



Bill Dewey
Director of Public Affairs



Impacts of Ocean Acidification on West Coast Shellfish Aquaculture

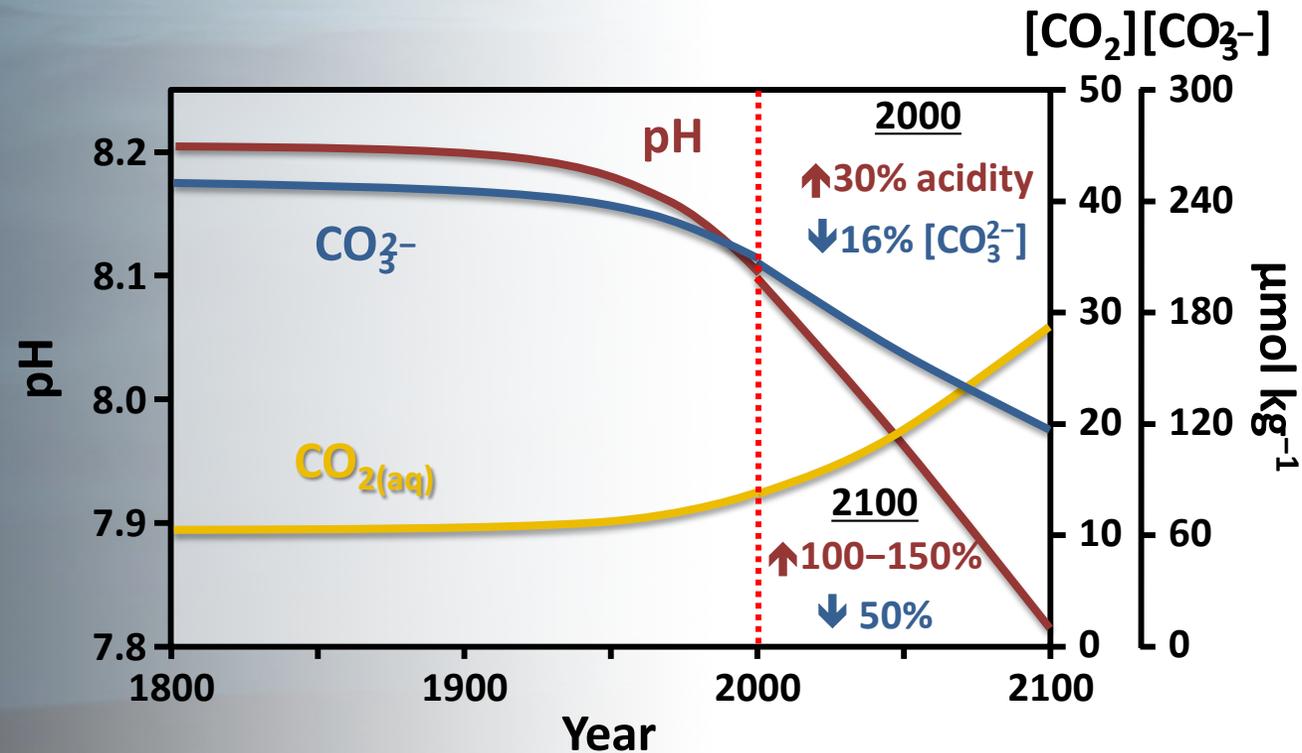
U.S. West Coast Shellfish Farms



West Coast Shellfish Products



Ocean chemistry changes from anthropogenic carbon dioxide



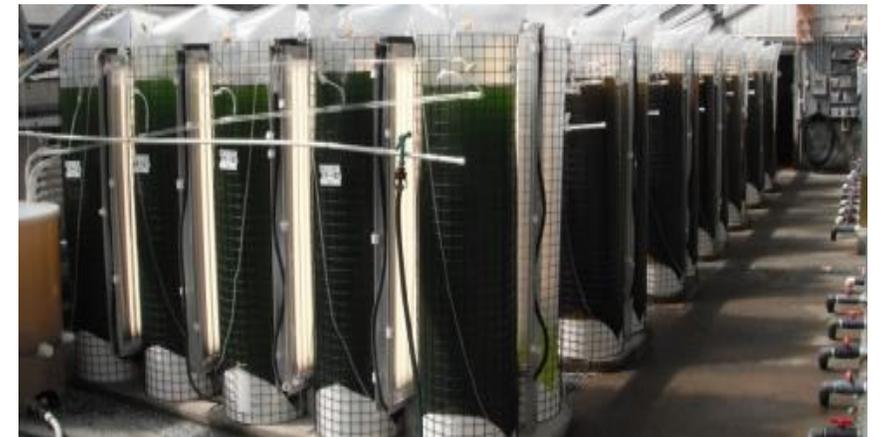
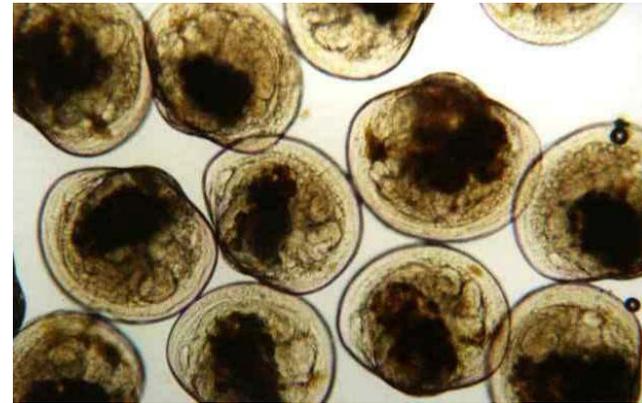
Shellfish seed production



Taylor Shellfish Farms Hatchery
Dabob Bay, Washington (USA)



