Nutrients in the Delta—the role of ammonium

Chris Foe
Central Valley Regional Water Quality Control Board
cfoe@waterboards.ca.gov
916-464-4713

http://www.swrcb.ca.gov/centralvalley/water_issues/delta_water_quality/ambient_ammonia_concentrations/index.shtml

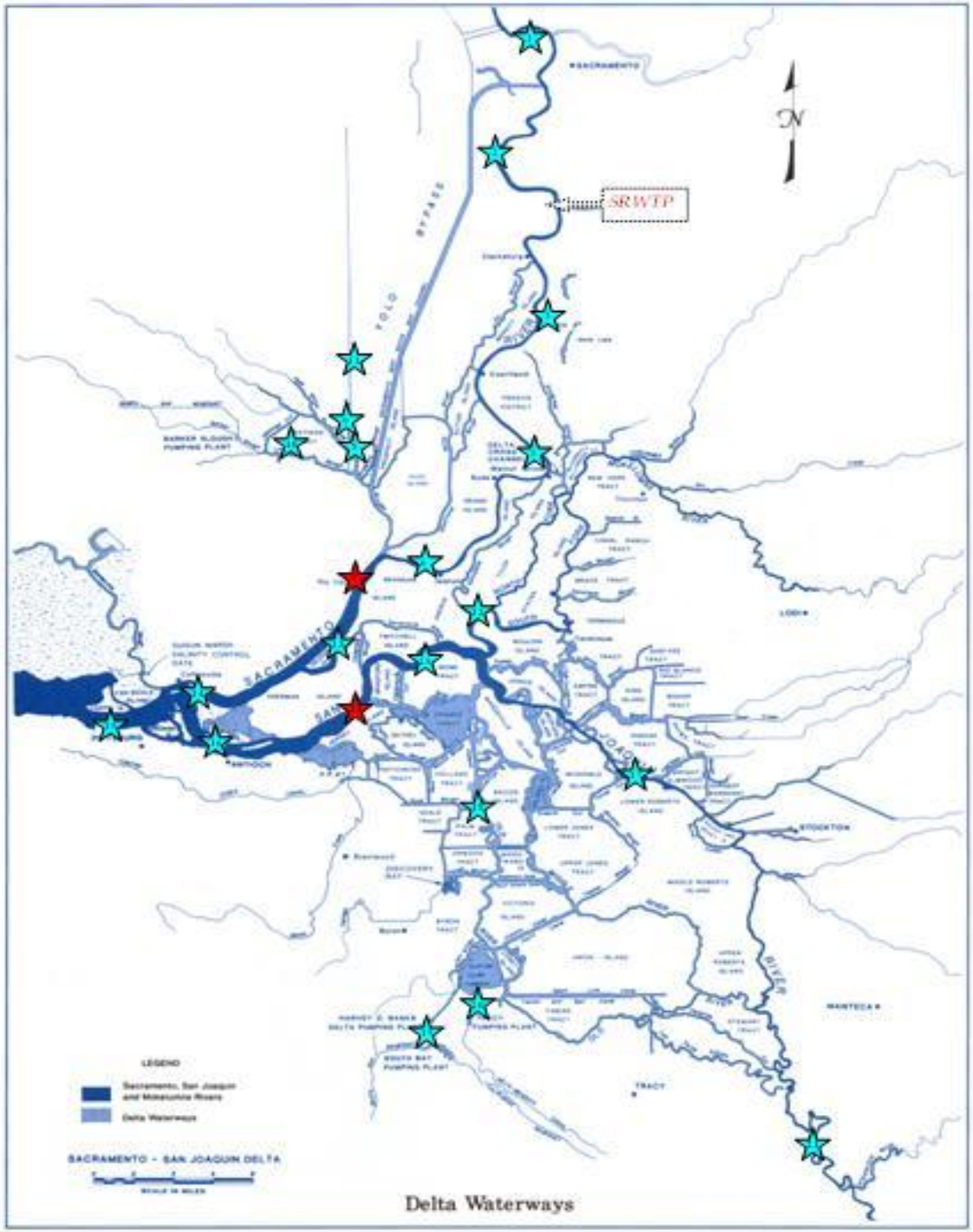
Outline

- Questions
- Study design
- Nitrogen and Phosphorus Patterns
- Answer Questions
- Conclusions

Questions

- Do ambient NH_4 concentrations exceed U.S. EPA criteria?
- Are ambient NH_4 concentrations at toxic levels to larval/juvenile delta smelt?
- Are ambient NH_4 concentrations at toxic levels to the copepod *Pseudodiaptomus forbesi?*
- Are ambient NH_4 concentrations high enough to inhibit nitrate uptake and reduce diatom primary production rates in the Delta?

