Limnology of the Sacramento Deepwater Ship Channel, Cache Slough – Port of West Sacramento, 2012-2014

Erwin Van Nieuwenhuyse[1], Randy Dahlgren[2], Chris Foe[3], Jon Burau[4], Scott Morford[2], Harry Horner[1], and Nick Sakata[1]

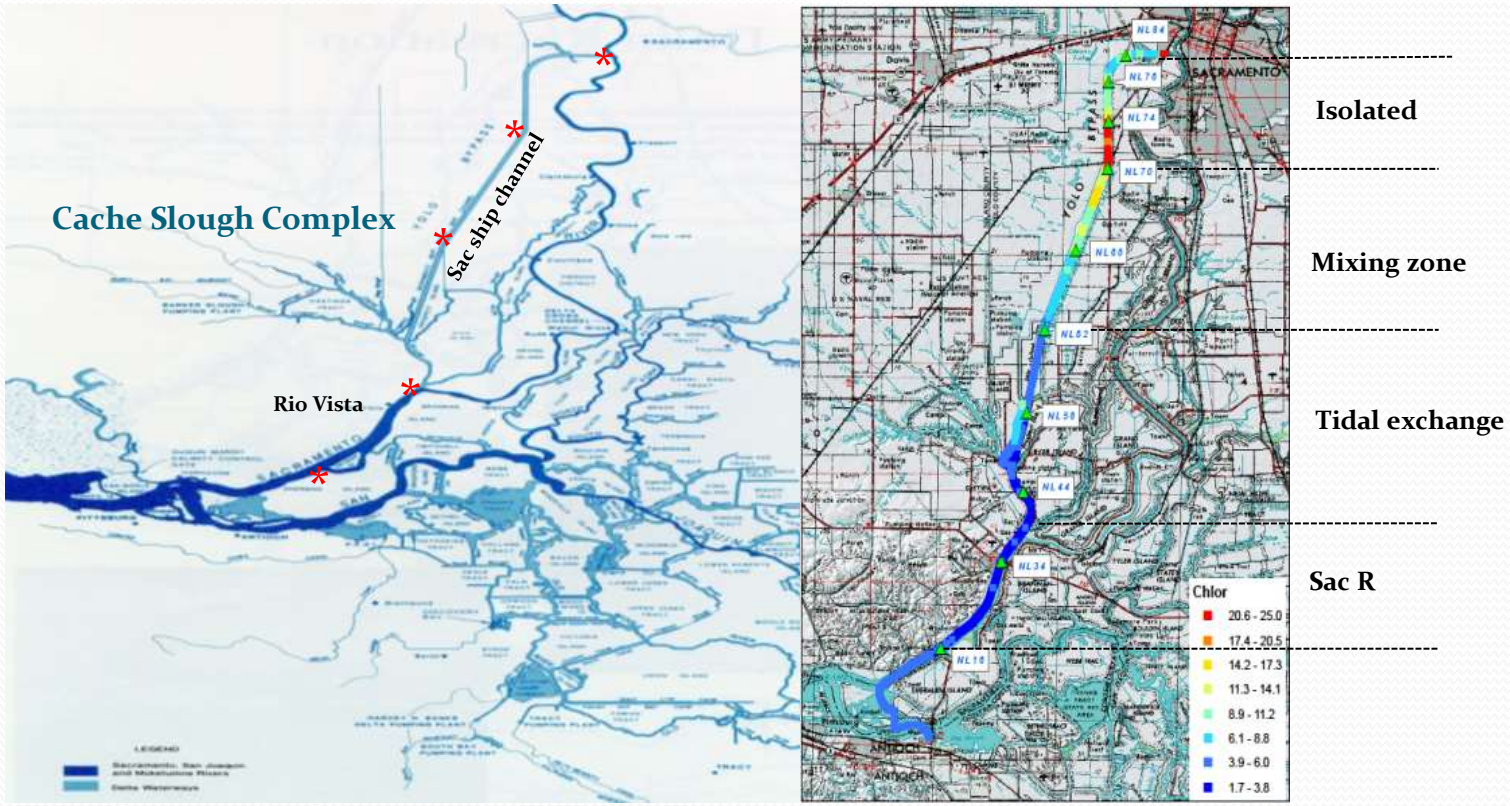
[1] Bureau of Reclamation
[2] University of California, Davis
[3] Central Valley Regional Water Quality Control Board
[4] U.S. Geological Survey

Bay-Delta Science Conference
Sacramento Convention Center, Sacramento, CA
October 28, 2014

