Shellfish hatchery* carbonate chemistry** observations in the Pacific Northwest***

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*Whiskey Creek Shellfish (Netarts Bay, OR), Taylor Shellfish (Dabob Bay, WA), Willapa Bay, WA (bay surveys conducted by A. Trimble)

**Continuous pCO_2 with modified showerhead/IR; sparse discrete pCO_2/TCO_2; S-based Alk; 'corrected' *p*H.

***some other work, too, including OR, WA, BC coastal waters, Columbia River estuary and plume, Neuse River/Pamlico Sound

I'll only be talking about WCH here today.

Netarts Bay, OR:

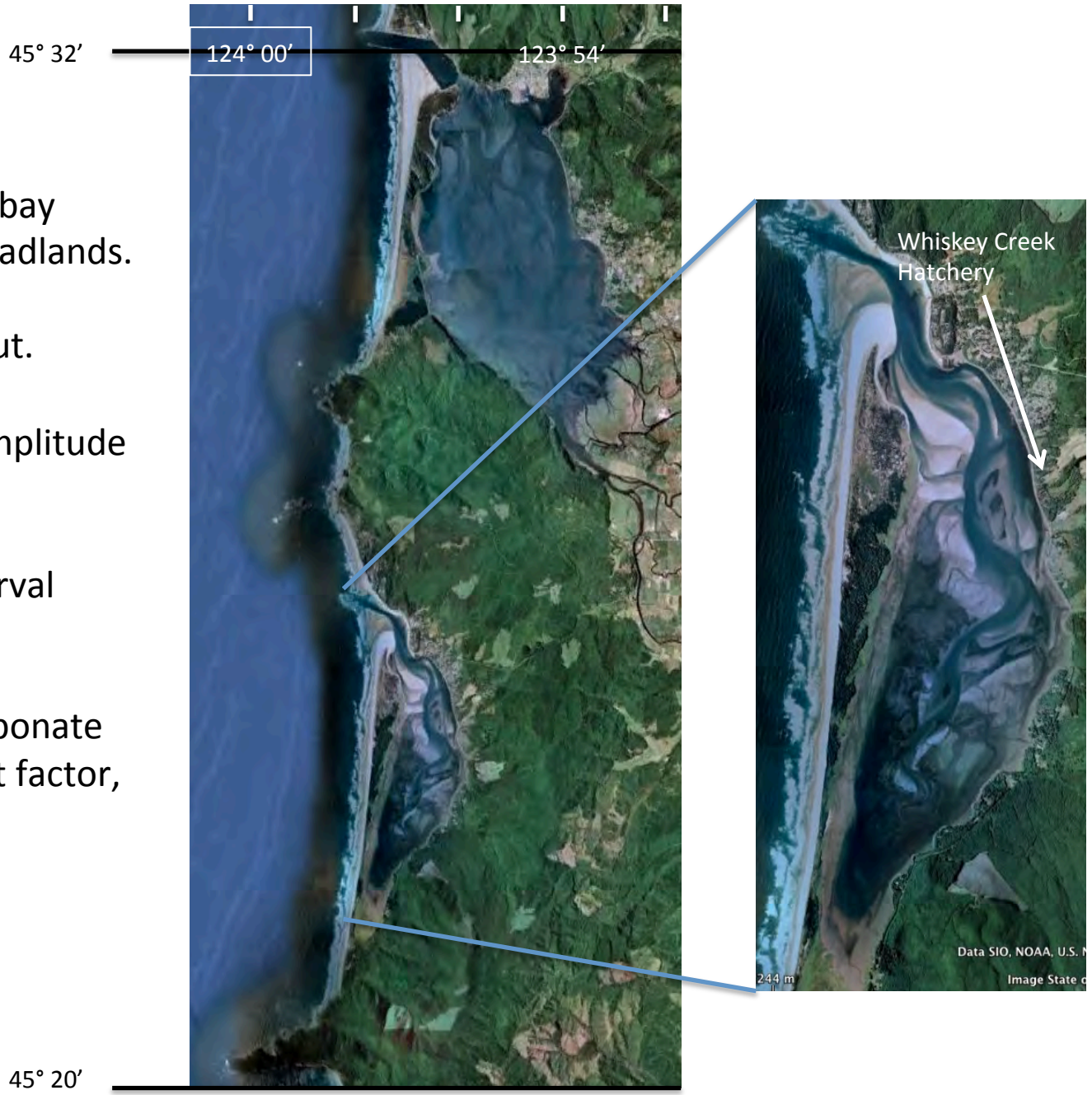
Sand-spit-enclosed bay between coastal headlands.

