Physiological responses of marine phytoplankton to oil exposure:

Santa Barbara Channel, 2015

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SIMONS FOUNDATION

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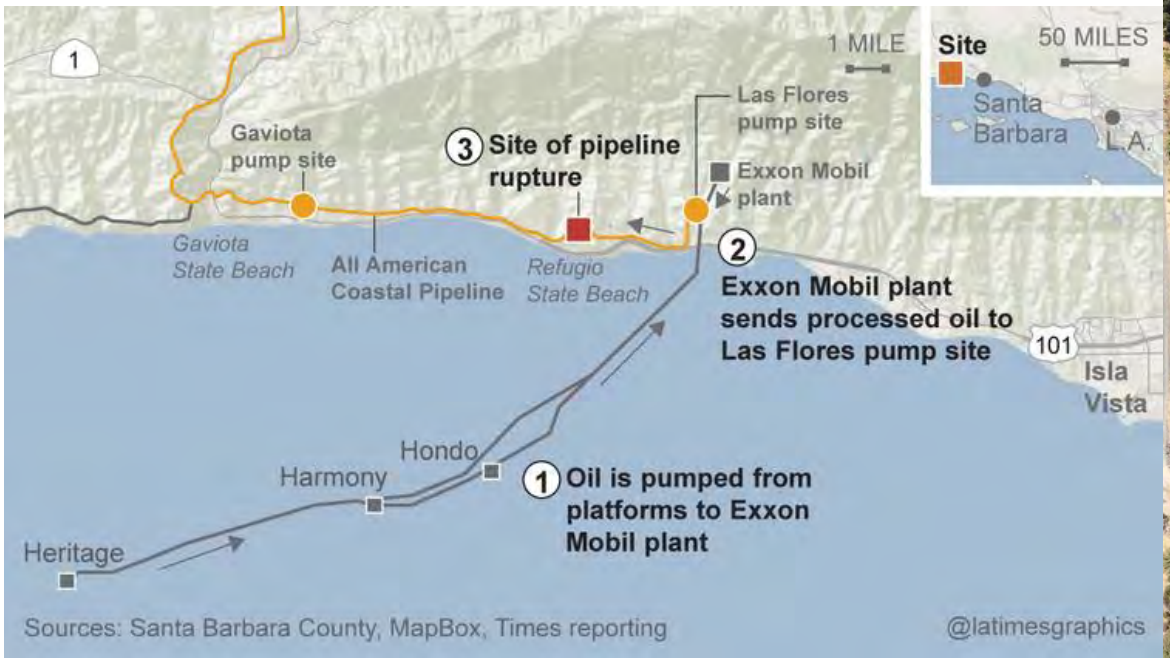
The Santa Barbara Channel

- Highly productive coastal region
- Influenced by seasonal upwelling and both equatorward and poleward flowing water masses

- Home to extensive natural oil and gas seeps
- Oil and gas production at 20 offshore oil platforms

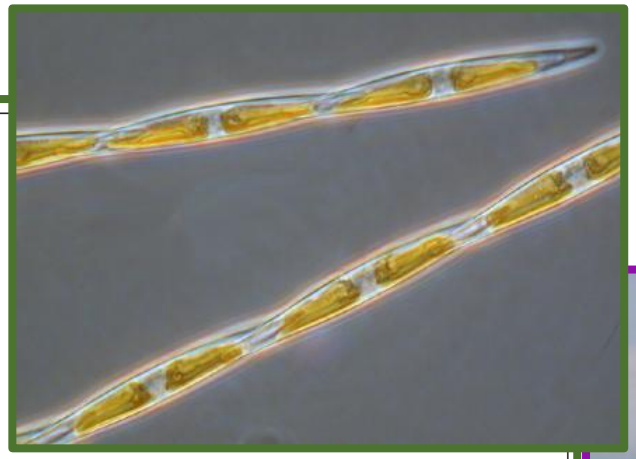
The Spill - May 19, 2015

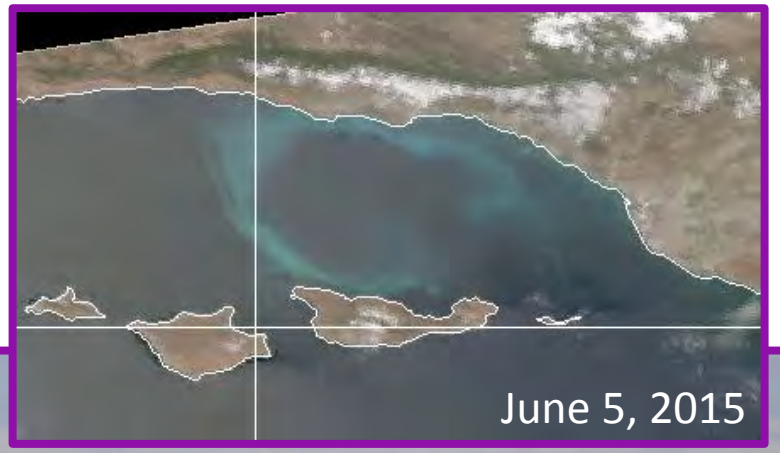
- 101,000 - 140,000 gallons leaked
- ~21,000 gallons entered the ocean



