

Factors Controlling Submersed and Floating Macrophytes in the Delta



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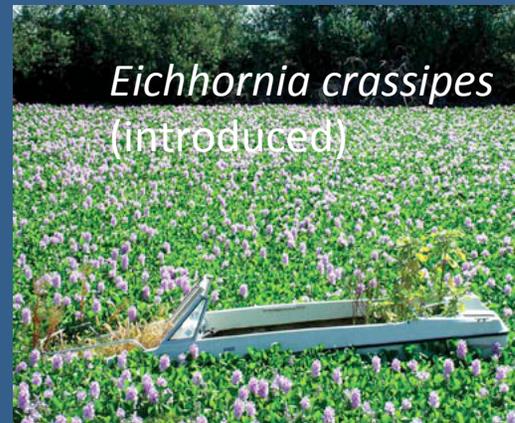
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Key Questions:

- 1) How do SAV and FAV support or adversely affect ecosystem services and related beneficial uses?
- 2) What is known about the spatial and temporal trends of this vegetation in the Delta?
- 3) What is the relative importance of nutrients versus other factors in promoting observed trends in SAV and FAV in the Delta?
- 4) What are the key data gaps and recommended future studies?

Review focused on six species:



Key Question:

What is known about the spatial and temporal trends of this vegetation in the Delta?

Egeria ~2000 hectares in 2007 and 2900 hectares in 2014

Water hyacinth covered ~200 hectares between 2004-2008 and 800 hectares in 2014.

Ludwigia spp. (water primrose). *Ludwigia* spp. (unknown proportion of *L. peploides* and *L. hexapetala*, and possibly *L. grandiflora*) are now equal in floating coverage to water hyacinth (800 hectares each estimated in 2014).

Hydrocotyle (pennywort) was much more common than *Ludwigia* during the period of 2004-2008, but now least common of the FAV.

Stuckenia pectinata appears to be expanding in Suisun and west Delta

Ceratophyllum common; unknown trends in coverage

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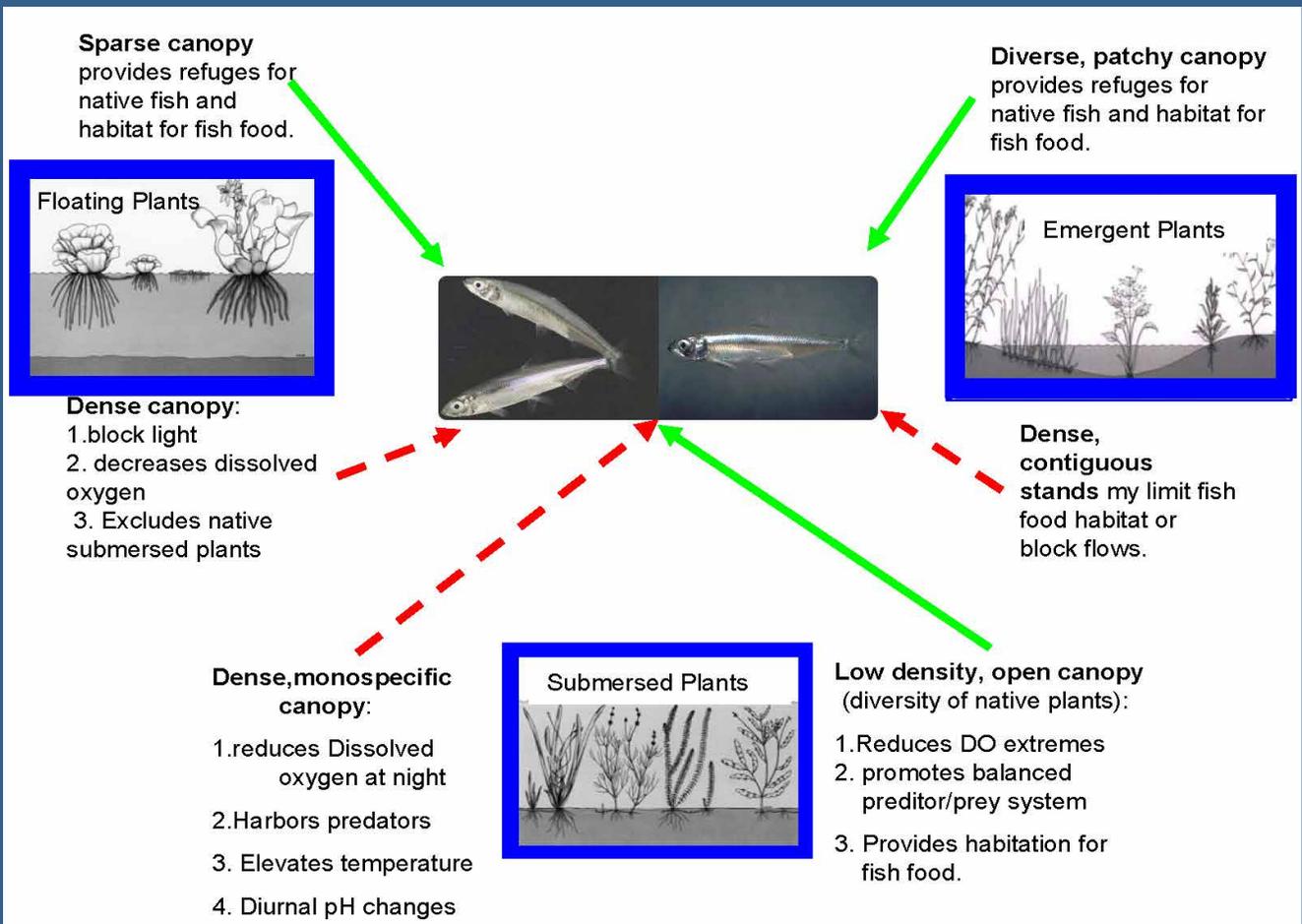
Aquatic vegetation can have many values