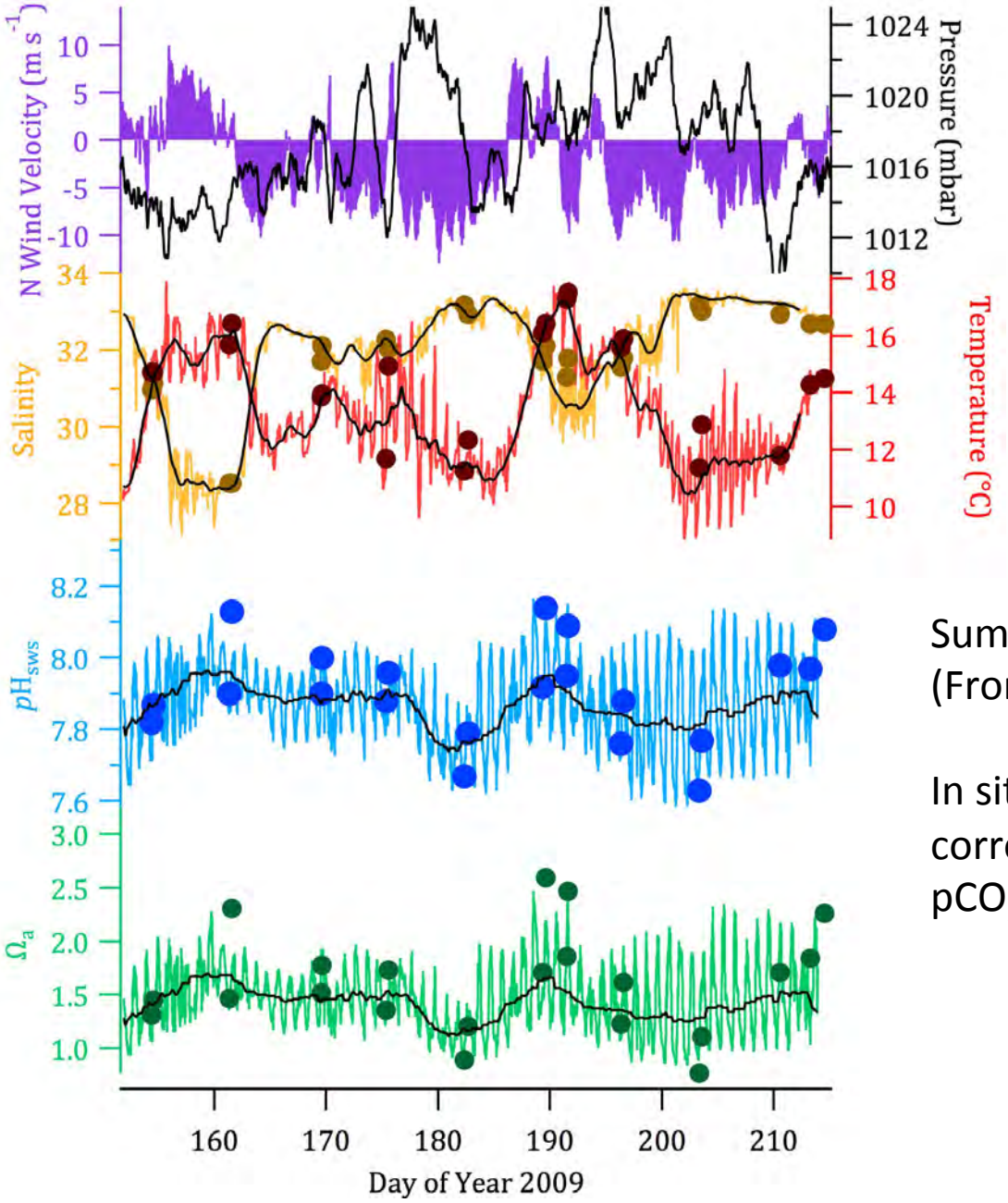
~no freshwater input.

~equivalent tidal amplitude and mean depth

Recent history of larval failures at WCH

Correlates with carbonate chemistry, but what factor, and why?



