Ocean Acidification:
What's already happening with Shellfish in the Pacific Northwest

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Los Angeles Times | ENVIRONMENT

A warning from the sea

Oyster 'seeds' are dying as Pacific Coast waters grow warmer.

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ALSO

Graphic: Oyster farming

By Kenneth R. Weiss
Los Angeles Times Staff Writer
July 13, 2008

QUILCENE, WASH.— For decades, the unwritten motto at shellfish hatcheries in the Pacific Northwest was "Better oysters through science."

- Initial seed failures attributed to naturally occurring bacteria, *Vibrio tubiashi*

July 13, 2008
Kenneth Weiss

Is the Pacific Ocean's chemistry killing sea life?

Craig Welch
Seattle Times
6/14/2009

The Seattle Times
Sunday
JUNE 14, 2009
seattletimes.com
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OYSTERS IN DEEP TROUBLE

Is the 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.

Northwest's top 100 companies? Nope, just 87 this year

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Fury erupts in Iran after contested vote

OYSTERS IN DEEP TROUBLE

< Oysters

LARVAE DYING BY THE BILLIONS

Possible factor: Corrosive water, which can dissolve shells, eat away at corals and kill fish eggs

Ripple effects for fish

"Growers are scrounging"

Asking for help

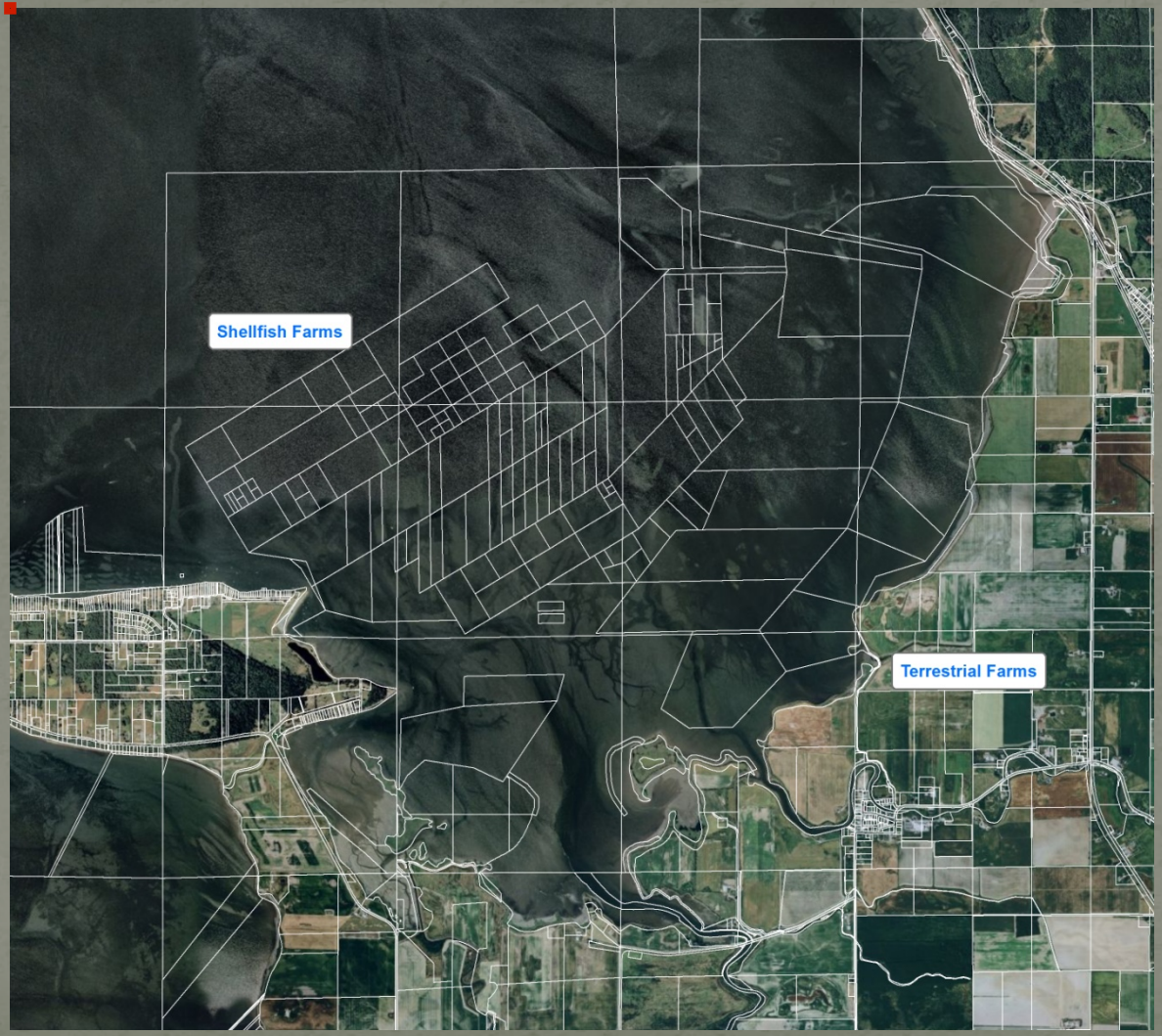
Economic value west coast farmed shellfish production

