Impacts of Ocean Acidification on the Shellfish Industry

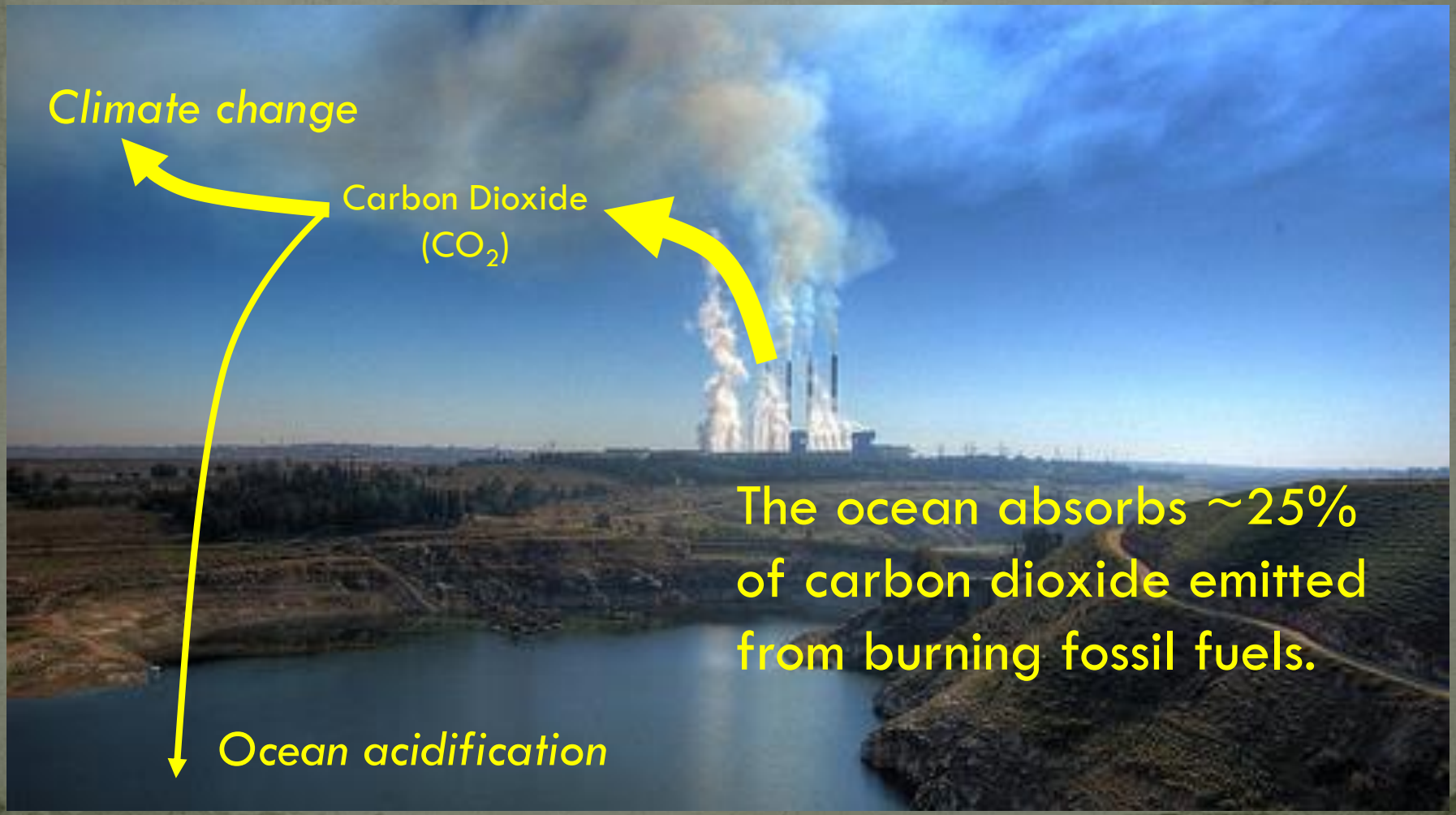
Bill Dewey
Taylor Shellfish Farms




Overview

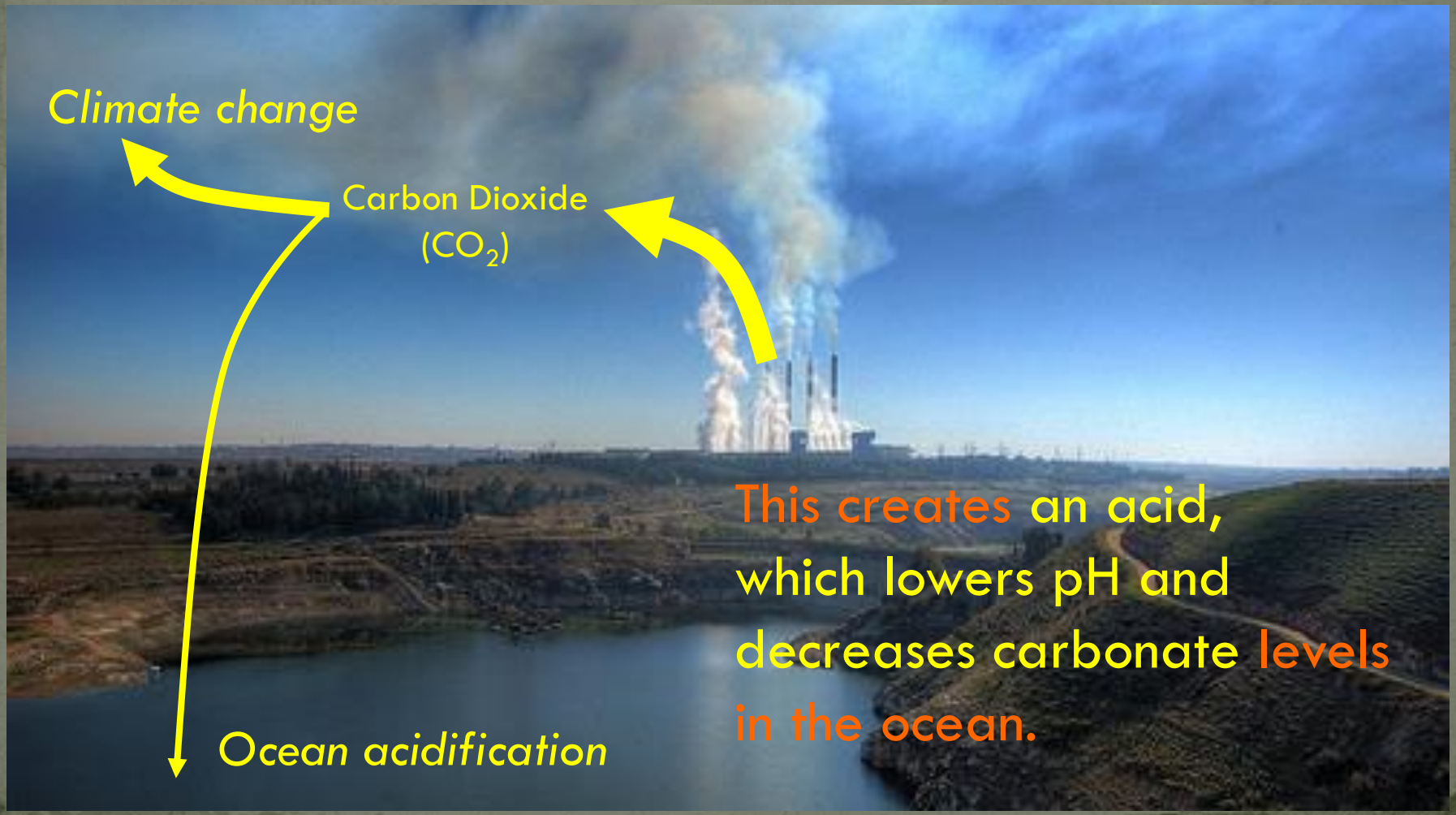
- Ocean acidification
- Impacts on shellfish growers
- What we are doing in response