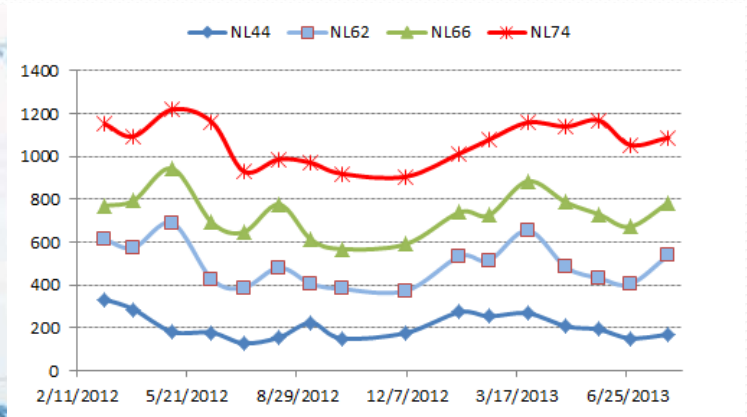
Cooperative Agreement R12AC20032

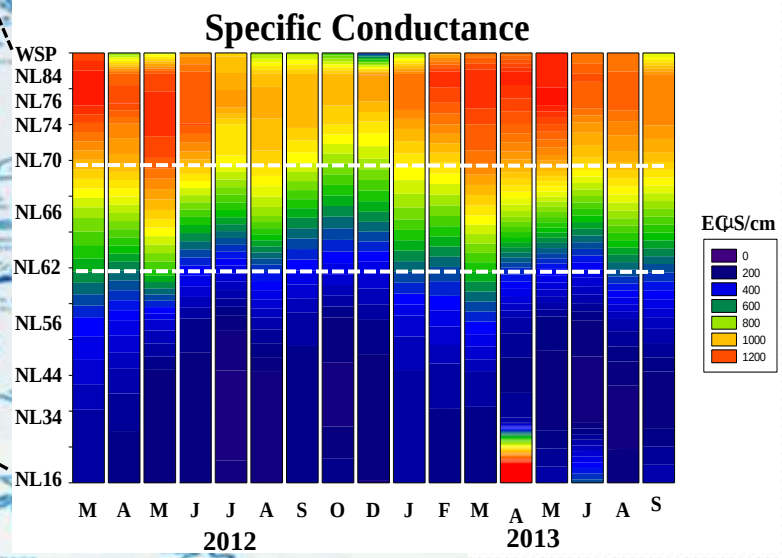
Objectives

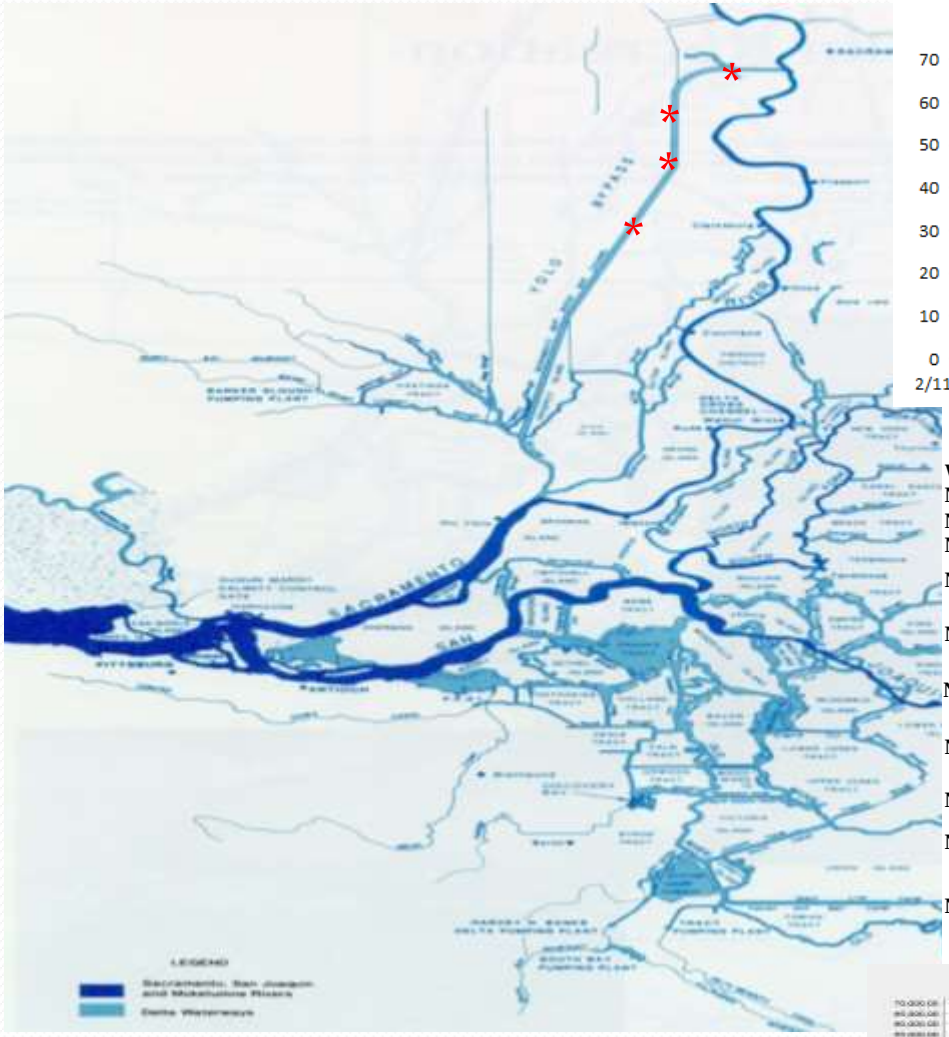
- Limnological overview
- Specific conductance, turbidity, temperature
- Nutrients (nitrate, ammonium, N:P)
- Phytoplankton
- Zooplankton
- Future work