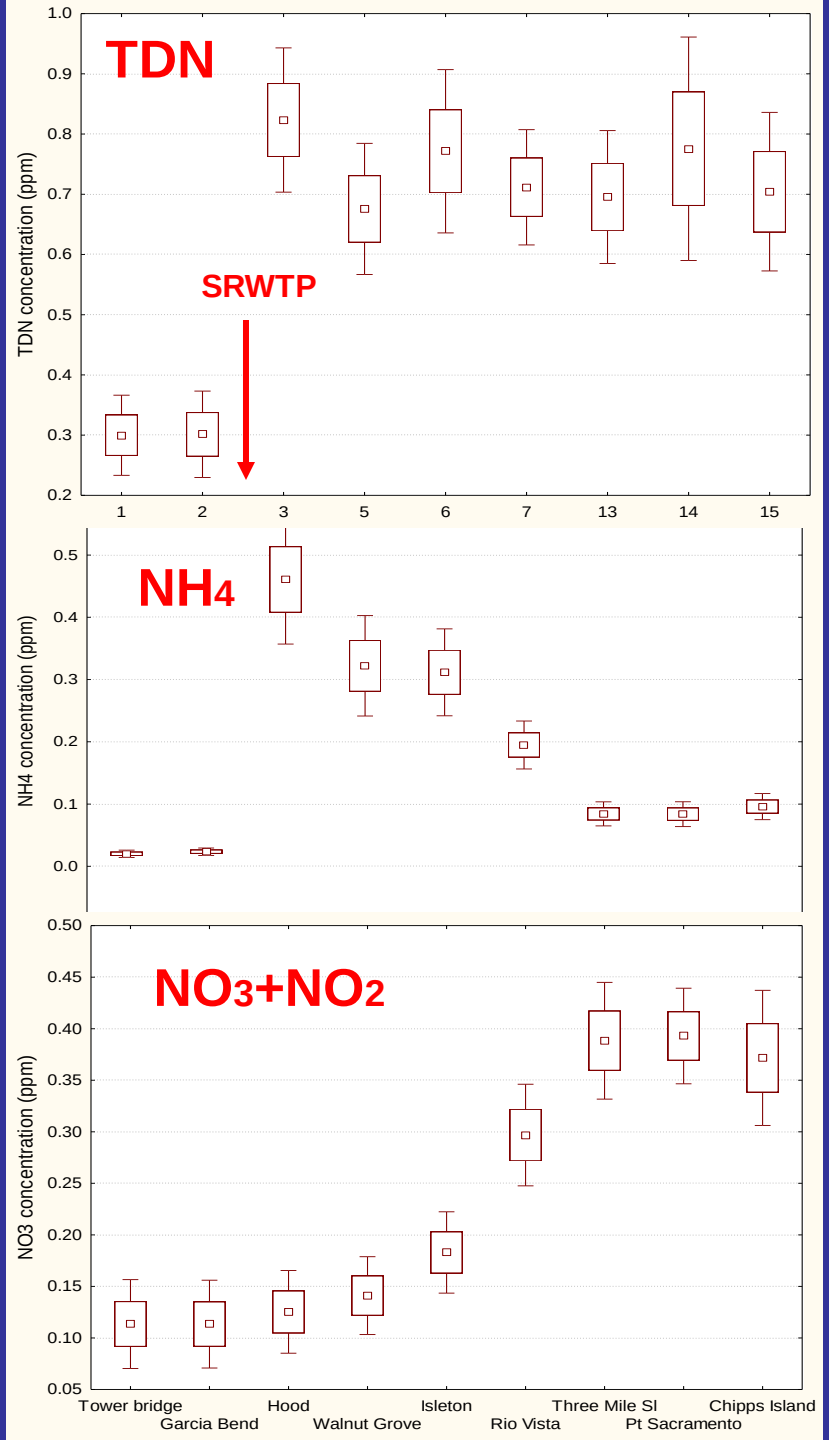
Map of Delta


SRWTP
N
SACRAMENTO
STOCKTON
TRACY
MANTECA
LEGEND
Sacramento, San Joaquin and Mokelumne Rivers
Delta Waterways
SACRAMENTO - SAN JOAQUIN DELTA
Delta Waterways