What is ocean acidification?



Sarah R. Cooley (scooley@whoi.edu)

What is ocean acidification?



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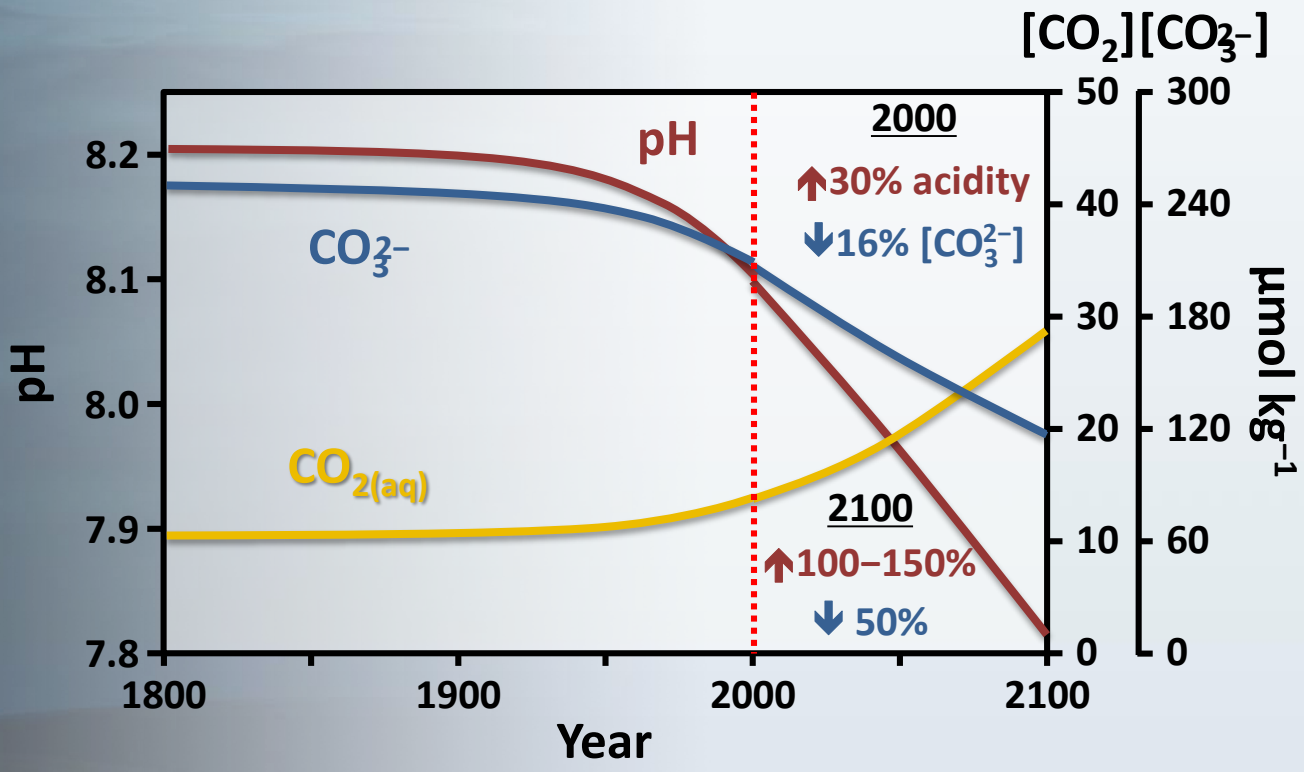
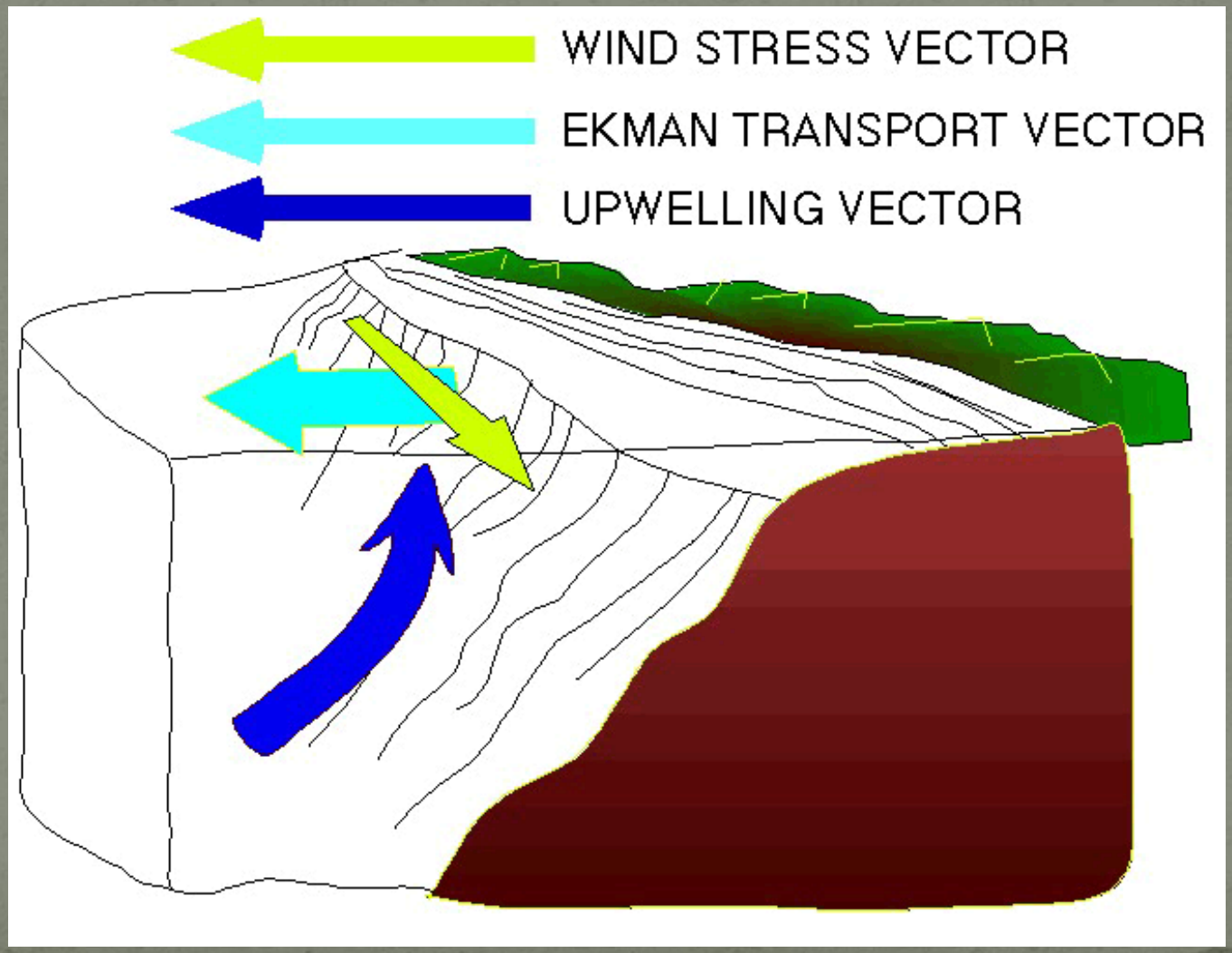
Ocean chemistry changes