- carbon storage
- uptake of nutrients
- oxygenation of waters
- trophic support through direct consumption by grazers or contributions to the detrital food web
- provision of surfaces for algal and invertebrate attachment (also providing trophic support)
- predation refuge for small fish

But...

Excessive biomass, or loss of native species functions reduce values

DRERIP conceptual model: loss of beneficial uses



Arrows show direction and primary effect caused by interaction of each “ecological type” of aquatic plant on fish (red, dashed = negative effect, green, solid = positive effect. From Anderson 2008)

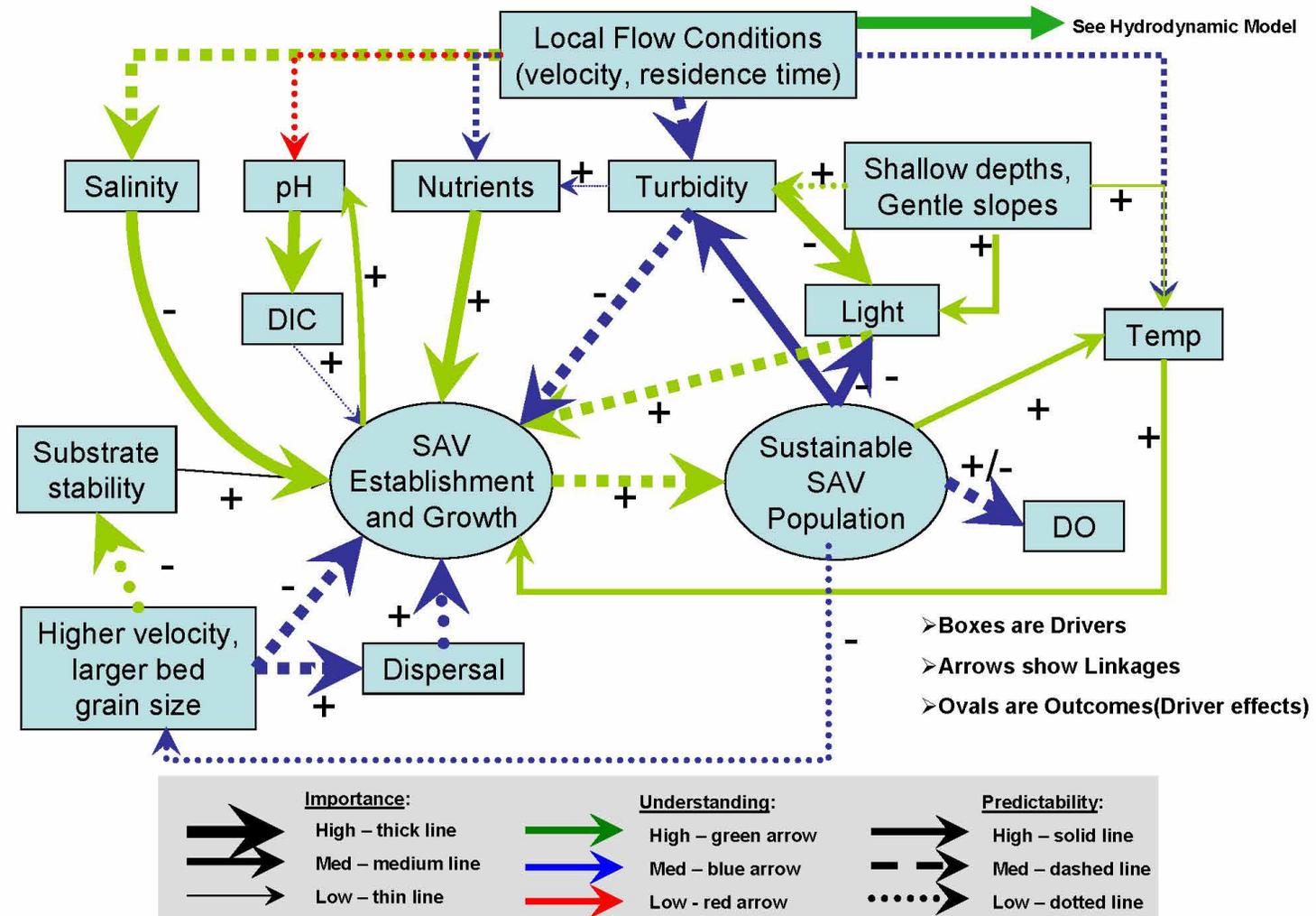
Dense *Egeria* resists fish movement, can have low DO and swings, and supports few native fish; but unknown benefit of native SAV to native fish – turbidity as predation refuge is still just a hypothesis