STATE	OYSTERS	CLAMS	MUSSELS	GEODUCKS	TOTAL
Washington	27,669 M/T	4,309 M/T	1,247 M/T	748 M/T	33,974 M/T
	$57.75 million	$19.55 million	$3.16 million	$20.1 million	$100.56 million
California	4,205 M/T	34 M/T	46 M/T	No record	4,684 M/T
	$12.36 million	$0.83 million	$0.95 million		$14.14 million
Oregon	1,080 M/T	No record	No record	No record	1,080 M/T
	$2.25 million				$2.25 million
Alaska	94 M/T	3.6 M/T	0.9 M/T	No record	98 M/T
	$0.44 million	$24,841	$6,610		$473,232
Total	33,048 M/T	4,658 M/T	1,391 M/T	748 M/T	39,845 M/T
	$72,806,242	$20,404,841	$4,114,110	$20,100,000	$117,425,193

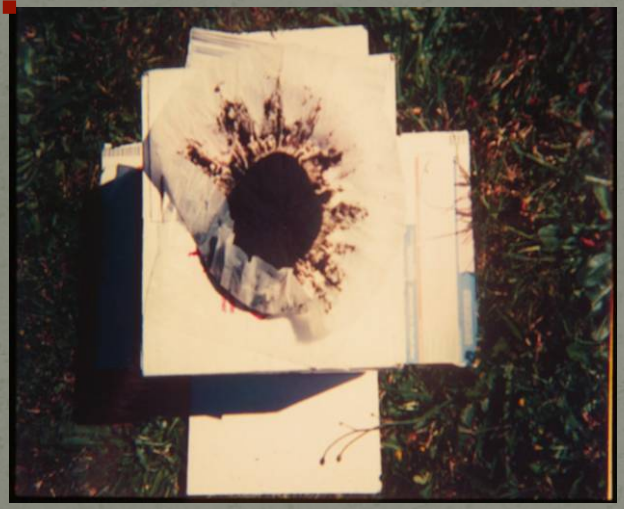
	OYSTERS	CLAMS	MUSSELS	GEODUCKS
% of shellfish	83	11.7	3.5	1.8
% of sales ($)	62	17.4	3.5	17.1

- An estimated 3,000 jobs are provided directly by shellfish culture
- Total economic impact for oysters with services, suppliers etc ~$207 million

