Ammonium Concentrations and the Food Chain in Suisun Bay and the Delta

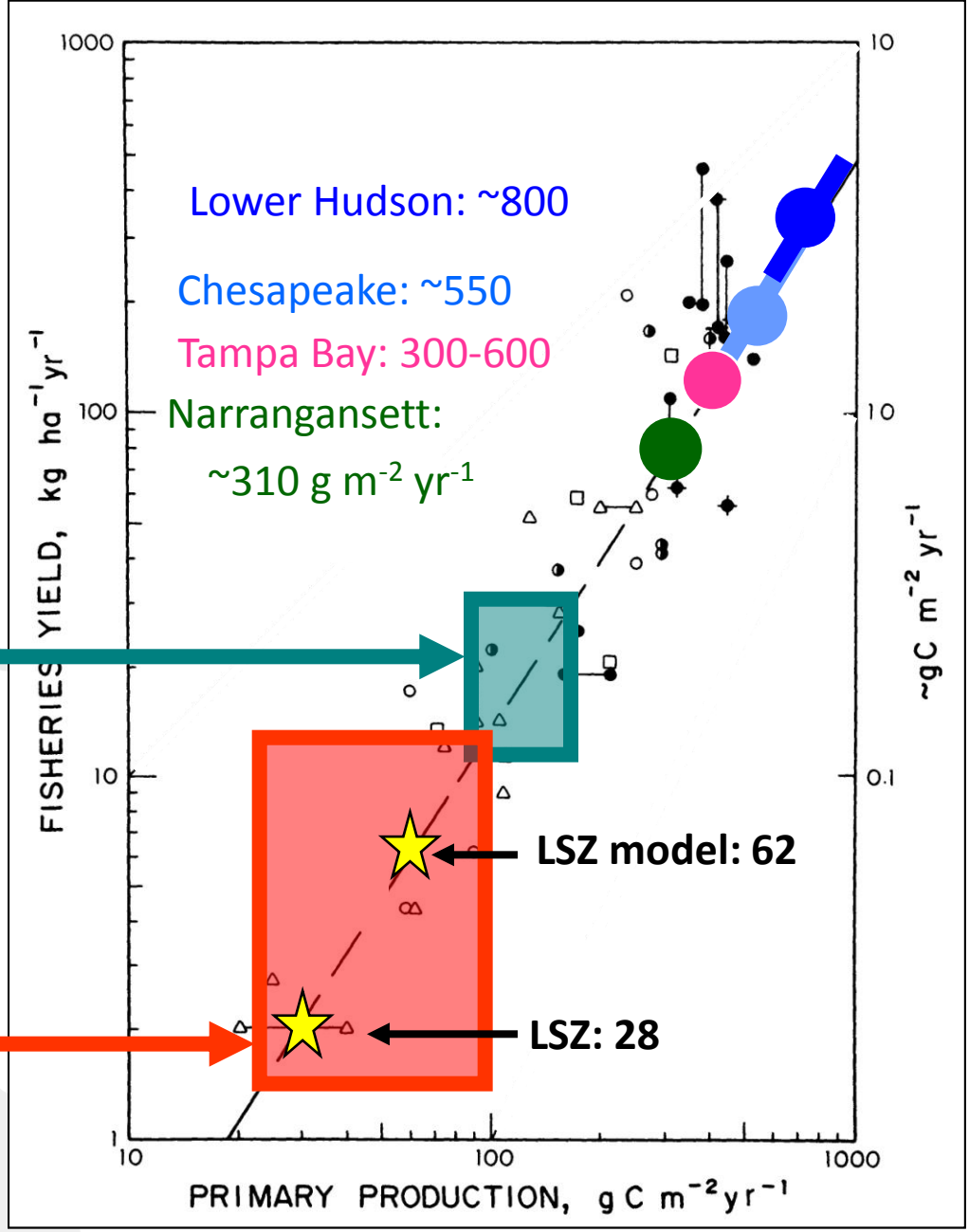
David Fullerton
Metropolitan Water District
August 18/19