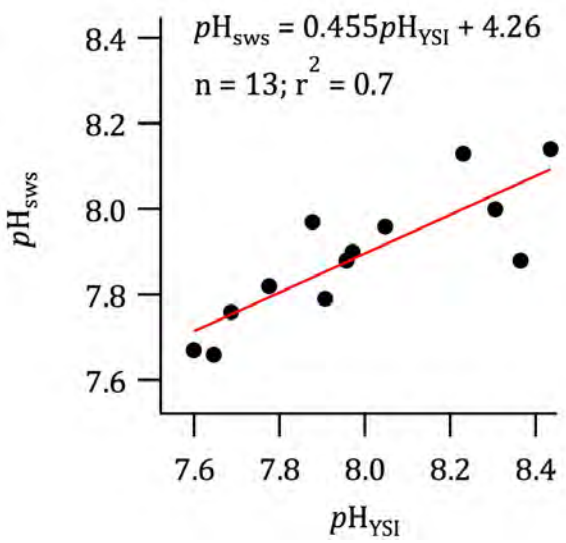


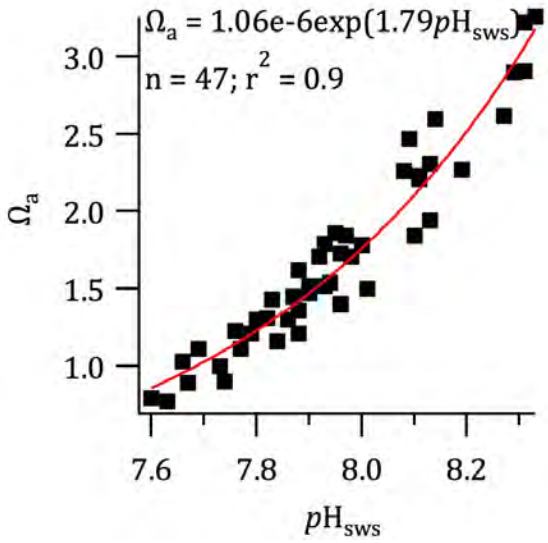
Summer, 2009
(From Barton et al., L&O, in revision)

In situ continuous T, S, *p*H data (YSI), corrected with discrete samples for pCO_2, TCO_2 (Hales lab).

Requires correction of in situ record:

1st to account for *p*H inaccuracy; 2nd, to relate corrected *p*H to relevant parameter





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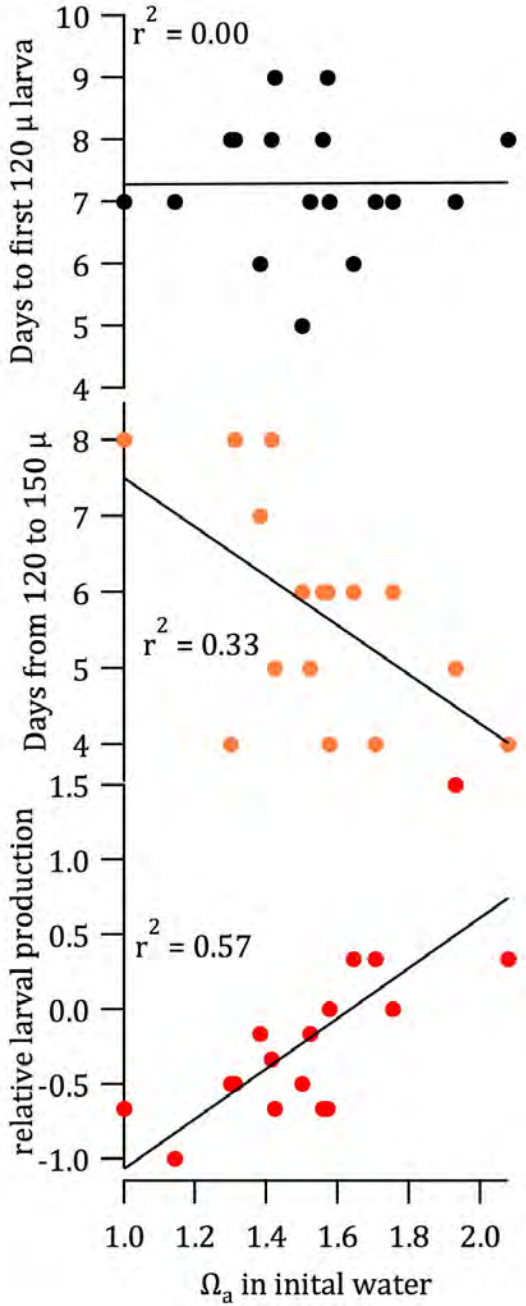
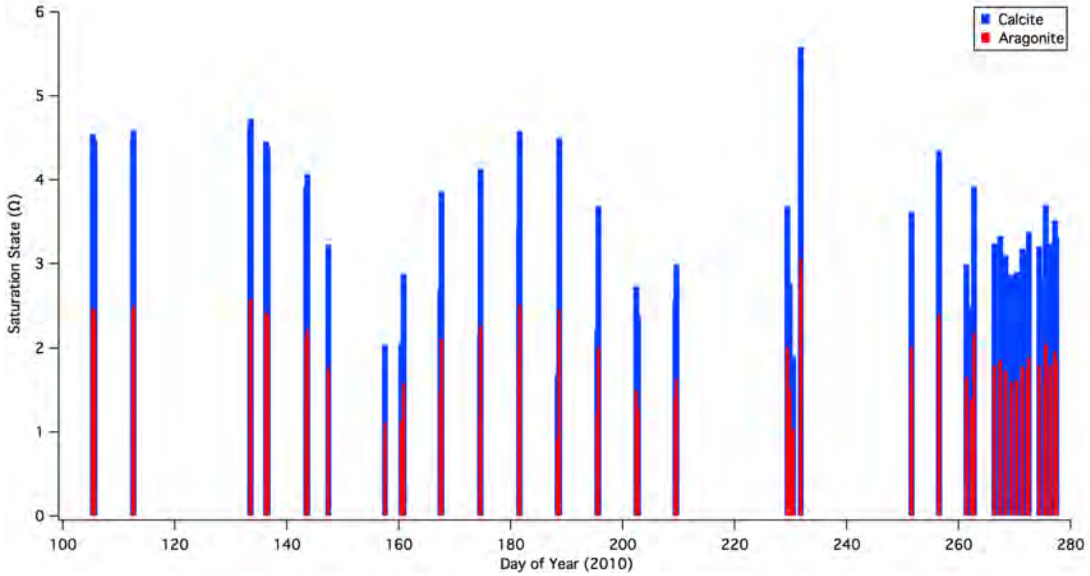
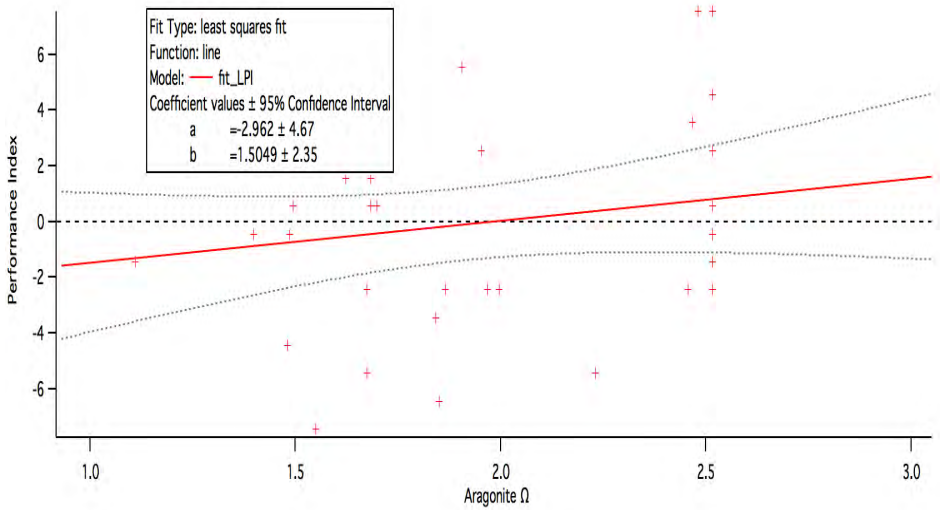