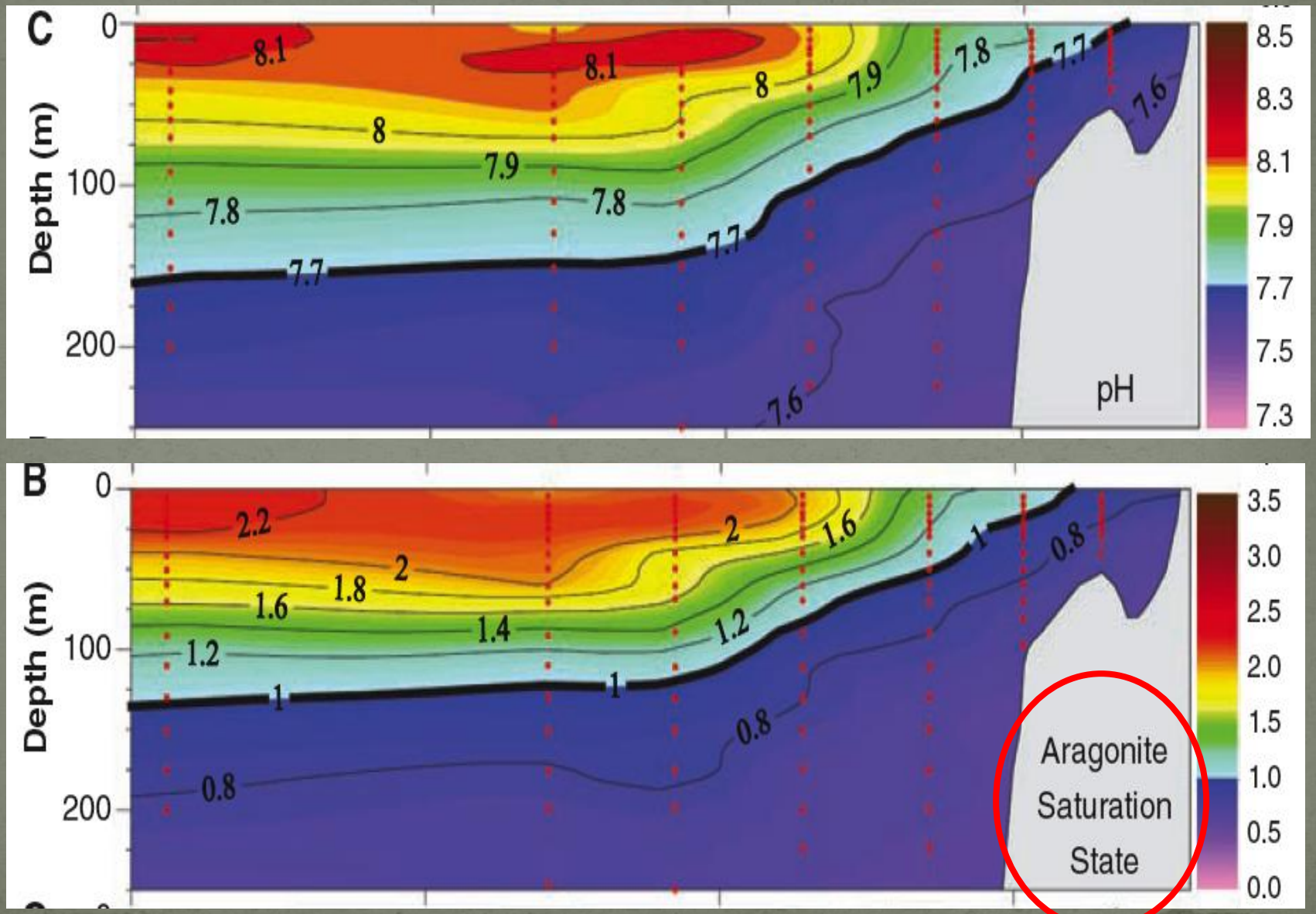


Wolf-Gladrow et al. (1999)