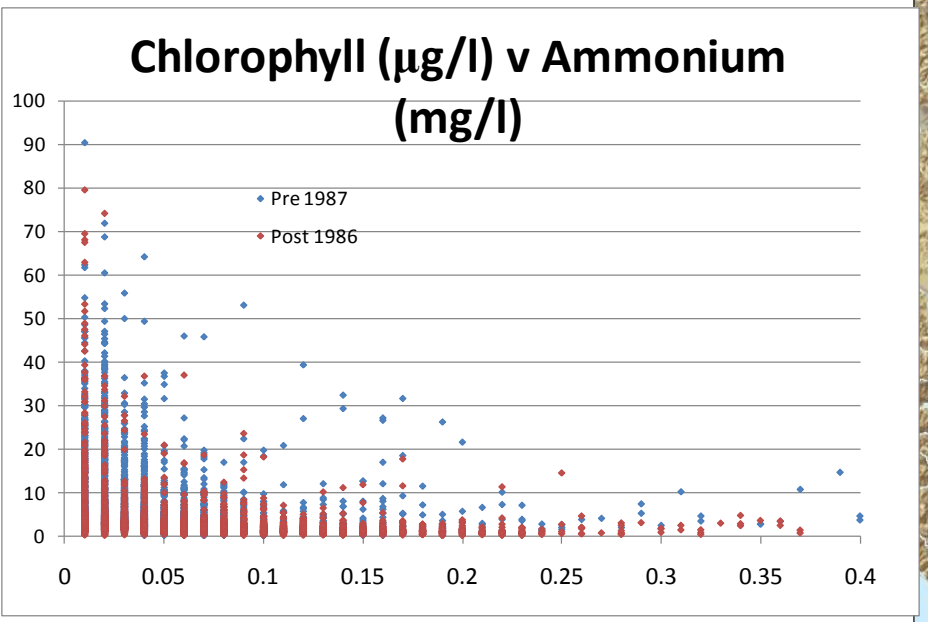
Food Matters

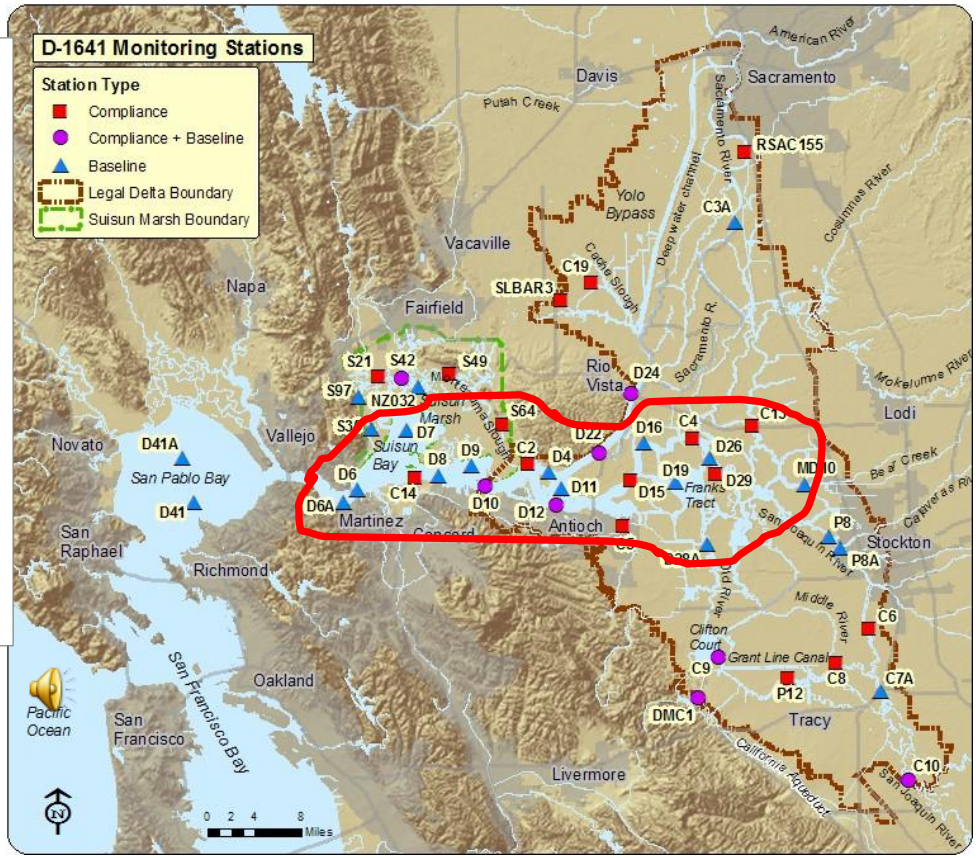
1976 – 1987

San Francisco Estuary Low-Salinity Zone

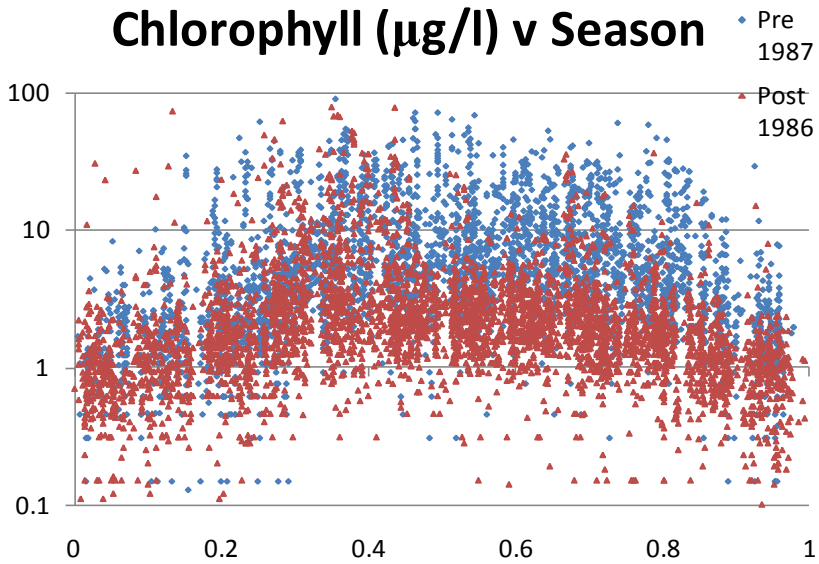
1988 - 2002

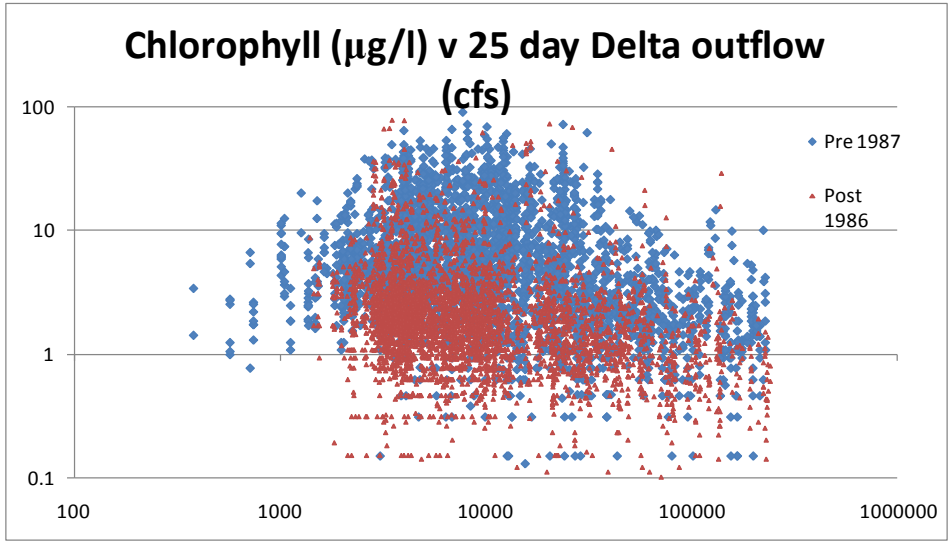


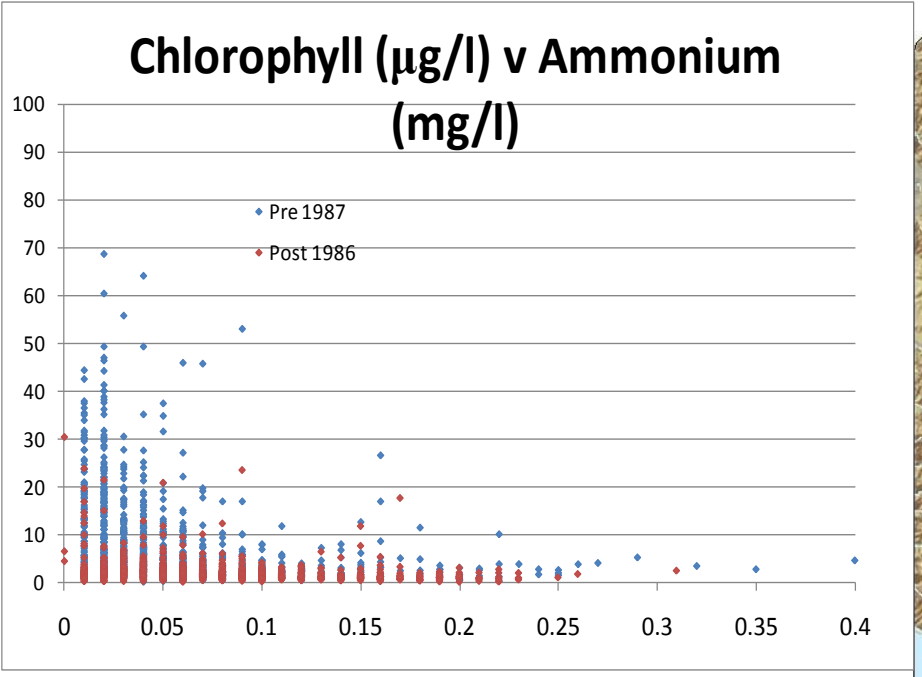


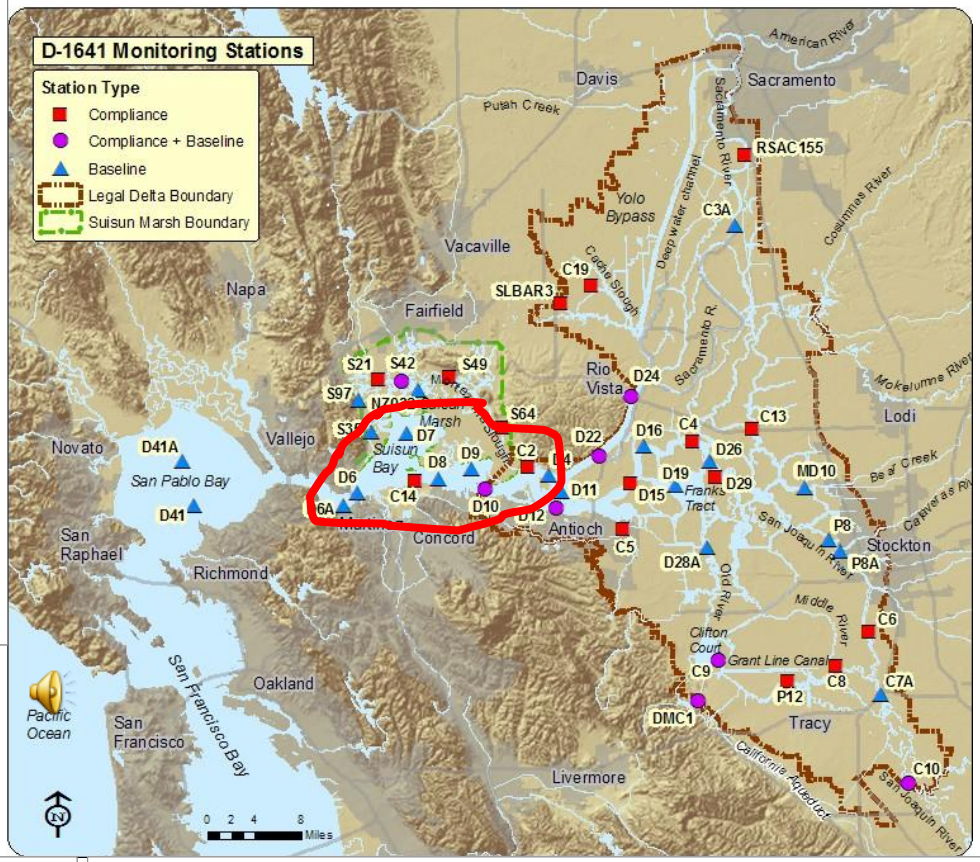


Chlorophyll relationships:
Lower Rivers to Martinez

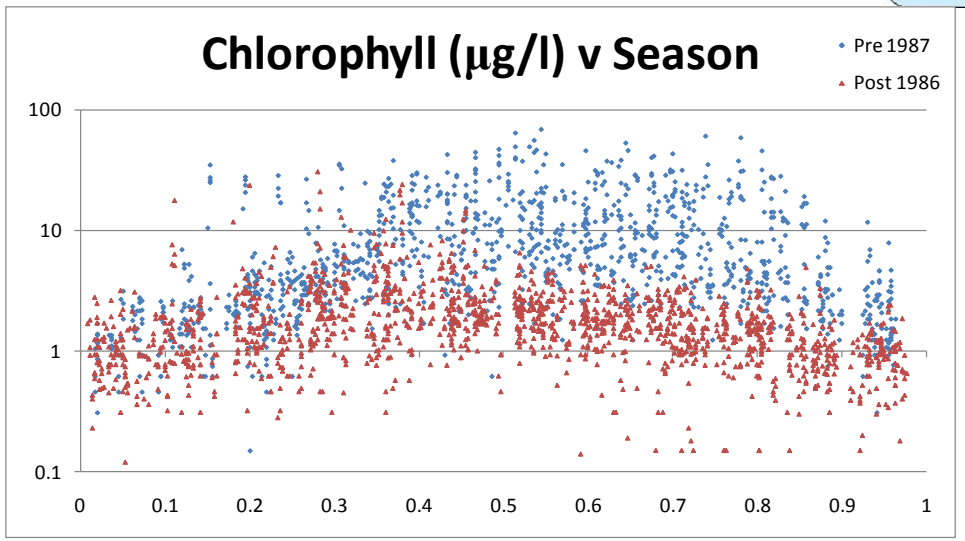


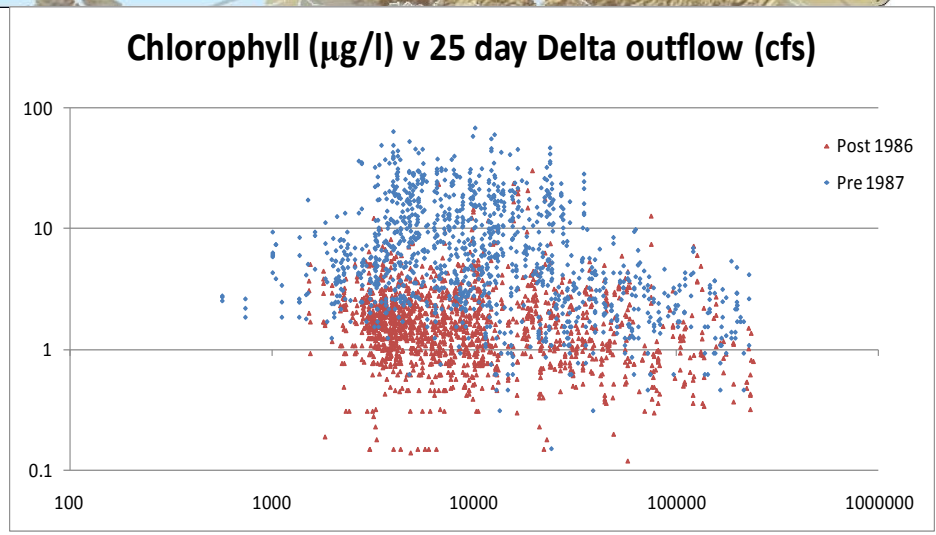


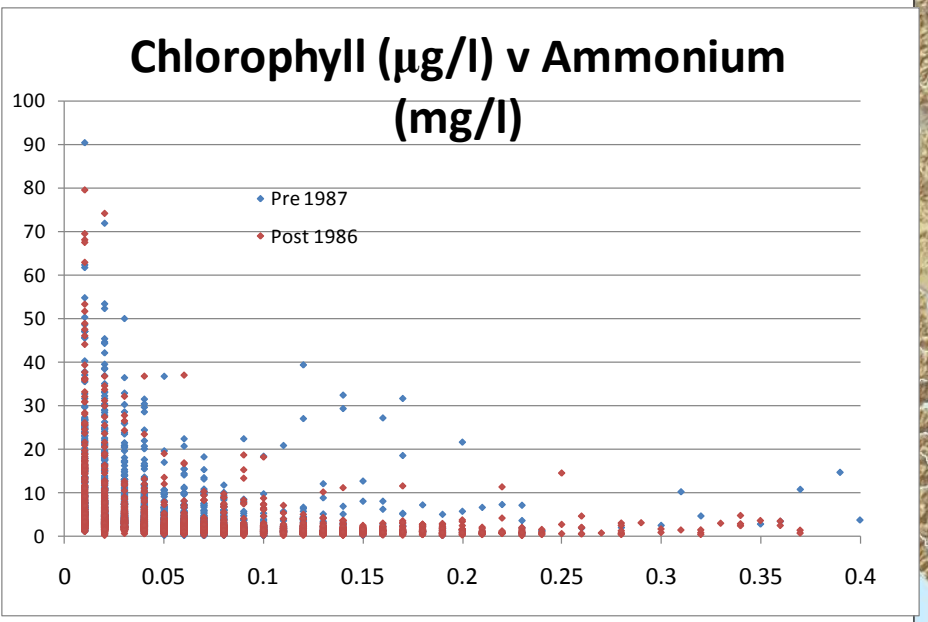


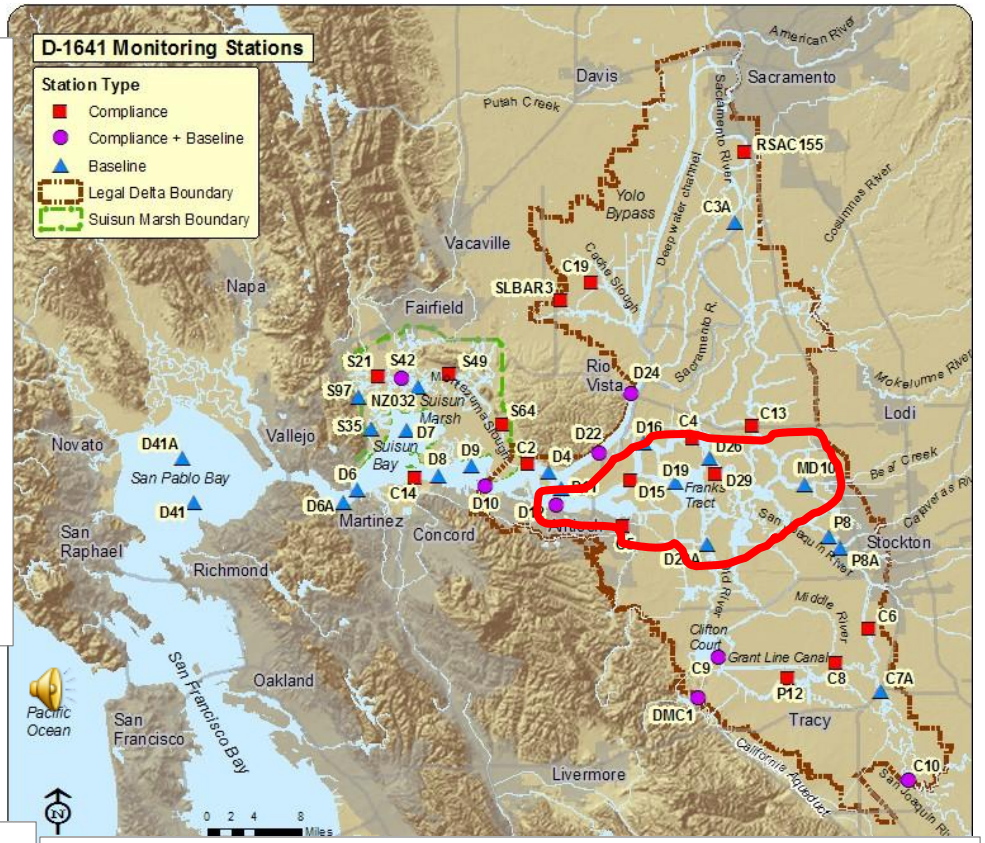


Chlorophyll relationships:
Confluence to Martinez

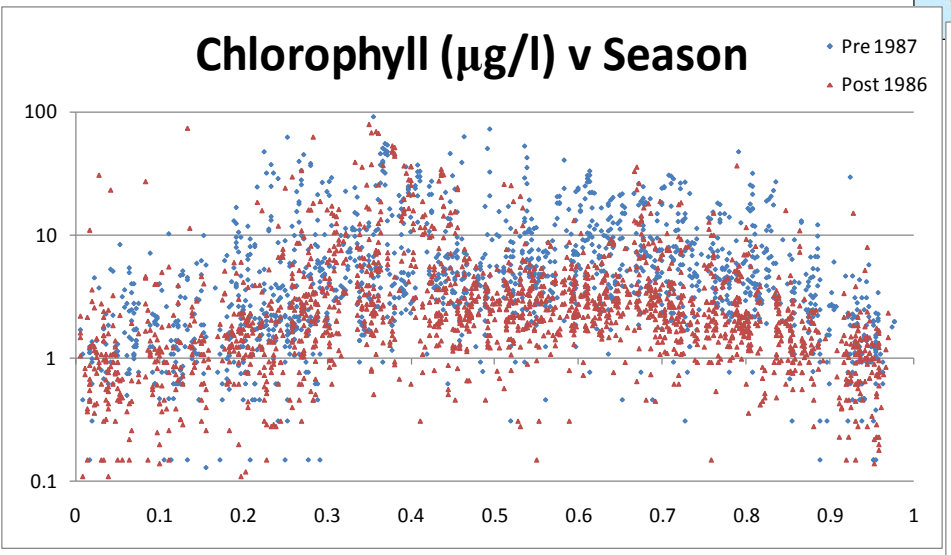