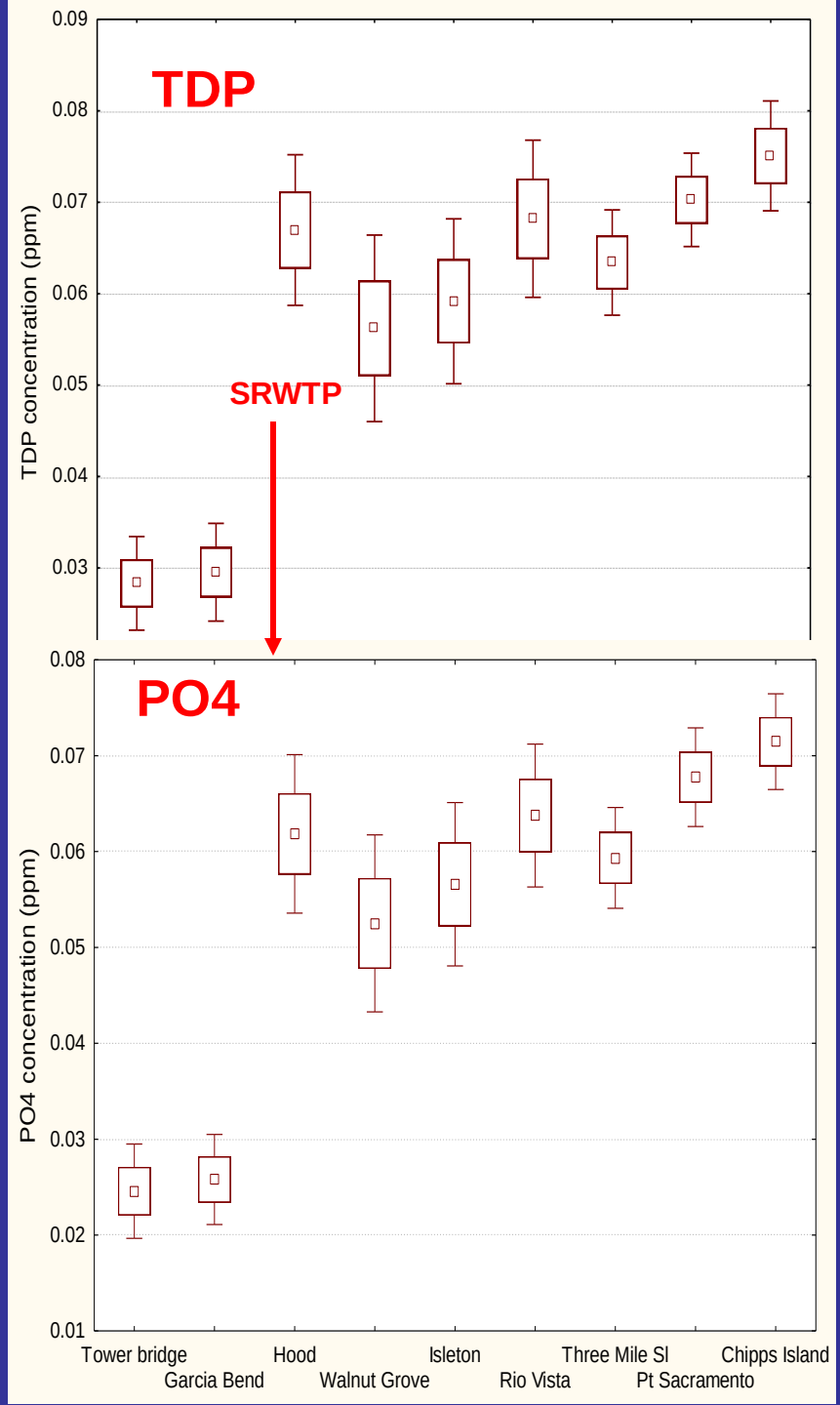
Chemicals Monitored

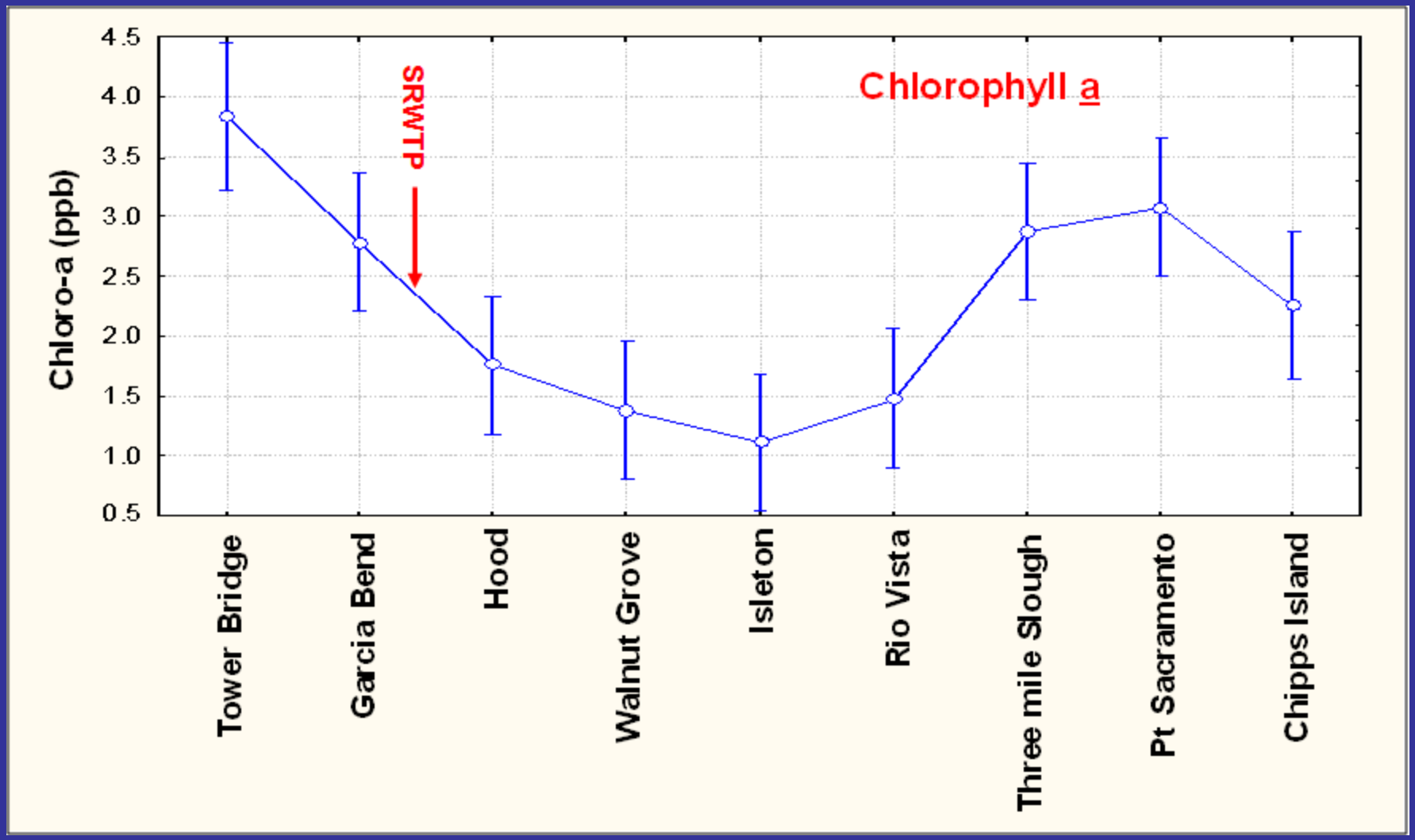
Constituent	MDL	Responsible party
Total Nitrogen	0.01 mg/l	UC Davis
Total Dissolved Nitrogen	0.01 mg/l	UC Davis
Ammonia	0.005 mg/l	UC Davis
Nitrite	0.01 mg/l	UC Davis
Nitrate	0.01 mg/l	UC Davis
Dissolved Organic nitrogen	0.01 mg/l	UC Davis
Total Phosphorus	0.005 mg/l	UC Davis
Total dissolved Phosphorus	0.005 mg/l	UC Davis
Soluble Reactive Phosphorus	0.002 mg/l	UC Davis
Dissolved Organic Carbon	0.1 mg/l	UC Davis
Chlorophyll a	0.5 ug/l	UC Davis
Phaeophytin	0.5 ug/l	UC Davis
EC (25^0C)	1 s/cm	Regional Board
Temperature	0.1 ^{0}C	Regional Board
Turbidity	0.1 ntu	Regional Board
Dissolved Oxygen	0.1 mg/l	Regional Board
pH	0.1 pH units	Regional Board