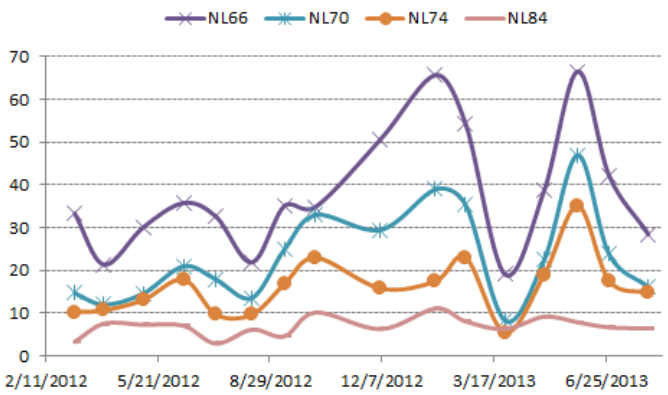


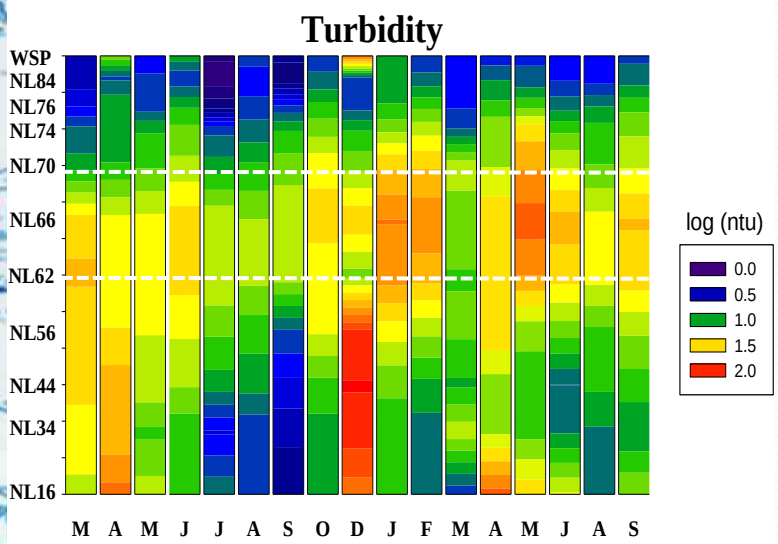
Map: Delta Atlas, California Department of Water Resources

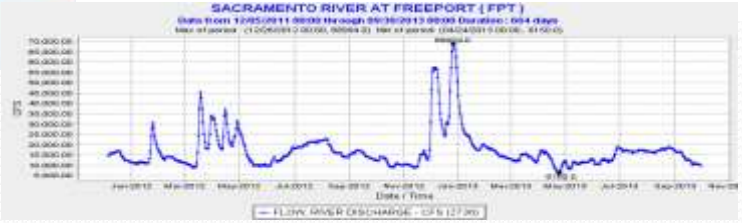

NL44
NL62
NL66
NL74
1400
1200
1000
800
600
400
200
0
2/11/2012
5/21/2012
8/29/2012
12/7/2012
3/17/2013
6/25/2013


Specific Conductance
WSP
NL84
NL76
NL74
NL70
NL66
NL62
NL56
NL44
NL34
NL16
M A M J J A S O D J F M A M J A S
2012
2013
EC µS/cm
0
200
400
600
800
1000
1200