Lower density of invasive SAV or FAV could be beneficial to fish

Key Question: What is the relative importance of nutrients versus other factors in promoting observed trends in SAV and FAV in the Delta?

DRERIP conceptual model: SAV

Fig.2 Submersed Aquatic Vegetation Establishment, Growth and Dispersal Sub Model



From Anderson 2008

Nutrients versus other factors?

Light, Salinity, Temperature (high and low), DIC, Competition...

vs. Nutrients

Can changes in water column nutrient concentrations or ratios explain patterns in expansion of invasive SAV and FAV?

~ 0.5 mg/L DIN

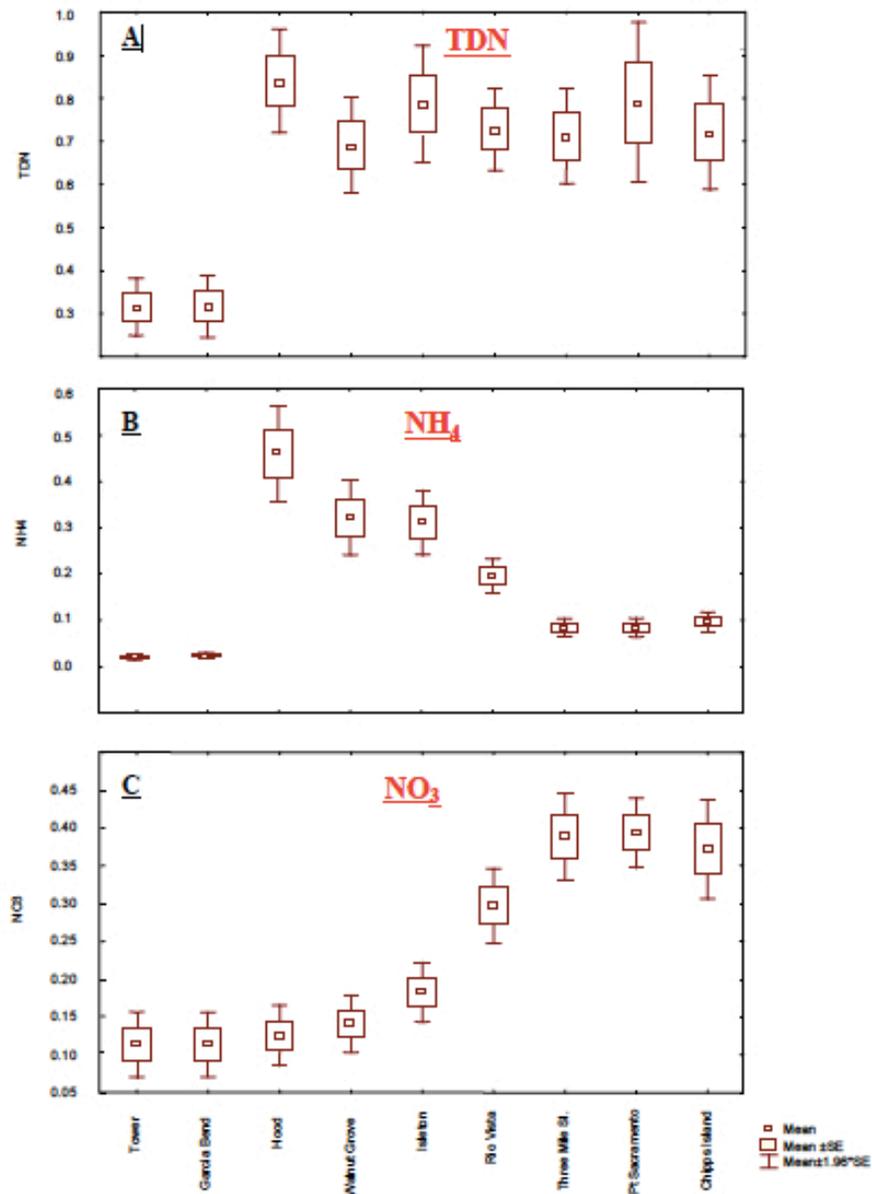


Figure 2. A. Mean annual total dissolved nitrogen (TDN) concentrations on the Sacramento River between Tower Bridge and Chipps Island. The SRWTP discharges between Garcia Bend and Hood. B and C Ammonia (NH₄) and nitrate (NO₃) concentrations over the same river reach. All nitrogen concentrations are as mg N/L

~ 0.05 mg/L DIP

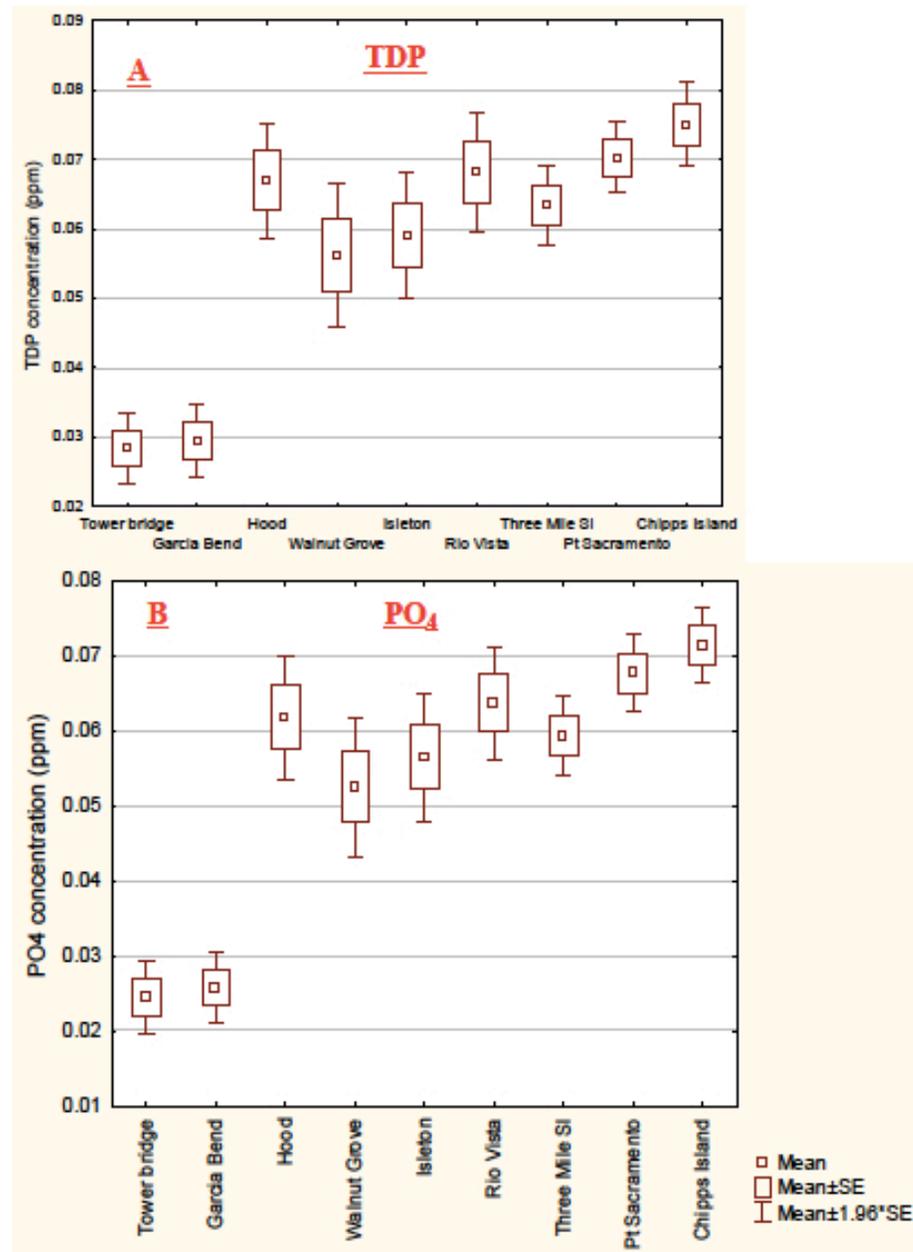
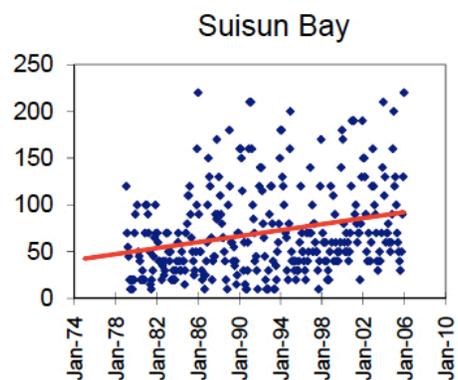
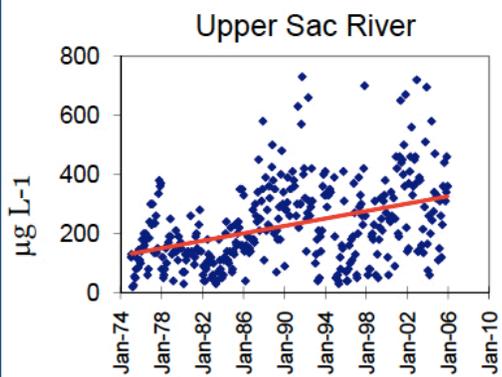
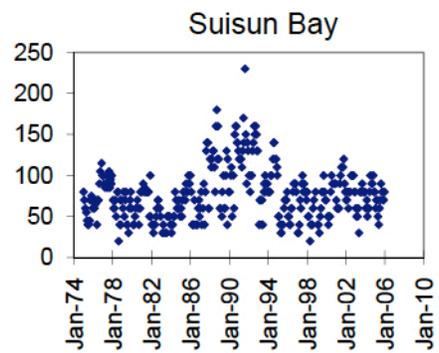
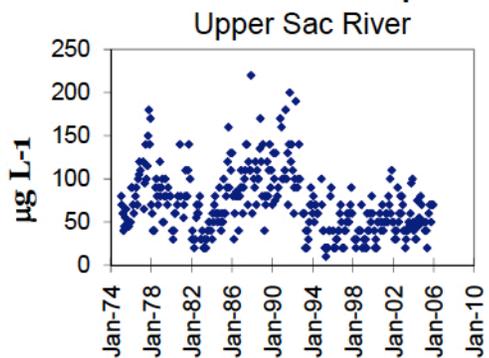


