

# Four Decades of Water Quality Research in San Francisco Bay FROM BELLBOTTOMS TO BLACKBERRIES

Sarah Q. Foster, Caitrin E. Phillips, Tara S. Schraga and James E. Cloern

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## San Francisco Bay

How has California's great estuary responded to changes over the last four decades? The continuous study of water quality in this urban estuary has provided an extensive dataset used to measure seasonal patterns, episodic events and long-term trends.



Sampling is designed to measure spatial and temporal variability along a 145 km transect. Regular monitoring includes monthly measurements of:

- Salinity
- Temperature
- Dissolved oxygen
- Chlorophyll a
- Nutrients
- Suspended particulate matter
- Light penetration
- Phytoplankton composition

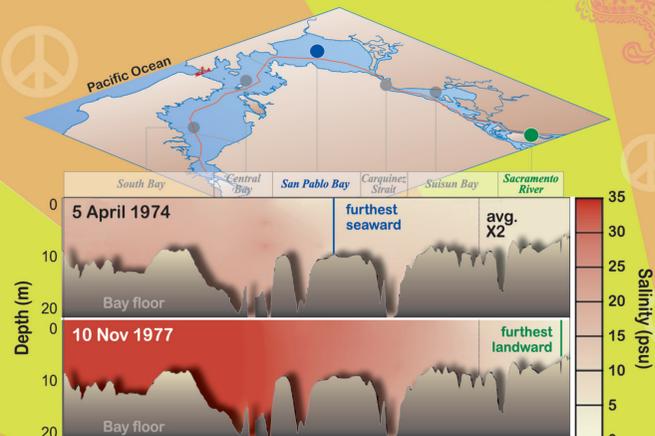


submersible instrument



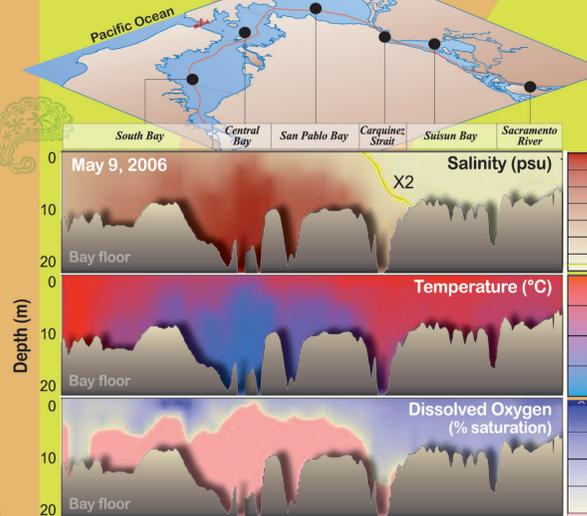
R/V Polaris, the oldest working ship in the U.S. Government.

## How do rivers influence the bay?



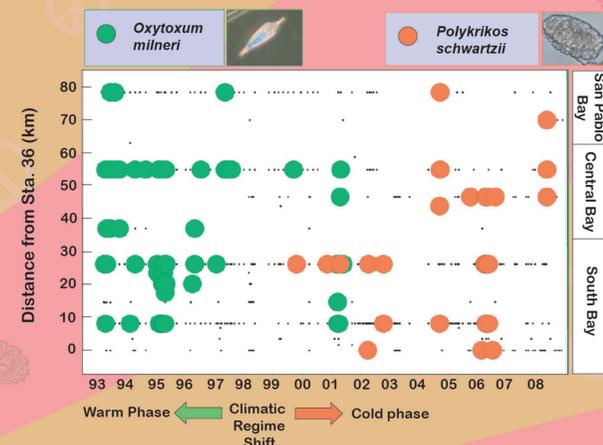
The fresh/salt water interface location is driven primarily by river flow. This interface is described by X2, the location where bottom salinity is 2 psu. On average, X2 is located in eastern Suisun Bay but can range from the Sacramento River (extreme drought) to San Pablo Bay (major flood).

## How does the ocean influence the bay?



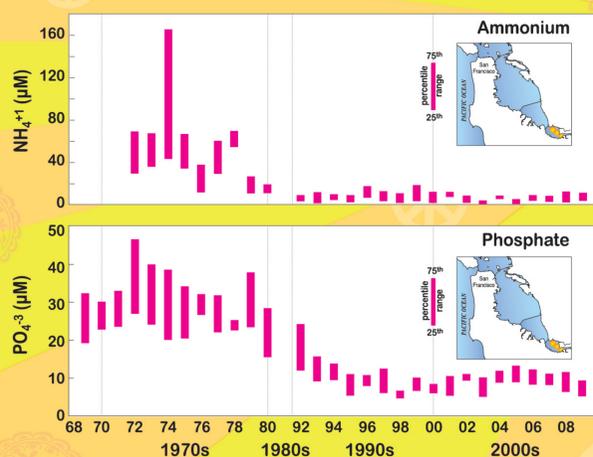
An example of oceanic influence can be seen in large intrusions of recently upwelled (cold, salty, low oxygen) ocean water. The largest of these events, spread south to the Dumbarton Bridge (Sta. 30) and north to Carquinez Strait covering a distance of 75 km.

## Are phytoplankton indicators of climate variability?



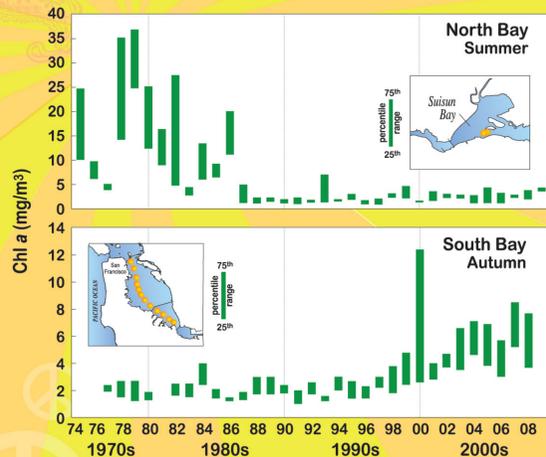
Phytoplankton species composition has changed since sampling began in 1993 (sample dates/locations indicated by small dots). For example, one dinoflagellate (*Oxytoxum milneri*) disappeared after 2001 but another (*Polykrikos schwartzii*) first appeared in 1999 and has been seen repeatedly since. These community changes spanned a large climate shift, suggesting that phytoplankton communities respond to global-scale climate variability.

## Have nutrient levels changed?



Ammonium and phosphate have been reduced in the Bay since the late 1970s. N and P concentrations still exceed levels that limit phytoplankton growth.

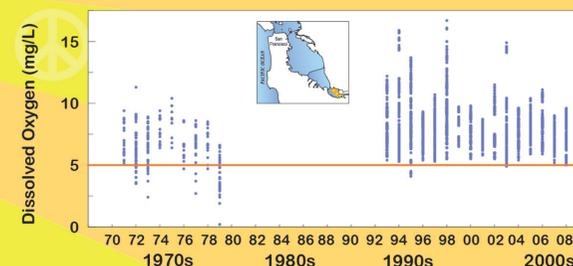
## Have phytoplankton blooms changed?



Since 1999, autumn phytoplankton blooms in the South Bay are increasing despite historically low chl a during this season.

## Does the bay suffer from low oxygen?

Not now! Improvements made to waste water treatment in the late 1970s and 1980s helps SF Bay waters to nearly always exceed the 5 mg/L (orange bar) standard.



Prior to these upgrades dissolved oxygen in the South Bay periodically fell below this standard and caused fish kills.