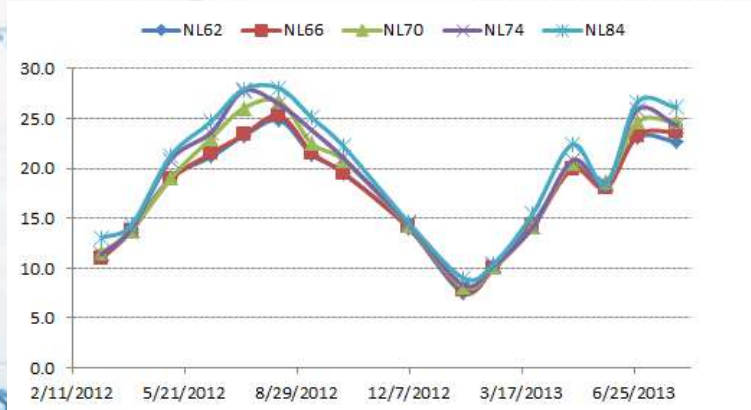

SACRAMENTO
LEGEND

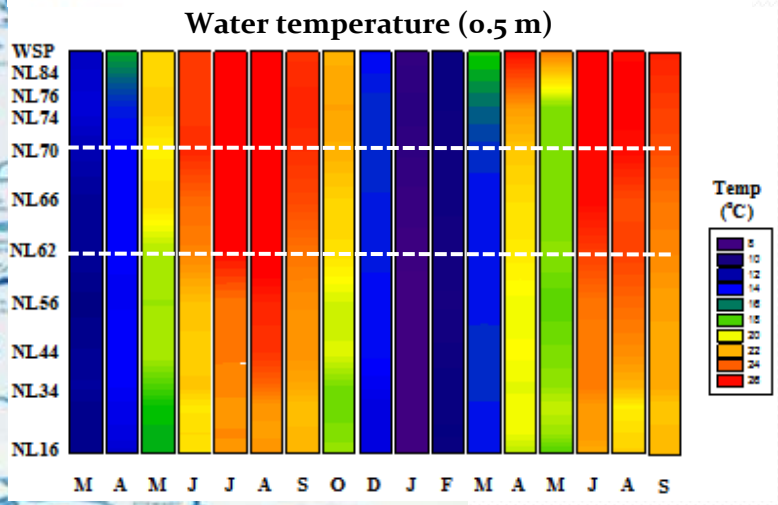

NL66
NL70
NL74
NL84
70
60
50
40
30
20
10
0
2/11/2012
5/21/2012
8/29/2012
12/7/2012
3/17/2013
6/25/2013

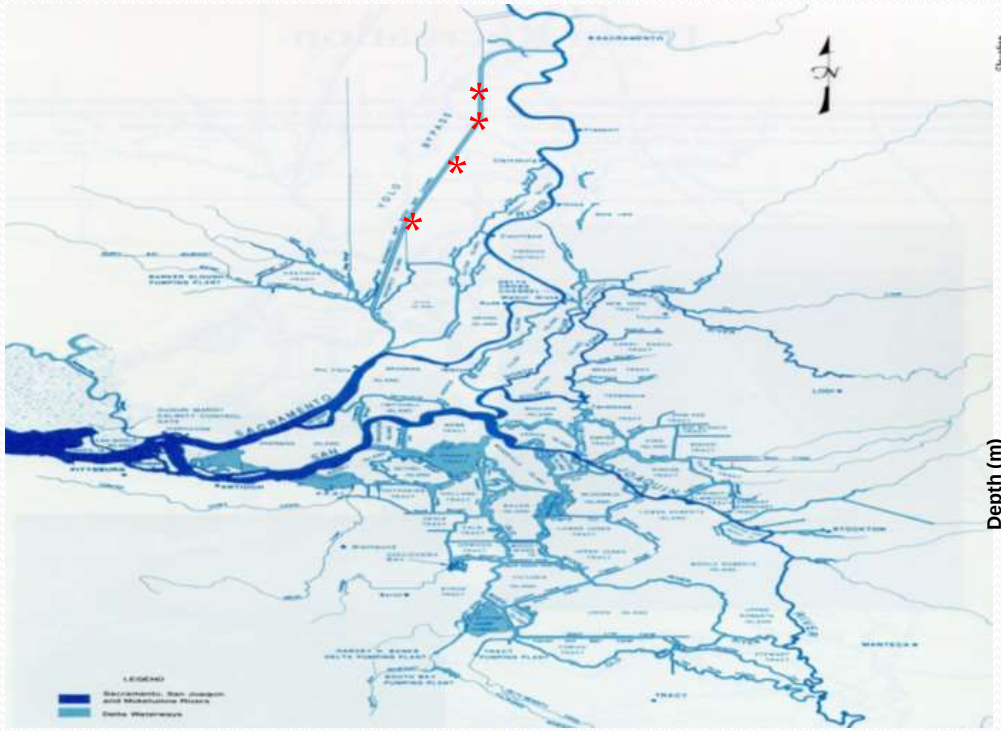

Turbidity
WSP
NL84
NL76
NL74
NL70
NL66
NL62
NL56
NL44
NL34
NL16
M A M J J A S O D J F M A M J A S
log (ntu)
0.0
0.5
1.0
1.5
2.0

