Bight '13 Water Quality

Briefing for SCCWRP Commission

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Bight '13 Water Quality: Three Study Elements

1. Characterize spatial and temporal patterns in pH and aragonite saturation state in the SCB
2. Characterize spatial and temporal patterns of subsurface chlorophyll layers in the SCB and factors affecting distribution
3. Measure key rates and processes related to carbon and nutrient cycling to support of Biogeochemical Modeling Project

A Need for a Assessment

There is no comprehensive assessment the magnitude and extent of acidification in SCB shelf water

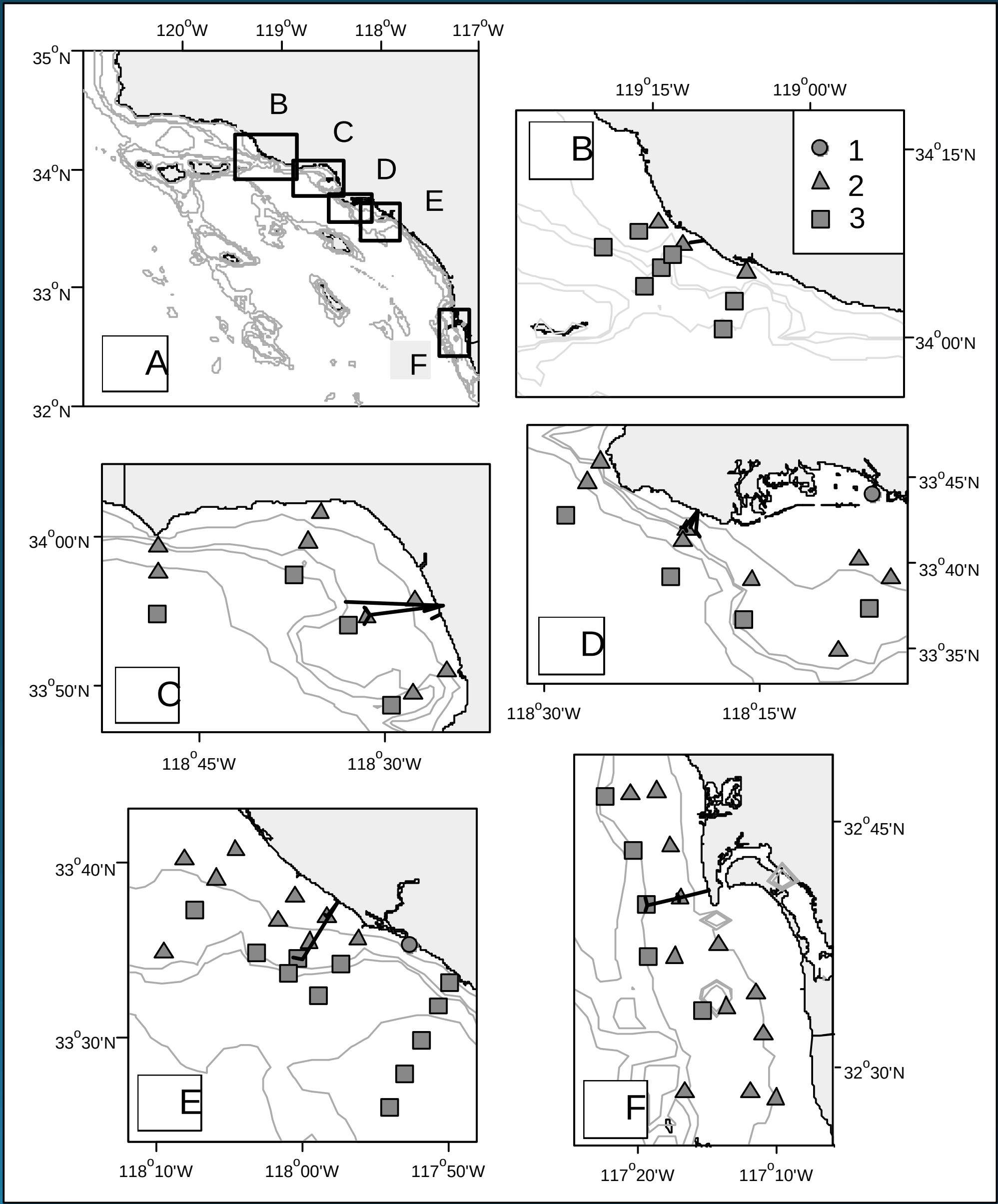
- For aragonite saturation state: Data is extremely limited
- For pH: There are methodological obstacles that create concerns over data quality

pH and Aragonite Saturation State: Study Objectives

1. Evaluate accuracy of existing glass electrode pH sensors
2. Examine alternative methodologies to improve pH measurements
3. Provide the first-ever synoptic survey of pH and aragonite saturation state on the SCB shelf