Looks like secondary growth and larval production at 150 µ are dependent on Ω_a at spawn

(From Barton et al., L&O, in revision)

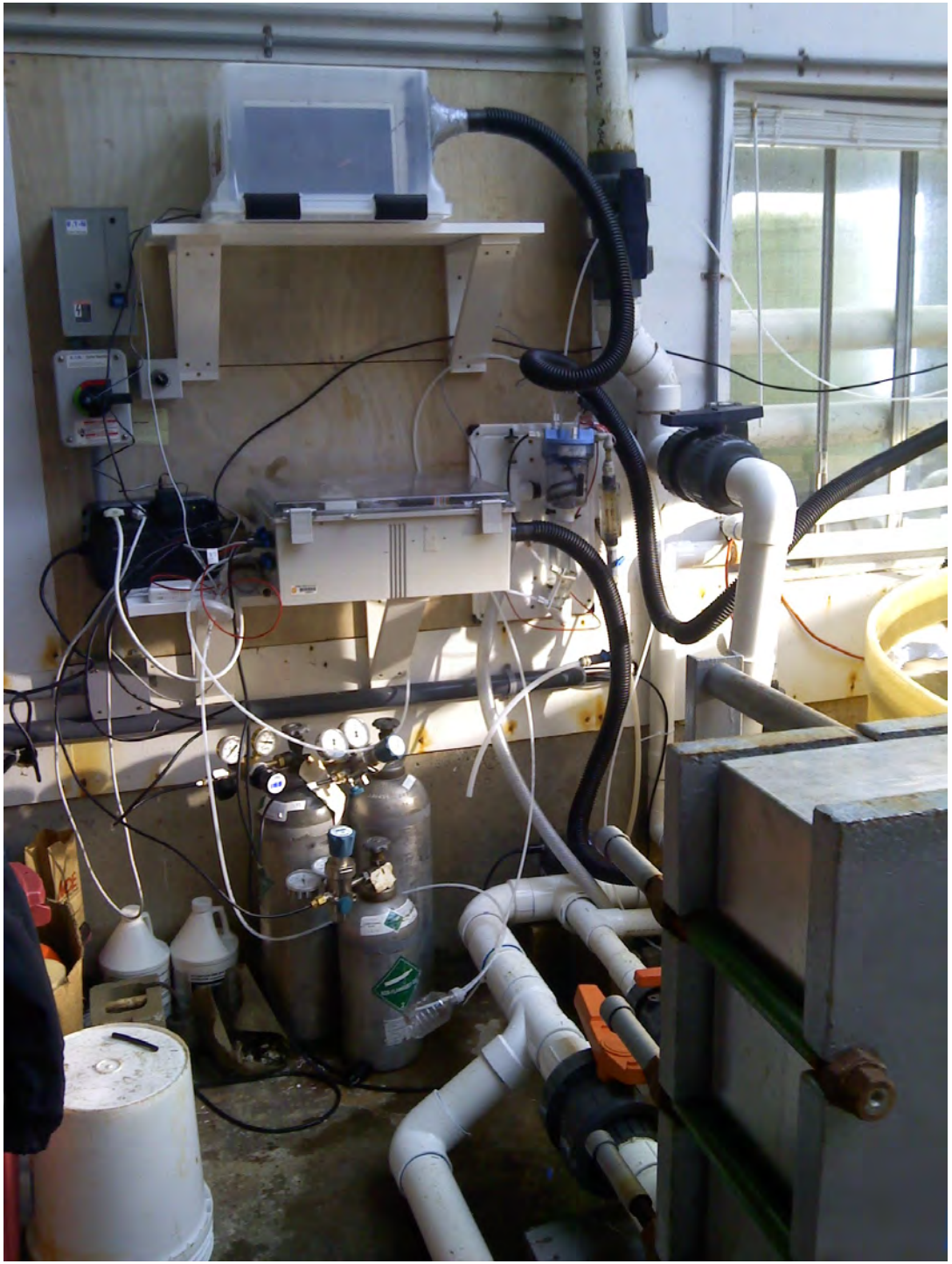
2010 WCH data-- Saturation State Threshold redux



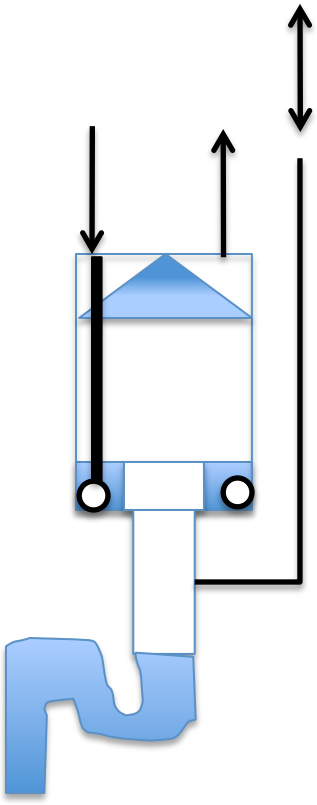


- Saturation state calculated from pCO2 and DIC of discrete water sample
- High variability in saturation throughout the upwelling season
- We need high resolution data to capture variability

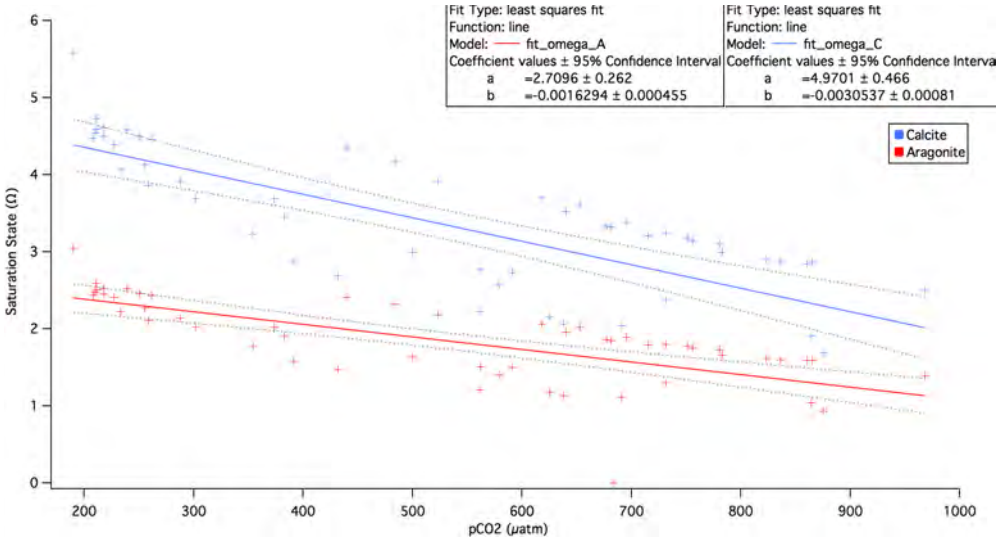
- The combined trends in larval growth and survival track with the saturation state
- Omega A v Performance
- P (Threshold
- Ω_A **~1.97**