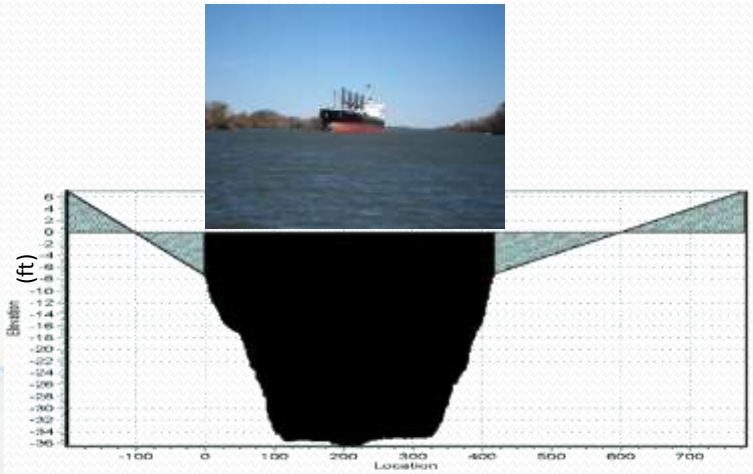

SACRAMENTO RIVER AT FREEPORT (FPT)
Date / Time

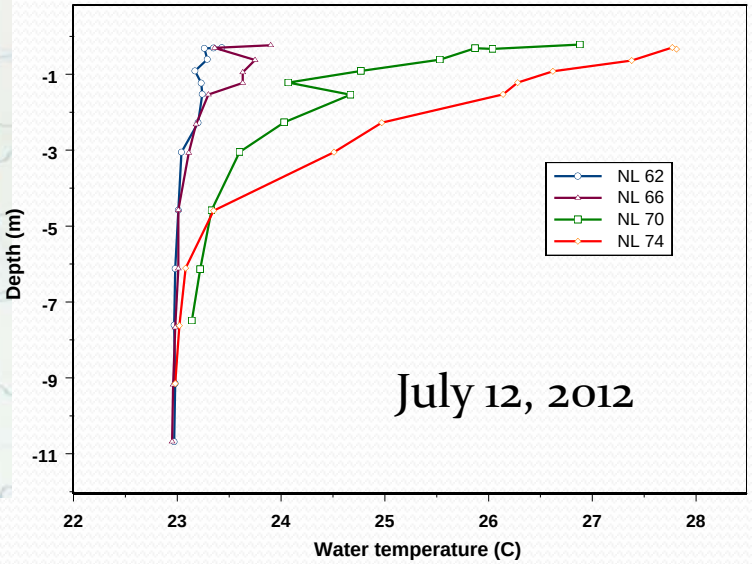
SACRAMENTO
SAN
LEGEND

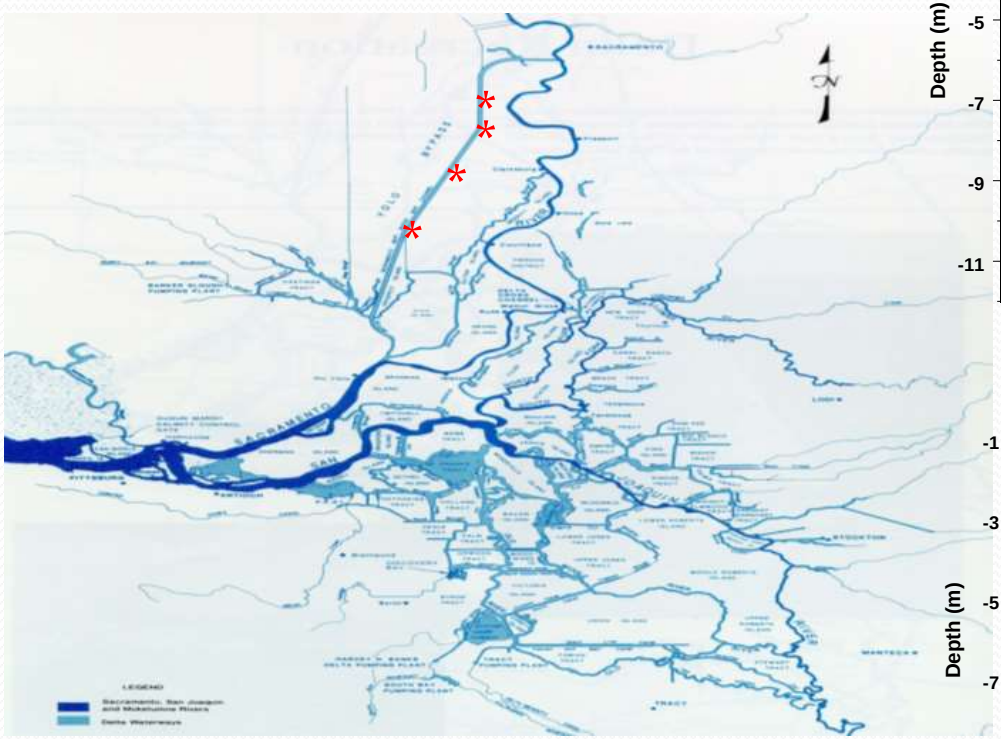

NL62
NL66
NL70
NL74
NL84
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2/11/2012
5/21/2012
8/29/2012
12/7/2012
3/17/2013
6/25/2013

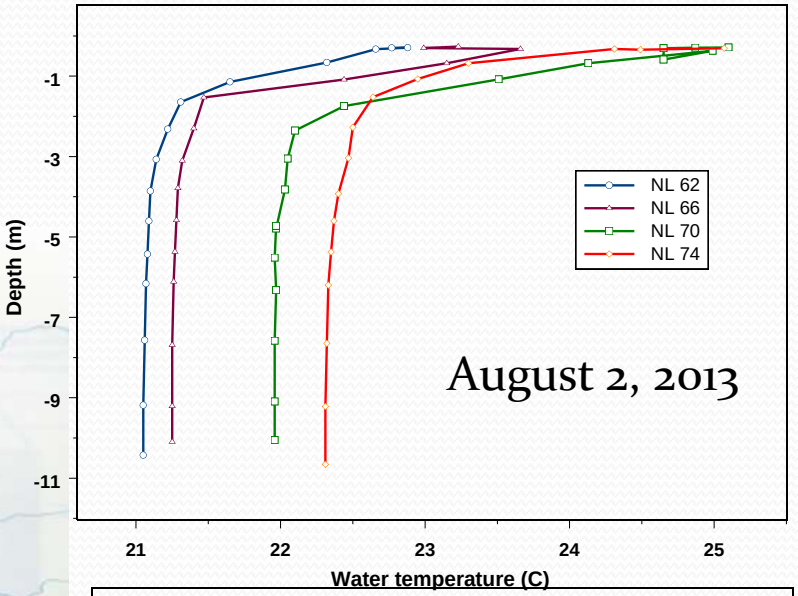

Water temperature (0.5 m)
WSP
NL84
NL76
NL74
NL70
NL66
NL62
NL56
NL44
NL34
NL16
M A M J J A S O D J F M A M J A S
Temp (°C)