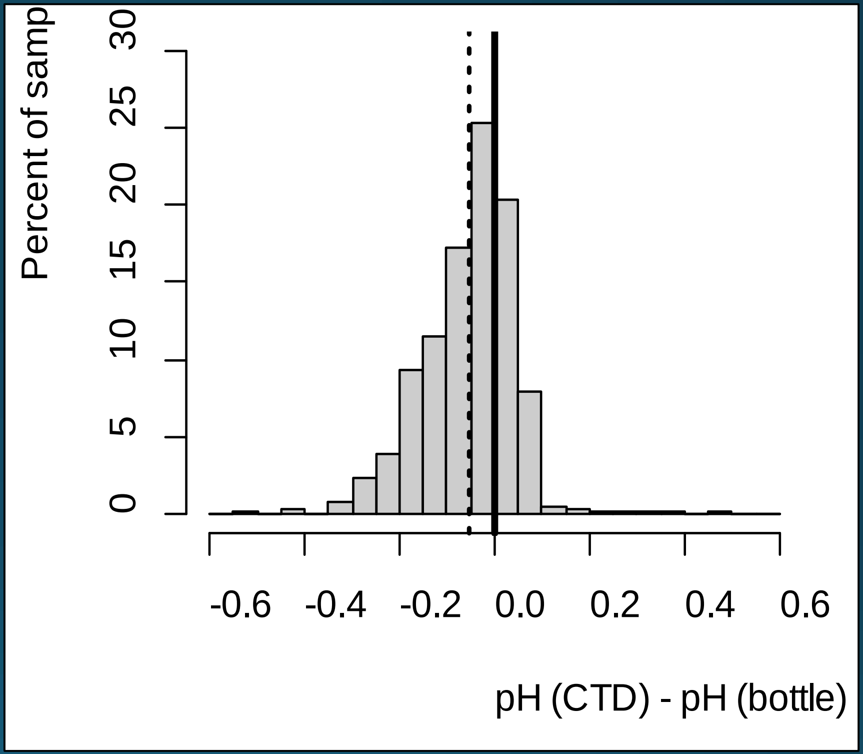
pH Sensor Evaluation: Approach

- Side-by-side comparison of bottle measurements of pH and SeaBird Sensors
  - Bottle samples run at SIO
- 5 agencies participating
- 72 grid stations; 2-3 depths per station
- Quarterly sampling for 2 years



pH Sensor Evaluation: Results

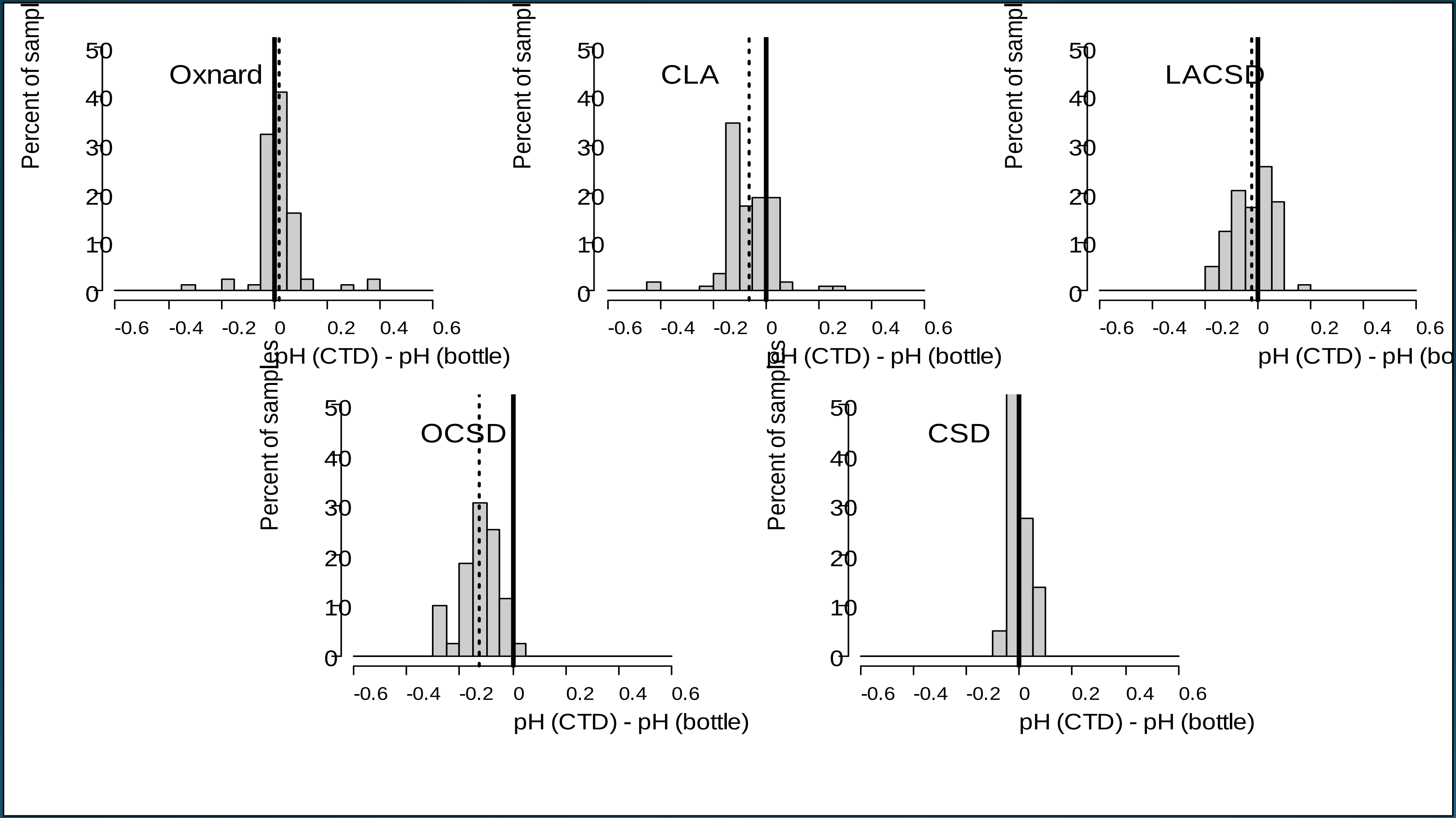
- Wide range of differences: -0.51 to 0.48 pH units
- Average absolute difference was 0.09 pH units