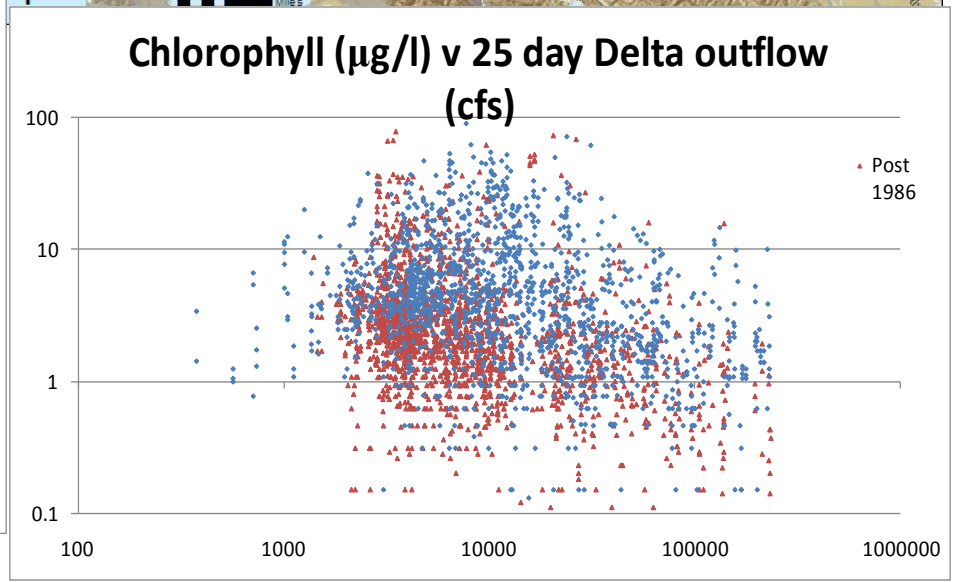


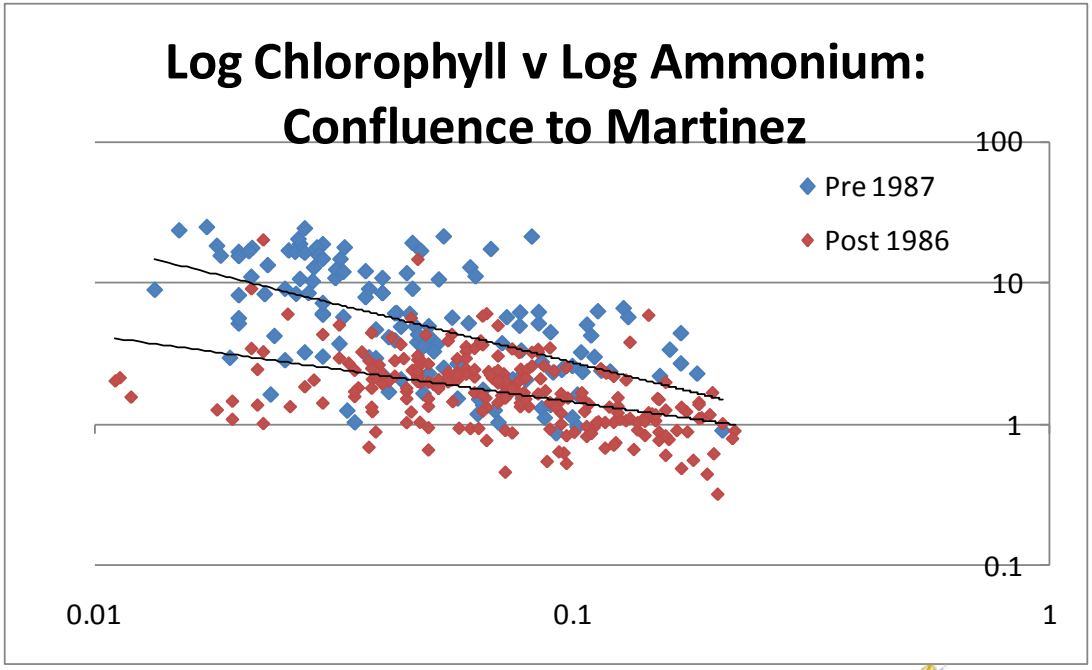




Chlorophyll relationships:
Lower San Joaquin River

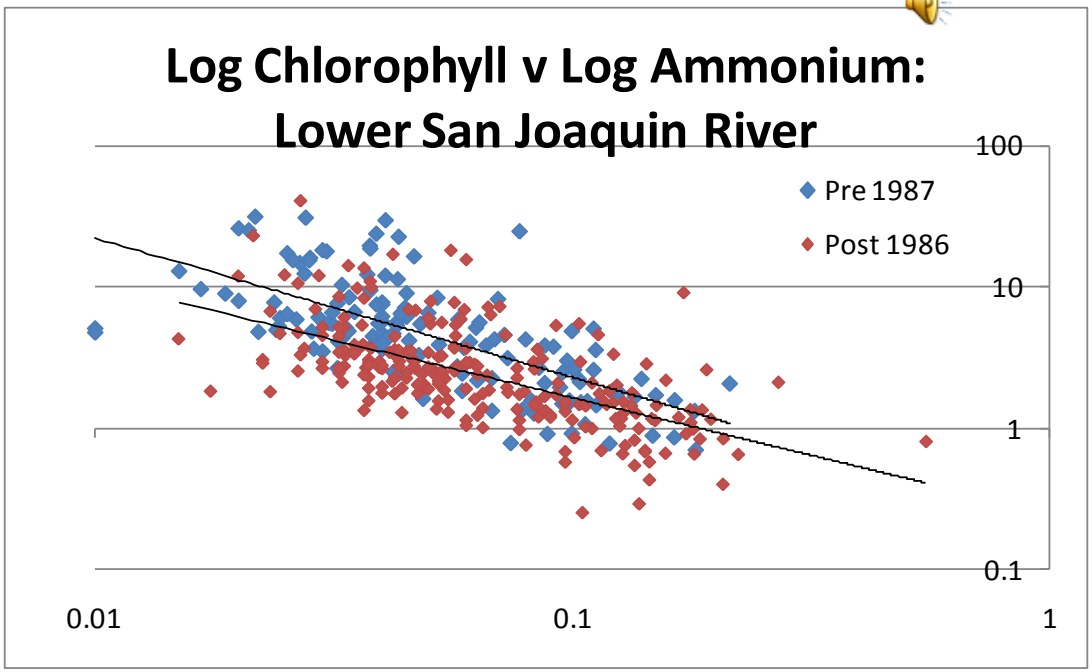




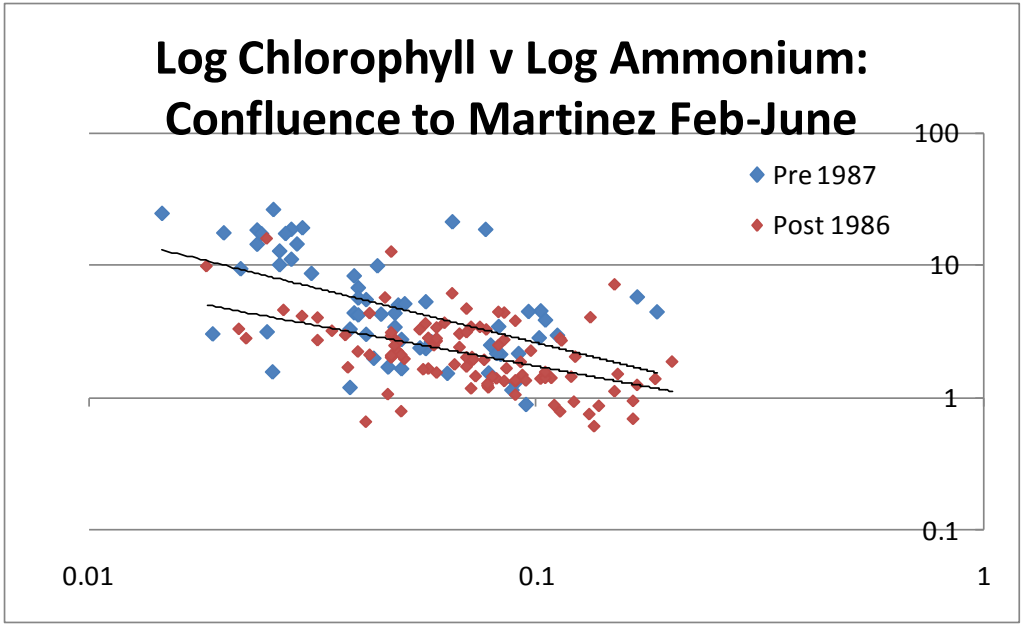


Monthly average log chlorophyll v average monthly log ammonium All Months

Suisun Bay relationship has weakened, probably due to clam grazing

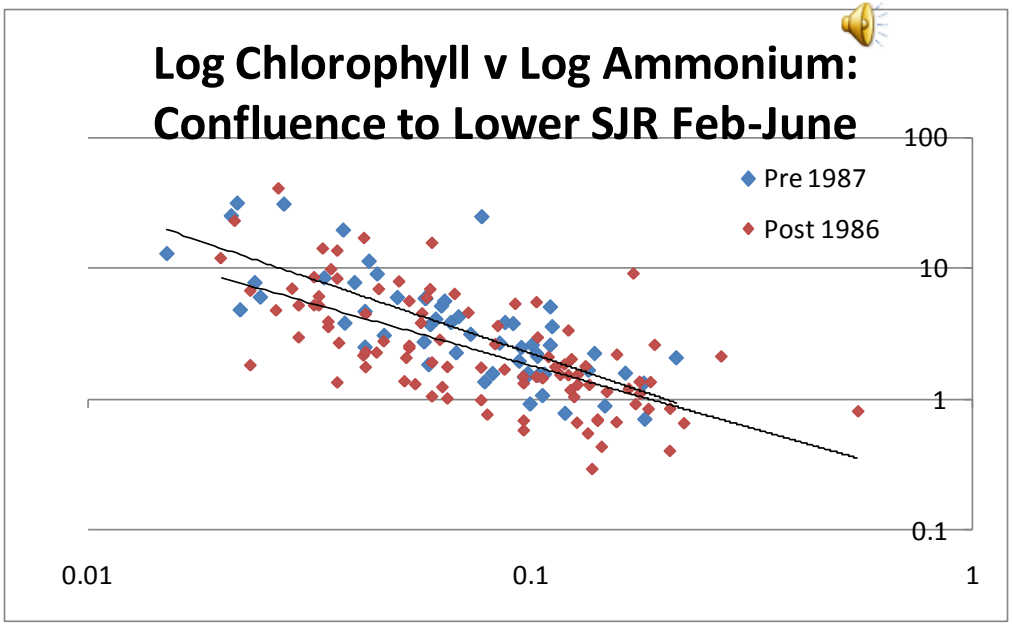


Lower SJR relationship remains largely unchanged



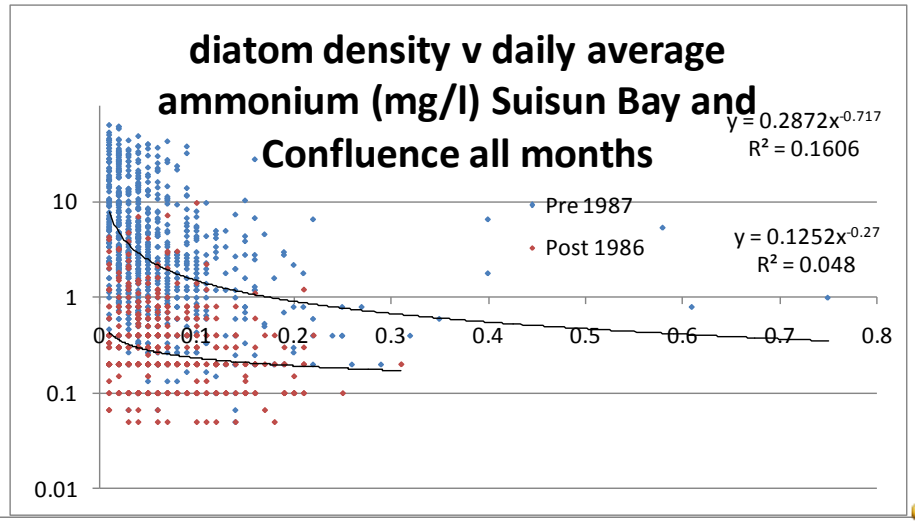
Monthly average log chlorophyll v average monthly log ammonium February to June

Suisun Bay relationship largely unchanged.