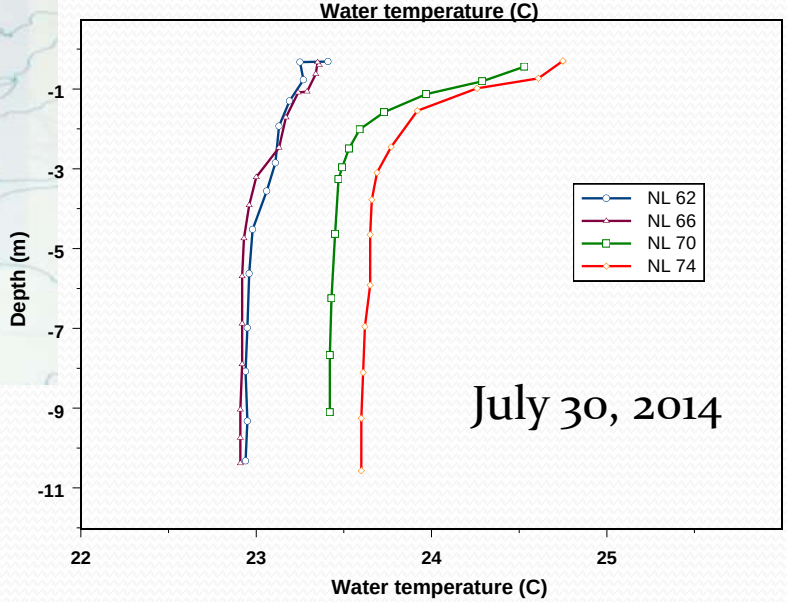



Elevation (ft)
Location

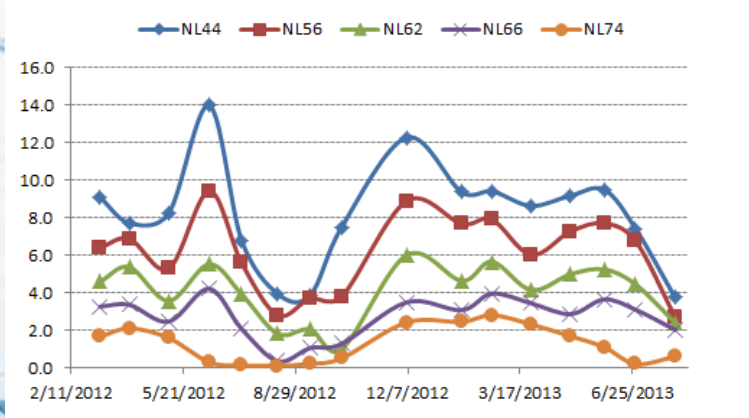

Depth (m)
Water temperature (C)
NL 62
NL 66
NL 70
NL 74
July 12, 2012

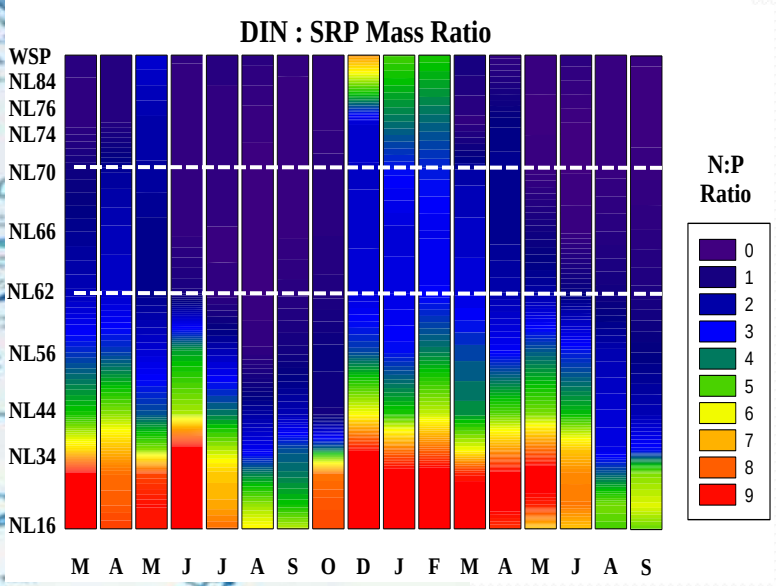


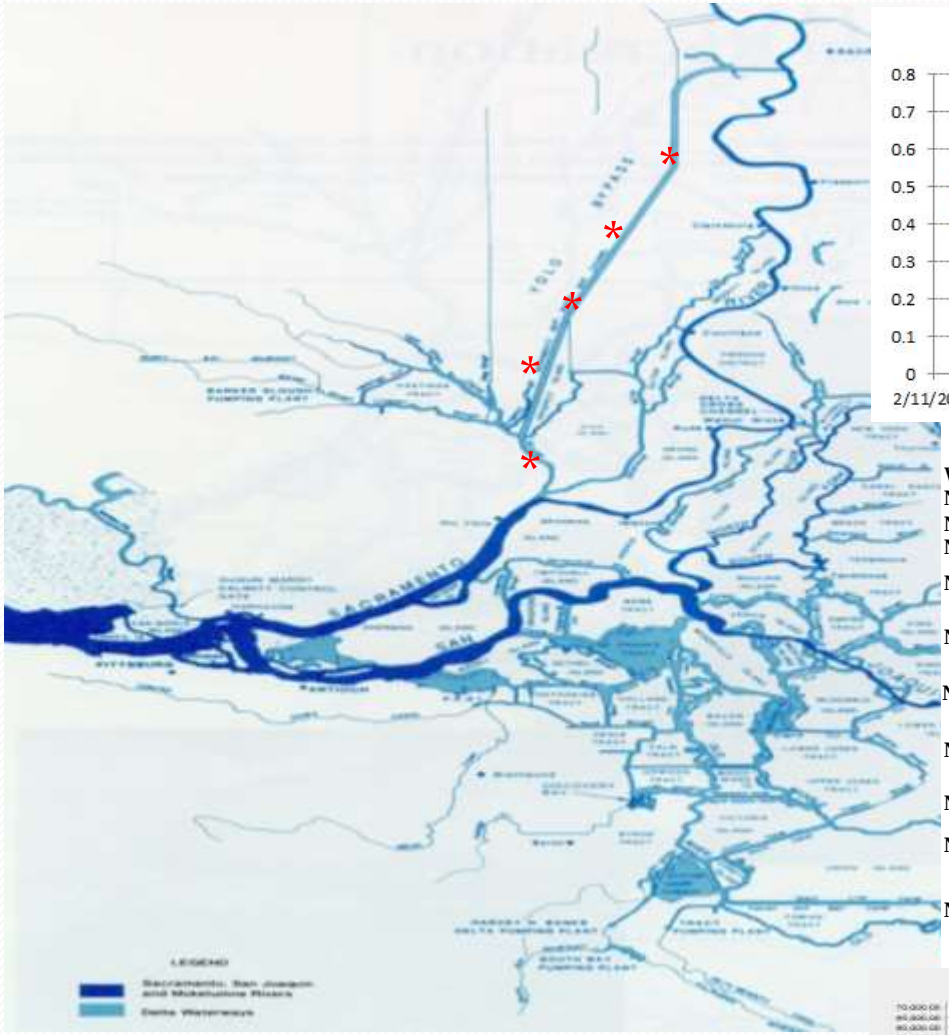

Depth (m)
-1
-3
-5
-7
-9
-11
21
22
23
24
25
Water temperature (C)
NL 62
NL 66
NL 70
NL 74
August 2, 2013