Context:

- Since industrial revolution oceans have changed 0.1 pH units
- California Ocean Plan: "pH shall not be changed at any time more than 0.2 units from that which occurs naturally"

Differences by Agency/Instrument



Two Ways to Address the Problem…

1. New sensor technology

2. Improve calibration protocols for existing sensors

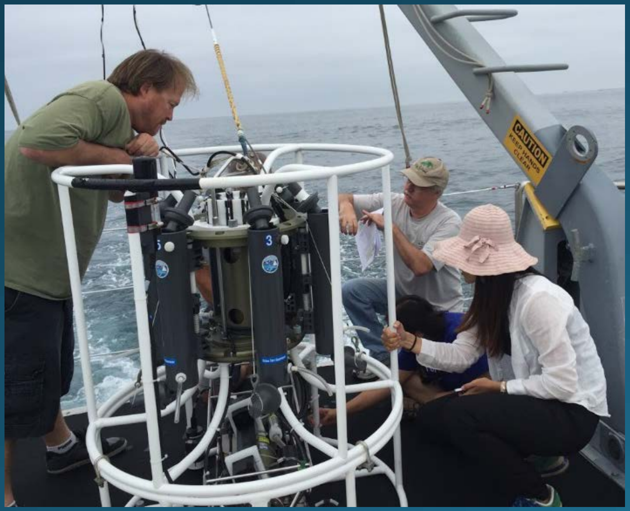
New Technologies for pH

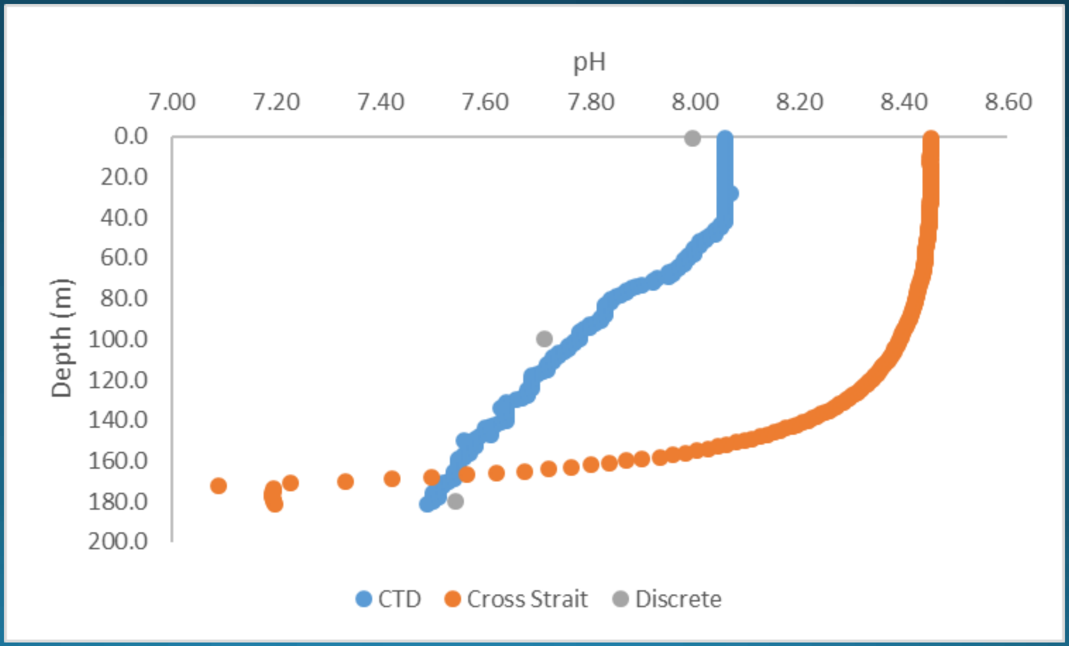
WENDY SCHMIDT OCEAN HEALTH XPRIZE®