Timing of the spill

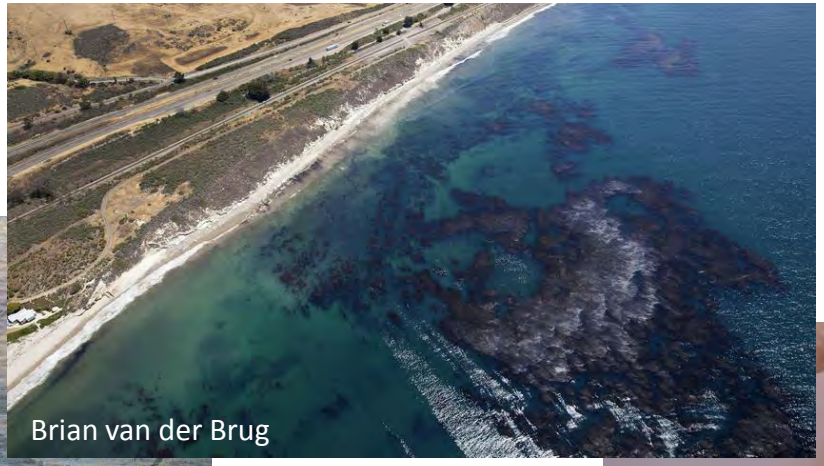
- During the spring phytoplankton bloom
  - *Pseudo-nitzschia* (toxin forming diatom) bloom throughout May
  - Unprecedented coccolithophore (mainly *Emiliania huxleyi*) bloom in early June





Phytoplankton and oil

- Previous work shows highly variable responses of individual phytoplankton and communities (Harrison et al. 1986, Nomura et al. 2007, Gonzalez et al. 2009, Gonzalez et al. 2013, Ozhan and Bargu 2014, Ozhan et al. 2014)
- Relevance to natural system and oil spill scenario is incredibly important for interpretation and implications