Nitrogen

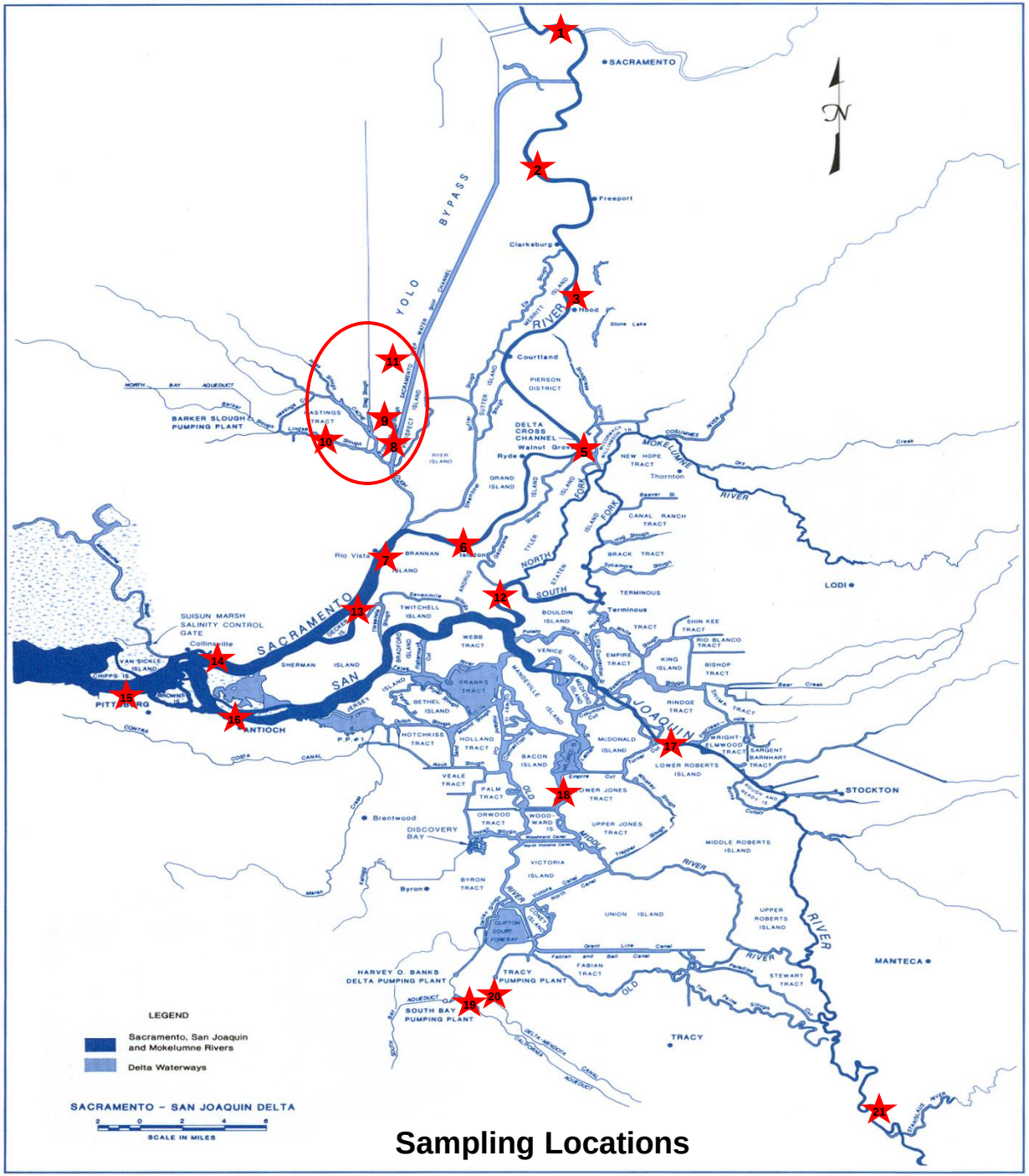

TDN
TDN concentration (ppm)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
SRWTP
1
2
3
5
6
7
13
14
15
NH4
NH4 concentration (ppm)
0.5
0.4
0.3
0.2
0.1
0.0
NO3+NO2
NO3 concentration (ppm)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
Tower bridge
Garcia Bend
Hood
Walnut Grove
Isleton
Rio Vista
Three Mile Sl
Pt Sacramento
Chipps Island

Phosphorus


TDP
SRWTP
TDP concentration (ppm)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
PO4
PO4 concentration (ppm)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
Tower bridge
Garcia Bend
Hood
Walnut Grove
Isleton
Rio Vista
Three Mile Sl
Pt Sacramento
Chipps Island