- XPRIZE selected 4 instruments for testing based on performance during principle competition
- XPRIZE sensors were evaluated against POTW SeaBird CTD and discrete, bottle pH values
- POTWs provide feedback on the technologies (ease of use, accuracy, etc.)

Results: Sensors Are Not Ready for Prime Time

- Sensors generally did not perform well
- Sensors were difficult to use
  - Not plug and play
  - Difficult to align profiles with CTD profiles





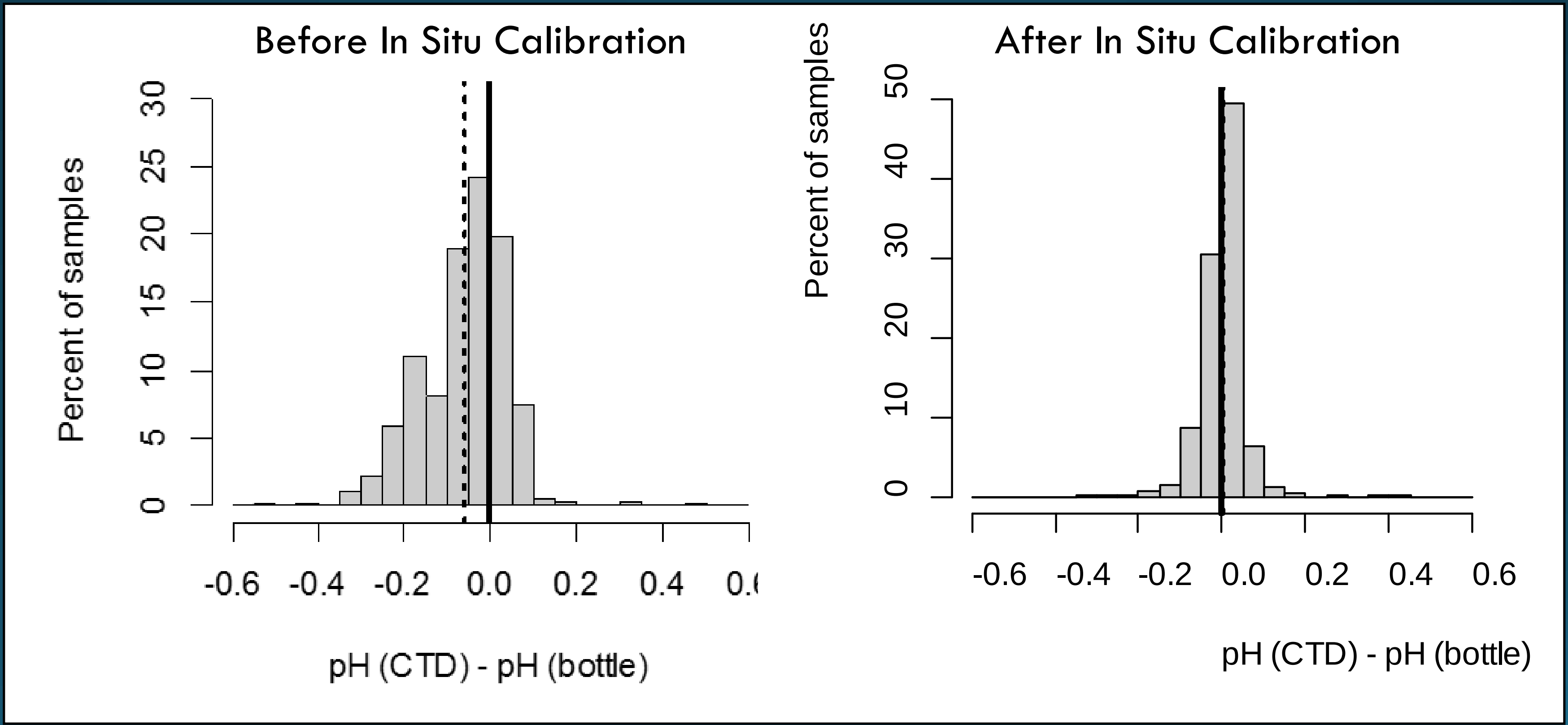
Can We Remove the Bias?