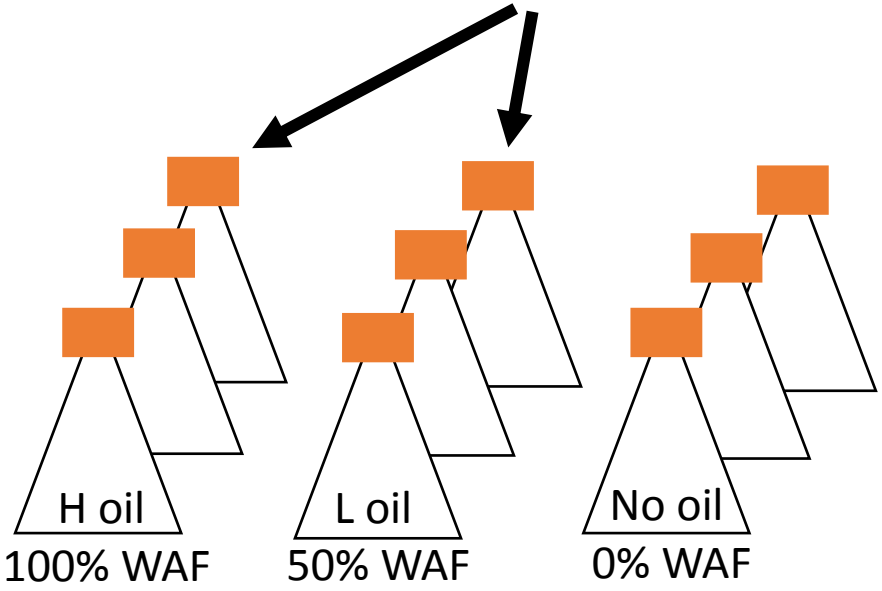

Brian van der Brug


Chris Wilkins

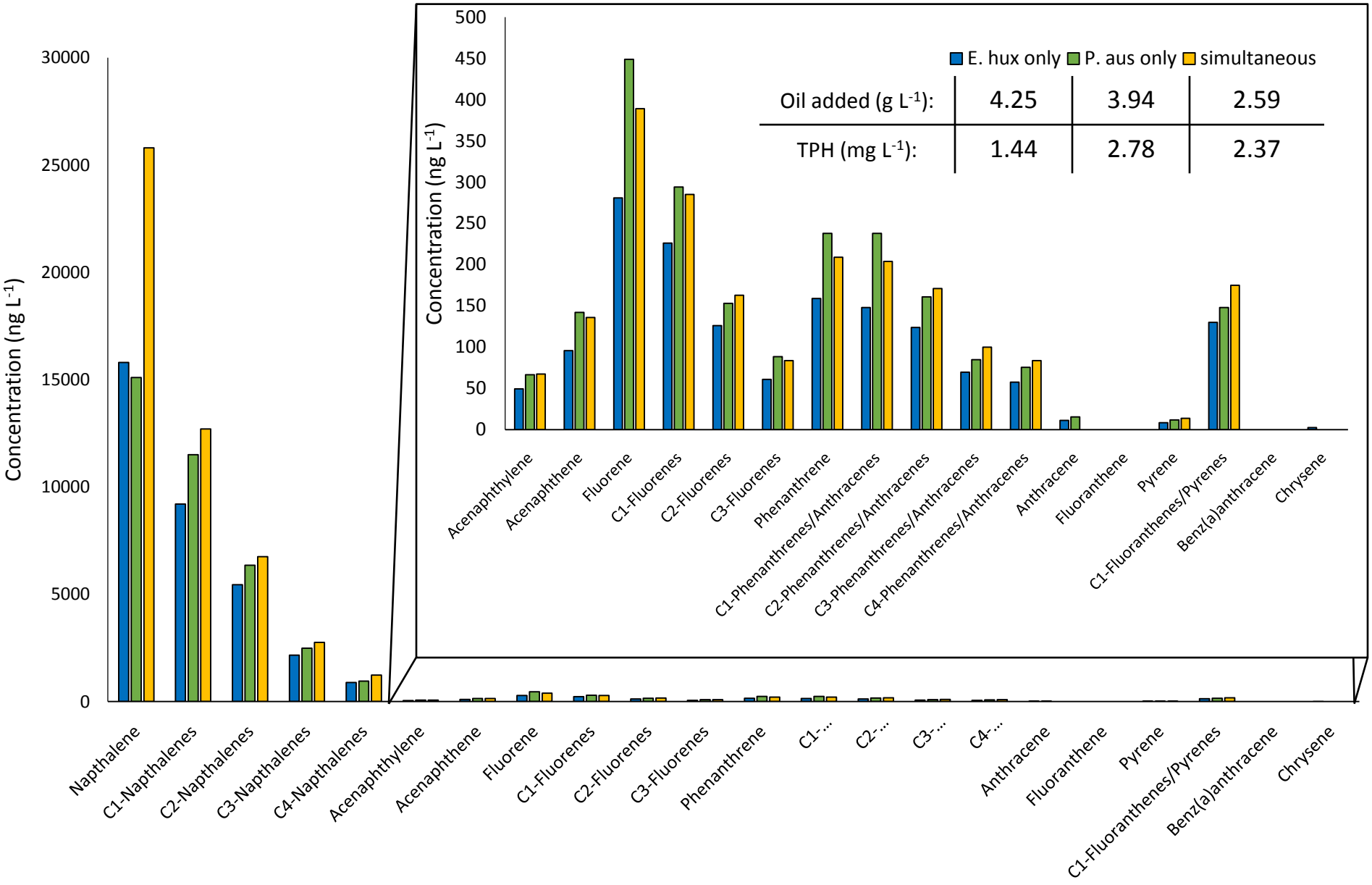

LA Times

Experimental design

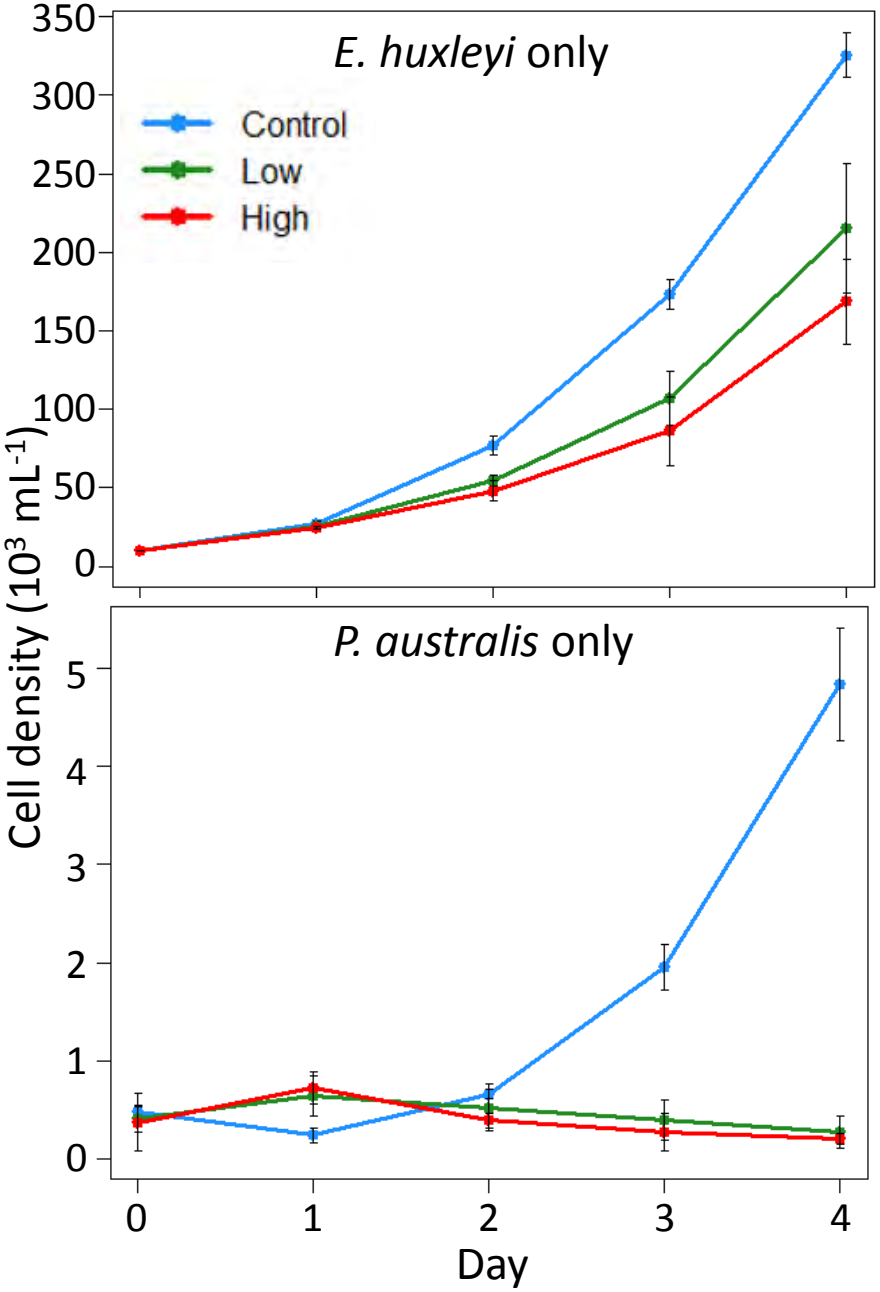
- *Pseudo-nitzschia australis* and *Emiliania huxleyi* isolates from California waters
- Water accommodated fraction (WAF) created with source oil and f/2 supplemented seawater media
- Short term exposure to the WAF (4-5 days) to test physiological effects