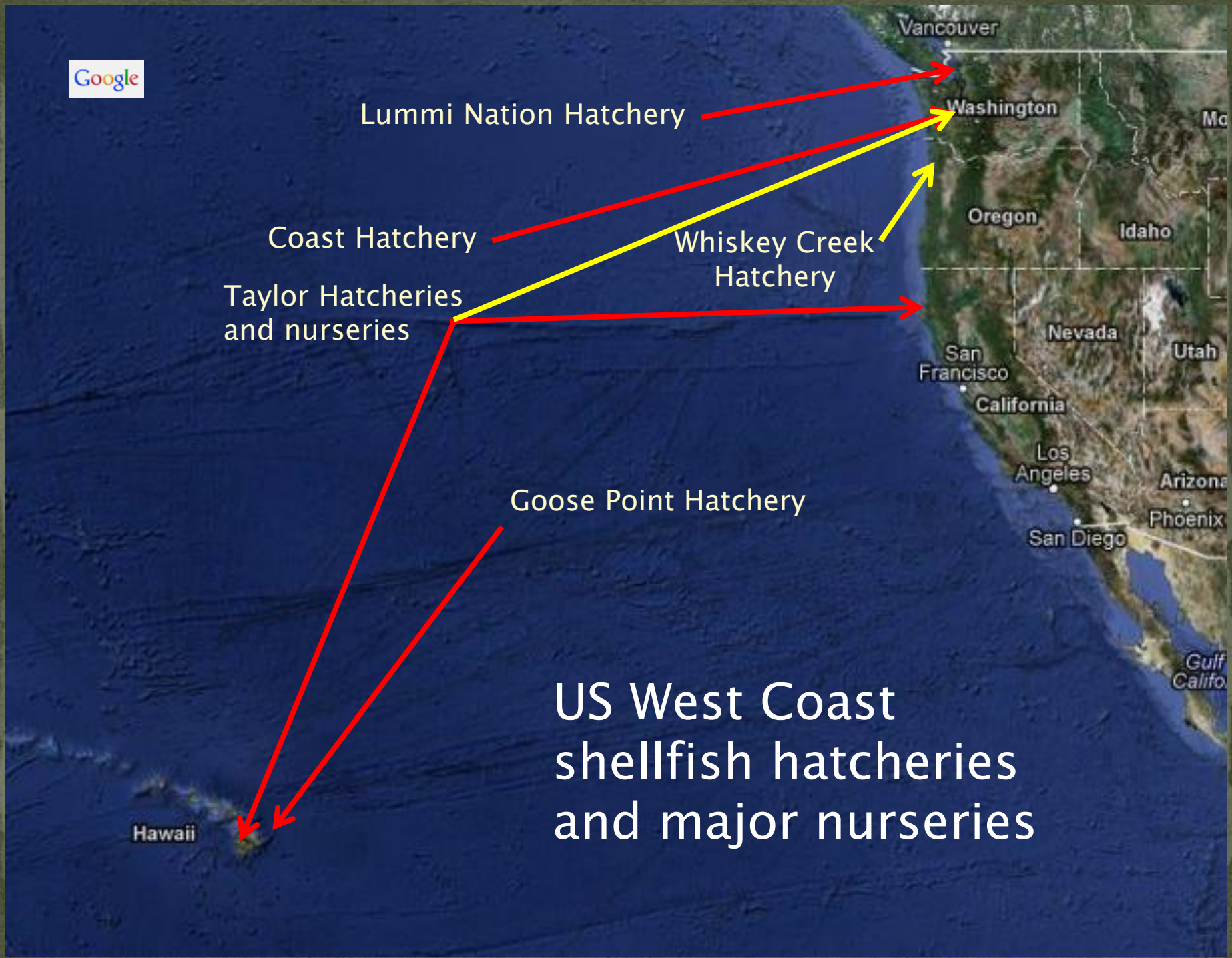
Upwelling on the U.S. West Coast
High CO2, low pH, low aragonite saturation brought to the surface with north winds



Vertical section off St. George, California summer 2007



Feely et *al.* 2008. Science 320: 1490 - 1492

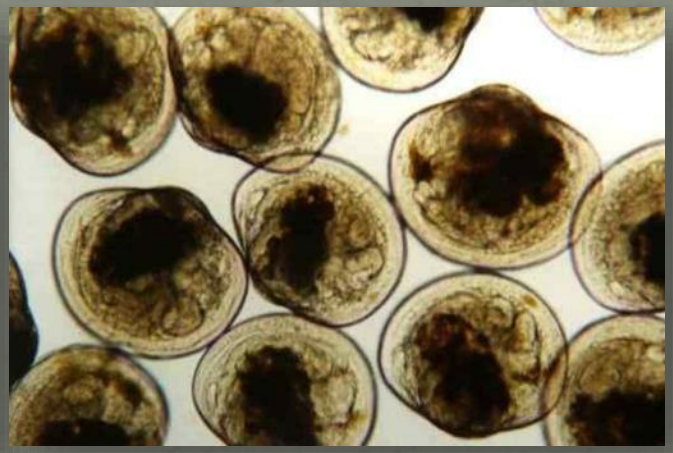


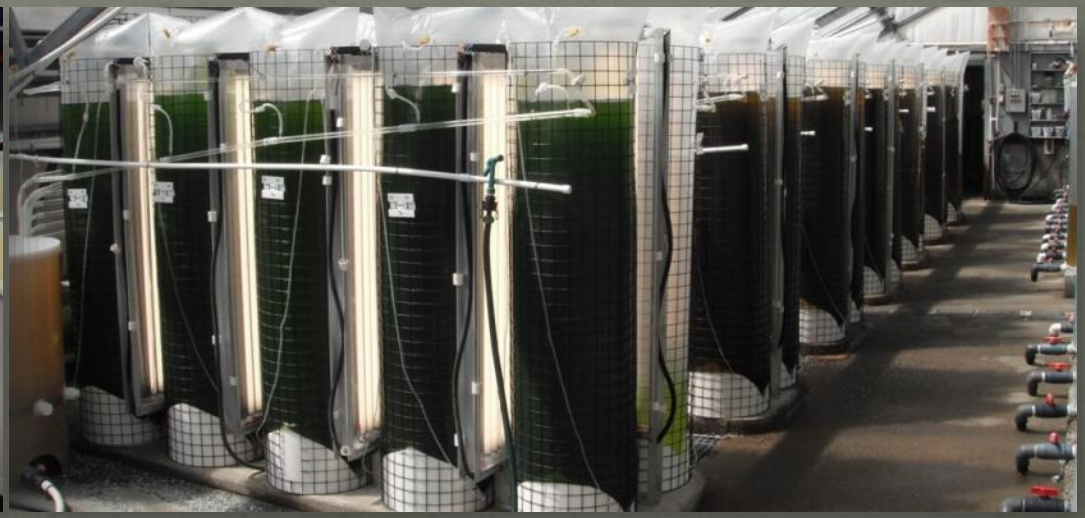
US West Coast shellfish hatcheries and major nurseries

