# Sign of the times: the lipid signature of a collapsing phytoplankton bloom

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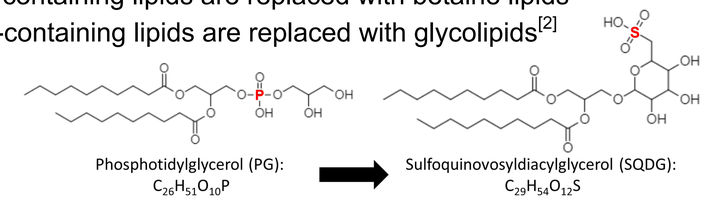
## Background

- **Phytoplankton blooms are impactful, large-scale events in the ocean**
- **They collapse abruptly when population controls are re-established**

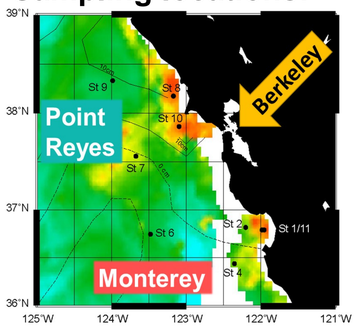

- **Traditional methods have emphasized nutrient limitation as the major decay factor**
- **Lipids are excellent biomarkers for environmental stresses and community composition**
- **In oligotrophic environments, lipid swapping has been used as a biomarker for nutrient stress**
  - P-containing lipids are replaced with betaine lipids[1]
  - N-containing lipids are replaced with glycolipids[2]




**Research question:**
**Can we use lipids to assess bloom dynamics in eutrophic systems?**

## Methods

**Sampling locations:**



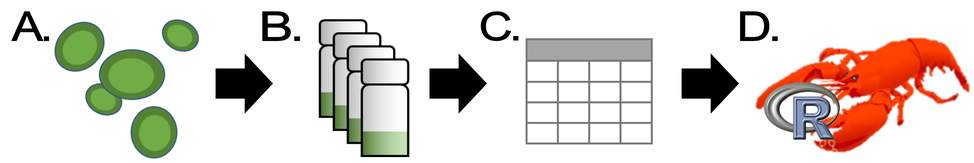

Samples were processed via lipidomics pipeline. Environmental samples were collected from 9 stations in the California Current Ecosystem then

**A.** filtered onto 0.2 µm Durapore filters and

**B.** extracted via a modified Bligh & Dyer.[3] These extracts were then

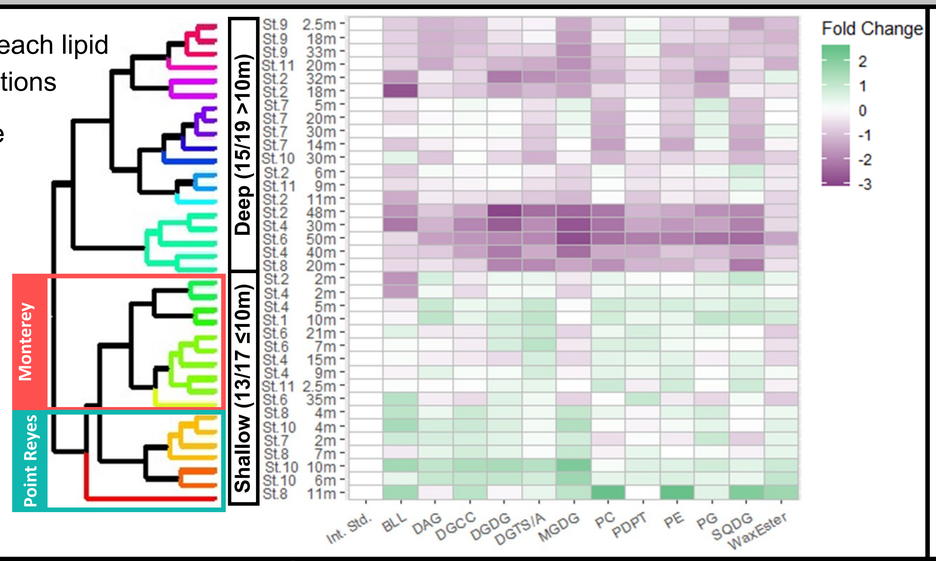
**C.** analyzed via HPLC-MS[4] and

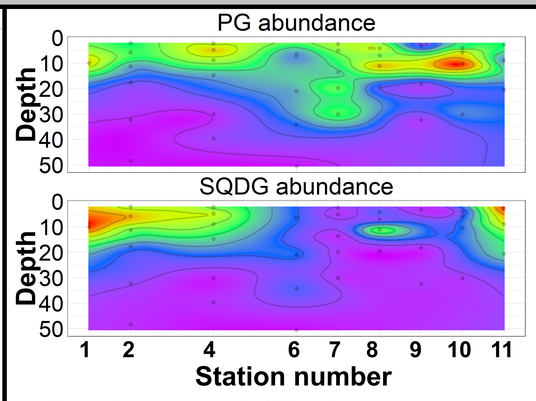
**D.** annotated via the R packages xcms, CAMERA, and LOBSTAHS.[5]




## Results

- Heatmap data shows the fold-change of each lipid sub-class relative to the mean across stations
- Dendrogram group colors denote that the lipidome structure is significantly similar between those samples[6]
- Deep samples (>10 meters) show a significant decrease in intensity, aligning with expectations based on lipid lability
- Among the shallow samples, all Point Reyes samples are significantly different from all Monterey samples

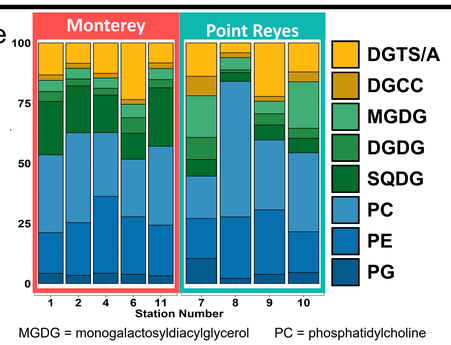



- Something about PG not changing implying that SQDG is driving biomarker changes

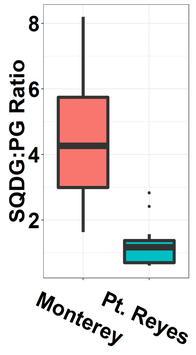
...and therefore community shift?

- Common intact membrane lipids (IP-DAGs) identified at every station
- Variation in relative abundances imply either nutrient stress induced lipid swapping or shifts in community composition




DGTS = diacylglyceryltrimethylhomoserine
DGTA = diacylglyceryl hydroxymethyltrimethyl-β-alanine
DGCC = diacylglyceryl carboxyhydroxymethylcholine
MGDG = monogalactosyldiacylglycerol
DGDG = digalactosyldiacylglycerol
SQDG = sulfoquinovosyldiacylglycerol
PC = phosphatidylcholine
PE = phosphatidylethanolamine
PG = phosphatidylglycerol

- Monterey stations have SQDG:PG ratios statistically different from Point Reyes stations (Mann-Whitney U, p-value < 0.001, n = 36)
- SQDG:PG values for oligotrophic regions typically vary between 2 and 7[7], implying the Monterey region is nutrient-limited




- However, SQDG:PG and phosphorus concentration are minimally correlated and other proxies for bloom health, such as chlorophyll:pheophytin, show that high SQDG:PG levels are correlated with...

## Conclusions

## Acknowledgements

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