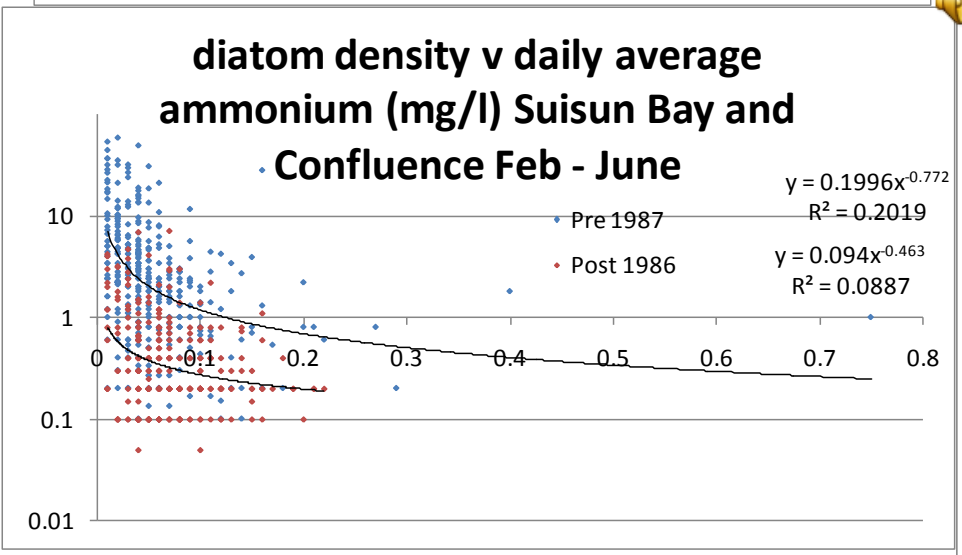


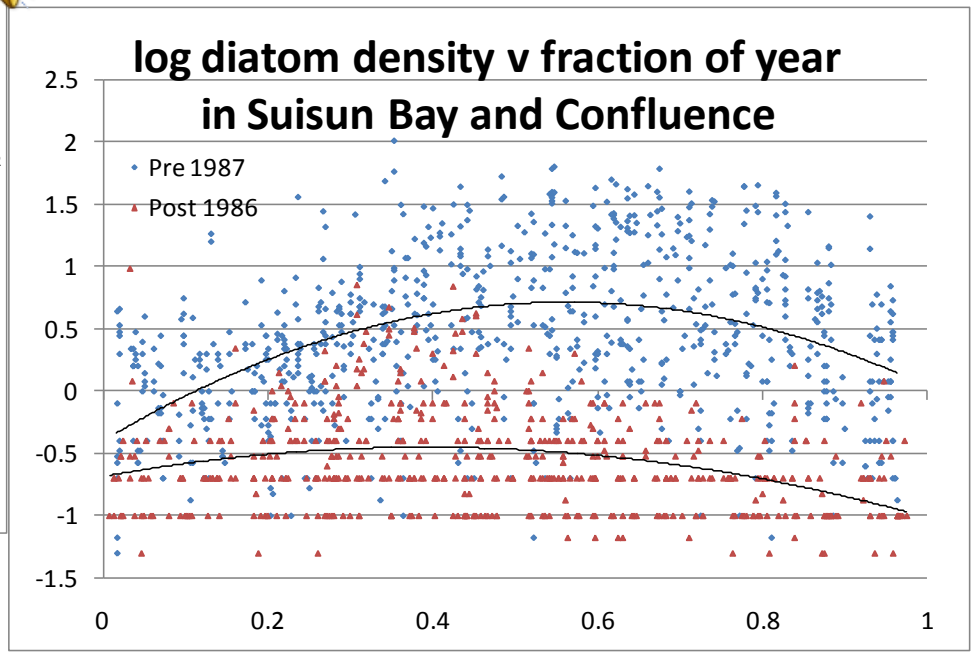
Lower SJR relationship largely unchanged

Diatoms show similar patterns: Suisun Bay

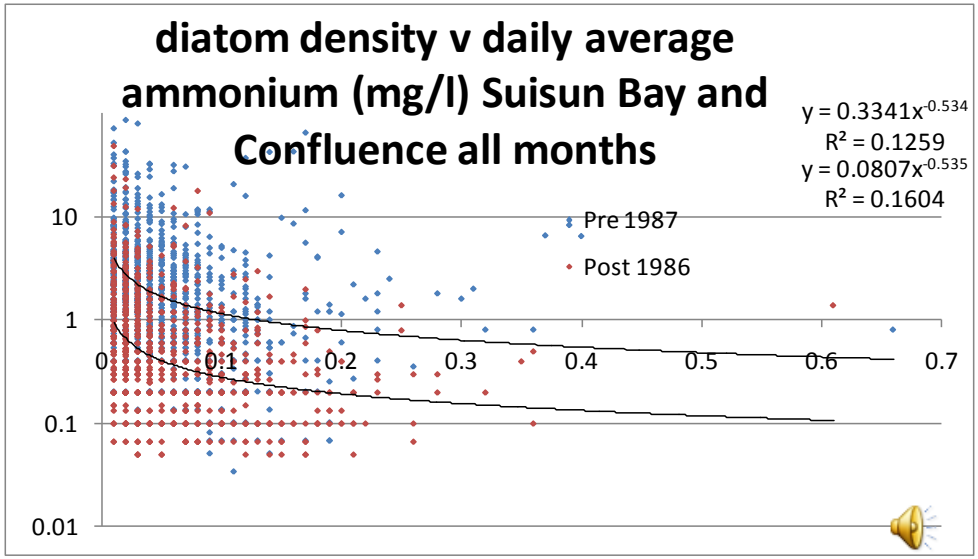


Suisun Bay: response to low ammonium much more muted since 1986. Response in spring remains, however. Seasonally, the summer is hit hardest, probably due to grazing.

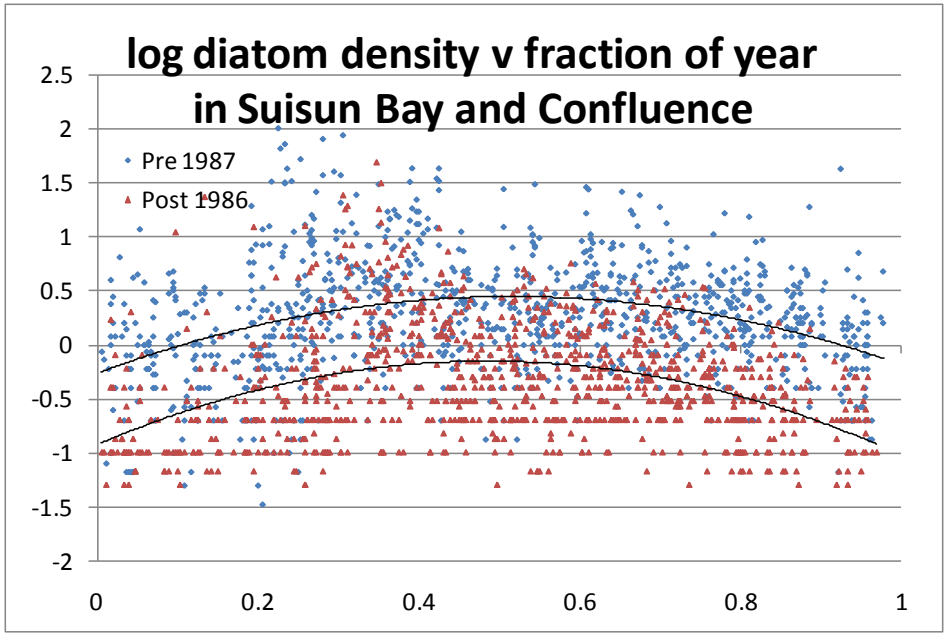




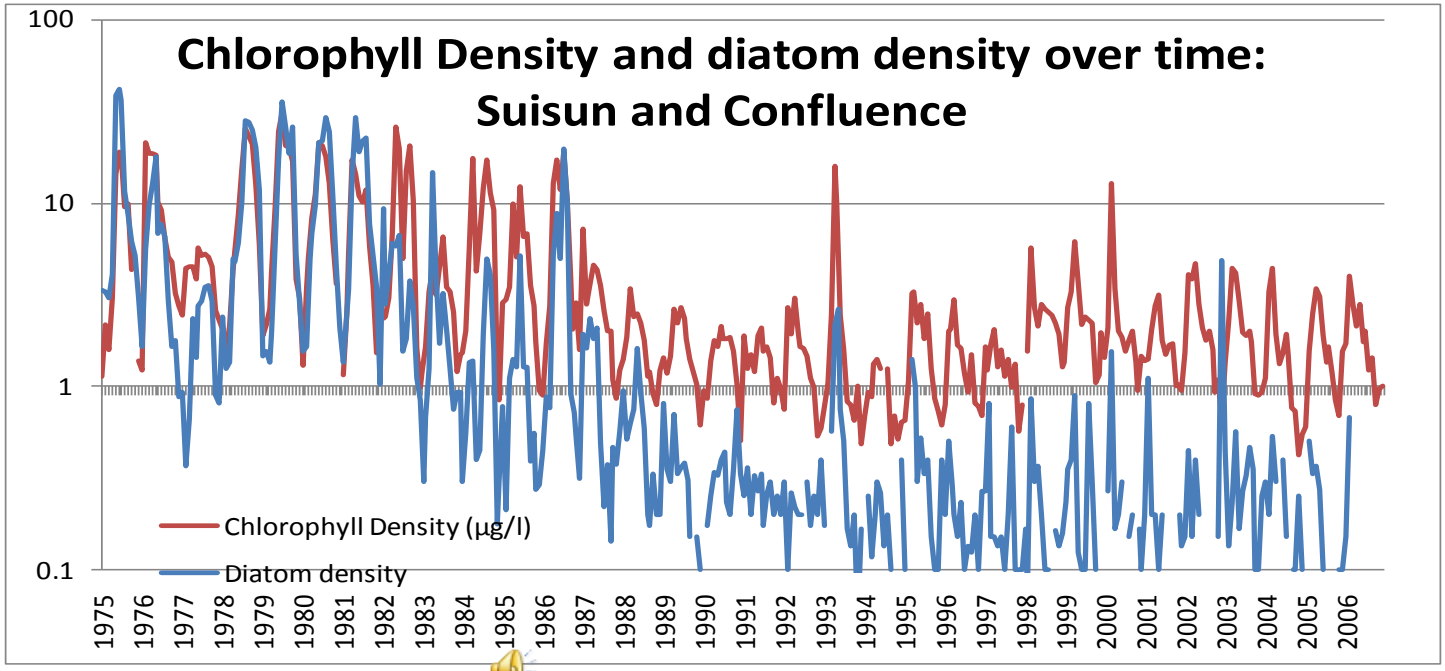
Diatoms show similar patterns: San Joaquin

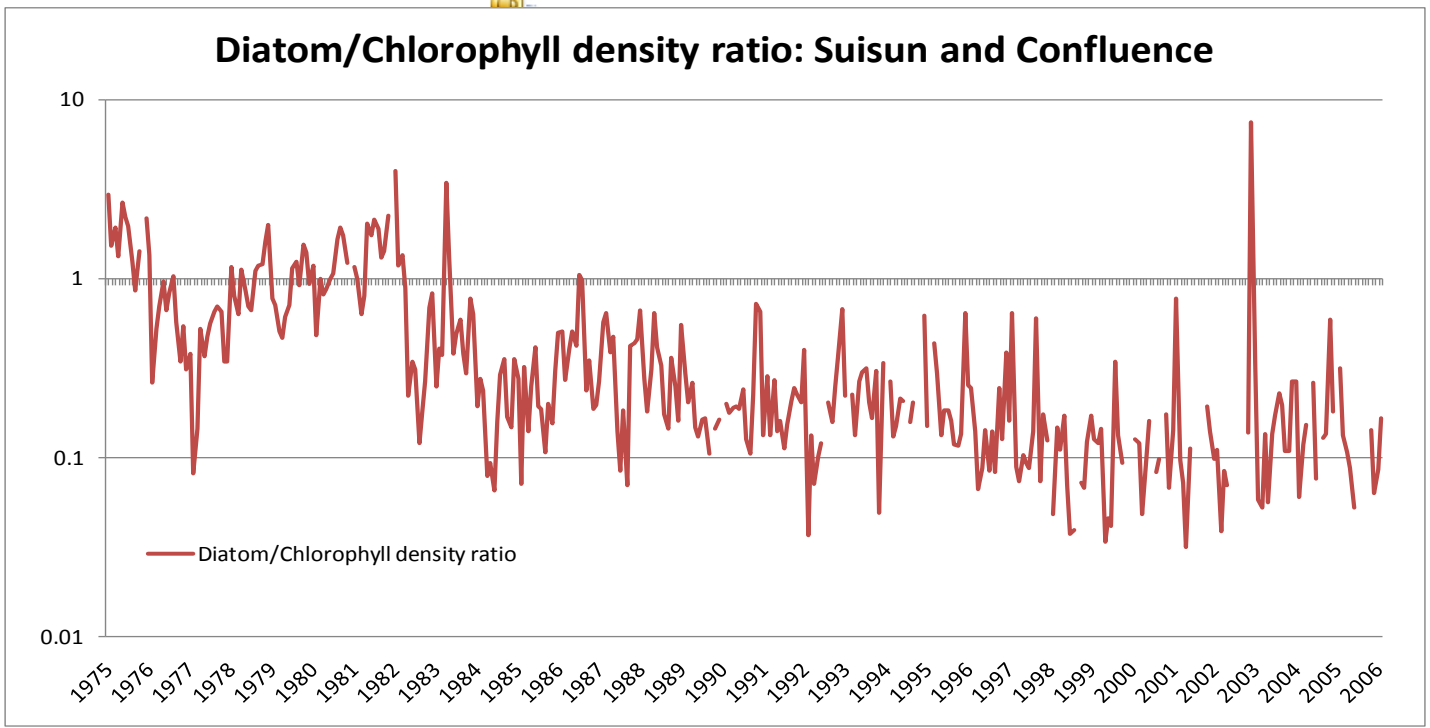


San Joaquin: diatom densities are down, but no summer depression and slope of response of log diatoms to ammonium remains unchanged.