Samish Bay Bush Act tidelands



Oyster seed for cluster production



Pacific oyster clusters

Pacific oyster longlines

Harvesting Pacific oyster clusters

Harvesting Pacific oyster clusters

Manila (steamer) clams

Rows of Manila clams

Geoduck clams

Baby geoduck clams

West Coast hatcheries

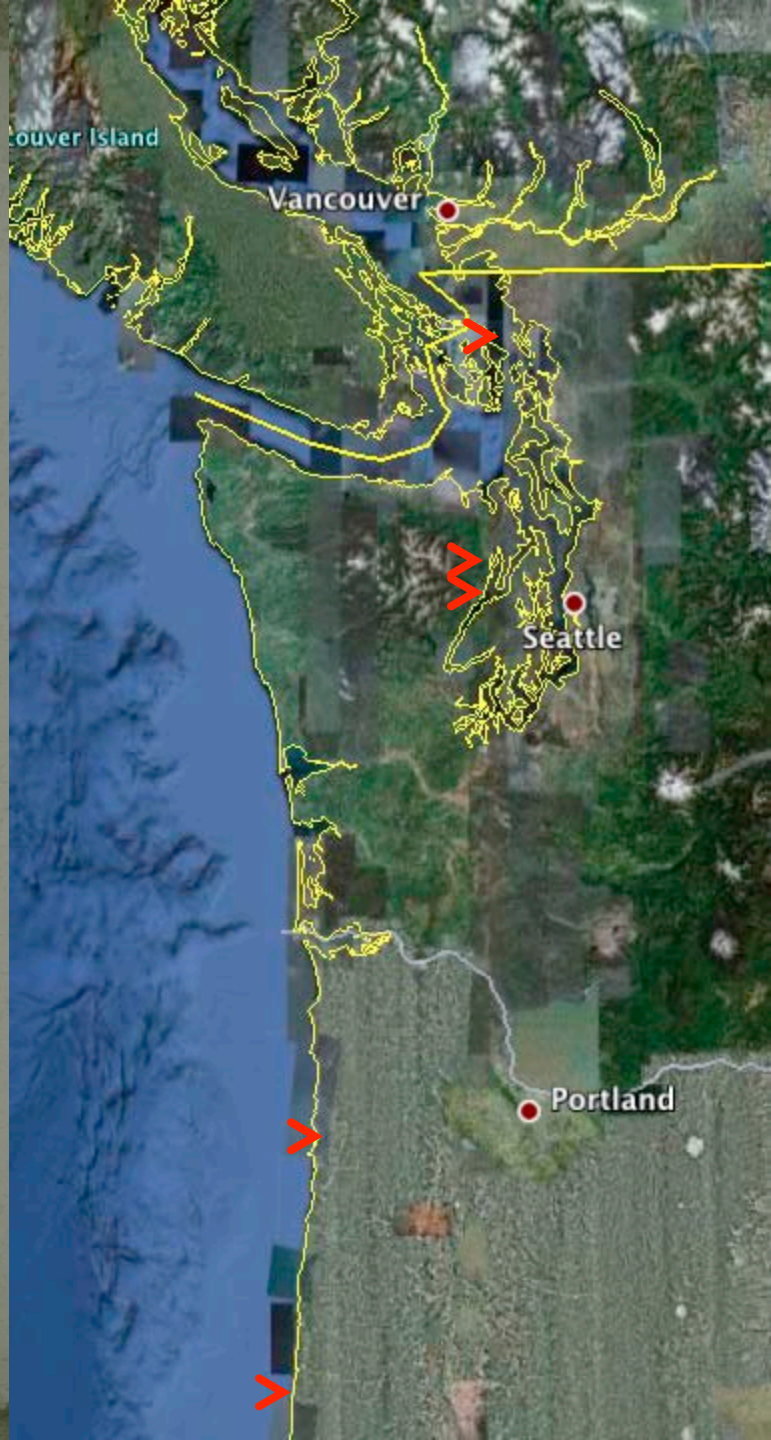
Lummi Hatchery

Taylor Hatchery

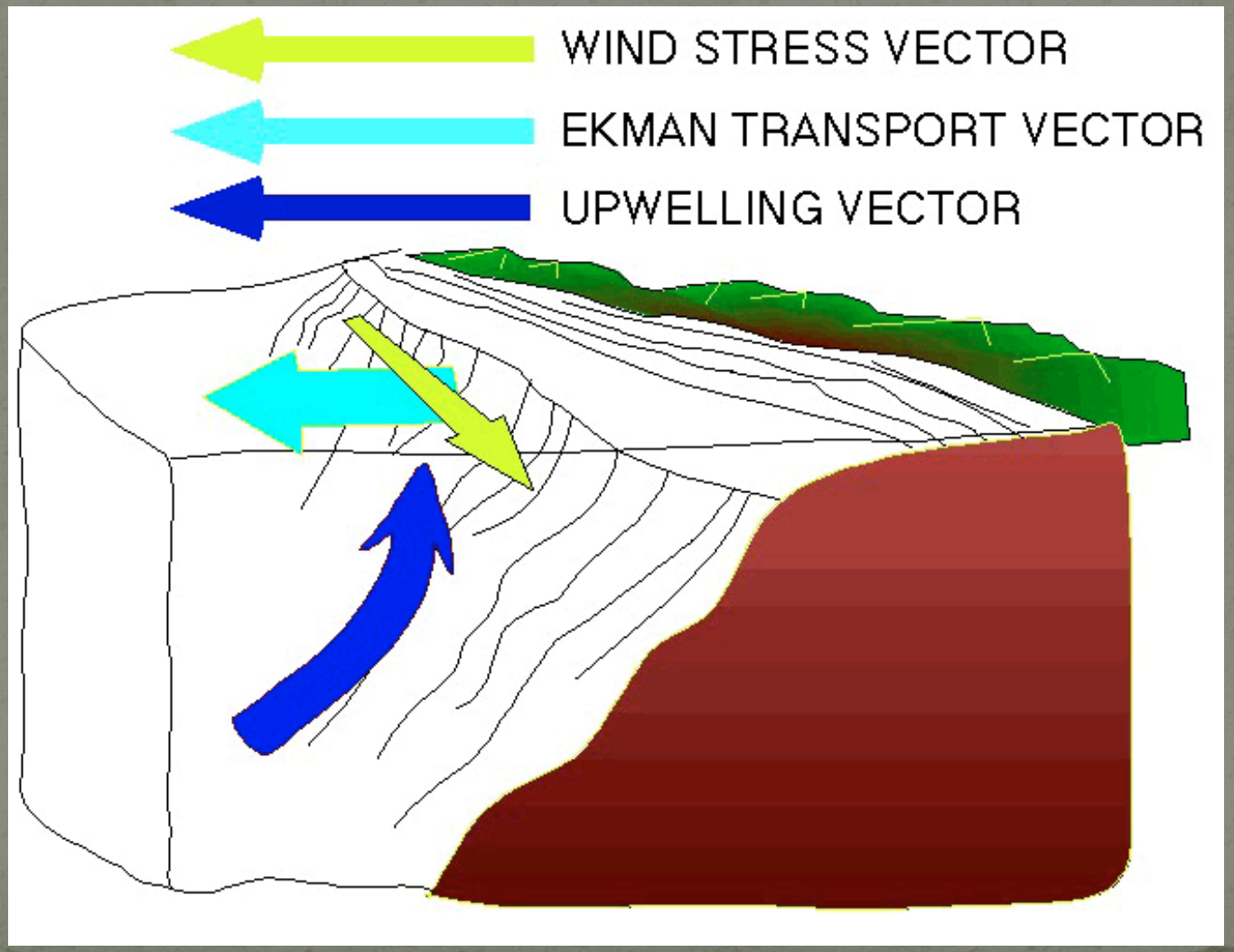
Coast Hatchery

Whiskey Creek Hatchery

MBP Hatfield Center

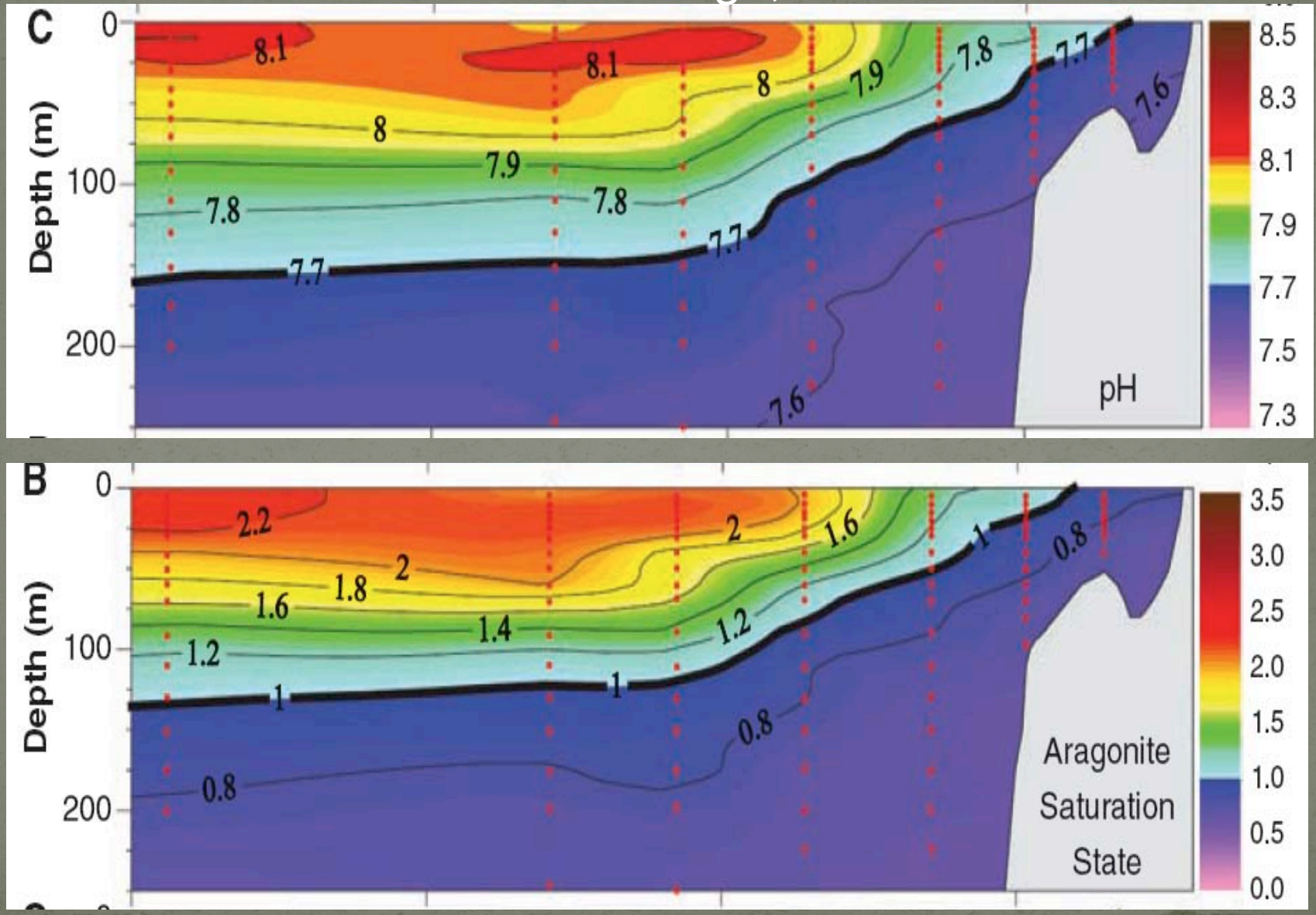


Upwelling on the West Coast
Deep cold nutrient-rich water brought to he surface with north winds