Figure 3A. Mean annual total dissolved phosphorus (TDP) in the Sacramento River and delta. B. Same values for soluble reactive phosphorus (PO₄).

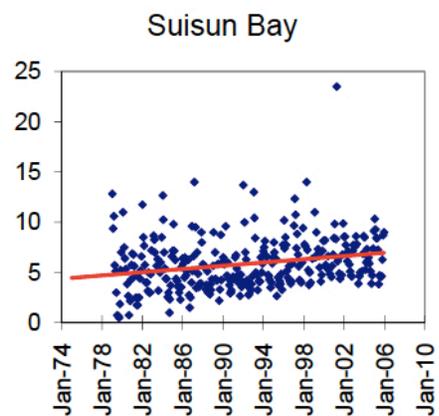
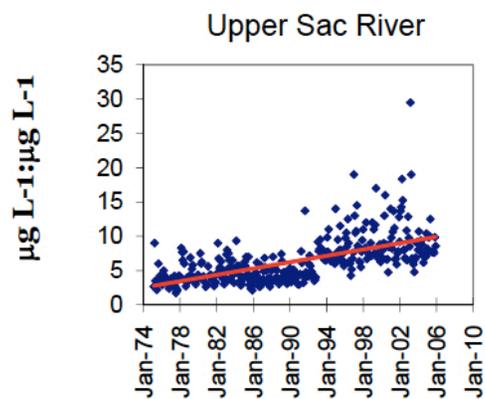
Ammonium