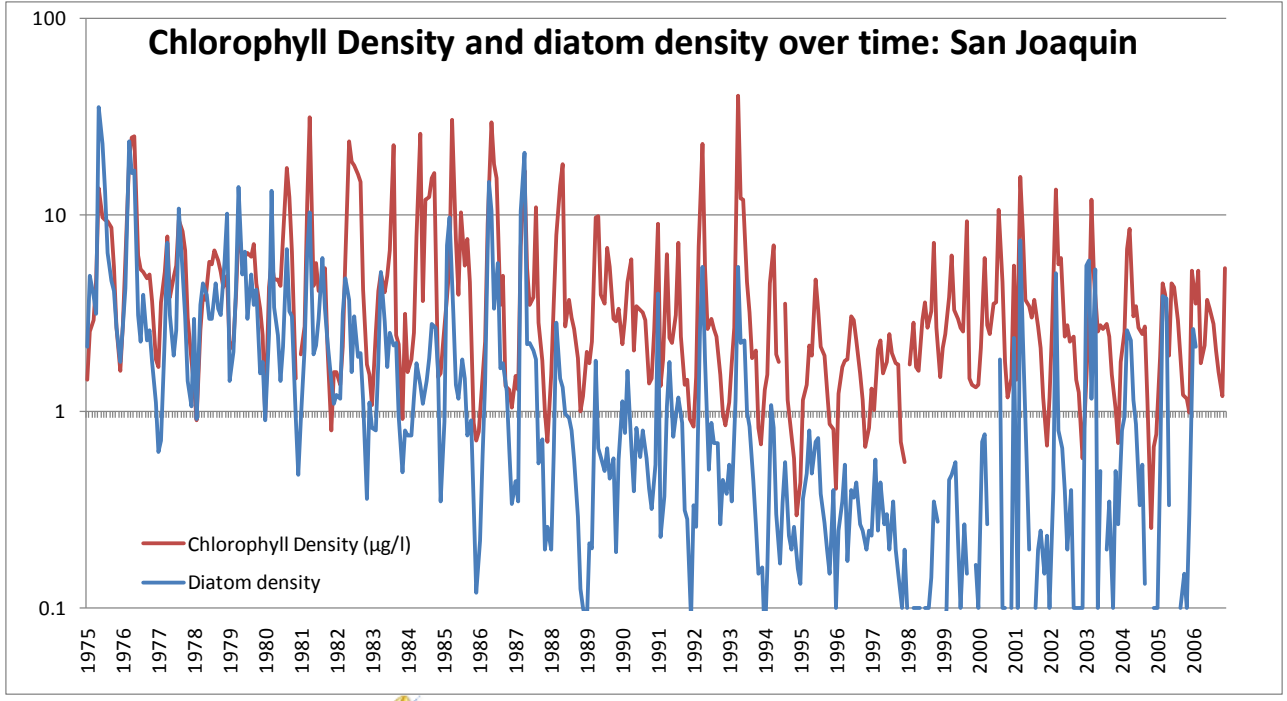


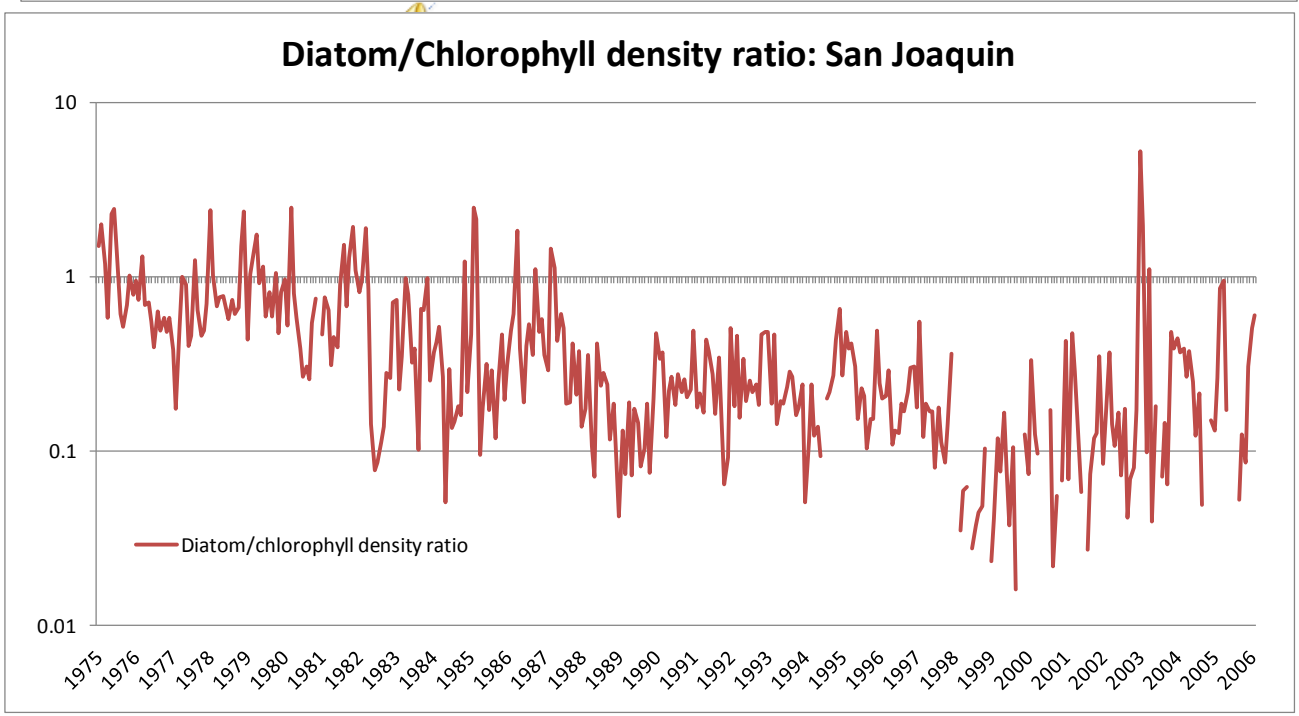
In Suisun Bay the relative contribution of diatoms crashed in about 1982 and certainly by 1984, long before the clam came on the scene.

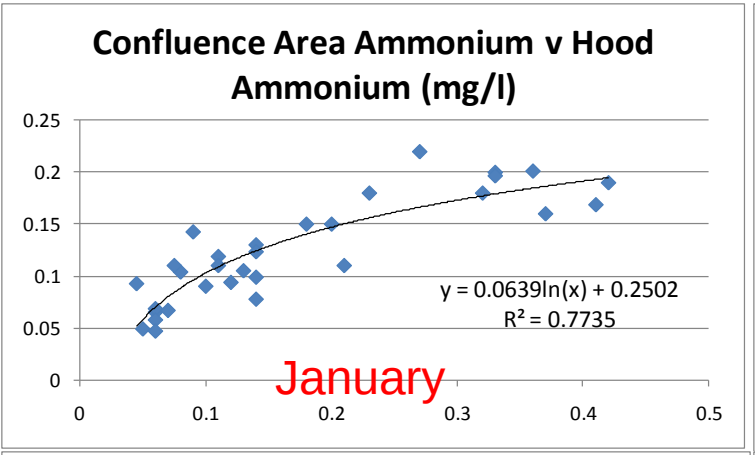


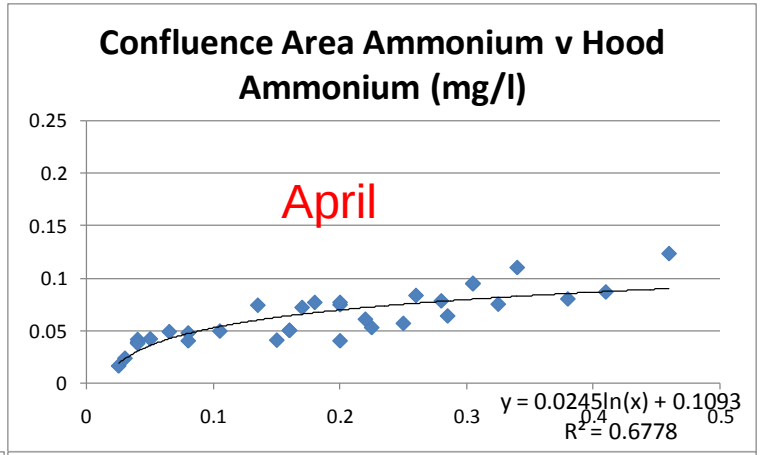


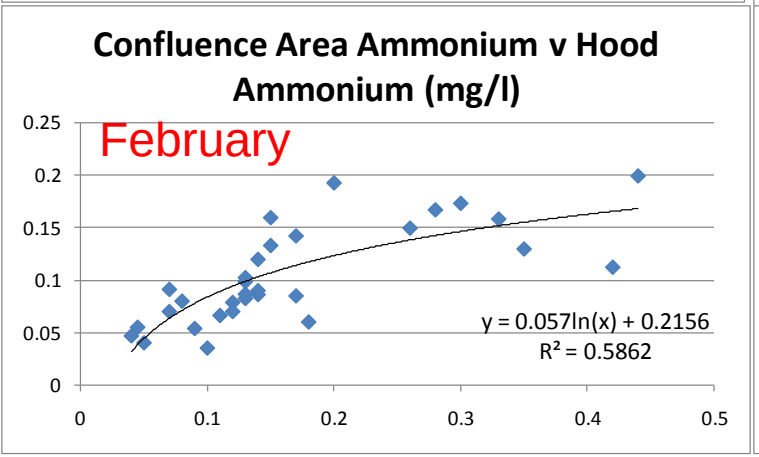
In the San Joaquin, diatoms have dropped relative to Chlorophyll over time, but appear to be coming back in recent years.