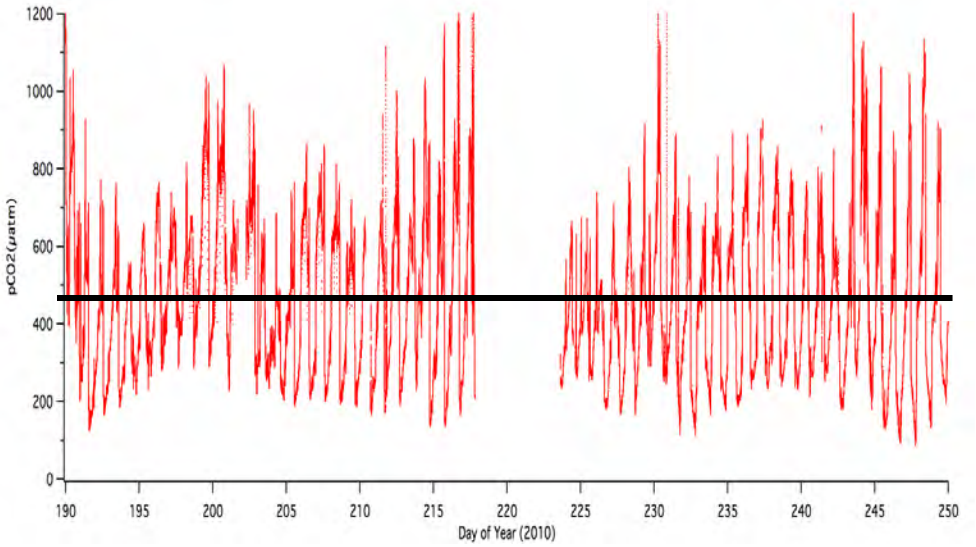


Continuous pCO_2 at WCH since spring of 2010



Similar conclusions to those seen in 2009--





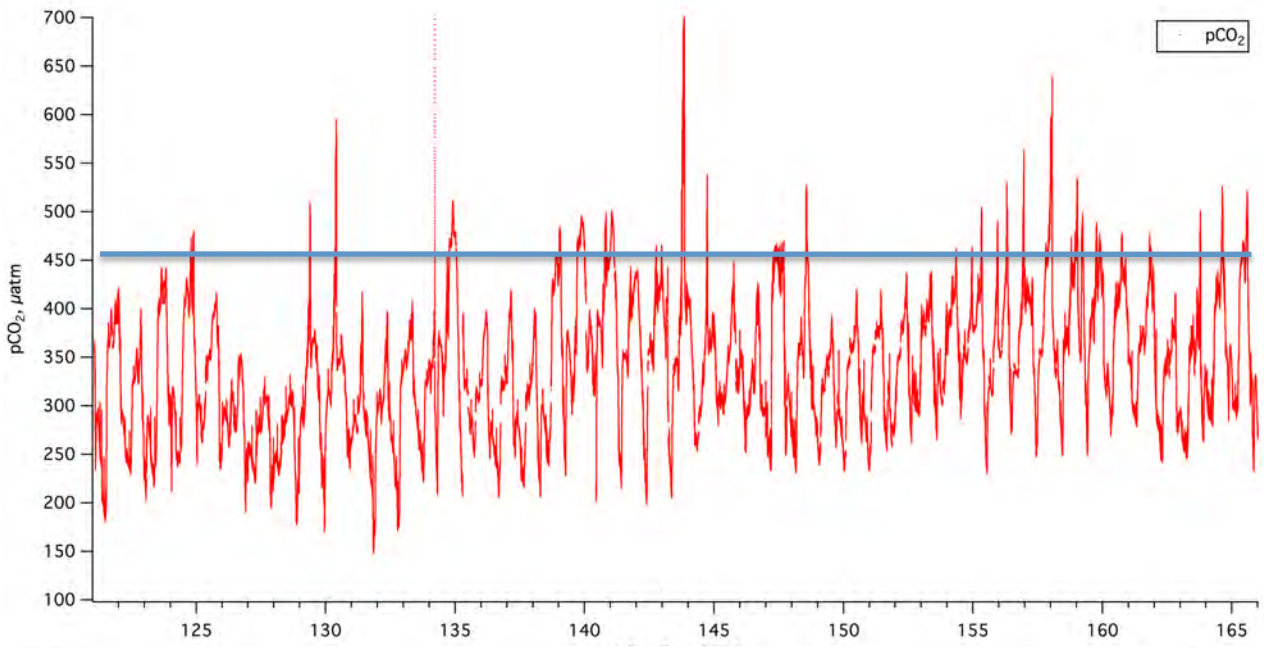
Using pCO_2 as proxy

[redacted]pCO_2[redacted]Thresh old

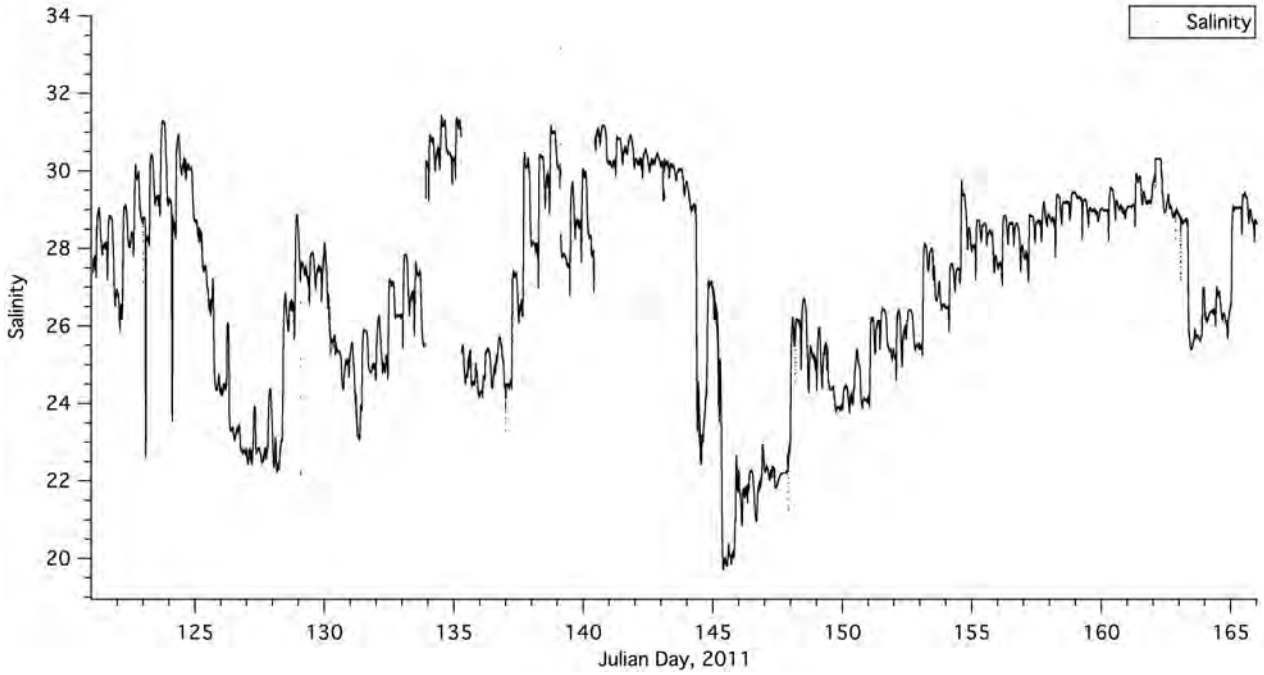