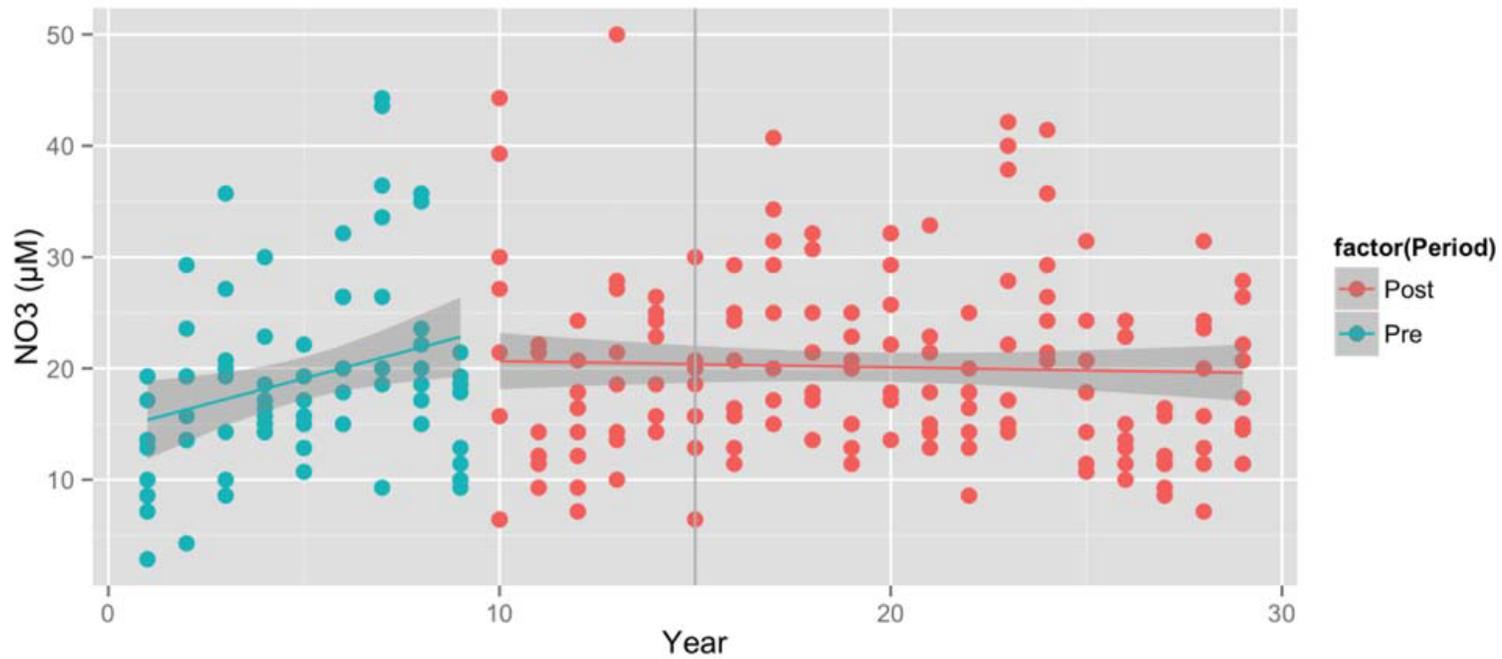
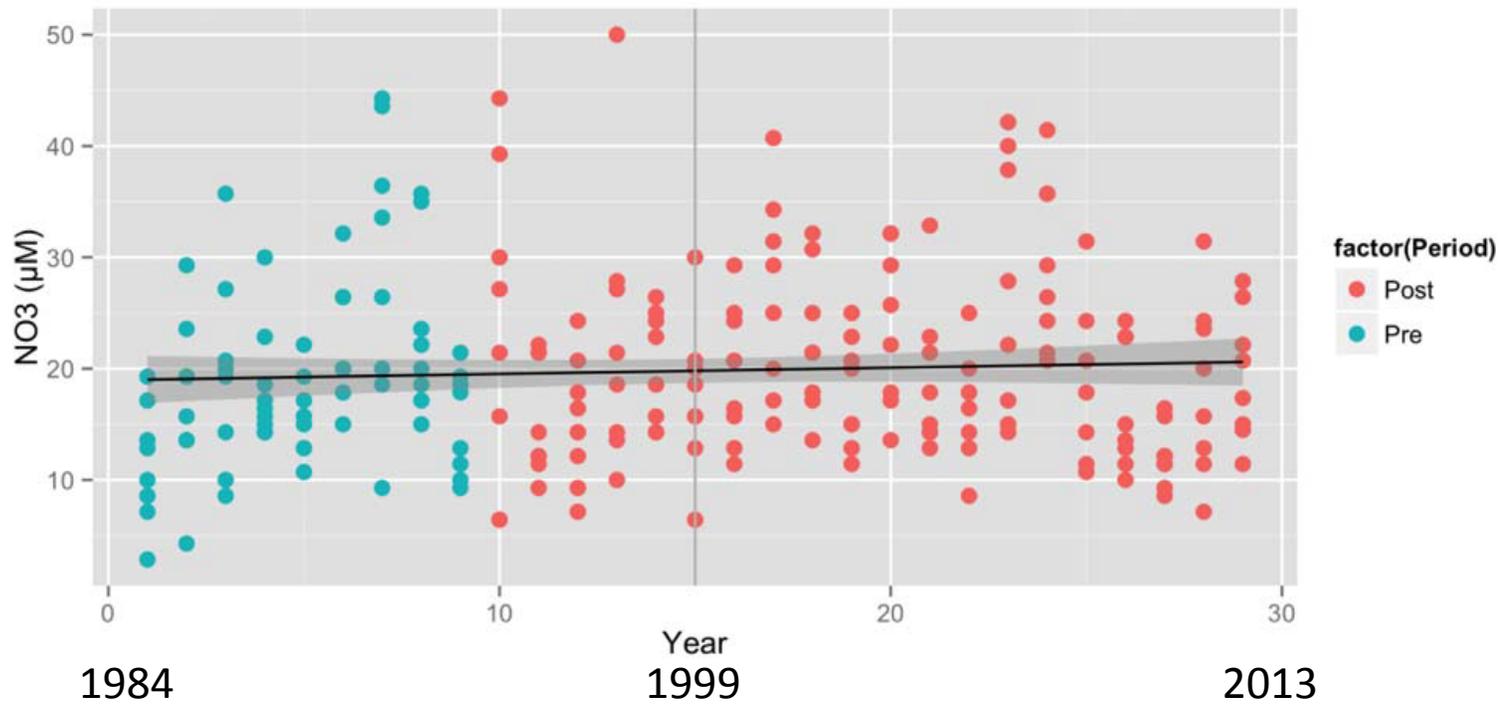