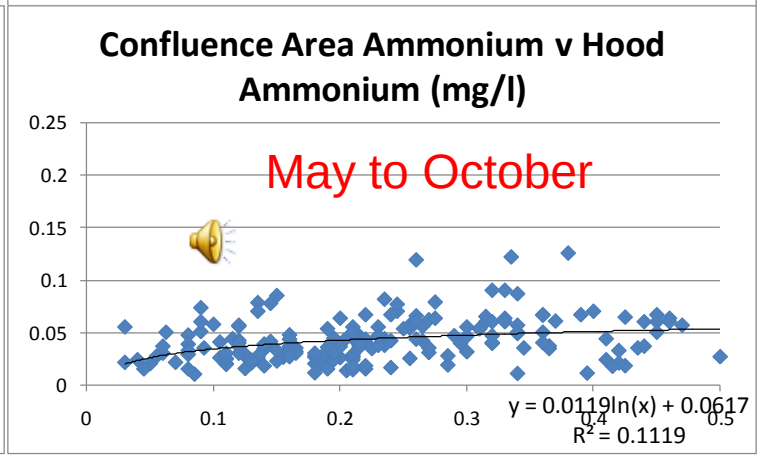


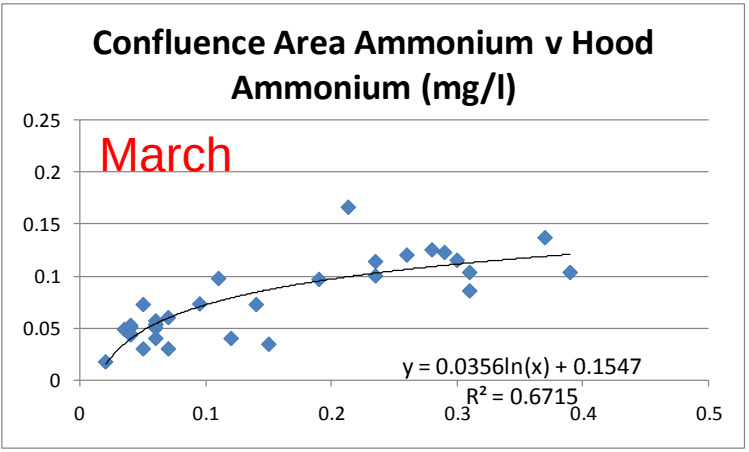


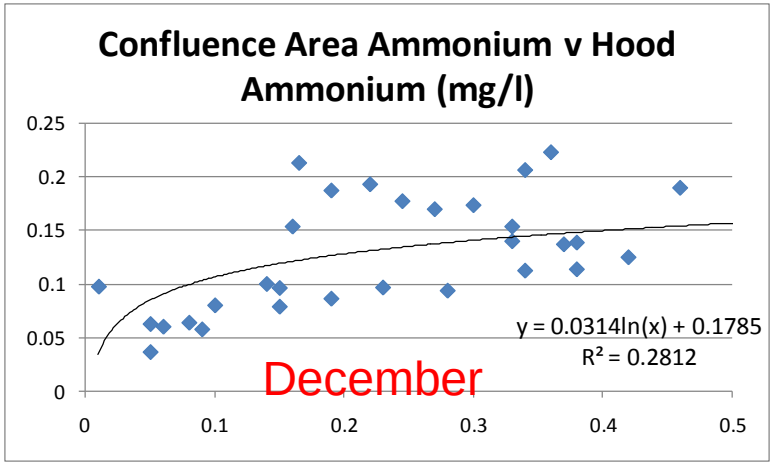




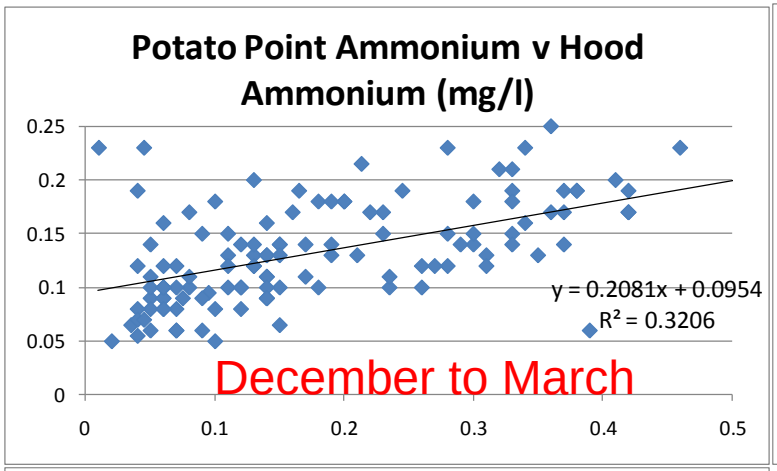


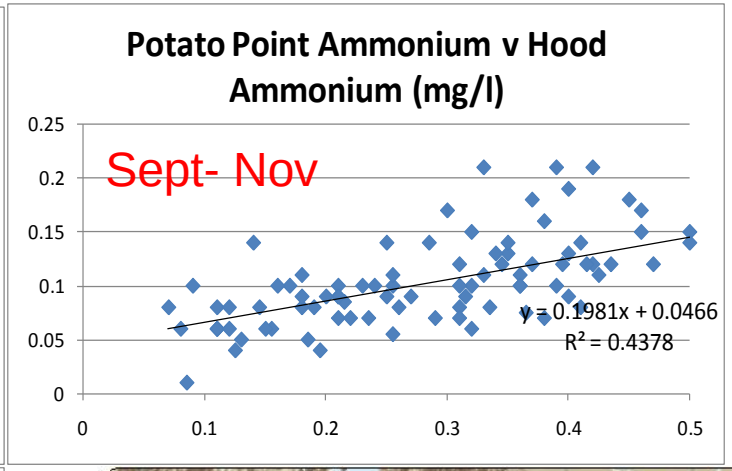




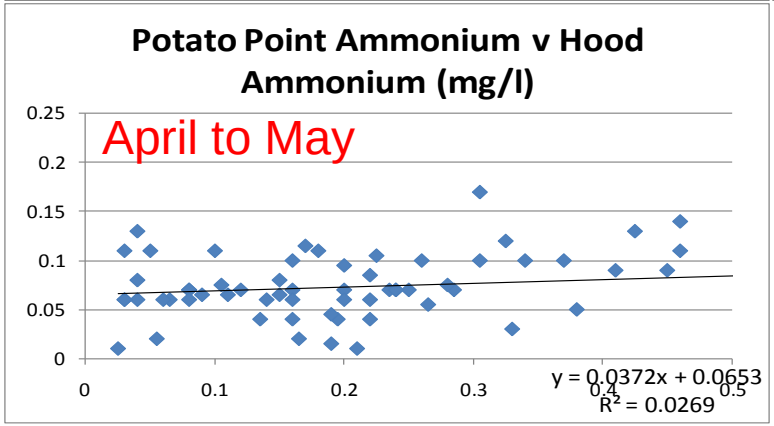


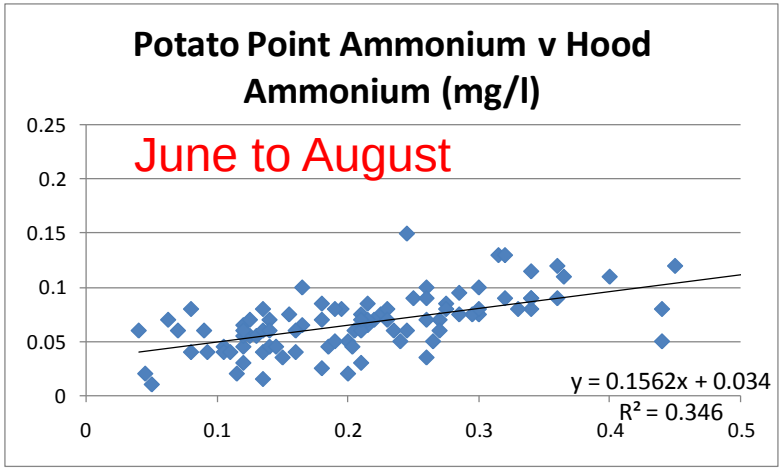
Confluence Area Ammonium is related to Hood ammonium in the colder months