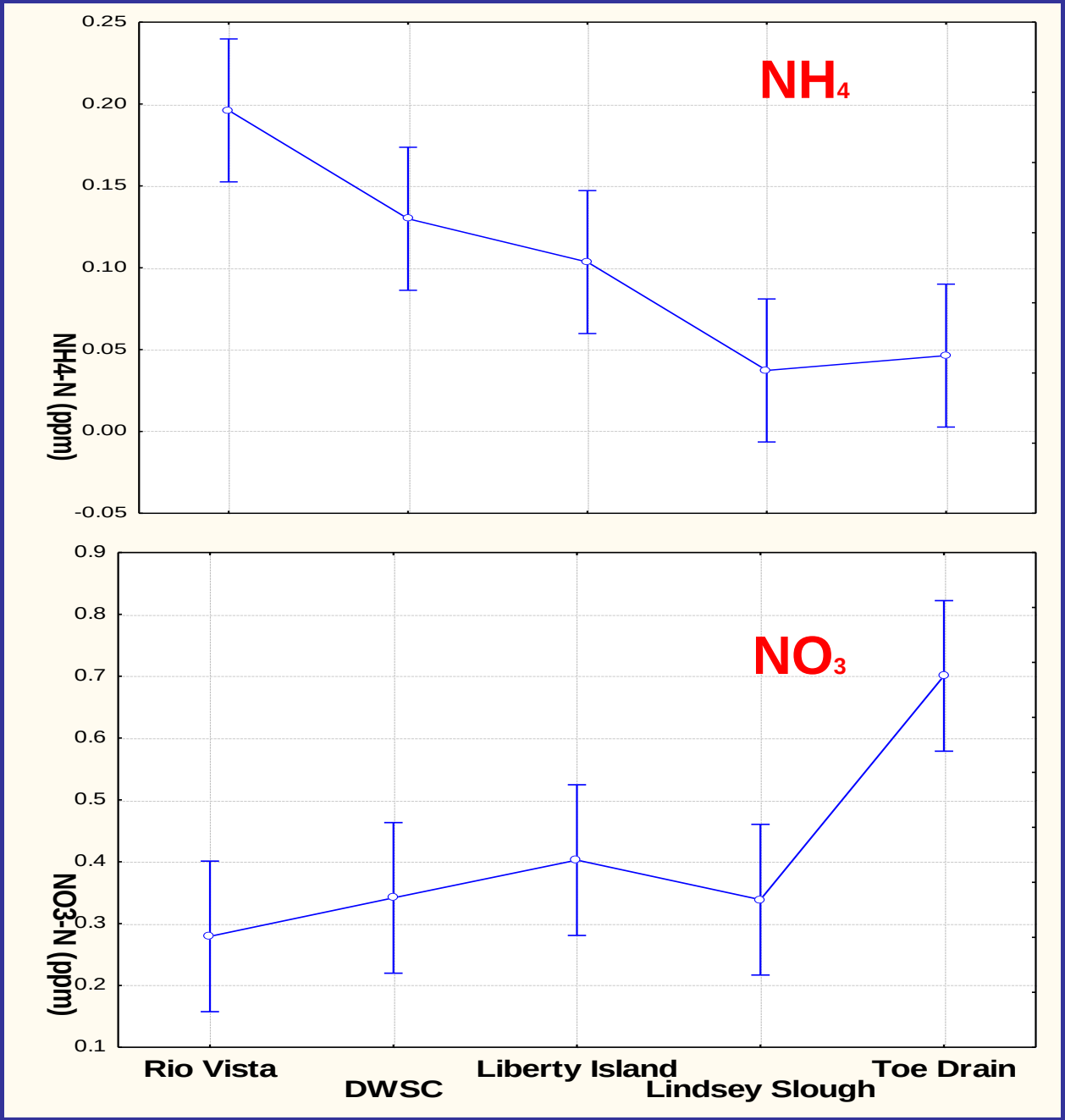


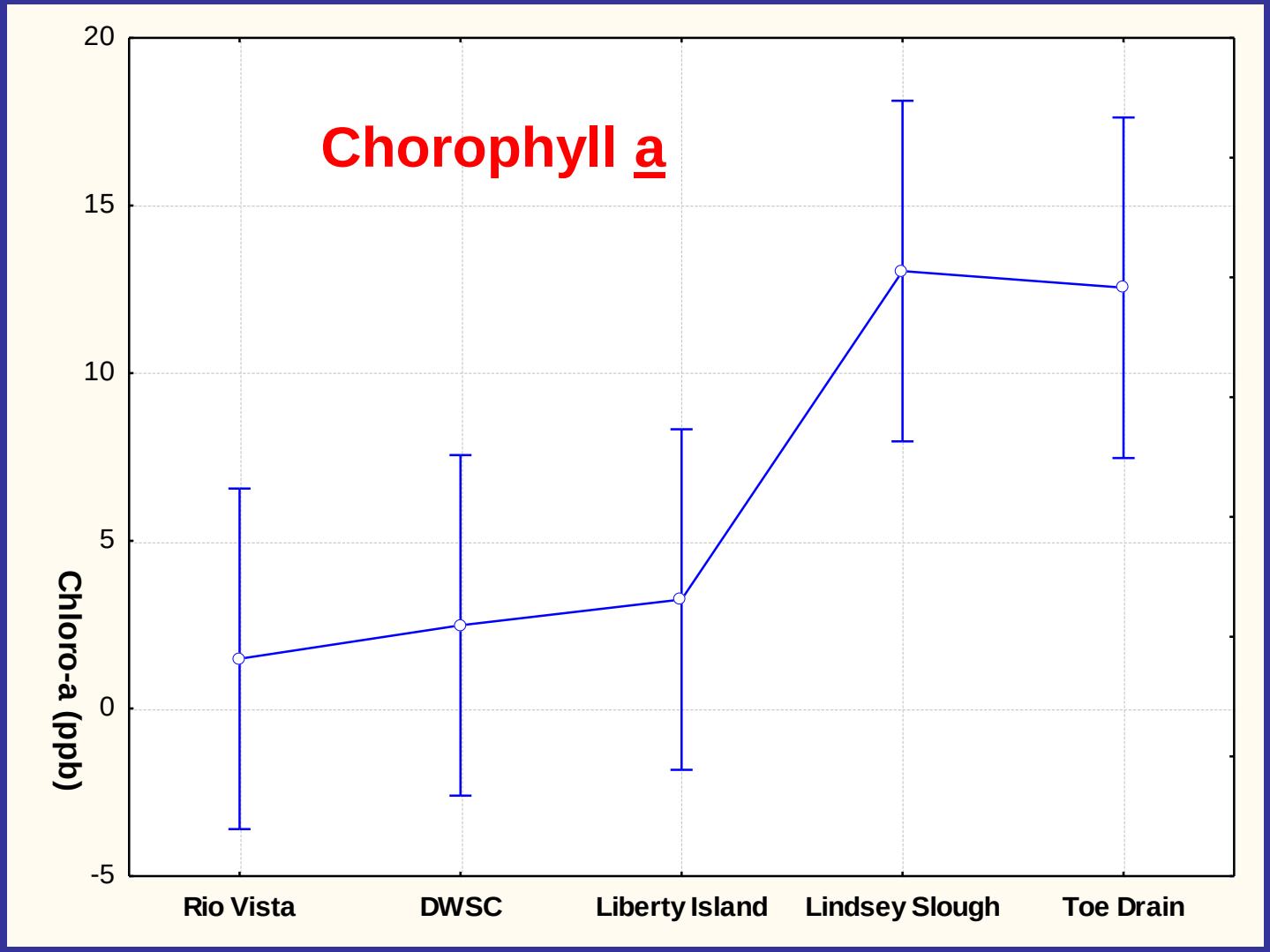
Average chlorophyll a concentrations between Tower Bridge on the Sacramento River and Chipps Island in the Delta.