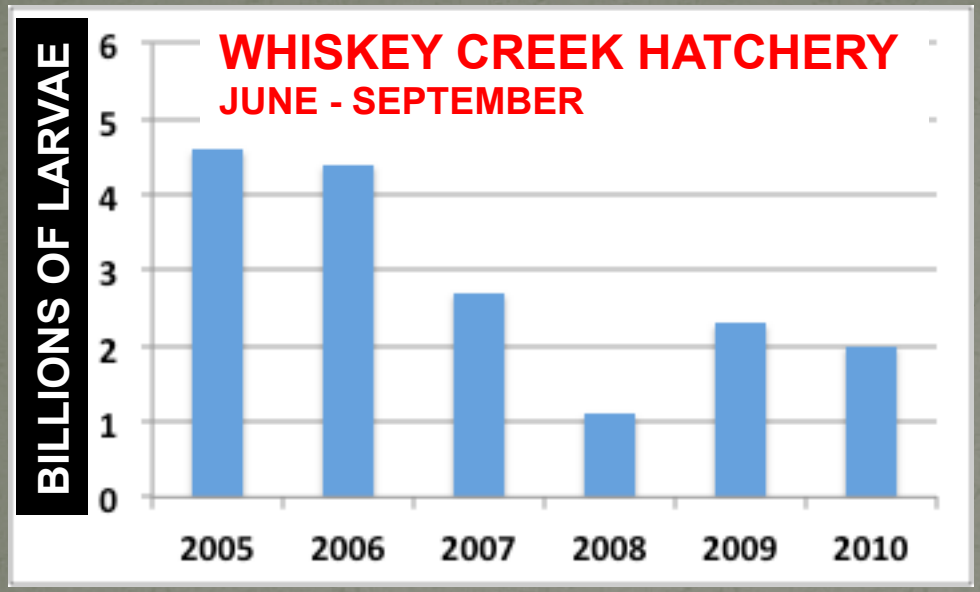
Upwelled deep water is acidic and can be corrosive for aragonite

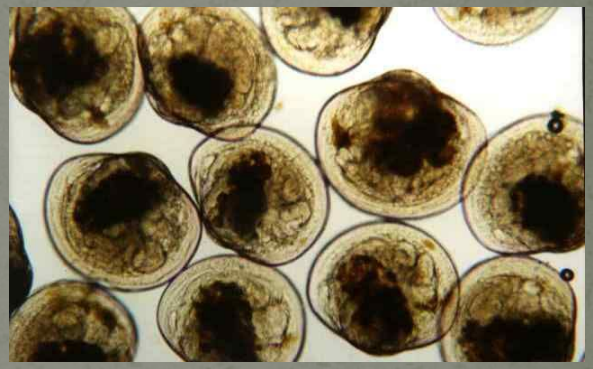
vertical section off St. George, CA. summer 2007