Shellfish seed production

Taylor Shellfish Farms Hatchery
Dabob Bay, Washington (USA)

Shellfish seed production



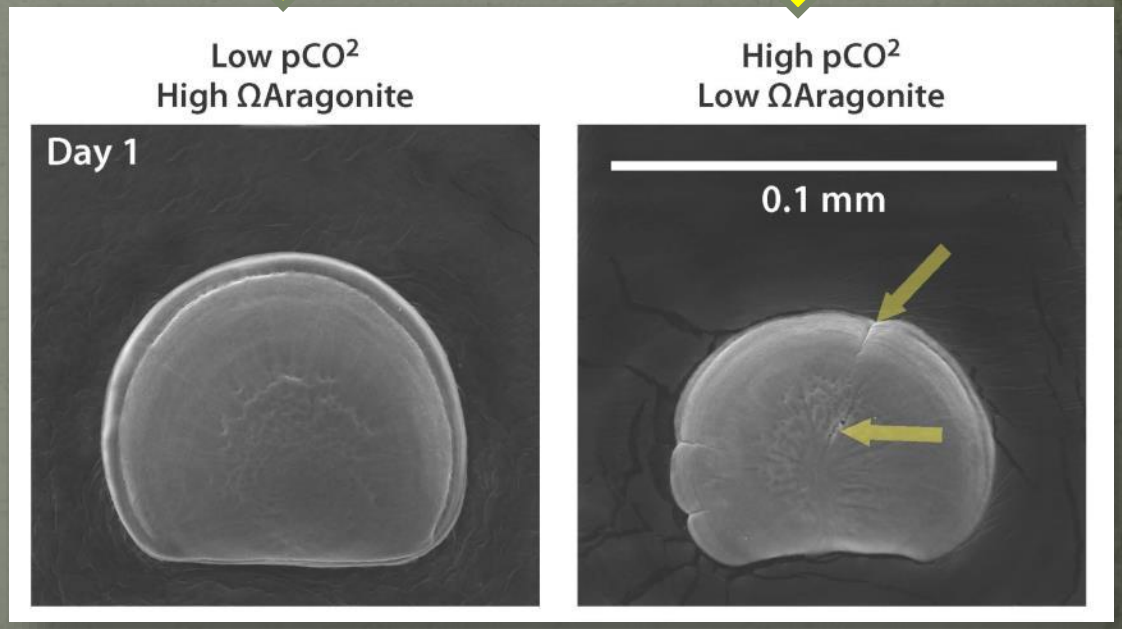


Taylor Shellfish oyster larvae

- First two days of life Pacific oyster larvae precipitate ~ 90 percent of their body weight as calcium carbonate shell
- Do this with energy derived from the egg
- With low aragonite they expend too much energy building shell
- Not enough left to build their feeding mechanism
- Stressed and/or die

Shallow water intake
pH = 8.0
High Ω Aragonite

Deep water intake
pH = 7.49
Low Ω Aragonite

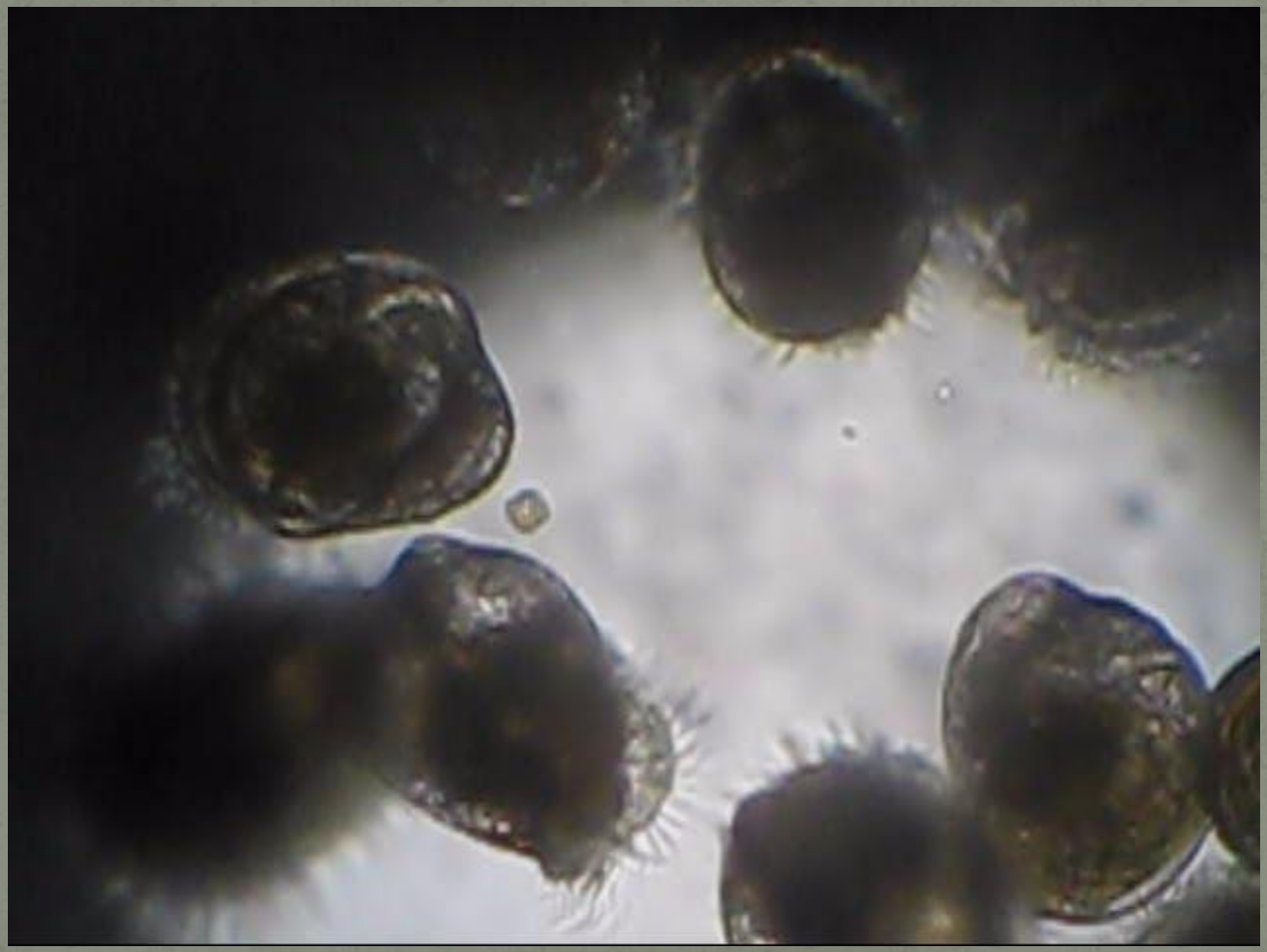


SEM photo: OSU Brunner/Waldbusser

Oyster larvae

Feeding and motatating appendage (velum)

Oyster larvae



Los Angeles Times | LOCAL

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.