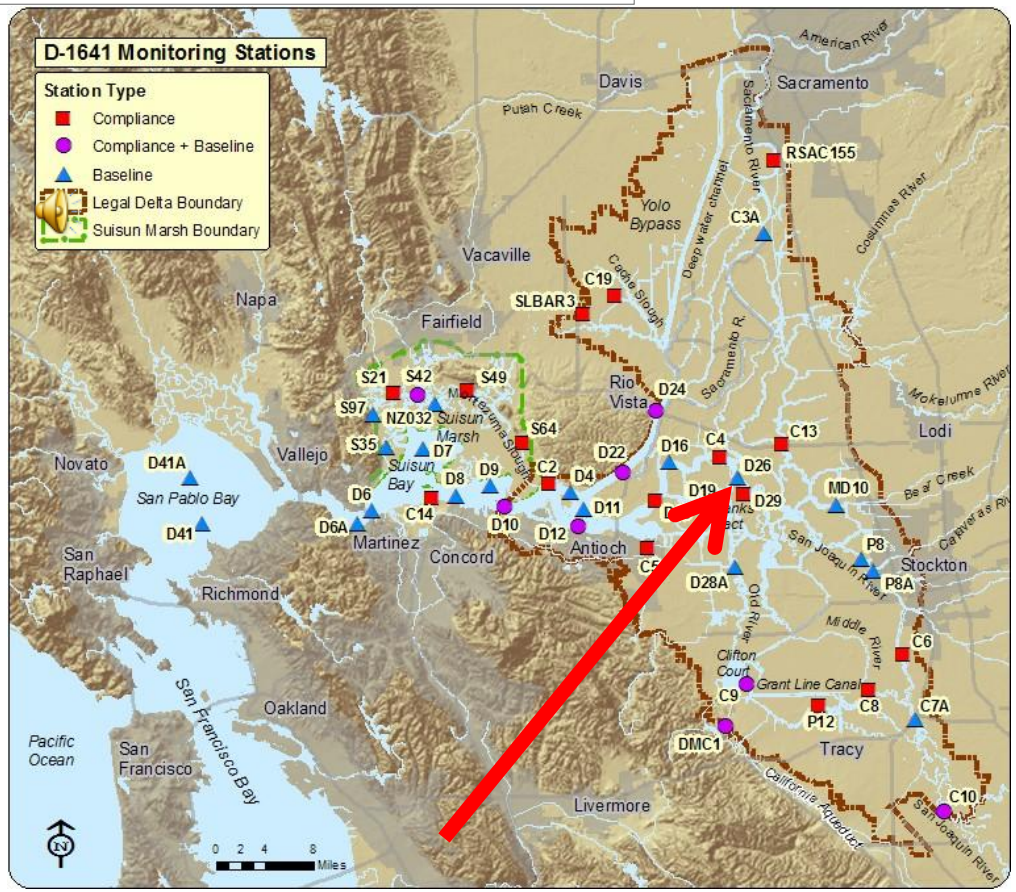


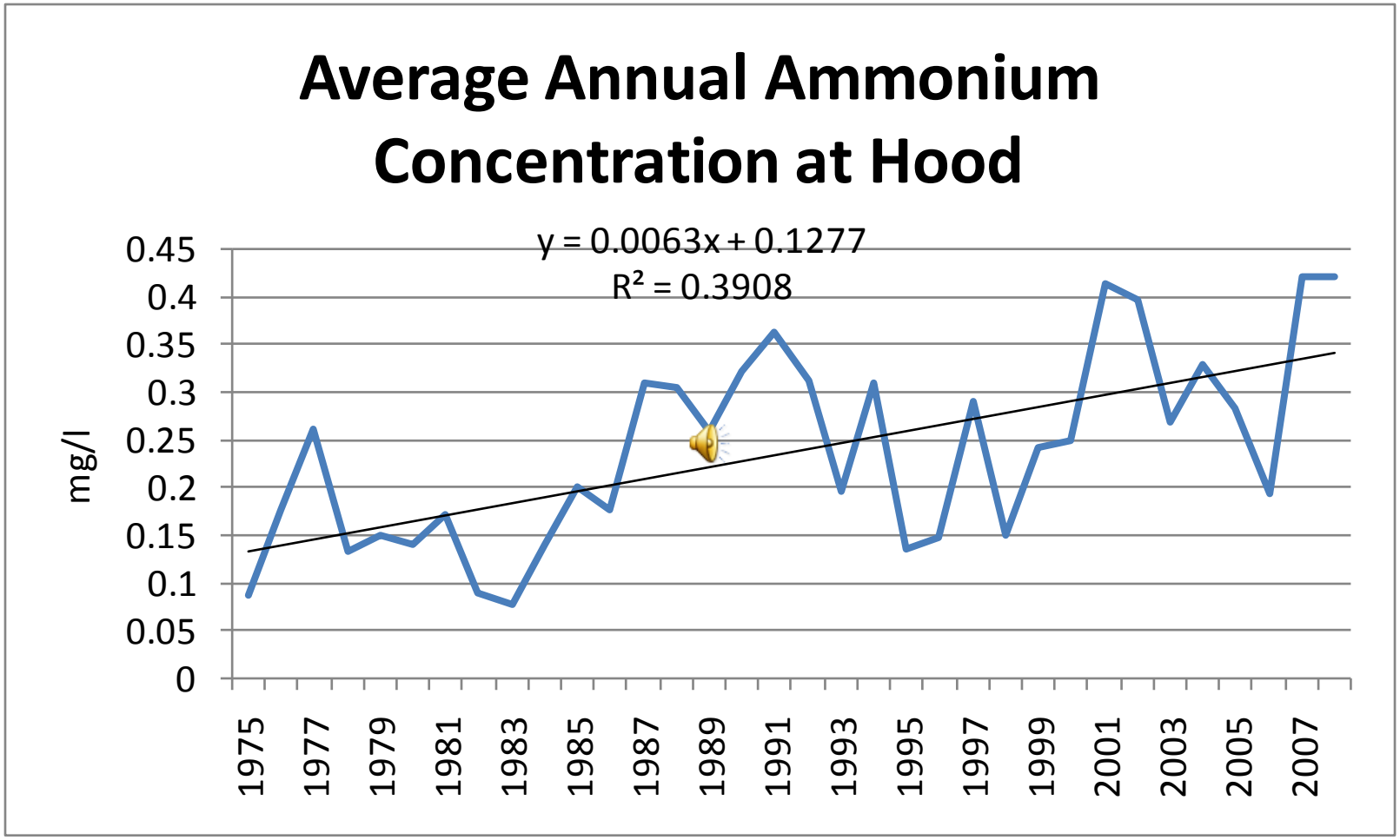


Lower Mokelumne ammonium appears related to Hood ammonium in most months








Average Annual Ammonium Concentration at Hood
y = 0.0063x + 0.1277
R² = 0.3908
mg/l
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1975
1977
1979
1981
1983
1985
1987
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1991
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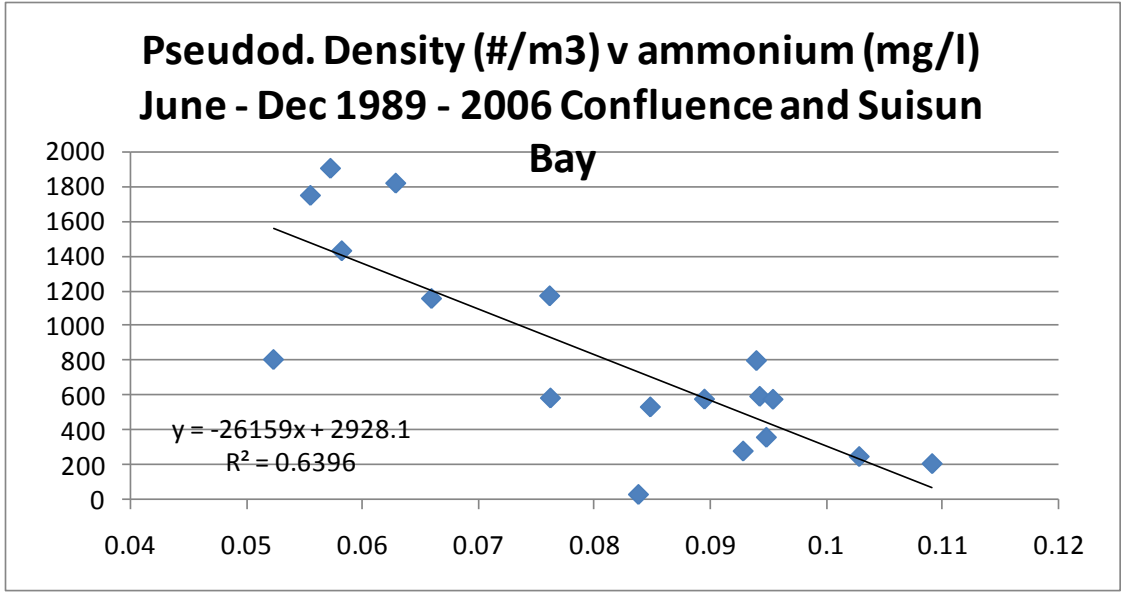
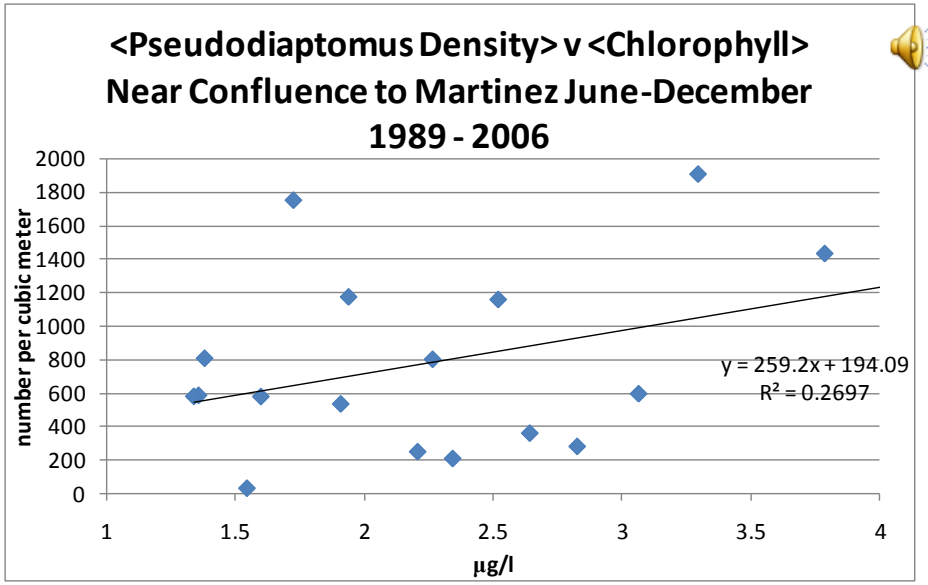
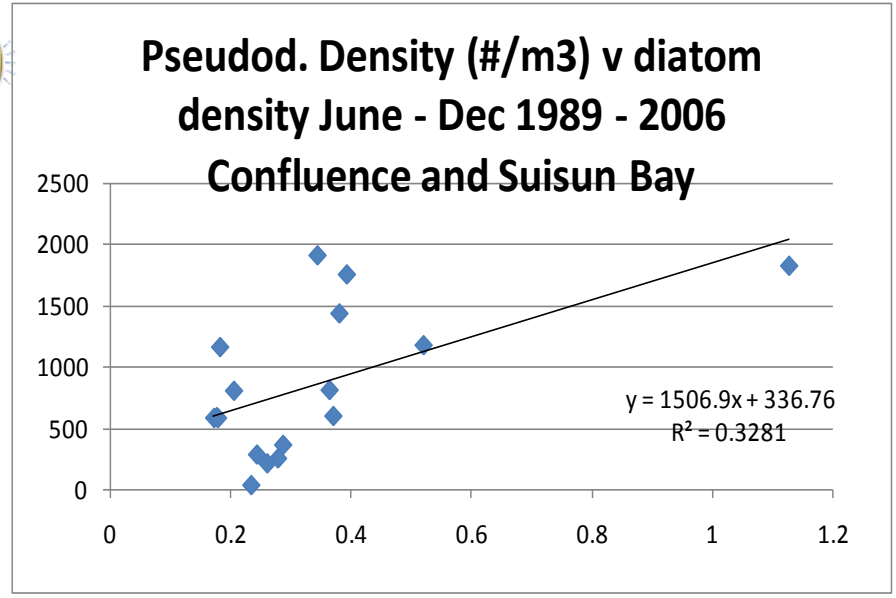
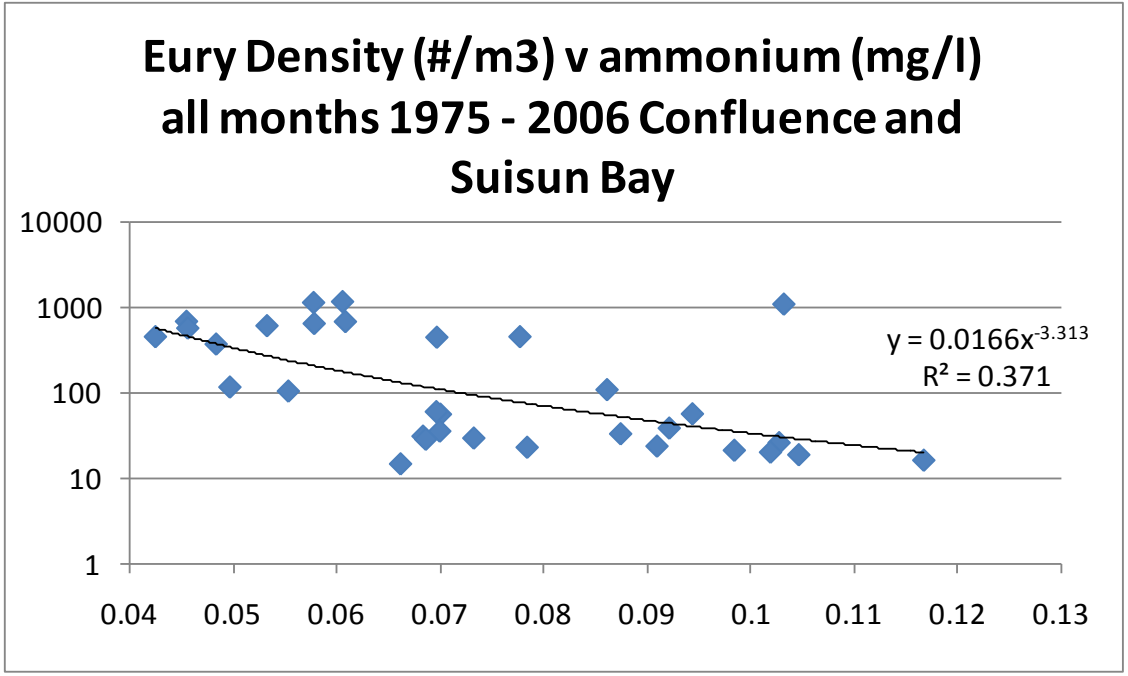
1995
1997
1999
2001
2003
2005
2007

