

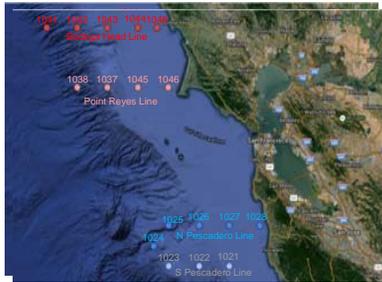
Effects of changing coastal conditions in 2014 on nutrients and productivity in the northern California upwelling system

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Sporadic data available from NOAA-NIMFS Rockfish Recruitment and Ecosystem Assessment Cruises
Surface, chlorophyll max and 100m samples collected each May (2002 to 2014)
Measured concentrations of nutrients, chlorophyll, DIC and $^{15}\text{NO}_z$, $^{15}\text{NH}_4$ and ^{13}C uptake rates
Warmer water may increase relaxation window for primary productivity, nutrient uptake, chlorophyll accumulation

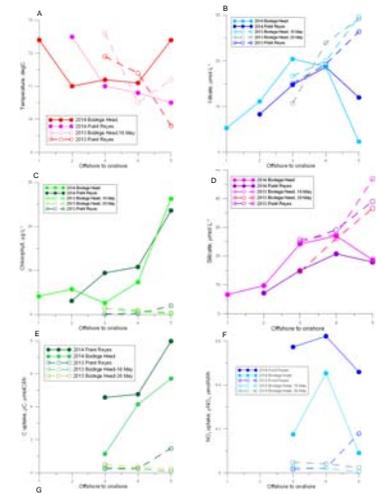
Northern CA Study Site



Bodega Head & Point Reyes Lines 2013 vs 2014

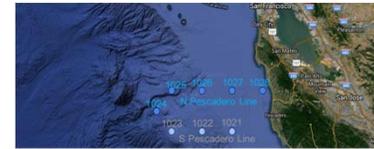


Offshore to onshore plots of temperature, NO_3 , chlorophyll, $\text{Si}(\text{OH})_4$, C uptake, NO_3 uptake, NH_4 uptake

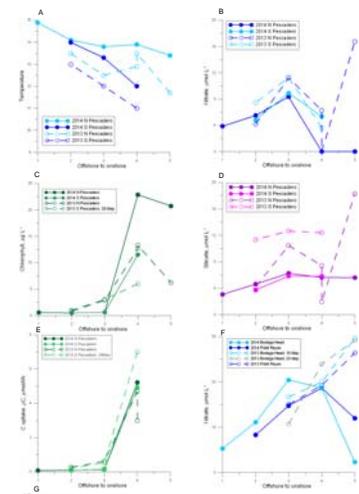


- In 2014, chlorophyll (C) and primary productivity (E) at both locations were high nearshore with evidence of NO_3 (B) and $\text{Si}(\text{OH})_4$ (D) depletion. Nitrate uptake was elevated offshore.
- 2013 was very different with no chlorophyll accumulation, low primary productivity and nitrate uptake and no evidence of nutrient depletion nearshore.

North and South Pescadero Lines 2013 vs 2014

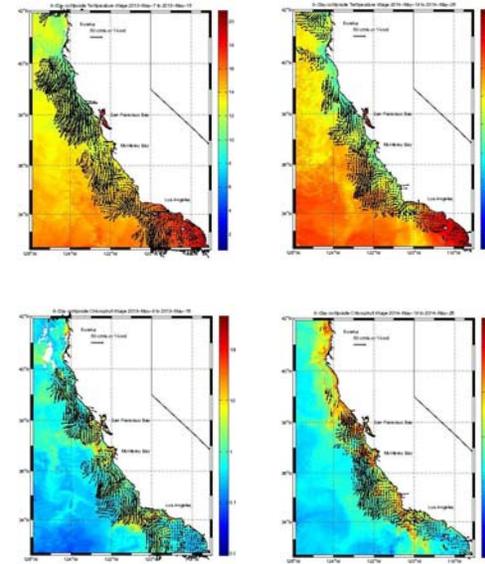


Offshore to onshore plots of temperature, NO_3 , chlorophyll, $\text{Si}(\text{OH})_4$, C uptake, NO_3 uptake, NH_4 uptake



- Along the Pescadero transects, elevated chlorophyll (C) tended to occur just offshore where NO_3 (B) was maximal (but lower than at Pt. Reyes or Bodega Head).
- Temperatures (A) were lower in 2013 compared to 2014 and as at Pt. Reyes and Bodega Head, the changes were positively related to chlorophyll (C), consistent with the analysis of anomalies.

May 2013 vs 2014



Preliminary Summary

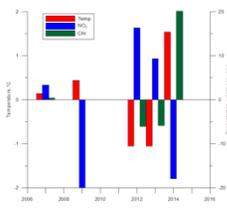
- Along the Bodega and Point Reyes transects temperatures were lower all near-shore locations in 2013 compared to 2014 and the pattern of chlorophyll and productivity is consistent with the analysis of anomalies.
- Along the Bodega and Point Reyes transects warmer water translated to more chlorophyll; rate data suggest that warmer conditions might be linked with increased relaxation window for primary productivity, uptake of upwelled nutrients and chlorophyll accumulation.
- Along the Pescadero transects, results less striking although there was still evidence of elevated chlorophyll in 2014, nutrient depletion accompanying the warmer conditions.

Acknowledgements

Thank you to the NOAA NIMFS Santa Cruz Lab for offering berth space for these cruises and the numerous SFSU grad students and personnel who collected the data.

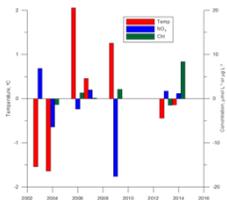
Climatology at most coastal stations

Bodega Head (1048)



- Temperature and nitrate anomalies are in the opposite direction.
- Temperature and chlorophyll anomalies are in the same direction, increased temperature and increased chlorophyll follow the same patterns.
- These interactions are the result of the upwelling.
- The higher temperatures in 2014 along with decreased nitrate and increased chlorophyll are consistent with the relaxation phase (the period where elevated chlorophyll and temperature and reduced nutrients occur).
- The 2012 and 2013 anomalies are indicative of early upwelling.

Point Reyes (1045)



- The temperatures, nitrate and chlorophyll anomalies are in the same relationship as at Bodega Head.
- However, chlorophyll anomalies are comparatively except for the positive anomaly in 2014.
- High anomalies tend to be offshore at Pt. Reyes and to be near shore at Bodega Head, probably reflecting lower average upwelling activity at Pt. Reyes and more representative of offshore conditions.