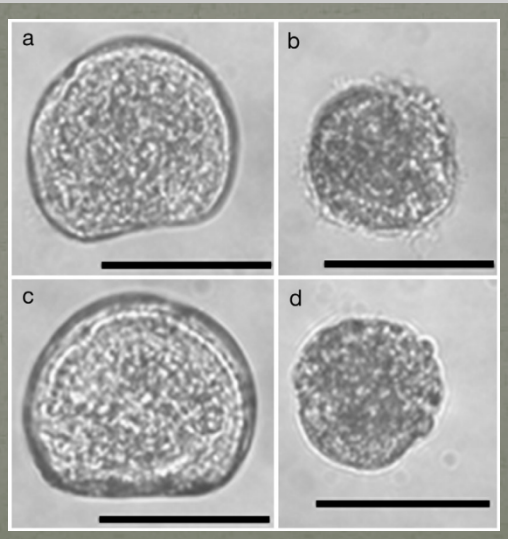


Feely et *al.* 2008. Science 320: 1490 - 1492

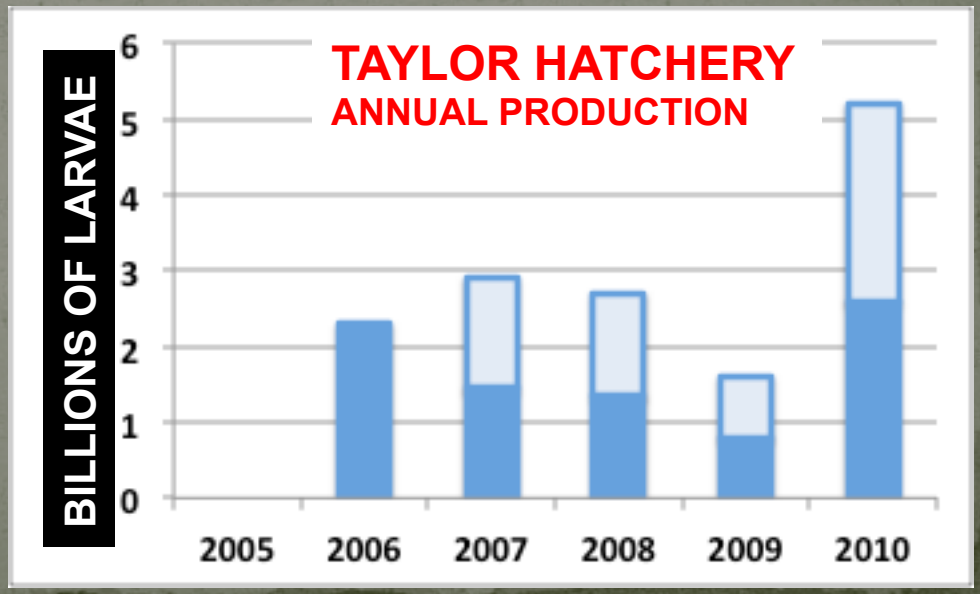
Impacts on larval production from two west coast commercial hatcheries





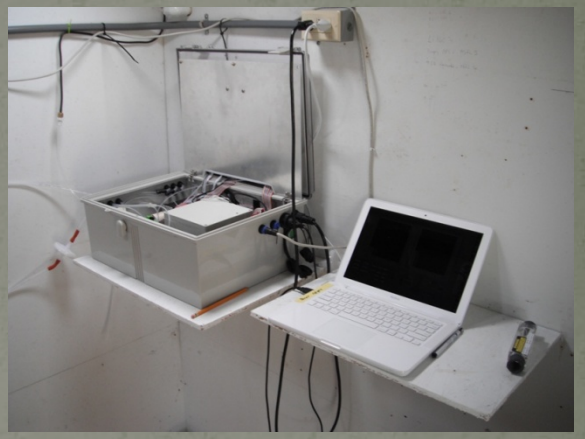


Kurihara et al 2007



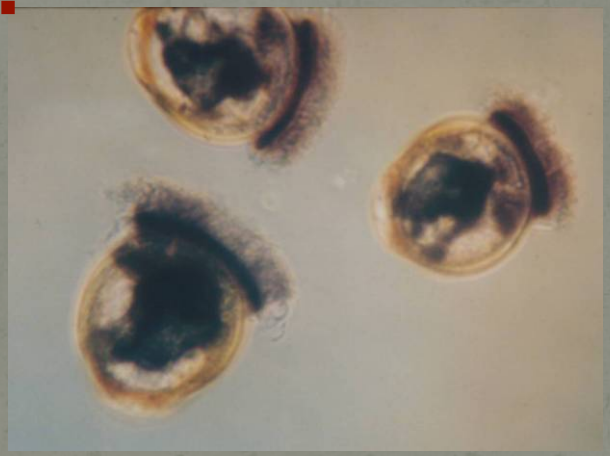
Panic/Adaptation

- Taylor Shellfish – ramped up research and monitoring at Dabob Bay Hatchery
- Expanded larvae production capacity at Kona, Hawaii hatchery to offset Dabob production set backs.