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)

The Seattle Times SEA CHANGE: Overview Updates Discuss Photos Video Map

Ocean acidification, the lesser-known twin of climate change, threatens to scramble marine life on a scale almost too big to fathom.

http://apps.seattletimes.com/reports/sea-change/2013/sep/11/pacific-ocean-perilous-turn-overview/

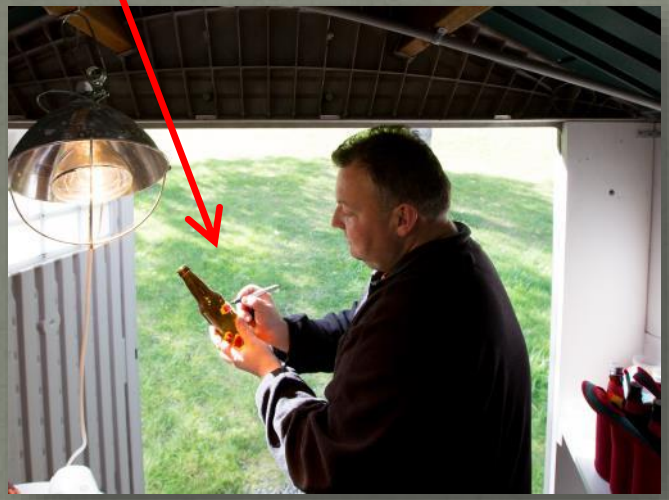
Expanded industry collaboration

- Pacific Coast Shellfish Growers Association working to:
  - Resolve seed shortage for industry
  - Secure funding for monitoring, research & modeling
- Sharing lessons learned between facilities

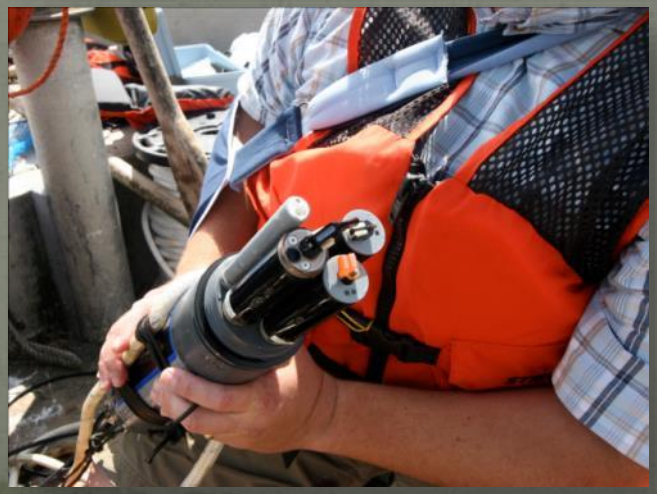
www.pcsga.org

Ramped up monitoring

Beer bottle



Burkilator



Ramped up research

- Industry scientists dedicated to improving hatchery production
- Collecting & interpreting data
- Experimenting with various water treatments
- Expanded collaboration with University and Government scientists

Evaluating breeding as potential adaptation tool

- Sea Grant funded research assessing early exposure to ocean acidification on subsequent performance and genetic parameters for an effective breeding program
- Oregon legislature appropriated funding to support efforts at the Hatfield Marine Science Center to develop oysters more tolerant to ocean acidification

Increased seed production capacity in Hawaii

- Taylor Shellfish doubling oyster larvae production capacity at existing facility in Kona
- New Goose Point Oyster Company hatchery in Hilo

Increased capacity at Taylor's Dabob Bay, Washington hatchery

Treating hatchery intake water

- Water treatment systems installed in Whiskey Creek's Netarts Bay hatchery and Taylor Shellfish Dabob Bay hatchery
- Injecting sodium carbonate in response to real-time monitoring to increase availability of carbonate ions for larvae to build shell.
- Targeting Ω of 3.0

Expanded outreach & education

- Local, national and international media attention
- Documentaries
- Speaking at various forums on ocean acidification
- Participating in public policy discussions

Secretary of State Kerry's Our Ocean conference

THE SECRETARY OF STATE
OF THE UNITED STATES OF AMERICA

INVITES YOU TO

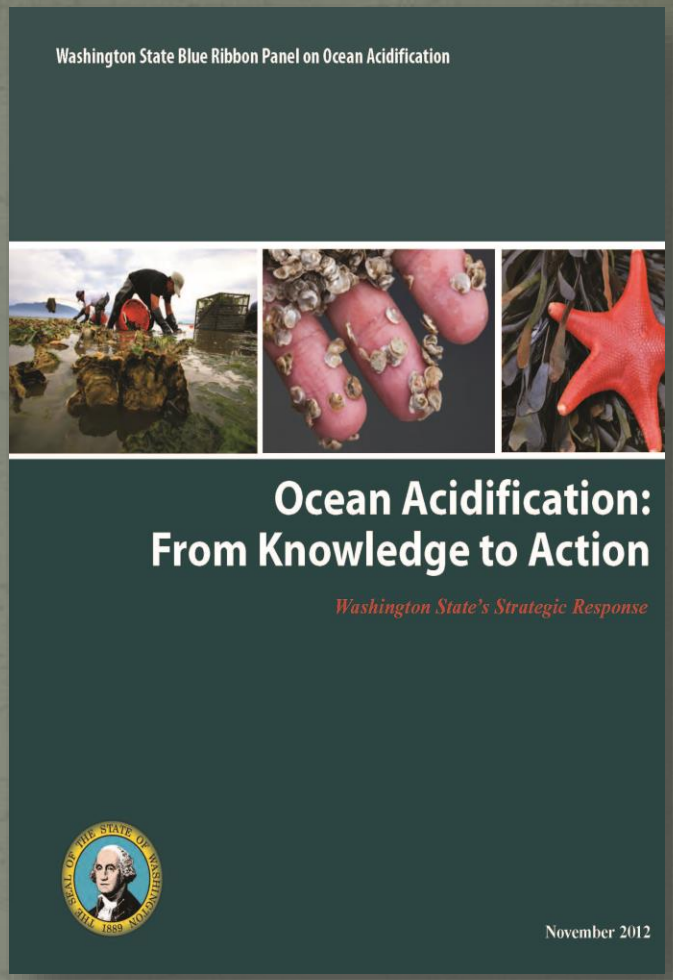
OUR OCEAN
US Department of State

JUNE 16-17, 2014

CONFERENCE TO BE HELD AT THE
US DEPARTMENT OF STATE
2201 C STREET, NW
WASHINGTON, D.C.