- It may be possible to use *in situ* bottle measurements to calibrate the electrode data
  - No significant sensor drift over a sample day
  - Variability in the differences between bottle samples and glass electrodes within a day is much less than between days

- Possibility: can we collect samples to calibrate the instrument within a day?

In Situ Calibration Greatly Improves Data Quality

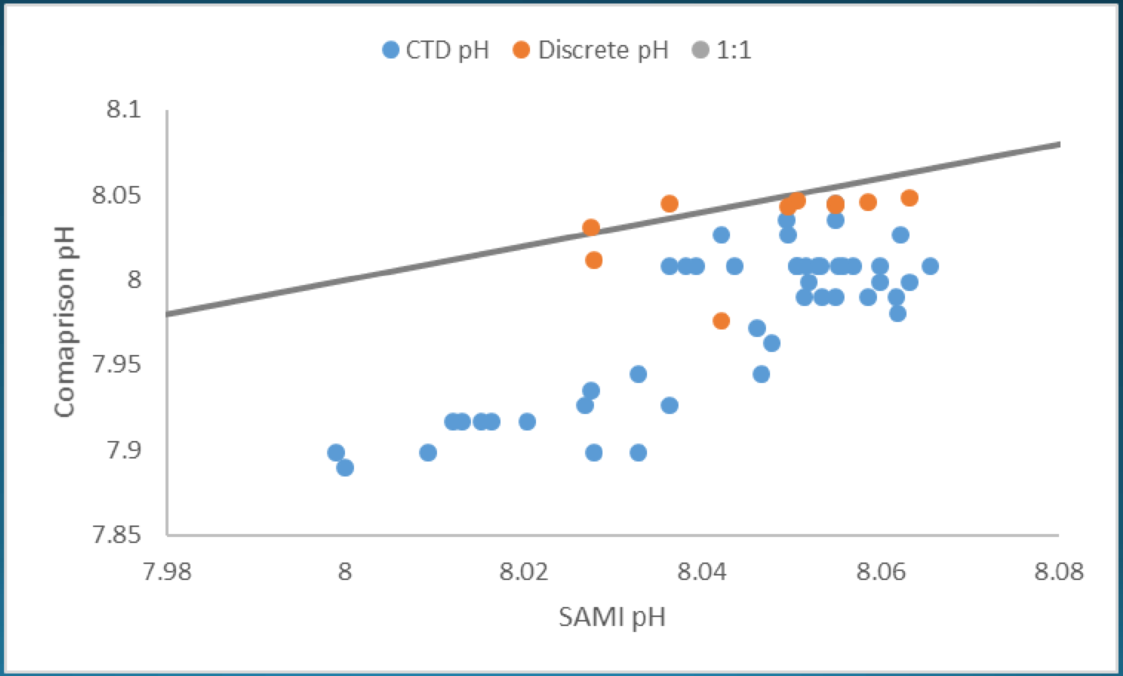
- 95% of values within ± 0.1 pH units
- Removes most of the bias from the distribution