Early life stages most vulnerable

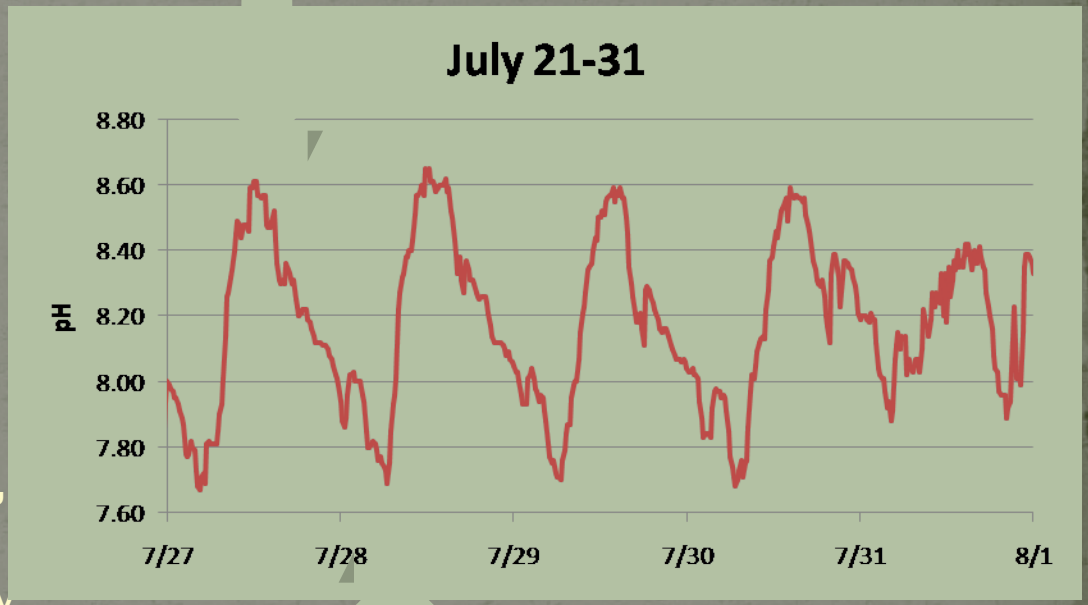
Amorphous calcium carbonate > Aragonite > Calcite



Managing around the problem

- Put small larvae into tanks filled in the afternoon or overnight
  - Works if the sun is out
- 24 hour notice– Upwelling takes a day or two to start up, so when winds from the North, fill tanks late in the day and spawn like crazy

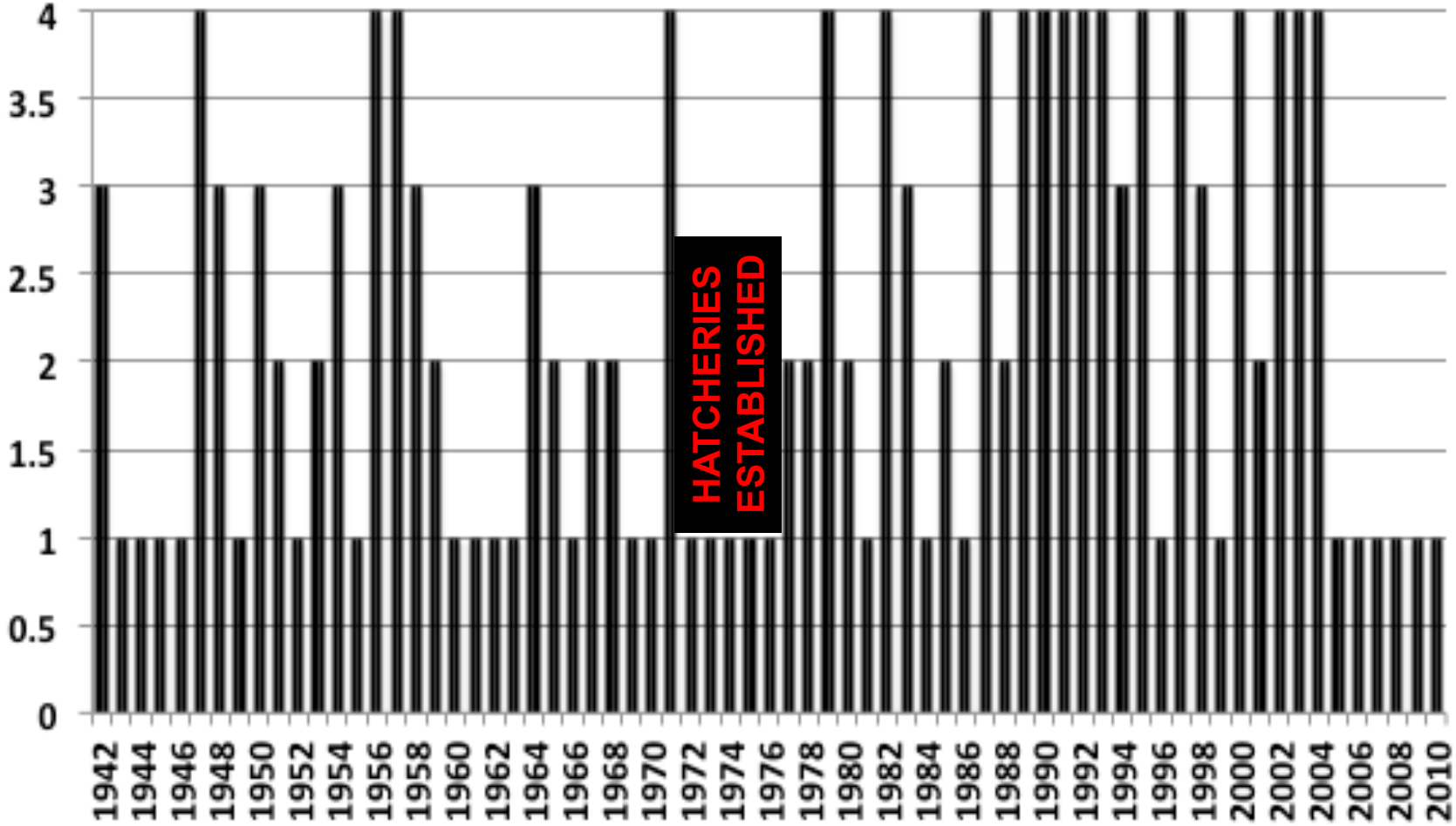
SPAWN!