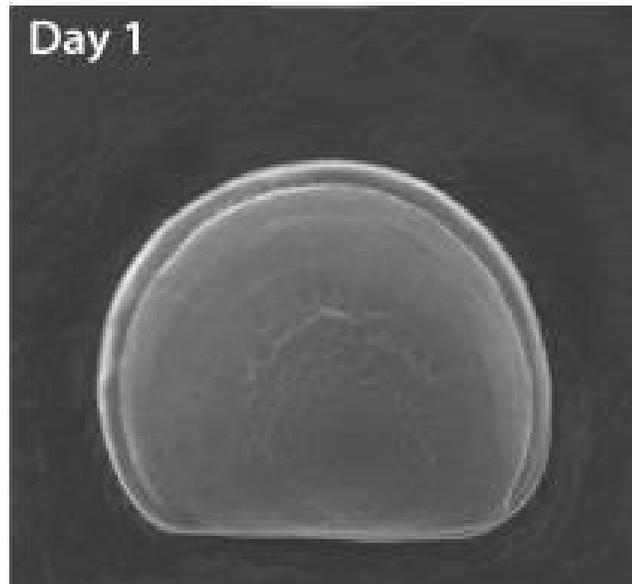
Shellfish seed production



Day old oyster larvae

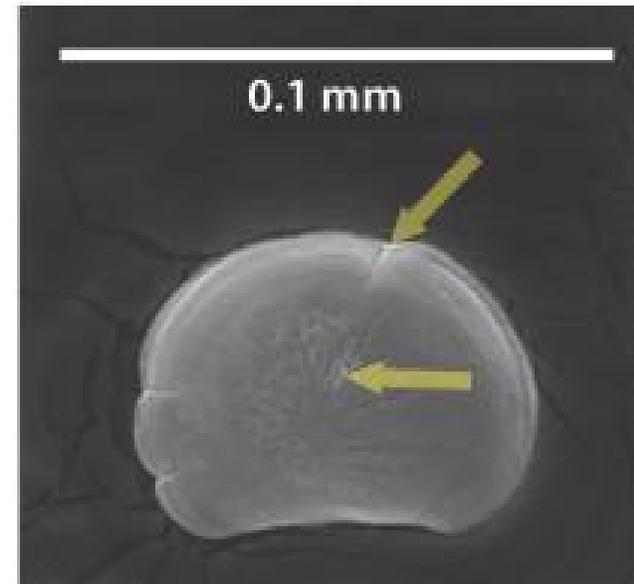
Healthy

Low $p\text{CO}_2$
High $\Omega\text{Aragonite}$



Not healthy

High $p\text{CO}_2$
Low $\Omega\text{Aragonite}$



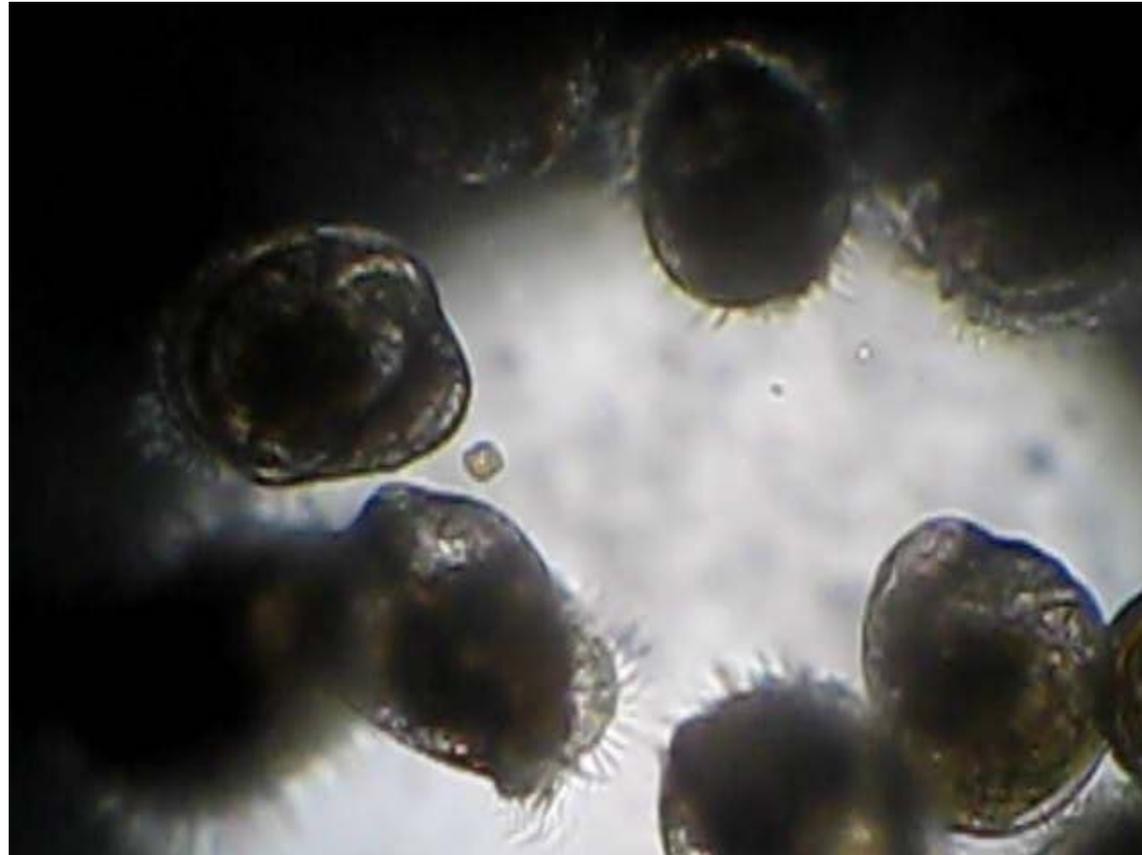
SEM photo: OSU Brunner/Waldbusser

~ 1 week old oyster larvae

Feeding and
swimming
organ (velum)



Swimming oyster larvae



Extensive media coverage

Los Angeles Times

Oceans' rising acidity a threat to shellfish — and humans

As carbon dioxide continues to build up in the atmosphere as a result of burning fossil fuels, the seas absorb much of it. The full effects have yet to be felt.


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Workers harvest oysters in Samish Bay, Wash., at low tide. Scientists have found that the rising acidity of the oceans is preventing the protective shells of some Pacific oysters from developing. (Liz O. Baylen, Los Angeles Times / June 21, 2008)

As Oysters Die, Climate Policy Goes on the Stump

By CORAL DAVENPORT AUG. 3, 2014



Washington
Governor
Jay Inslee

Me

Gov. Jay Inslee, left, with Bill Dewey of Taylor Shellfish Farms during a tour of the company's Quilcene, Wash., hatchery in June. Matthew Ryan Williams for The New York Times