Please complete the attached form and submit no later than Friday, May 2nd
to ProtocolRSVP@state.gov

Washington State Governor Christine Gregoire



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

Governor Gregoire's Executive Order 12-07

CHRISTINE O. GREGOIRE
Governor

STATE OF WASHINGTON
OFFICE OF THE GOVERNOR
P.O. Box 40002 · Olympia, Washington 98504-0002 · (360) 753-6780 · www.governor.wa.gov

EXECUTIVE ORDER 12-07

WASHINGTON'S RESPONSE TO OCEAN ACIDIFICATION

WHEREAS, acidification of the world's oceans, measured by the lowering pH numbers and caused primarily by increasing levels of carbon dioxide in the atmosphere, has arrived on the West Coast sooner than predicted and is already reaching levels that are corrosive for shellfish and other marine organisms; and

WHEREAS, Washington's marine waters are particularly vulnerable to ocean acidification because they experience the effects of global carbon dioxide absorbed by the oceans in addition to regional and local factors. One of the most important regional factors is coastal upwelling, which occurs when strong northerly winds blow across the Pacific Ocean, bringing deeper water up to the surface, along the Washington coast, into coastal estuaries like Willapa Bay and Grays Harbor, and the Puget Sound basin. Today's upwelled water is rich in carbon dioxide and low in pH and oxygen, and was in contact with the atmospheric concentration of carbon dioxide from 30 to 50 years ago, meaning we will continue to see acidification for several decades after global carbon dioxide emissions begin to fall; and

WHEREAS, acidification near the coasts, and particularly in highly populated and developed areas, is often exacerbated by local sources of pollutants, such as nutrients and organic material, that generate additional carbon dioxide in marine waters; and

WHEREAS, between 2005 and 2009, the Pacific Northwest oyster hatcheries experienced disastrous production failures when billions of their youngest oysters, the larvae, died due to acidified seawater that dissolved shells or prevented their formation; and

WHEREAS, Washington is the country's top provider of farmed oysters, clams, and mussels. Our shellfish growers employ directly and indirectly more than 3,200 people around the state and provide an annual total economic contribution of $270 million statewide. The increasing levels of acidification in Washington's marine waters pose serious and immediate threats to our shellfish resources, and the revenue and jobs supported by the shellfish industry; and

WHEREAS, ocean acidification has important implications to Washington's tribal communities and fishermen who increasingly depend on shellfish species to support their families; and

WHEREAS, increasing levels of acidity also have implications for the broader marine ecosystem because many organisms that are important food sources for species such as salmon, whales, and seabirds, are dependent on their ability to form and maintain shells, skeletons, or other hard parts; and

Washington's Response to Ocean Acidification

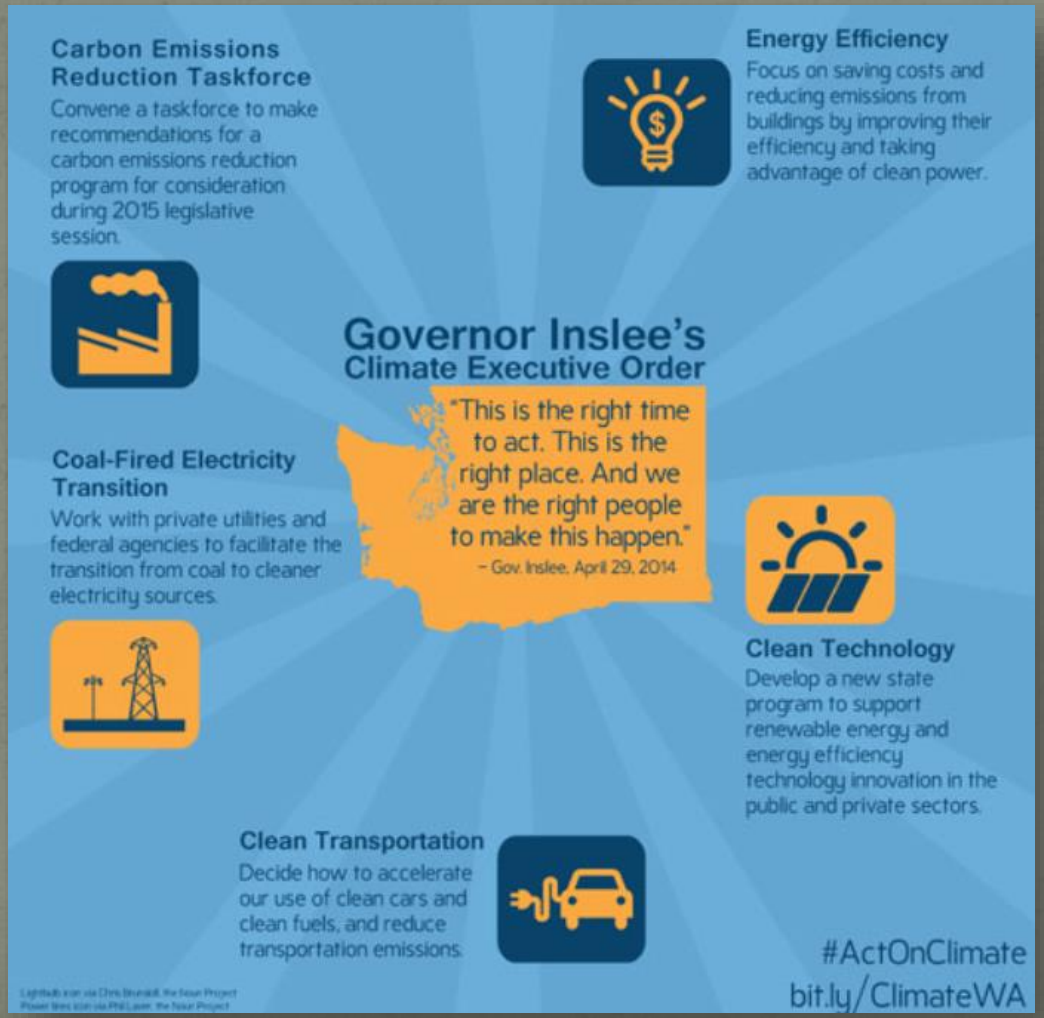
Senate Bill 5603

- Passed legislature June 2013
- Creates the Washington Marine Resources Advisory Council in Governor's office
  - Sustainable coordinated focus to address the impacts of ocean acidification
  - Advise and work with the UW Ocean Acidification Center on effects and sources of ocean acidification
  - To deliver recommendations to the Governor and Legislature
  - To seek public and private funding to assist in effort
  - To do outreach and education on ocean acidification