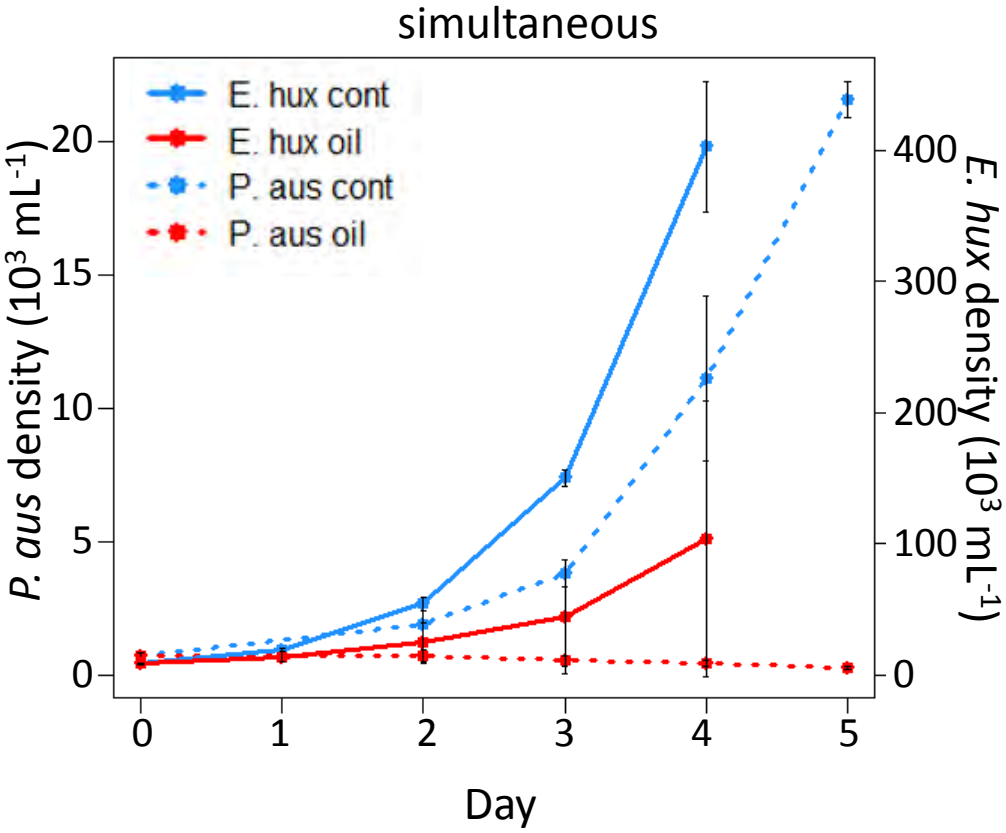


Variable WAF concentrations

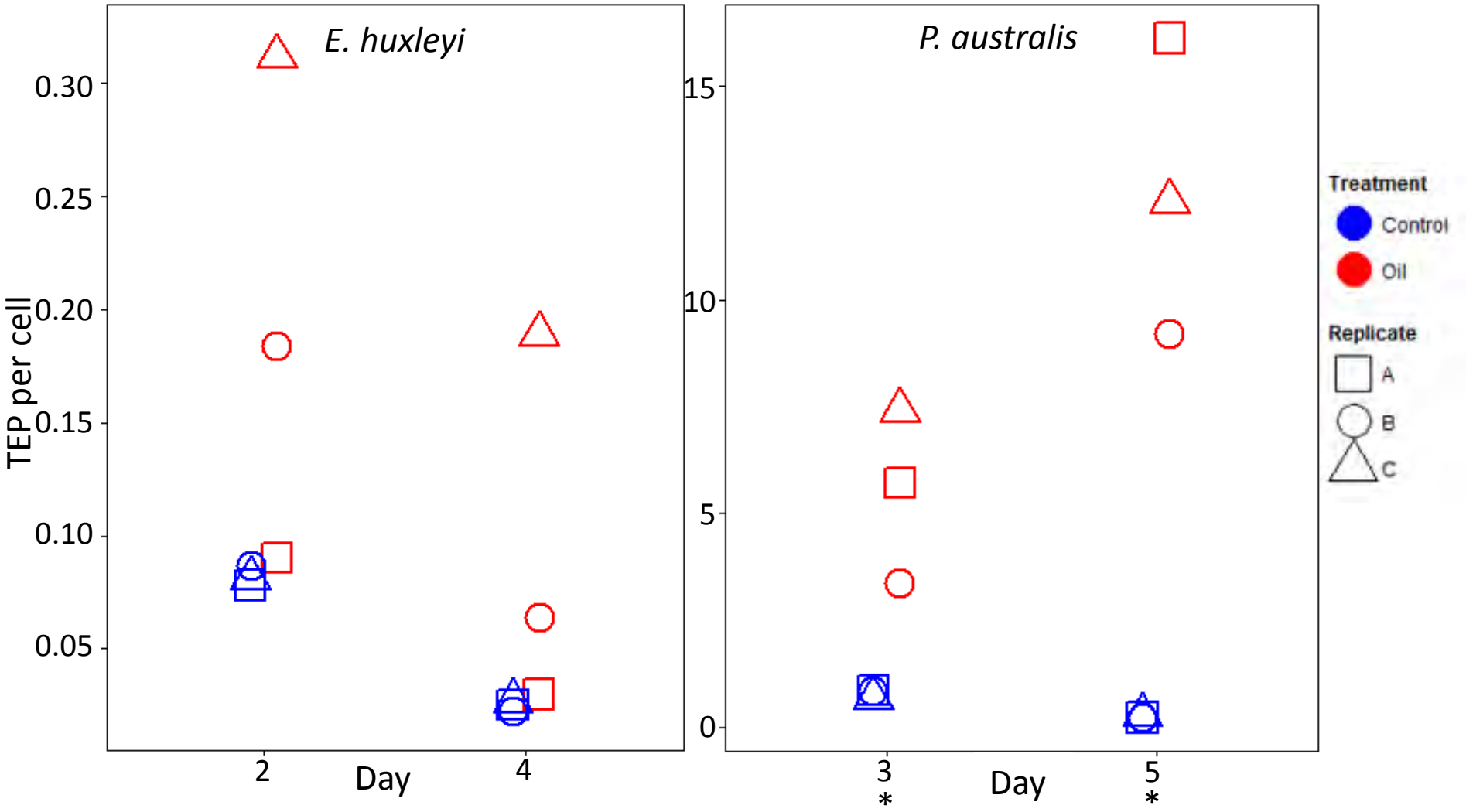


Oil reduced phytoplankton growth

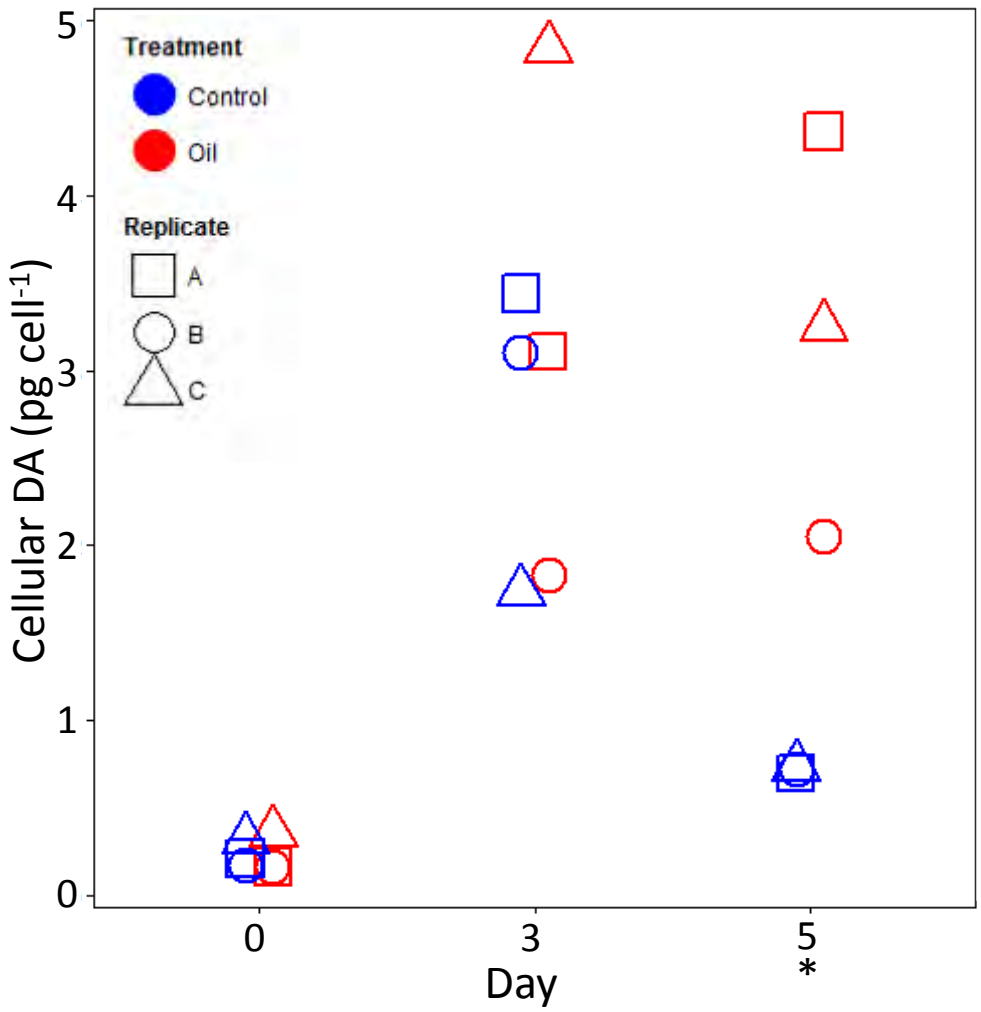