The New York Times

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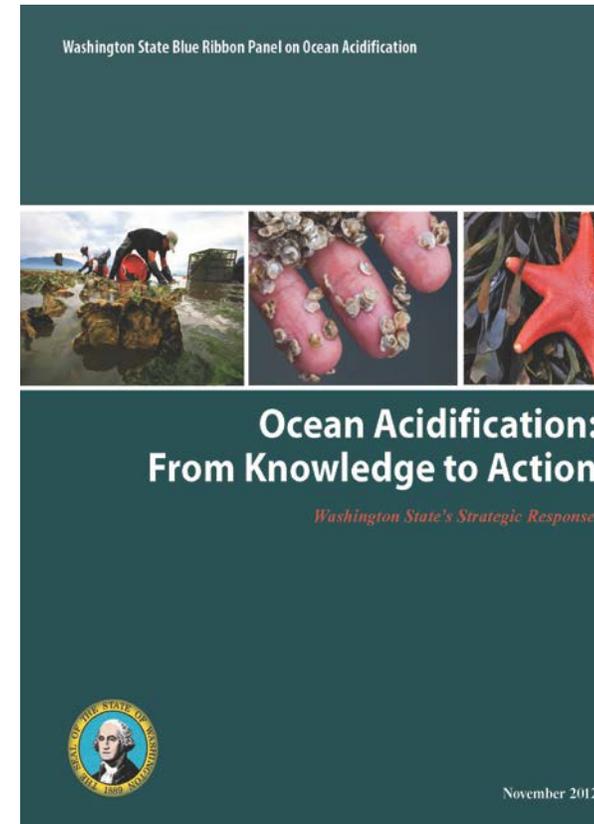
OLYMPIA, Wash. — Billions of baby oysters in the Pacific inlets here are dying and Gov. Jay Inslee of Washington is busy spreading the bad news.

"It used to be the canary in the coal mine," Mr. Inslee said in a recent interview. "Now it's the oyster in the half shell. You can't overstate what this means to Washington."

Outstanding government response



Washington Governor Christine Gregoire



Panic/Adaptation

- Ramped up monitoring and research
- Treating hatchery rearing water
- Breeding OA resistant oysters
- Expanded seed production in Hawaii
- Experimenting w/ seaweed/seagrass refuges



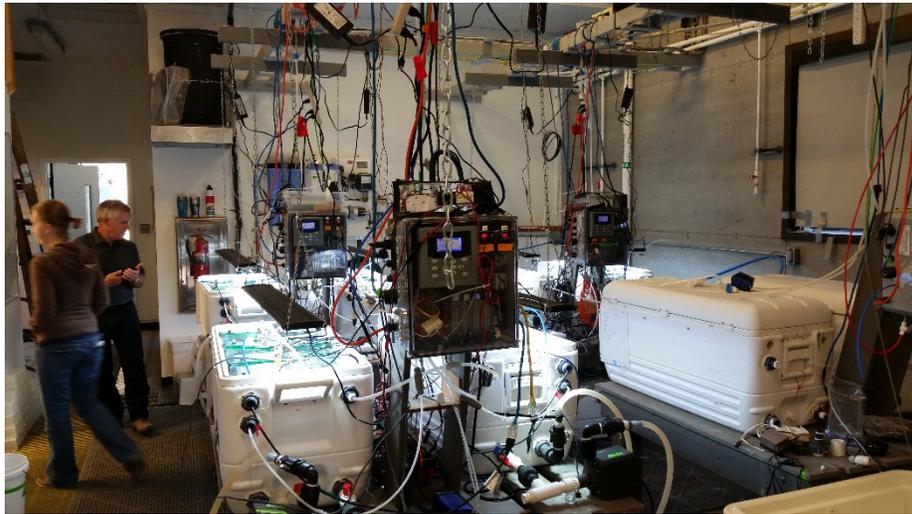
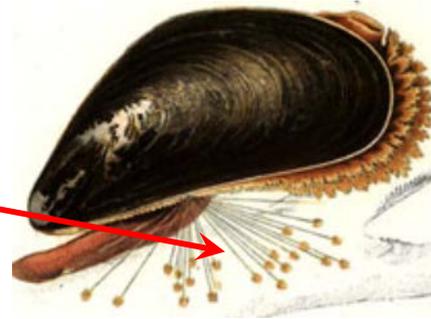
Red Box Pictures