DON'T SPAWN!

Slide: Alan Barton

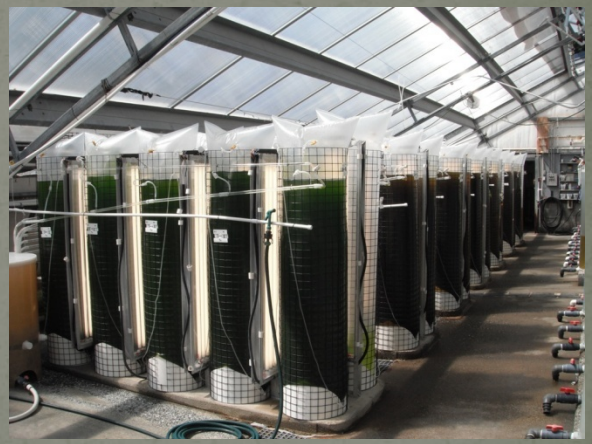
No natural set of Pacific oysters in Willapa Bay, WA for past 6 years



DATA OF WASHINGTON DEPT. FISHERIES AND WILDLIFE

Some of what we don't know

- What characteristics of upwelled water are harmful?
  e.g. pH, PCO2, DIC, DOM, reduced compounds or a combination of these factors
- How does upwelling affect *vibrio tubiashii*?
- How can hatcheries best address the long-term problems



Is the Pacific oyster the canary in the mineshaft?

"Miners would try to alert themselves to dangerous levels of carbon dioxide in a mine shaft by bringing a caged canary with them as they worked. The canary would inevitably die before CO_2 reached levels toxic to people."

Source: Wikipedia

Serinus canaria domestica

Is the Pacific oyster the canary in the mineshaft?

Of the $4 billion in ex-vessel revenue that US commercial fishing generated in 2007, three-quarters came from animals that need calcium carbonate or fish that prey directly on “calcifiers.”

Serinus canaria domestica

http://www.sightline.org/research/energy/ocean-acidification/northwest-ocean-acidification

Sightline INSTITUTE

Northwest Ocean Acidification

The hidden costs of fossil fuel pollution

Jennifer Langston

November 2011

Sue Cudd couldn't keep a baby oyster alive.

Four summers ago, she'd start with hundreds of millions of oyster larvae at the Whiskey Creek Shellfish Hatchery on Oregon's Netarts Bay. Sometimes, they'd sw for a couple of weeks. Then they'd stop growing before a crucial shell structure developed, or maybe the foot or eyespot. They'd feed poorly. Eventually the larva would all die.

"They just sort of fade away," said Cudd, who owns the hatchery with her husband. "In all the years I've been here, I've never seen this kind of consistent problem."[1]

For months, the hatchery produced virtually no oysters. Because the commerci popular Pacific oyster spawns unreliably in Northwest waters, hatcheries grow la for everyone from multi-million-dollar seafood producers to beachfront shellfish gardeners. When those hatchery incubators have problems, the effects ripple across $73 million West Coast oyster industry, which pumps more money into the regional economy than farmed clams, mussels, geoduck, and other forms of shellfish combined.[2] It would be like every tomato farmer in the state plowing the ground in spring and getting ready to plant, only to find they can't get their hands on any tomato seeds.

It's also a preview of what may be in store for the Northwest as fossil fuel pollution from cars, power plants, and other human sources changes the chemistry of our marine waters, making them more acidic and inhospitable to sea life. A mix of currents

Northwest Ocean Acidification

The hidden cost of fossil fuel pollution

Jennifer Langston
Sightline Institute

http://www.sightline.org/research/energy/ocean-acidification/northwest-ocean-acidification

What can we do?

- Embrace proven and often profitable strategies to increase energy efficiency
- Manage fossil-fuel emissions
- Limit nutrient runoff
- Reduce harm to seafood supplies through scientific monitoring and research