Sampling Locations

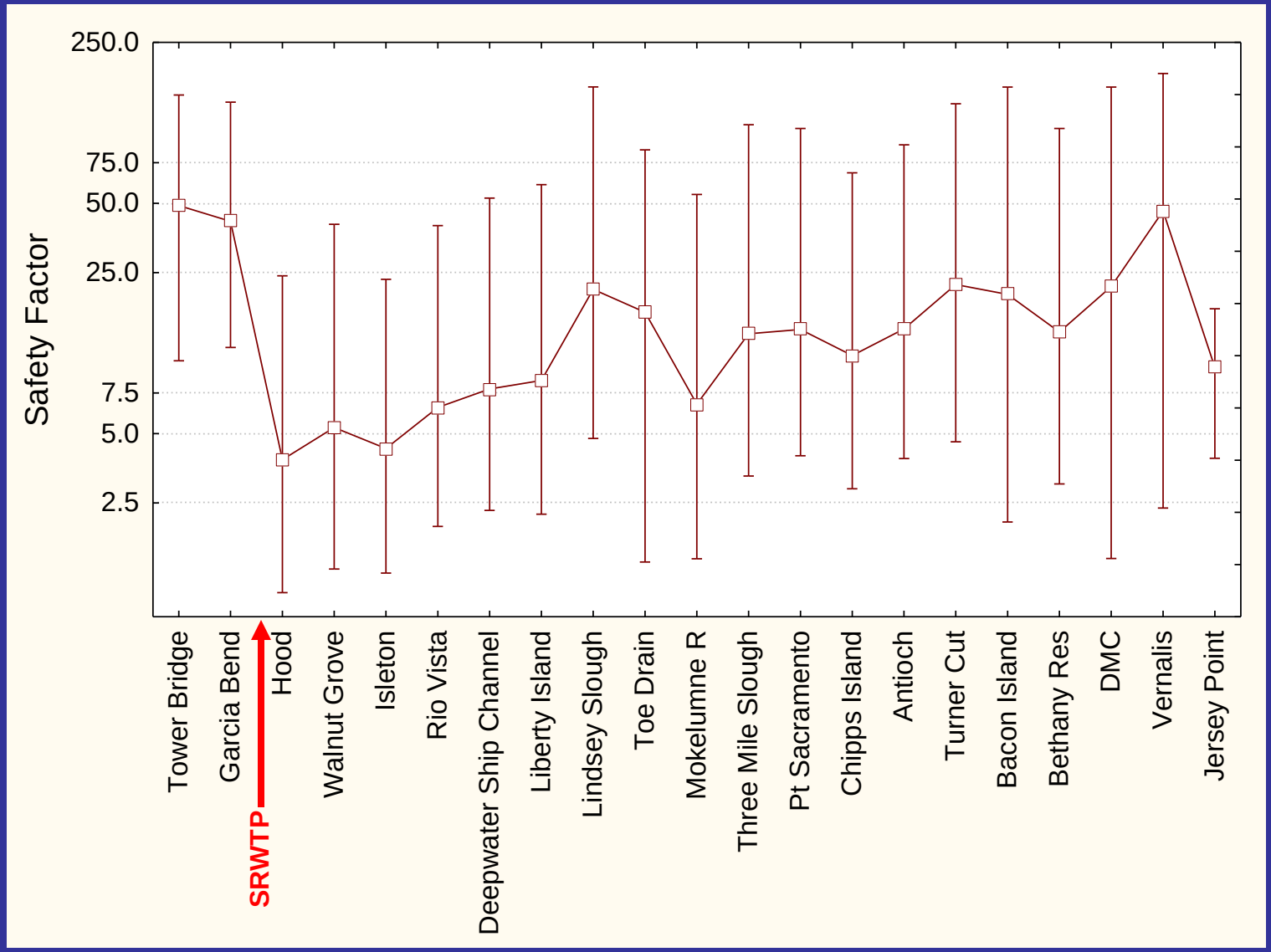
Average nitrogen concentrations in Yolo Bypass complex