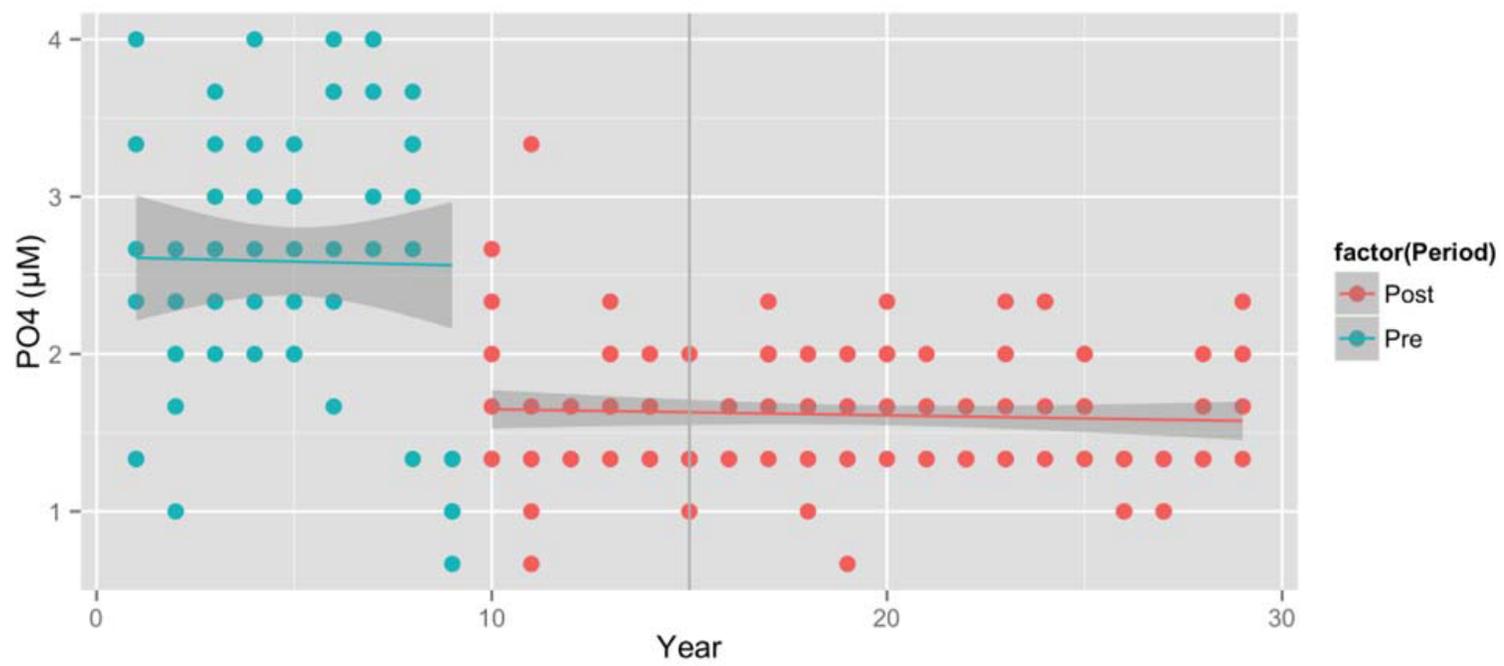
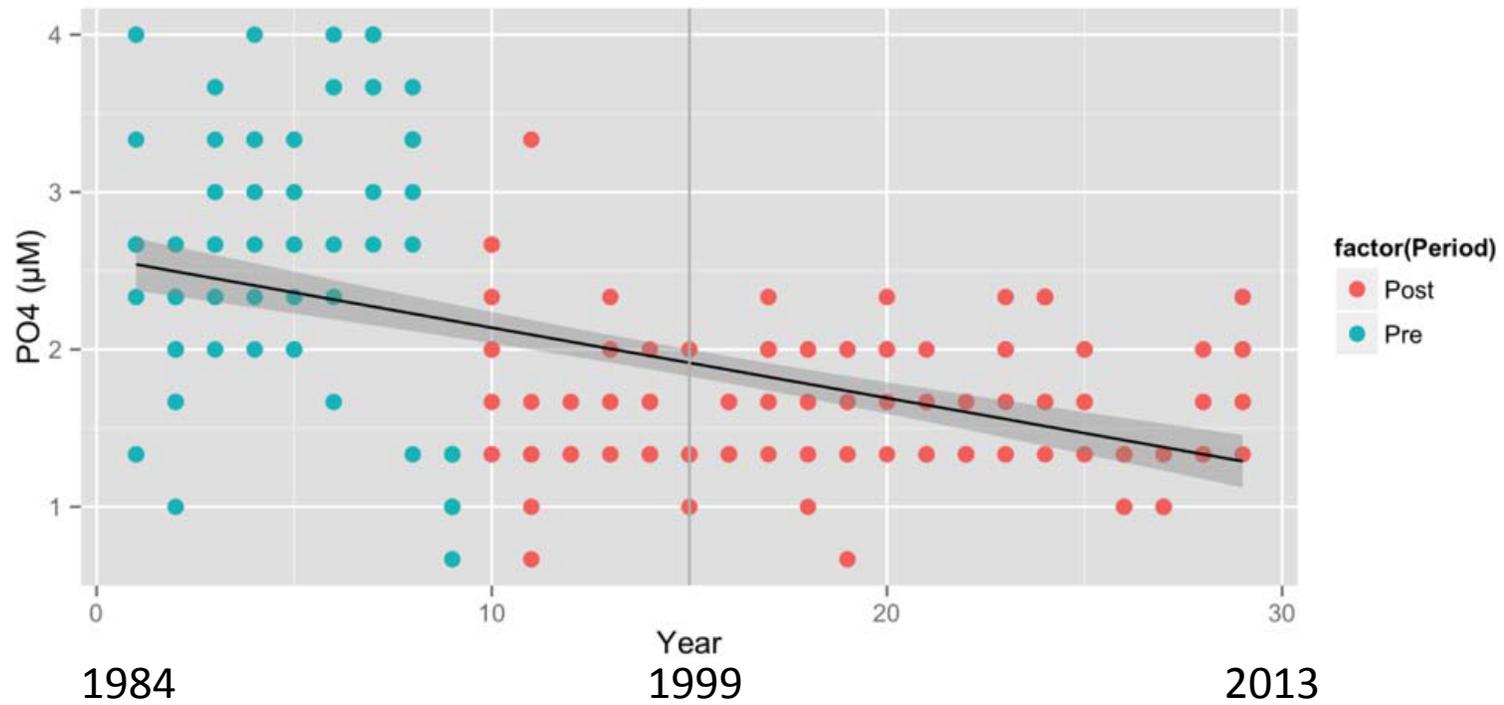
Phosphate



Inorganic Nitrogen:Inorganic Phosphorus







Nutrients versus other factors?

Light, Salinity, Temperature (high and low), DIC, Competition...

vs. Nutrients

Can changes in water column nutrient concentrations or ratios explain patterns in expansion of invasive SAV and FAV?

No, but that does not mean that nutrient supply from water column or sediment not important –

- Fluxes from sediments (e.g., of P when overlying water has low DO or high sulfates)
- Inability of water column measures to consider uptake by macrophytes, storage, recycling