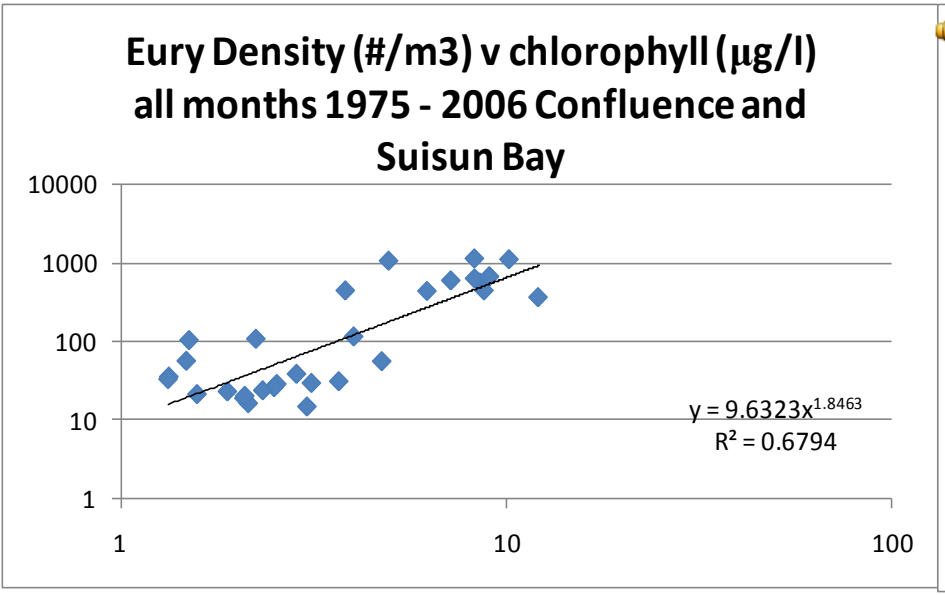


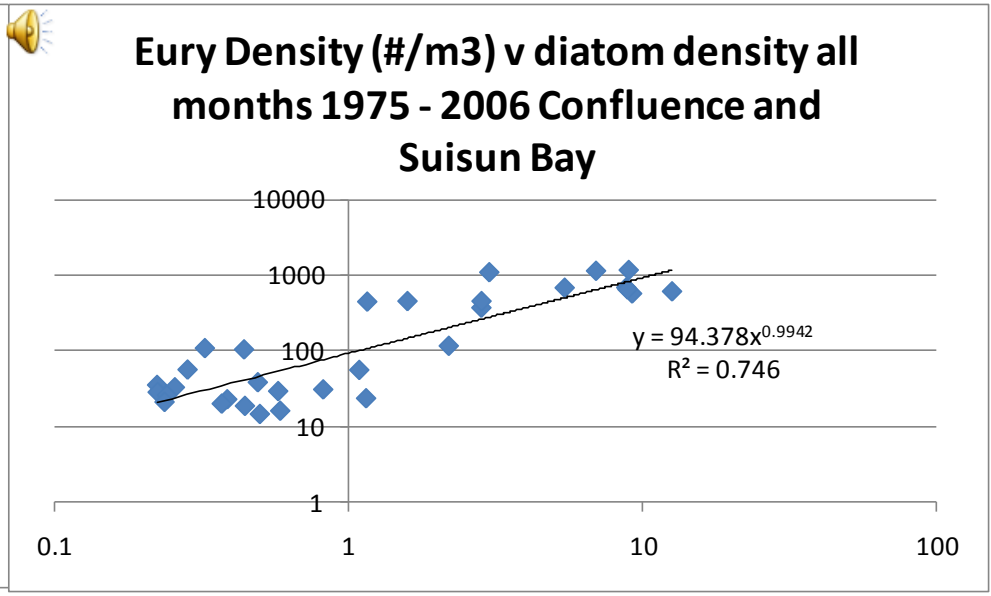




Zooplankton are correlated to chlorophyll and ammonium

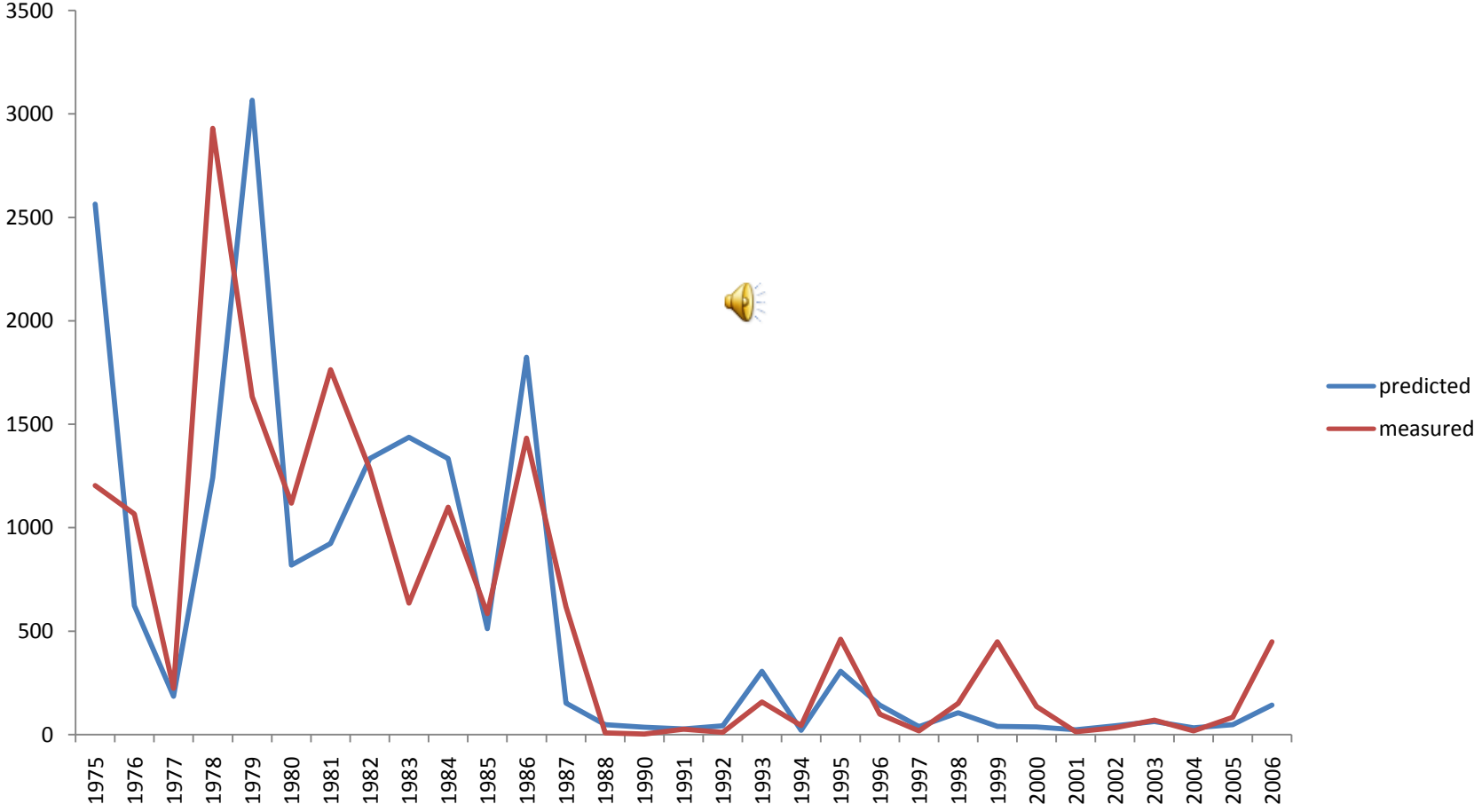


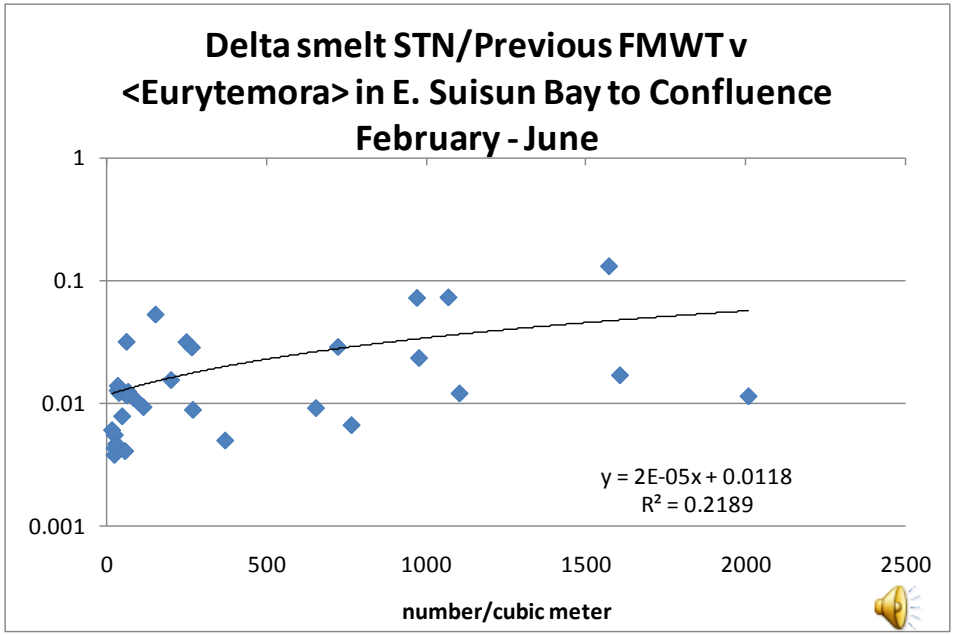




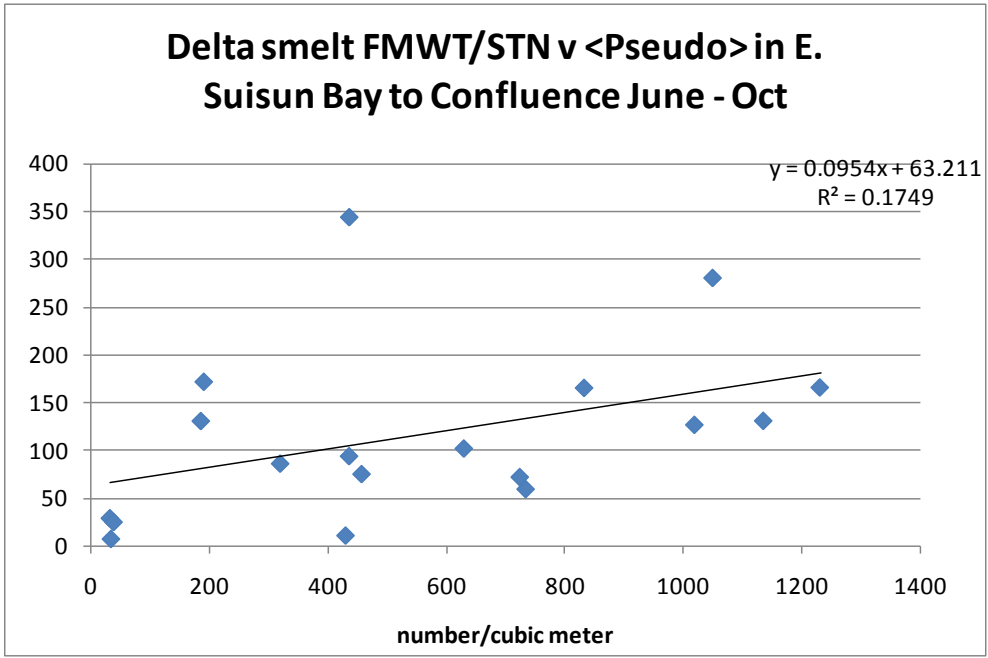
Zooplankton are correlated to chlorophyll and ammonium

April - June *Eurytemora* density in Eastern Suisun Bay
Predicted from ln(*Eurytemora*) = -0.24 - 2.19 ln(ammonium) -1.96 clam; clam = 0 before 1987, 1 thereafter; R^2 = 0.74: clam, p = 6 x 10^{-5}; ammonium, p = 0.0002

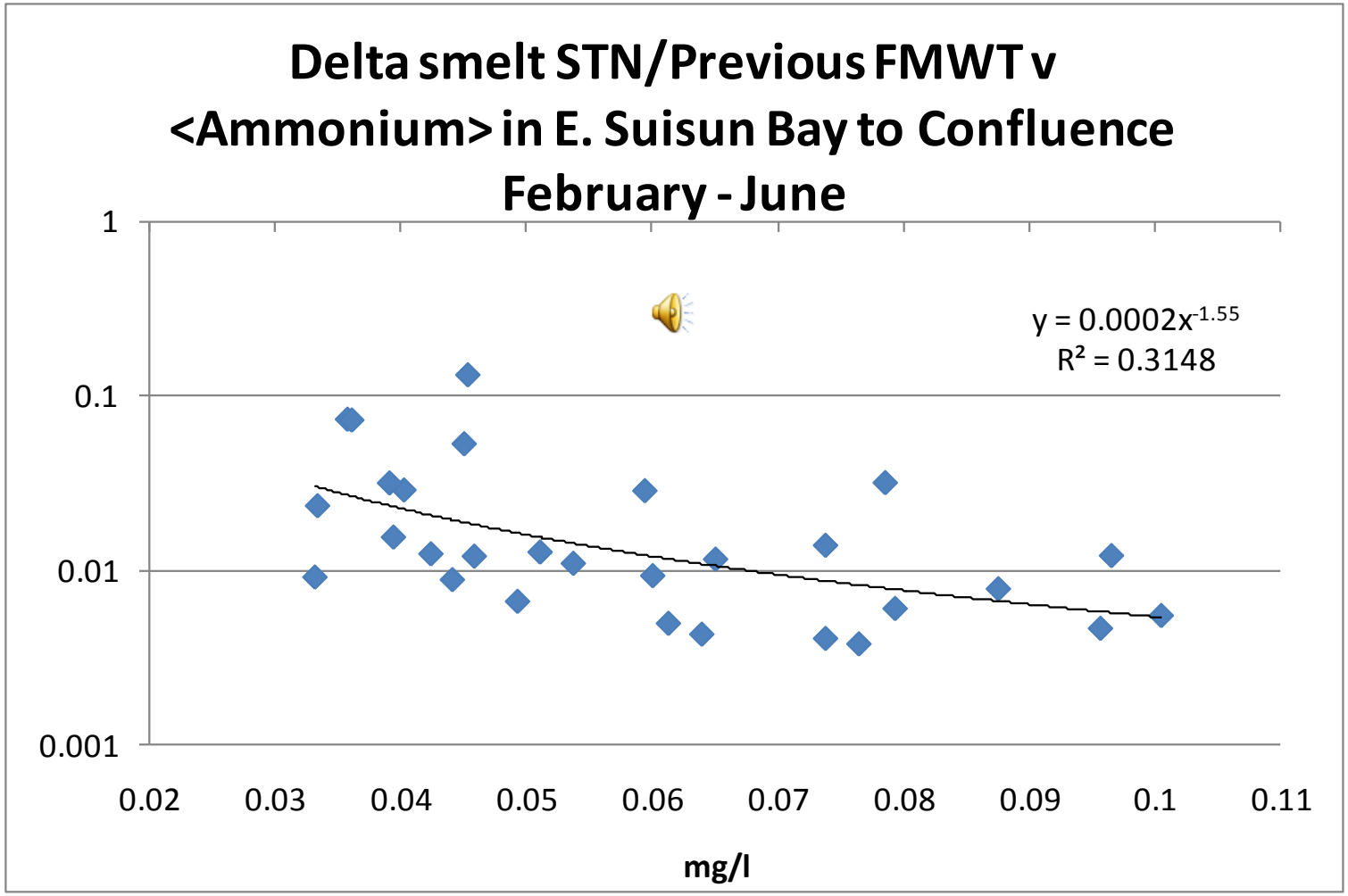




Smelt abundance ratios are correlated to zooplankton density



Smelt Summer/Previous Fall abundance ratio is correlated to winter/spring ammonium levels



Final Remarks

- In Suisun Bay, clams have muted the response of chlorophyll/diatoms to ammonium, but correlation still exists in spring.
- In the San Joaquin, a shift away from diatoms begins in the early 1980s (not 1987), but correlation of chlorophyll and diatoms with ammonium remains strong.
- Reductions in chlorophyll and diatoms in turn correlate to reductions in zooplankton and smelt.
- Arguably then, reductions in ammonium would boost food chain all the way up to Delta smelt.