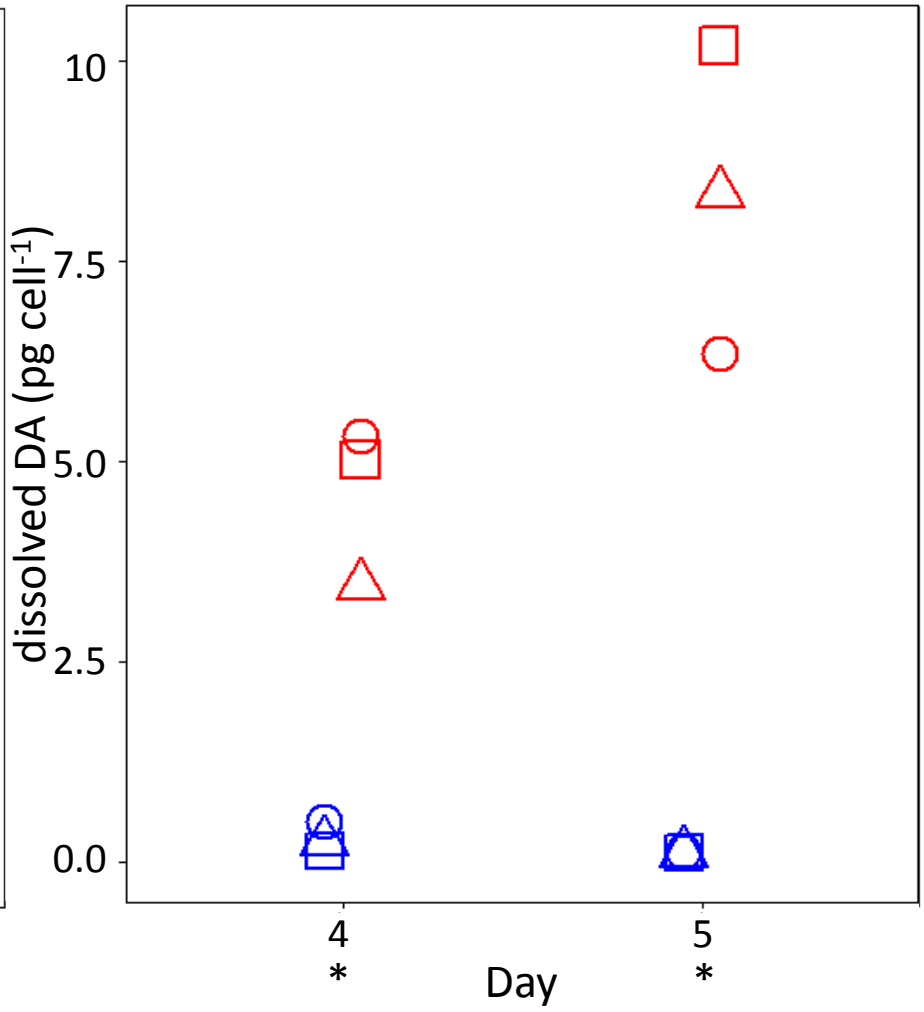


Oil increased transparent exopolymer particle (TEP) production



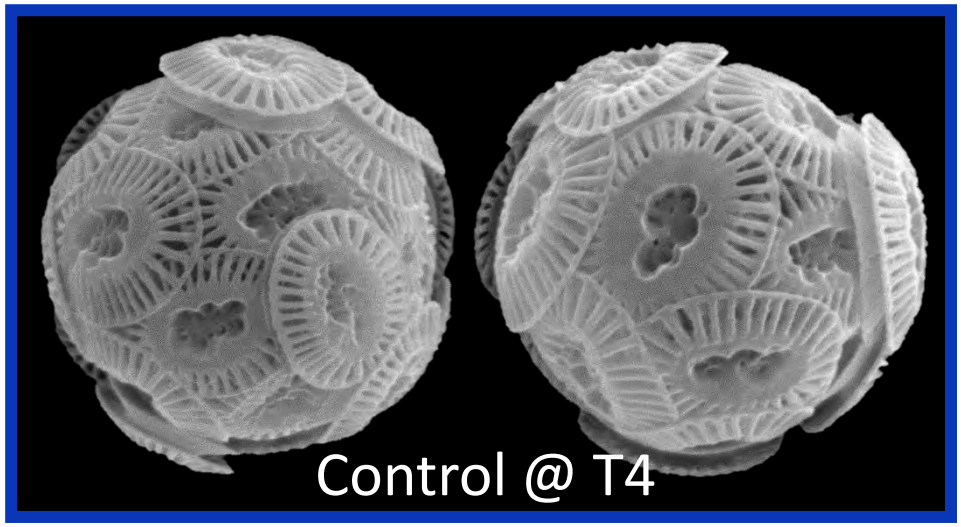
Oil increased *P. australis* domoic acid (DA) production