SAMI pH Sensor: A Substitute For Bottle Samples

- Takes in situ spectrophotometric measurements of pH

- Performed well compared to discrete water samples

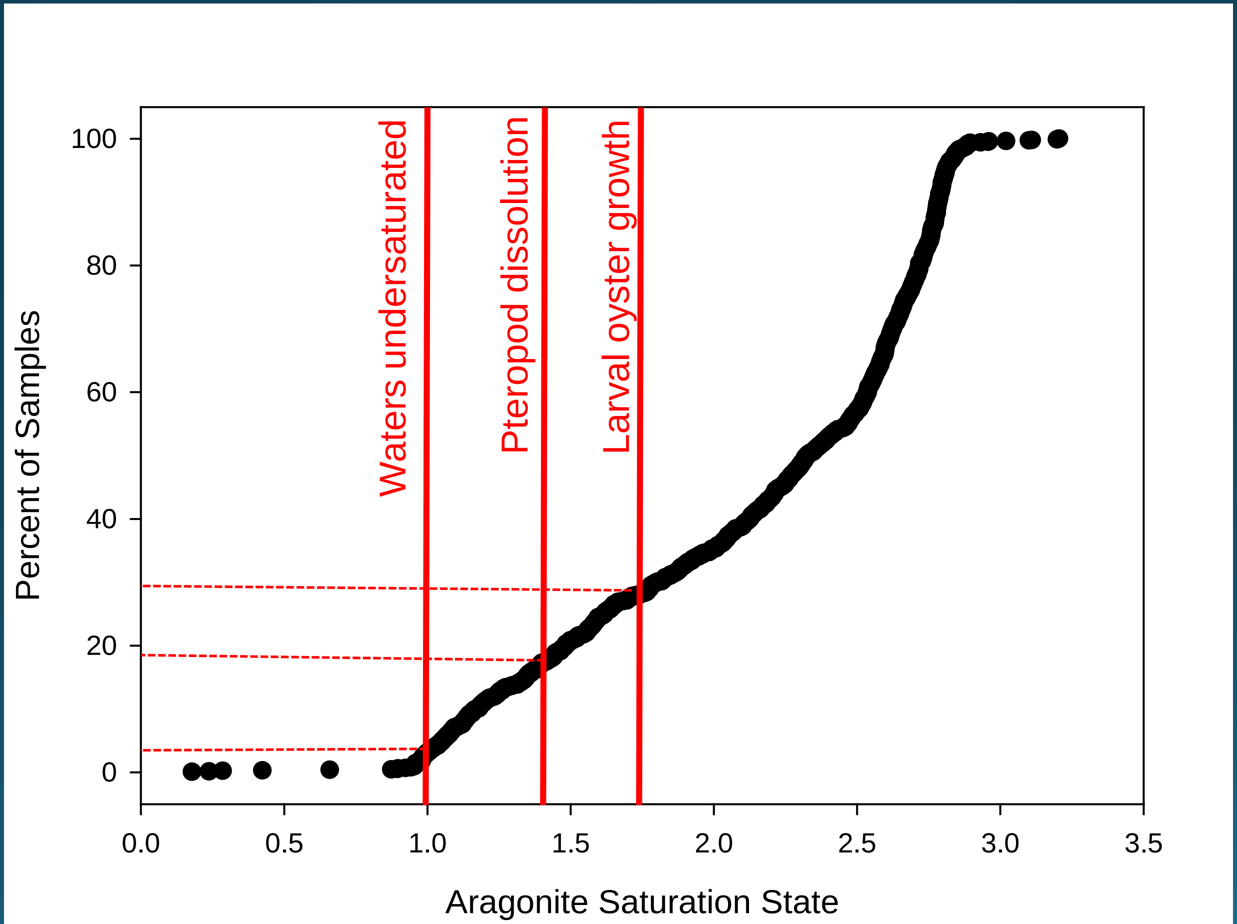


High Quality Acidification Data For the First Time

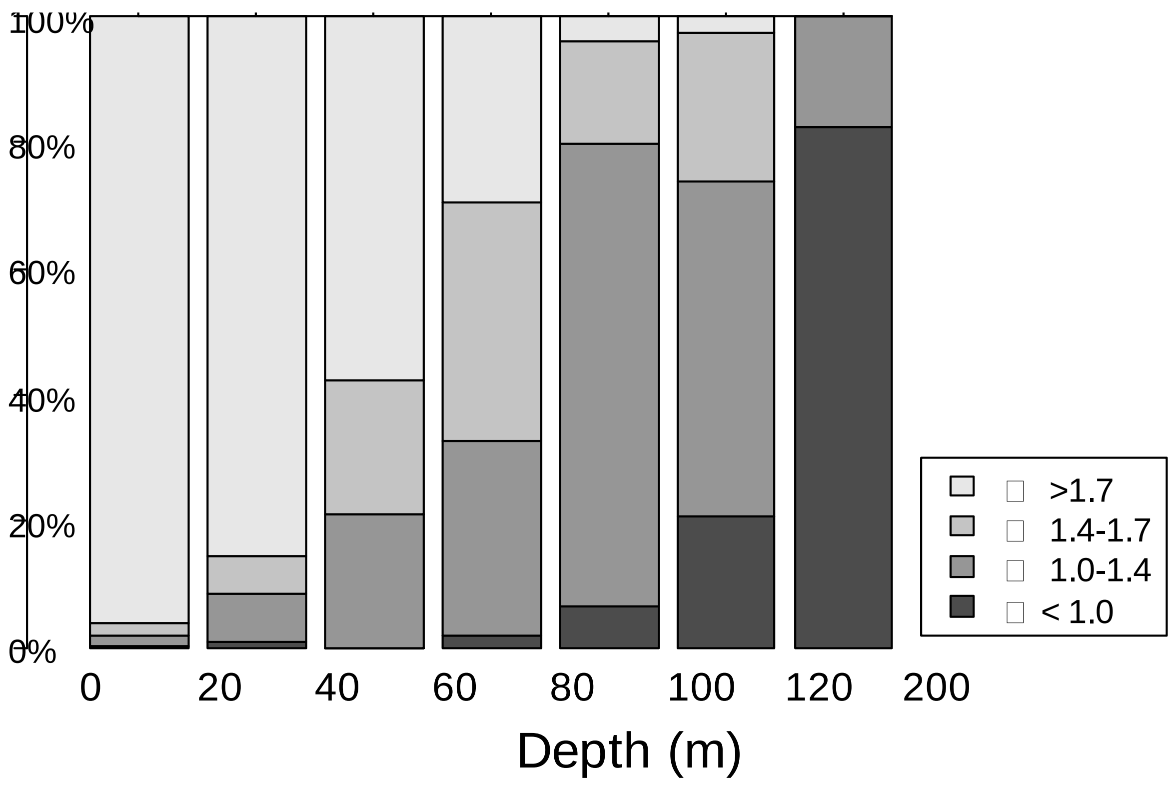
- We collected bottle samples for pH and Total Alkalinity so that we could calculate Aragonite Saturation State
  - Growing consensus that Aragonite Saturation State is a key variable for assessing ocean acidification