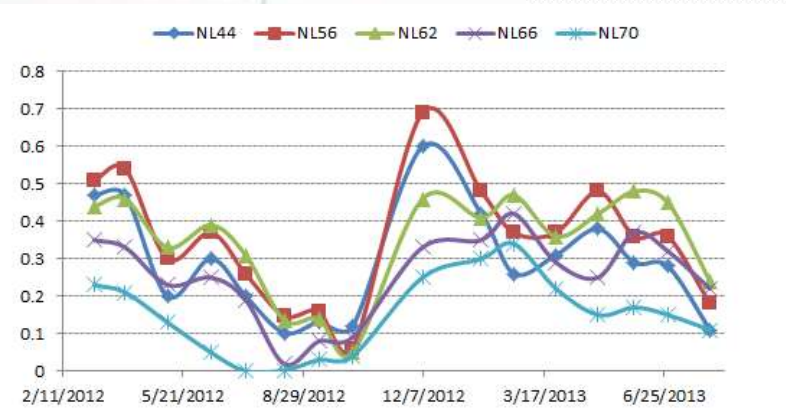

Depth (m)
-1
-3
-5
-7
-9
-11
22
23
24
25
Water temperature (C)
NL 62
NL 66
NL 70
NL 74
July 30, 2014

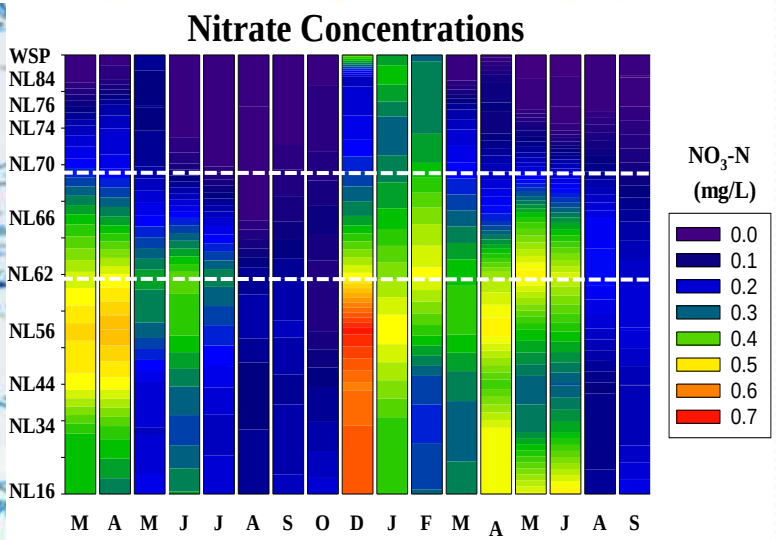
SACRAMENTO
SAN
LEGEND

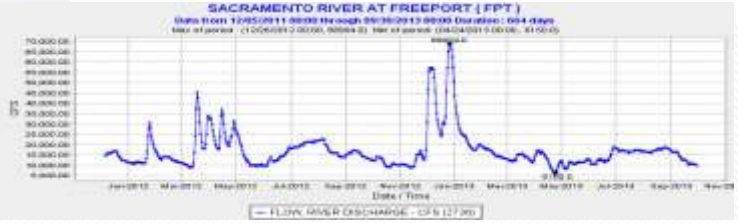

NL44
NL56
NL62
NL66
NL74
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
2/11/2012
5/21/2012
8/29/2012
12/7/2012
3/17/2013
6/25/2013


DIN : SRP Mass Ratio
WSP
NL84
NL76
NL74
NL70
NL66
NL62
NL56
NL44
NL34
NL16
M A M J J A S O D J F M A M J A S
N:P Ratio
0
1
2
3
4
5
6
7
8
9

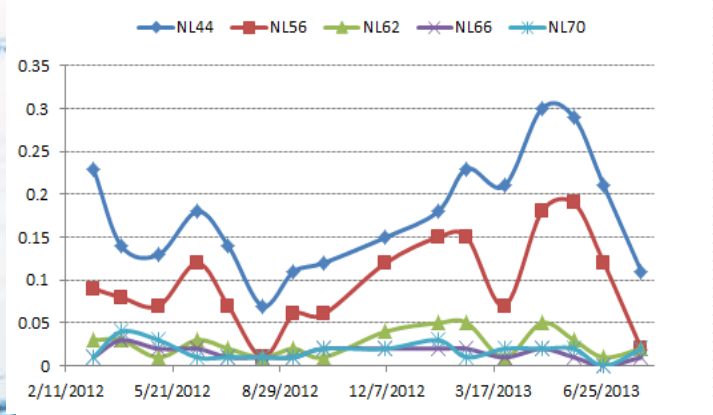

YOLO
BYPASS
SACRAMENTO
SAN
LEGEND

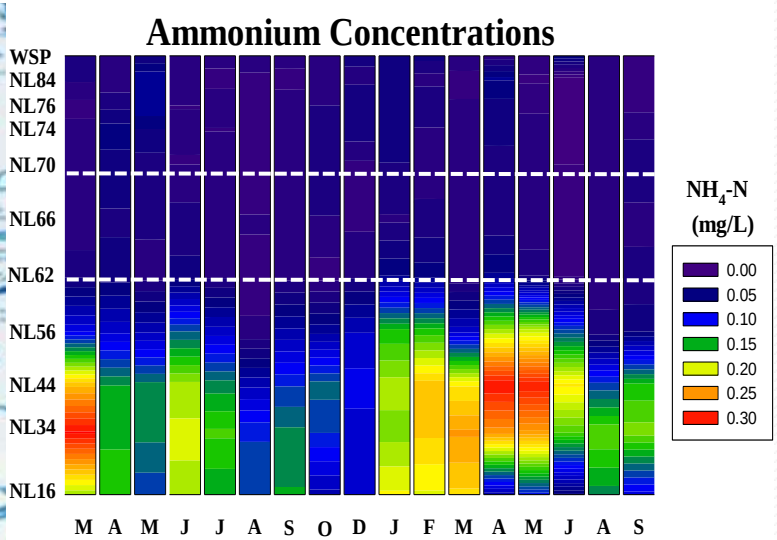

NL44
NL56
NL62
NL66
NL70
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2/11/2012
5/21/2012
8/29/2012
12/7/2012
3/17/2013
6/25/2013