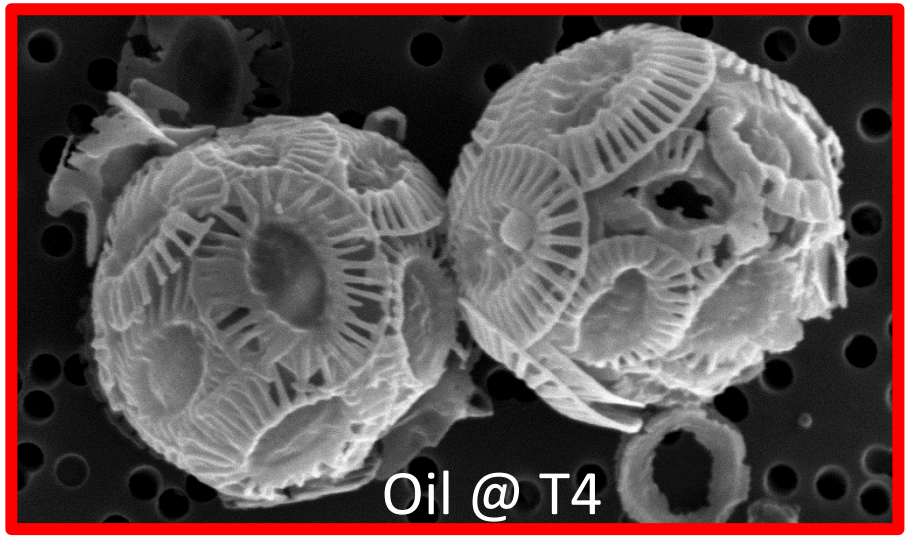




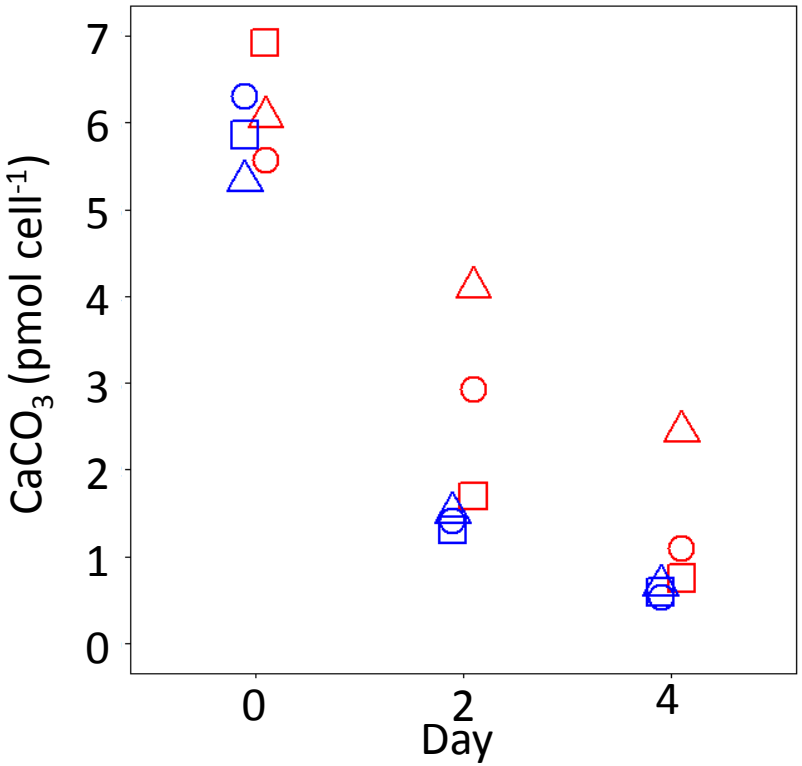
Data from Raphael Kudela (UCSC)

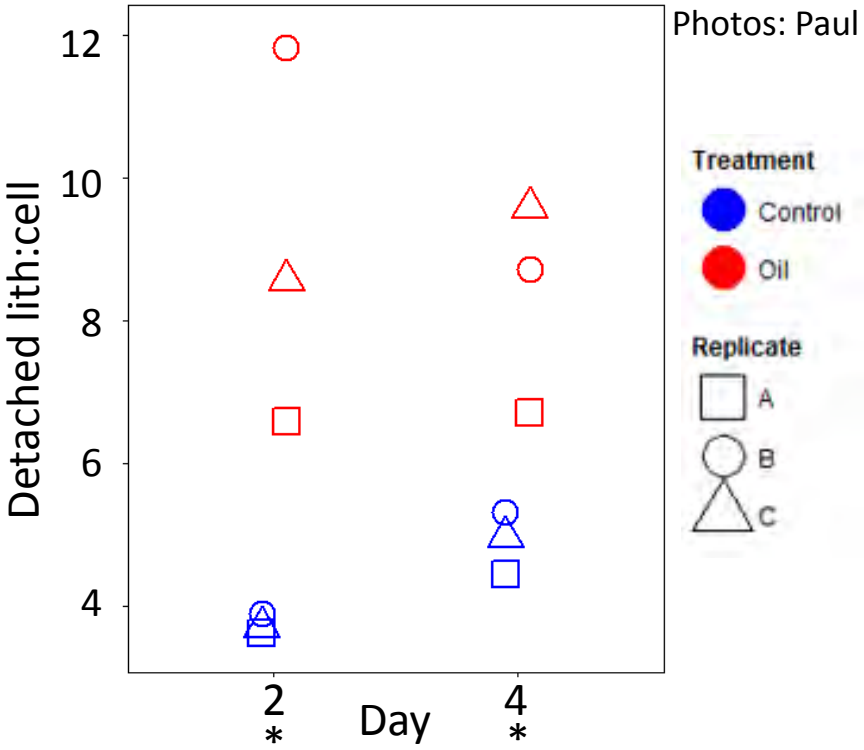
Oil caused abnormal *E. huxleyi* calcification