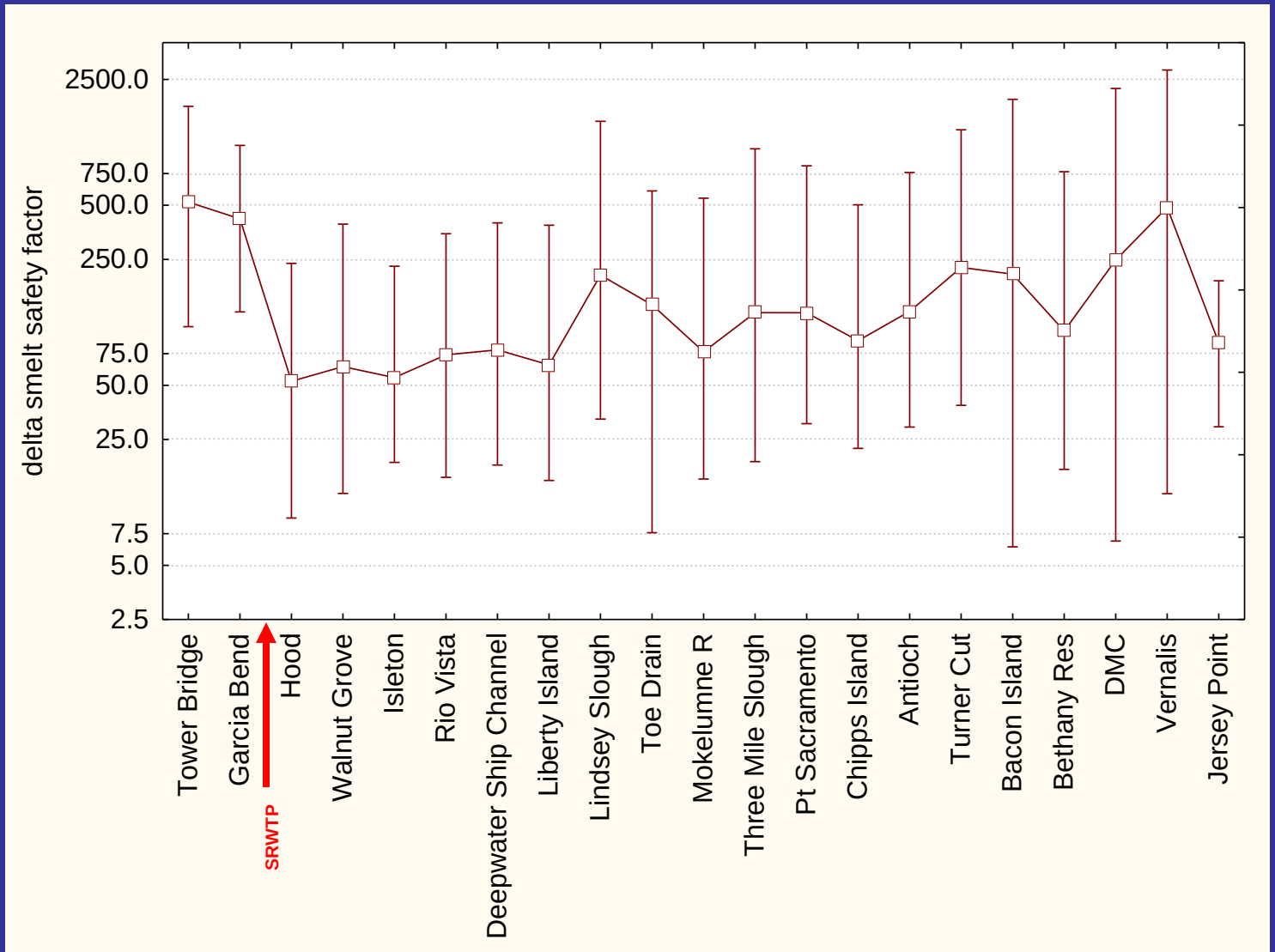


Average chlorophyll a concentrations in the Yolo Bypass complex

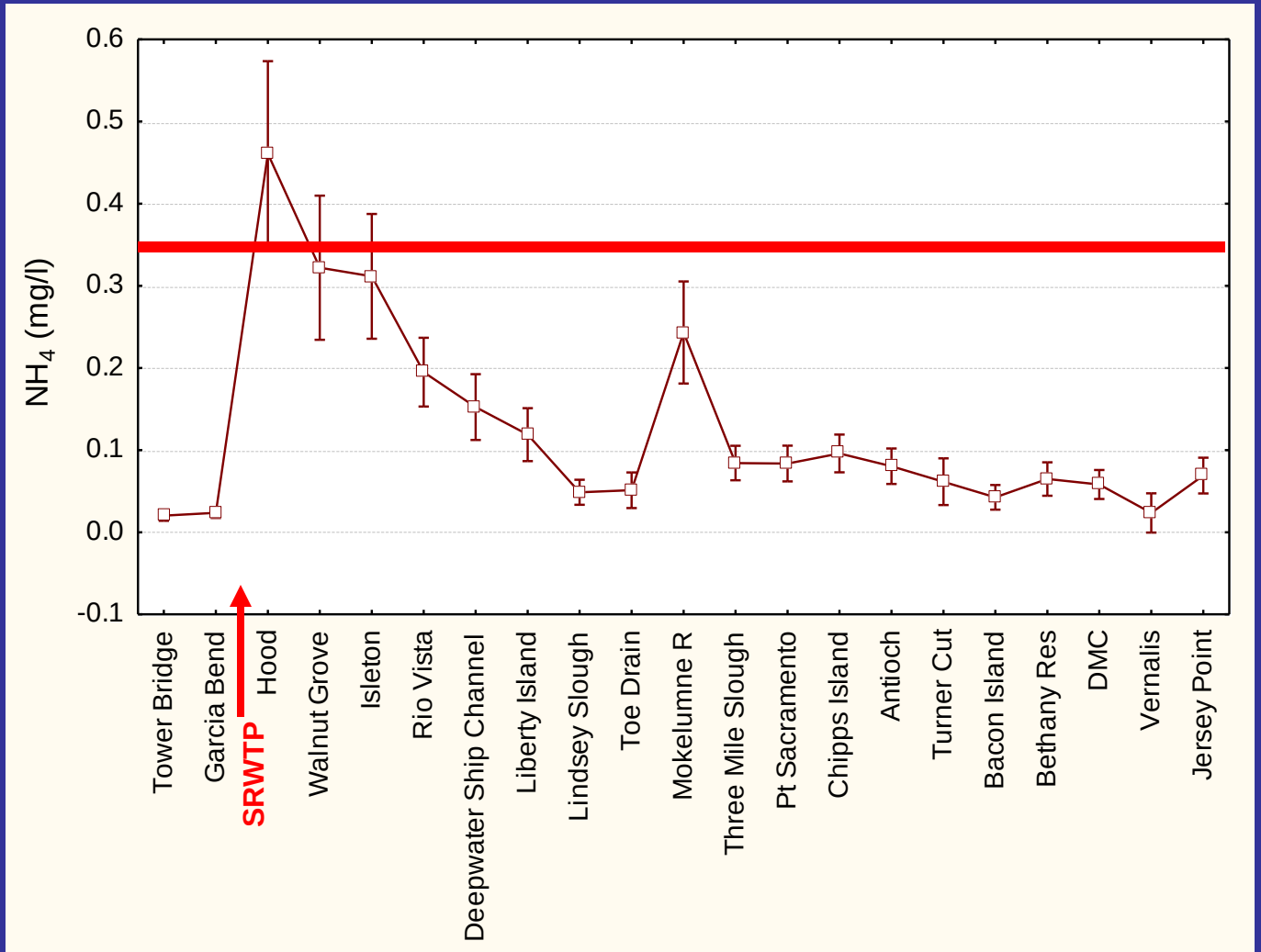
Draft US EPA NH4 criterion for mussels present