University of Washington Ocean Acidification Center

- Created by Legislature in June 2013
- Five priority actions:
  - Water quality monitoring at the six existing shellfish hatcheries and rearing areas
  - Expanded and sustained ocean acidification monitoring network
  - Establish the ability to make short-term forecasts of corrosive conditions
  - Laboratory studies to assess the direct causes and effects of ocean acidification
  - Investigate and develop commercial-scale water treatment methods or hatchery designs

Governor Inslee's Executive Order 14-04

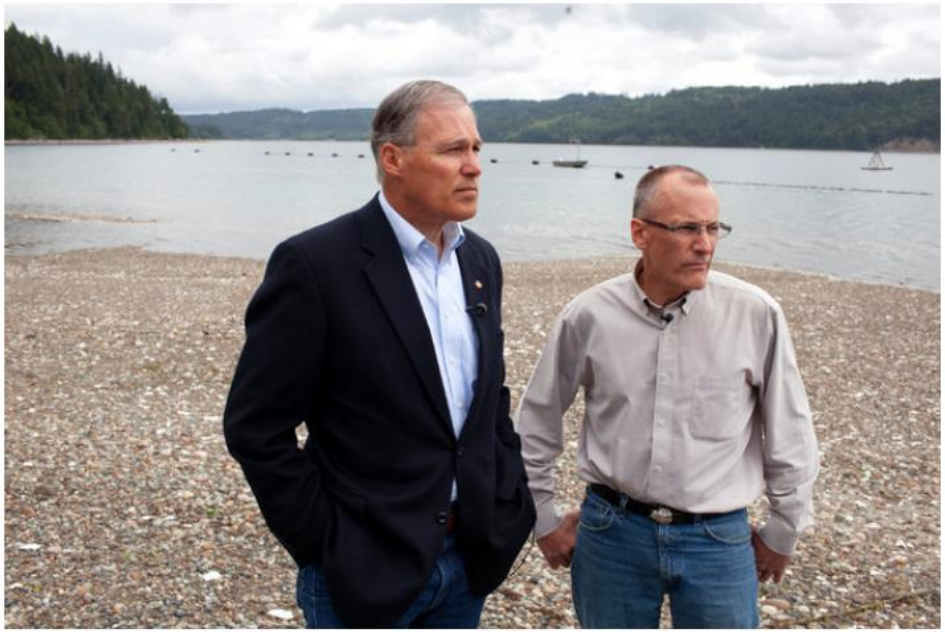


The New York Times

August 3, 2014

As Oysters Die, Climate Policy Goes on the Stump

By CORAL DAVENPORT AUG. 3, 2014



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

EMAIL
FACEBOOK
TWITTER
SAVE

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."

"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."

Pacific Coast Shellfish Growers Association

Climate forum at PCSGA Annual Membership meeting 9/22/14

Washington Shellfish Initiative

WASHINGTON SHELLFISH INITIATIVE

The Washington State Shellfish Initiative is a convergence of the National Oceanic and Atmospheric Administration's (NOAA) National Shellfish Initiative and the State's interest in promoting a critical clean water industry. While the initiative supports Governor Gregoire's goal of a "dig-able" Puget Sound by 2020, it also encompasses the extraordinary value of shellfish resources on the coast. As envisioned, the initiative will protect and enhance a resource that is important for jobs, industry, citizens and tribes.

Overview

Washington State is taking additional action to protect and enhance shellfish resources. This effort supports the long-term goal of abundant shellfish resources for Washington's residents and Native American tribes, as well as a thriving and healthy shellfish aquaculture industry. As an outcome of the 2007 treaty rights settlement, many Puget Sound tribes are undertaking shellfish aquaculture as a means of enhancing shellfish resources for cultural and economic gain.

We recognize and respect that shellfish aquaculture and commercial and tribal harvest of wild shellfish resources are water-dependent uses that rely on excellent water quality. Shellfish also can help filter and improve the quality of our marine waters thereby being part of the solution to restore and preserve the health of endangered waters. We can have healthy marine waters and productive shellfish beds for a growing industry, Native American tribes and for all the citizens of Washington.

The Puget Sound Partnership has targeted a net increase from 2007 to 2020 of 10,800 harvestable shellfish acres, which includes 7,000 acres where harvest is currently prohibited in Puget Sound. However, the recent shellfish downgrade in Samish Bay is a reminder of the constant vigilance needed by landowners, businesses and local, state, federal and tribal governments to protect and restore shellfish beds. Such efforts also are required on the coast where there is considerable opportunity to enhance shellfish resources.

To restore and expand shellfish resources, Washington must renew its protection, restoration and enhancement efforts. These efforts will pay off in increased recreation, additional clean water jobs, and a healthier Puget Sound and coastal marine waters.

Shellfish: Jobs and Economic Opportunity

Shellfish are critical to the health of Washington's marine waters and the state's economy. Washington leads the country in production of farmed clams, oysters and mussels with an annual value of over $107 million. Washington shellfish growers directly and indirectly employ over 3,200 people and provide an estimated total economic contribution of $270 million. Surveys from the early 2000's indicate shellfish growers are the largest private employer in Pacific County and the second largest in Mason County. In just those two counties, they generate over $27 million annually in payroll. In addition, there is ceremonial and subsistence harvest in Puget Sound and coastal waters that tribes consider invaluable and unquantifiable.

Bivalves coming from Washington's cool clean waters are prized as some of the best in the world. This reputation has ensured that domestic and international demand for them has long exceeded

- Launched 12/9/11
- Included formation of OA Blue Ribbon Panel
- Julie Horowitz – Governor Inslee shellfish policy advisor
  - She is overseeing implementation of WSI and BRP actions
- Re-launch in the works

Washington State's OA webpage:

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

UW Ocean Acidification Center webpage:

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

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Questions?