2014 at 1:43 PM, updated July 11, 2014 at 7:01 AM
Data from M. Poach
NOAA/NMFS,
James J Howard Marine Sciences Laboratory
• YSI took continuous measurements (15 min)
  – pH, Temperature, Salinity, turbidity, dissolved Oxygen
• Discrete samples ~ weekly
  – DIC, pH and microscopic analysis
Sustained Southwest winds
Peak of upwelling

$\text{r}^2 \sim 0.32$
\[ r^2 \approx 0.32 \]

The graph shows a scatter plot of pH values over time, with a circled area highlighting a specific period. The x-axis represents date and time, with specific dates and times marked. The y-axis represents pH values ranging from 7.5 to 8.0. The equation above the graph indicates a regression model involving factors such as TideLevel, ebb.Flood, Day.Night, DO_Conc_mg.L, and their interactions.
Count of particles >70 um and <300um, per ~ 100mL

Particle Count from Raw Seawater Coming into the Hatchery

Count of particles >70 um and <300um, per ~ 100mL

6/17/14, 6/19/14, 6/24/14, 7/1/14, 7/8/14, 7/15/14, 7/22/14, 7/29/14, 8/5/14, 8/12/14, 8/19/14, 8/26/14

upwelling
Count of particles >70 μm and <300 μm, per ~100mL

Particle Count from Raw Seawater Coming into the Hatchery

- Diameter: 540 μm
- Diameter: 300 μm
- Diameter: 171 μm
- Diameter: 129 μm
- Diameter: 88 μm
- Diameter: 84 μm
- Diameter: 300 μm
- Diameter: 540 μm
Questions
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<th>DF</th>
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<td>Residuals</td>
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Adjusted R-squared = 0.013
p-value <<0.000001
Adjusted R-squared: 0.2696
p-value: << 0.000001
Atmospheric and Oceanic CO$_2$

- ↑ partial pressure of CO$_2$ (air)
- causes ↑ in CO$_2$ across ocean surface