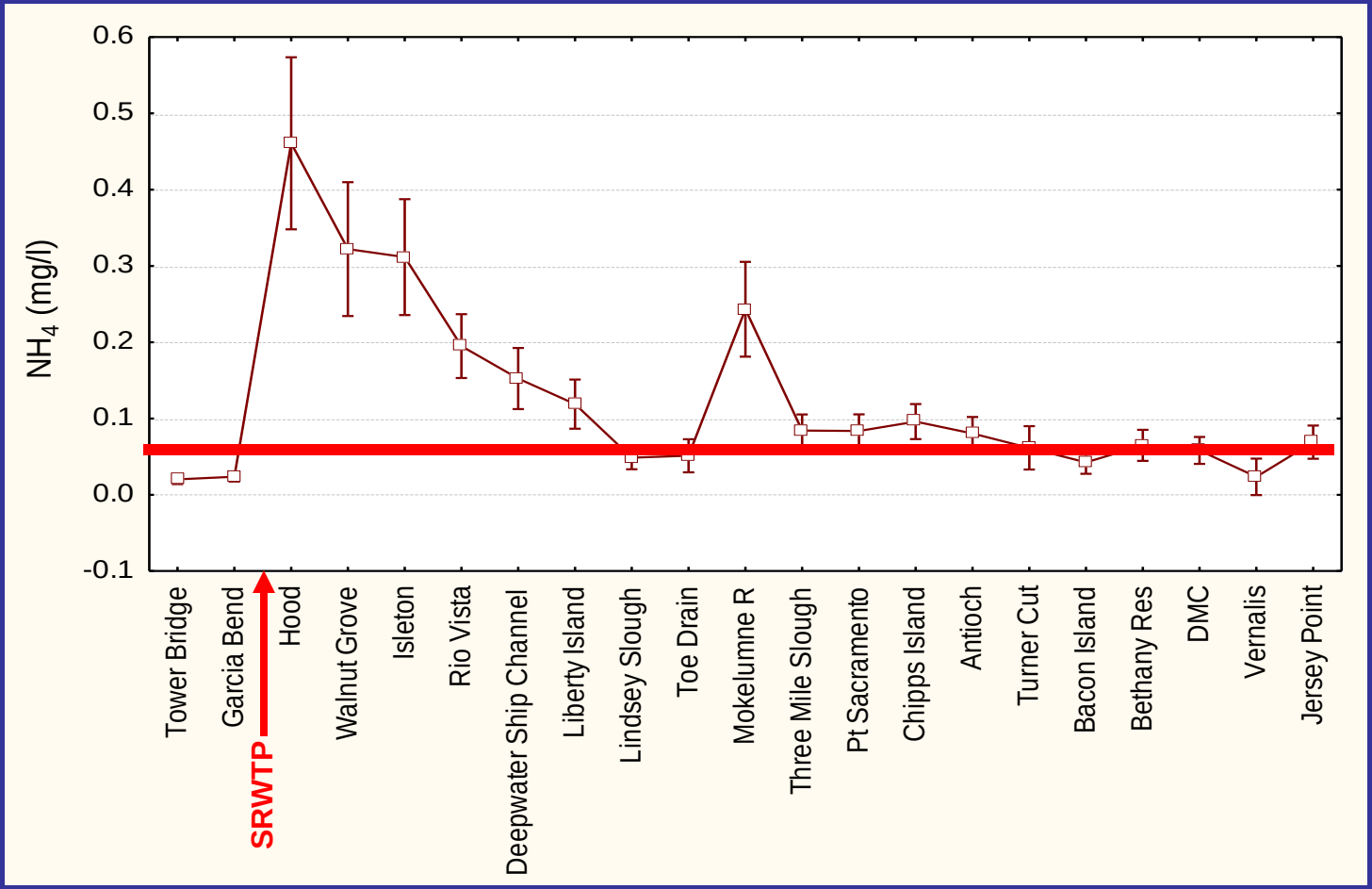
Delta Smelt Acute Safety Factor



Pseudodiaptomus Toxicity



Inhibition of Nitrate Uptake by Diatoms



New Permit for SRWTP

- Ammonia limit of 1.8-mg N/l
- Nitrate limit of 10-mg N/l
- Filtration

Conclusions (1)

- The SRWTP increases N and P levels in the Delta 2 to 2.5-fold.
- Ammonia is the major form of nitrogen. Concentrations increase about 11-fold.
- Ammonia and nitrate/nitrite are the mirror image of each other suggesting that nitrification is the major biological process.
- New permit adopted for the SRWTP requiring both nitrification and denitrification.

Conclusions (2)

- Do ambient NH4 concentrations exceed U.S. EPA criteria? NO
- Are ambient NH4 concentrations at toxic levels to delta smelt? NO
- Are ambient NH4 concentrations at toxic levels to the copepod *P. forbesi?* Yes
- Are ambient NH4 concentrations high enough to inhibit nitrate uptake by diatoms? Yes