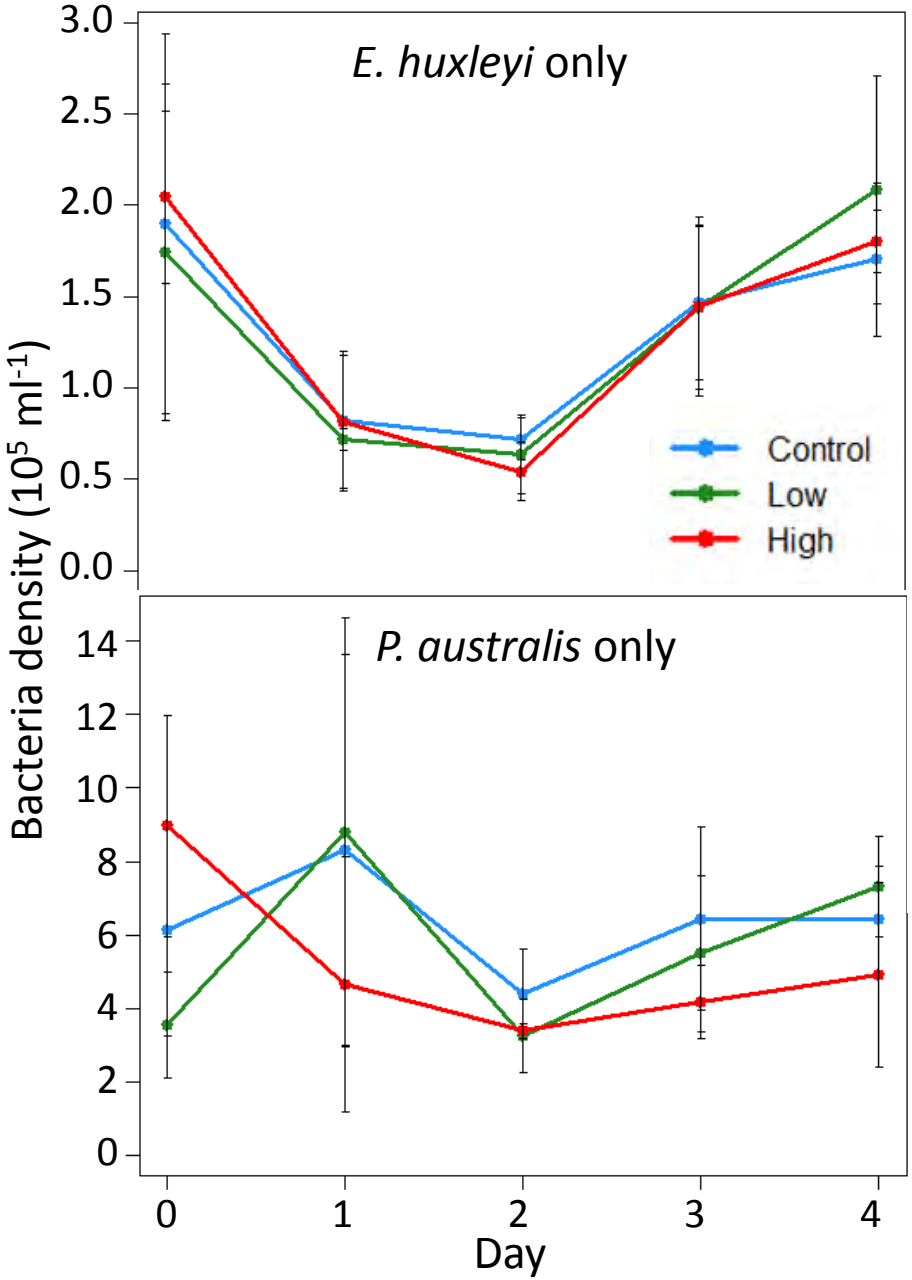


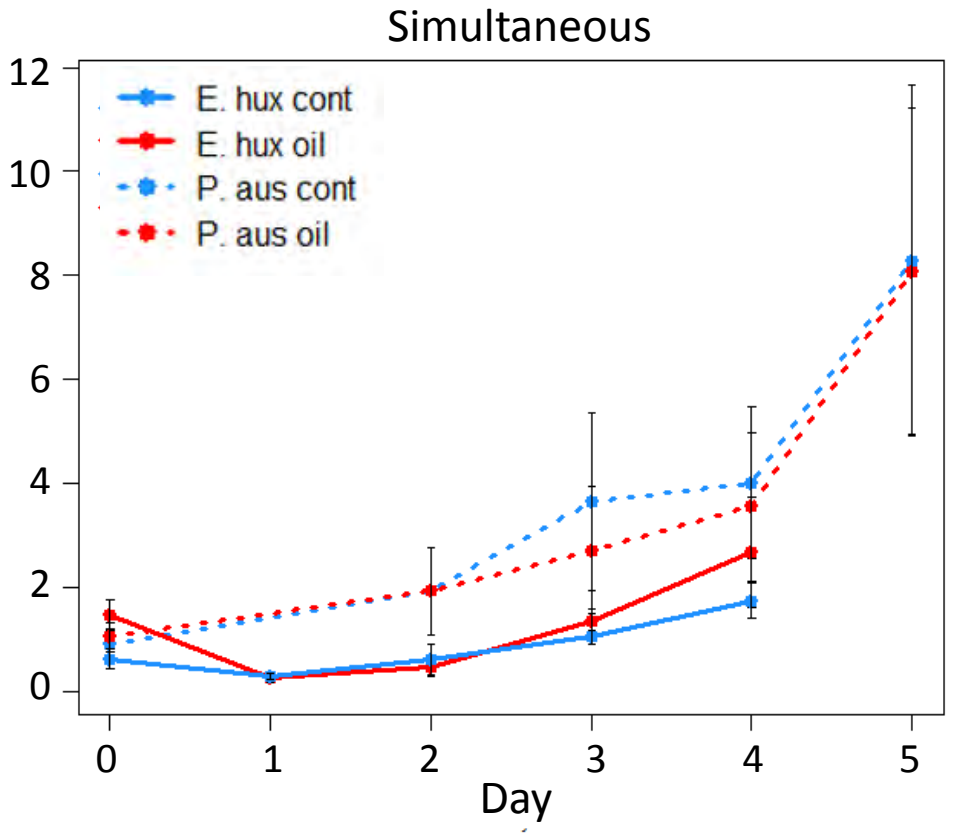
Photos: Paul Matson





Oil did not alter bacterial abundance





Conclusions and implications

- Growth was reduced (*E. huxleyi*) or completely inhibited (*P. australis*) during oil exposure
- *P. australis* seems to be more sensitive to oil exposure than *E. huxleyi*
- Cells were stressed during oil exposure
  - **More TEP** per cell
  - *P. australis* cellular **DA increased**
  - *E. huxleyi* **coccoliths abnormal**
- Bacterial abundance did not differ between treatments

This work would not be possible without funding support and all the hard work by many people

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