Seaweed/Seagrass refuge



OA impact on mussels

- University of Washington research
- Weaker byssal threads
- Thinner shells



Outstand monitoring collaborations

- Industry scientists and facilities
- ENGO's (e.g. Global Ocean Health)
- University scientists and technology
- National Oceanographic and Atmospheric Administration (NOAA)
 - Integrated Ocean Observing System (IOOS)
 - Ocean Acidification Program (OAP)



U.S. IOOS is an integrative collaboration of 11 Regional Associations; 17 Federal Agencies

IOOS
INTEGRATED OCEAN OBSERVING SYSTEM

NOAA

NATIONAL SCIENCE FOUNDATION

NASA

ENVIRONMENTAL PROTECTION AGENCY

OCEANOGRAPHER OF THE NAVY

DEPARTMENT OF STATE

U.S. COAST GUARD

DEPARTMENT OF TRANSPORTATION UNITED STATES OF AMERICA

CSREES
EDUCATION RESEARCH USDA NUTRITION

DEPARTMENT OF ENERGY UNITED STATES OF AMERICA

U.S. MARINE MAMMAL COMMISSION

BOEM
BUREAU OF OCEAN ENERGY MANAGEMENT

ONR
DEPARTMENT OF THE NAVY
Science & Technology

USGS

US Army Corps of Engineers

FDA

UNITED STATES ARCTIC RESEARCH COMMISSION

'Like putting headlights on a car'
Pacific oysters gain from IOOS® data

About six years ago, production at some Pacific Northwest oyster hatcheries began declining at an alarming rate, posing severe economic impact and challenging a way of life held by shellfish growers for more than 130 years.

By 2008, the oyster harvest at Whiskey Creek, a major Oregon supplier to the majority of West Coast oyster farmers, plummeted 80 percent. At about the same time, corrosive, acidified seawater was hitting the shores of the Pacific.

Something had to be done. Oyster production accounts for more than \$84 million of the West Coast shellfish industry, which supports more than 3,000 jobs.

"When you see oyster shells dissolving in water, there's a compelling need to know why," says Bill Dewey of Taylor Shellfish Farms in Washington state.

Thanks to a \$500,000 federal investment in monitoring coastal seawater strengthened by data and observational information from the U.S. **Integrated Ocean Observing System (IOOS®)** and the **NOAA Ocean Acidification Program**, oyster hatcheries on the verge of collapse just a few years ago are again major contributors to the \$111 million West Coast shellfish industry.

IOOS is a NOAA-led interagency and regional effort aimed at "knowing" — that



IOOS partners in the Northwest Association of Networked Ocean Observing Systems (NANOOS) deployed this buoy in 2010 as part of a three-piece observing array to assess issues in the Northwest, including **ocean acidification**, **hypoxia** and **harmful algal blooms**, and **climate change**. The coastal buoy will aid computer models that predict ocean and atmospheric conditions. Known as "Chá bá," the buoy is named for the Native American word (pronounced "chay buh") for "whale tail."

(Photo courtesy of Dr. John Payne, Pacific Ocean Shelf

"Putting an IOOS buoy in the water is like putting headlights on a car. It lets us see changing water conditions in real time," says Mark Wiegardt, co-owner of Whiskey Creek Shellfish Hatchery.



International Alliance to Combat Ocean Acidification



- Announced at State Department's Our Oceans conference (Sept. 2015)
- Being spearheaded by the Pacific Coast Collaborative
- Goals:
 - *advance scientific understanding of OA*
 - *reduce the causes of OA*
 - *protect the environment and coastal communities from impacts of a changing ocean*
 - *expand public awareness and understanding of OA*
 - *build sustained support for tackling OA problem*
 - *actively seek inclusion of ocean acidification mitigation and adaptation commitments in the COP 23 international climate agreement*
- <http://oaalliance.org/>

In summary

- Ocean Acidification is a critical international issue that is altering the oceans chemistry at a startling rate
- These changes are impacting west coast shellfish now
- It requires coordinated local and oceanic monitoring to understand its impacts and to facilitate adaptation
- There is a global need to share information on ocean acidification research and adaptation strategies

Contact information

Bill Dewey

Email: billd@taylorshellfish.com

Cell: (360) 790-2330