for pCO_2 ~ **460 µatm**

Daily variability during a typical upwelling season

Favorable spawning/ growing conditions ~50% of time



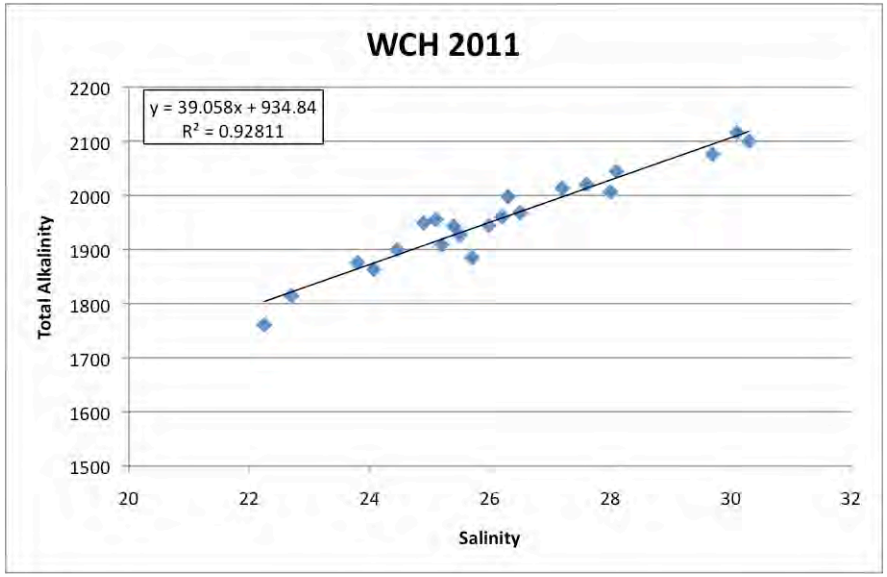
Not just CO_2 chemistry, though. Mostly good conditions in early 2011, but larva stall in mid-April. Why?