- This dataset represents the first-ever synoptic survey of pH and aragonite saturation state on the SCB shelf
  - Where does the shelf stand in terms of acidification thresholds?
  - How does this compare to offshore?
  - Are there regions and/or time periods where the Bight approaches tipping points?

Aragonite Saturation State in the SCB

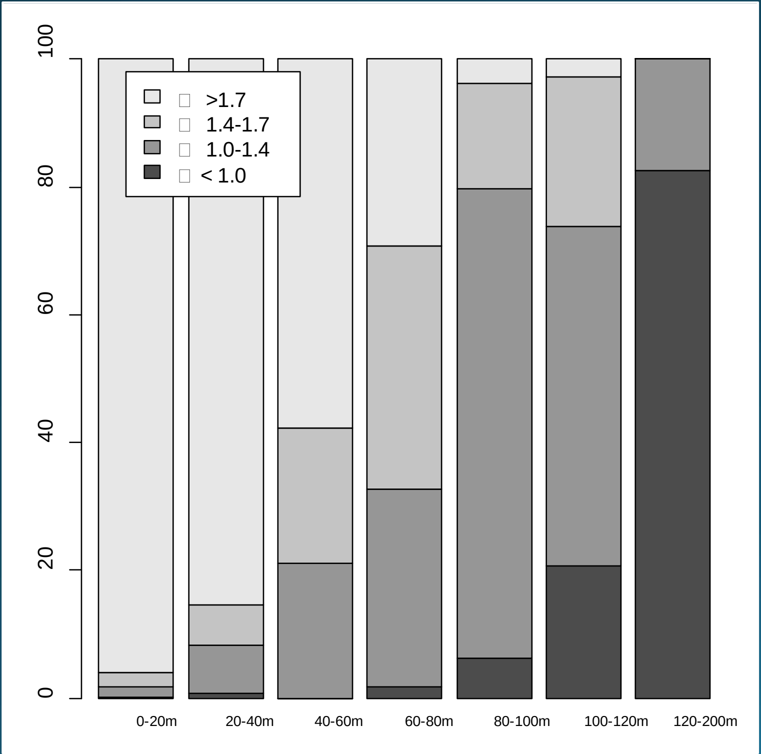


Aragonite Saturation By Depth

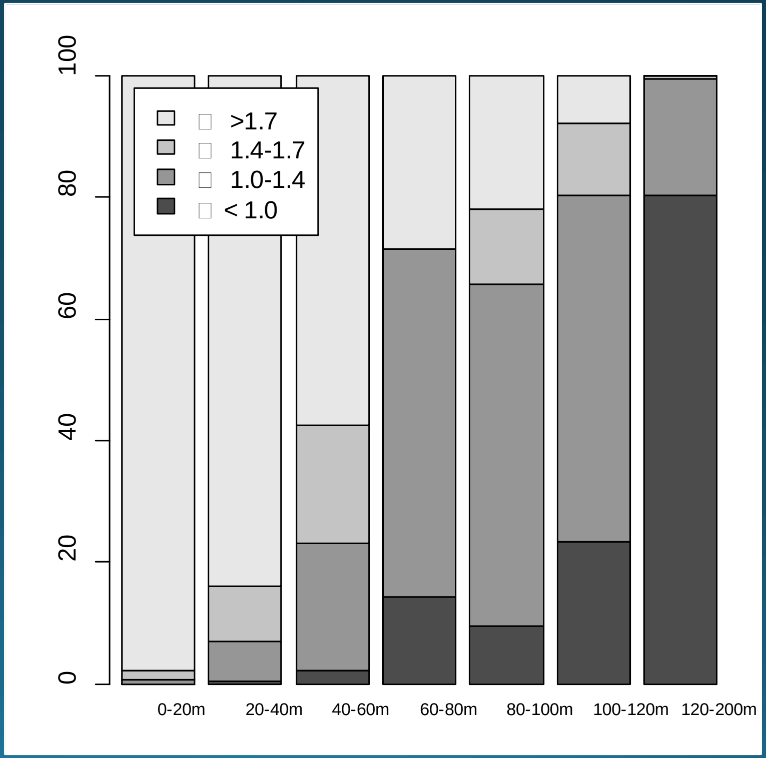


No Difference In Nearshore Versus Offshore

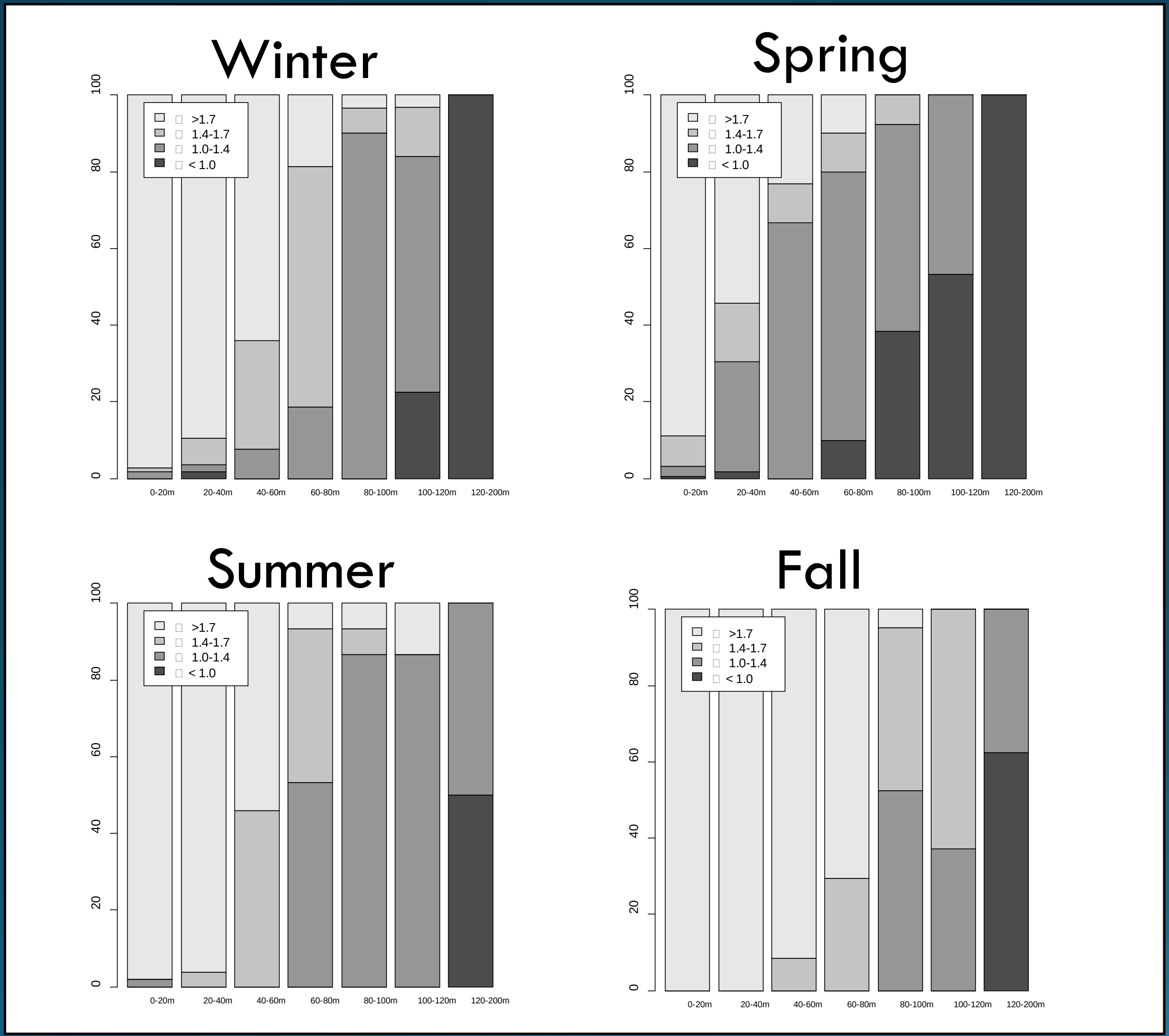
Bight '13 data



CalCOFI data



There is a Clear Seasonality in Aragonite Saturation State



Bight '13 Water Quality: Next Steps

- pH and Aragonite Saturation State
  - Analysis complete: September 2016
  - Subcommittee meeting: October 2016
  - Draft chapter: December 2016

- Algal Biomass/ Chlorophyll a
  - Analysis complete: September 2016
  - Subcommittee meeting: October 2016
  - Draft chapter: December 2016

- Biogeochemical Rates and Processes
  - Analysis complete: November 2016
  - Subcommittee meeting: January 2017
  - Draft chapter: April 2017

- Draft Final Report: June 2017

- Final Report: December 2017