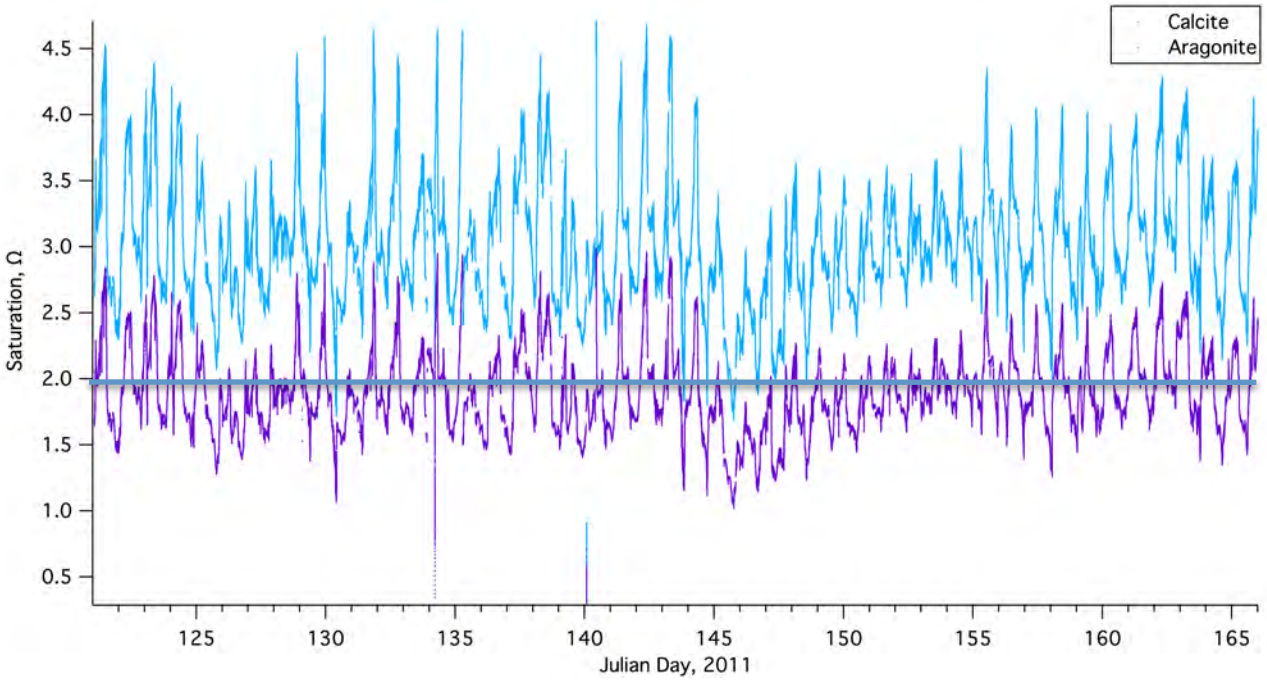


Extreme freshwater input event. Netarts has ~no freshwater input and high tidal flushing. Bay S diluted by ocean input! This fresh water was present on the surface of the inner shelf S to Florence.

Calculate Alk from S; calculate Ω_a from pCO_2 and Alk. ~2-week period of low Ω driven by freshwater input.

Mitigation by addition of $CaCl_2$ + Na_2CO_3 worked(?)





Parting shots:

1. Variable of consequence *seems to be* mineral stability, Ω_a, but This Is Speculative.

2. *p*H is treacherous without rigorous calibration.

3. Proxies are not likely to be general.

4. Preferred measurement pair (imho) is pCO_2 + TCO_2, but continuous ~autonomous T_{CO2} is a work in progress. And even my cheapskate approaches are still big $ in the eyes of the resource managers.

5. Be aware of multiple, non-oceanic contributors, even at long range. Climate-change-driven amplification of 'natural' forcing needs to be viewed with as much

Discrete Sampling and water chemistry manipulation:

	TCO2	Alk	*p*Hsws	pCO2	Ωa
Target:	**1675**	**1787**	**7.69**	**800**	**1.15**
Method 1 trial 2	1673.7	1771.4	7.67	833.9	1.13
Method 1 trial 2	1672.1	1771.5	7.67	822.9	1.14
		Measured	Calculated		