Nitrate Concentrations
WSP
NL84
NL76
NL74
NL70
NL66
NL62
NL56
NL44
NL34
NL16
M A M J J A S O D J F M A M J A S
NO3-N (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7


SACRAMENTO RIVER AT FREEPORT (FPT)

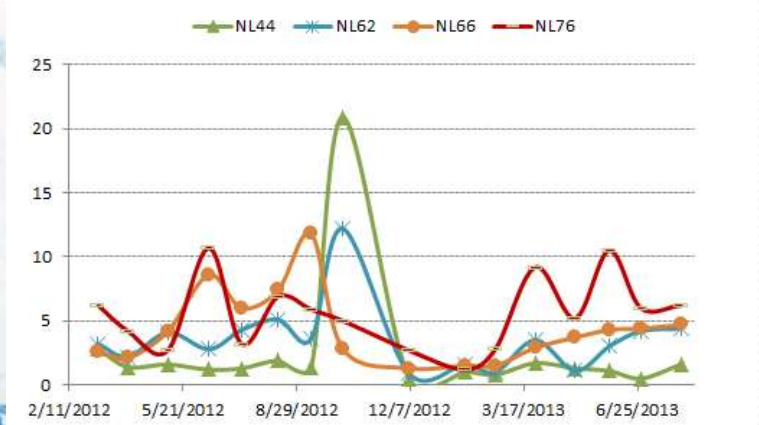
SACRAMENTO
LEGEND

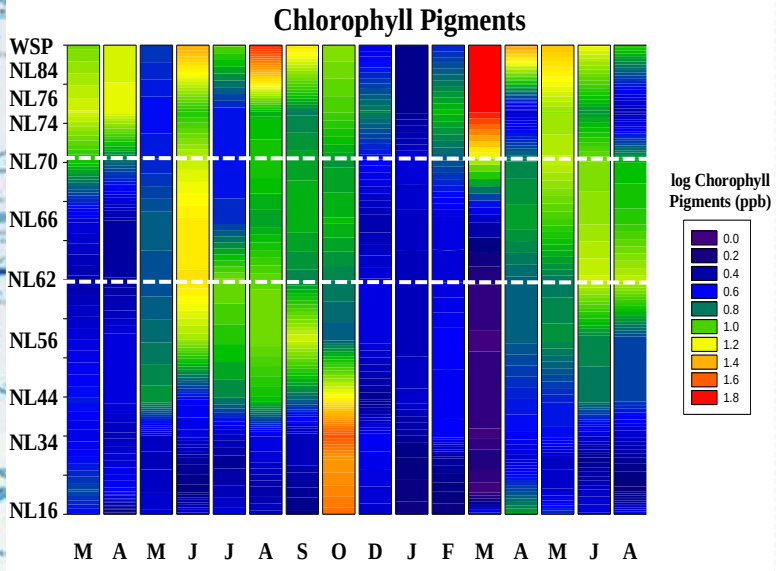

NL44
NL56
NL62
NL66
NL70
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2/11/2012
5/21/2012
8/29/2012
12/7/2012
3/17/2013
6/25/2013


Ammonium Concentrations
WSP
NL84
NL76
NL74
NL70
NL66
NL62
NL56
NL44
NL34
NL16
M A M J J A S O D J F M A M J A S
NH4-N (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30

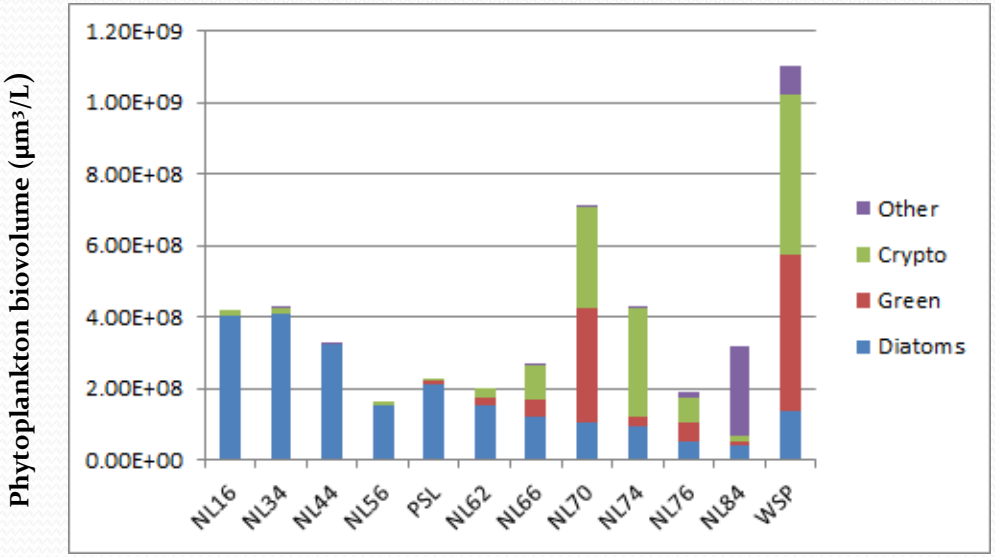
SACRAMENTO RIVER AT FREEPORT (FPT)

SACRAMENTO
LEGEND


NL44
NL62
NL66
NL76
25
20
15
10
5
0
2/11/2012
5/21/2012
8/29/2012
12/7/2012
3/17/2013
6/25/2013


Chlorophyll Pigments
WSP
NL84
NL76
NL74
NL70
NL66
NL62
NL56
NL44
NL34
NL16
M A M J J A S O D J F M A M J A
log Chorophyll Pigments (ppb)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8

Common phytoplankton genera



July 12, 2012

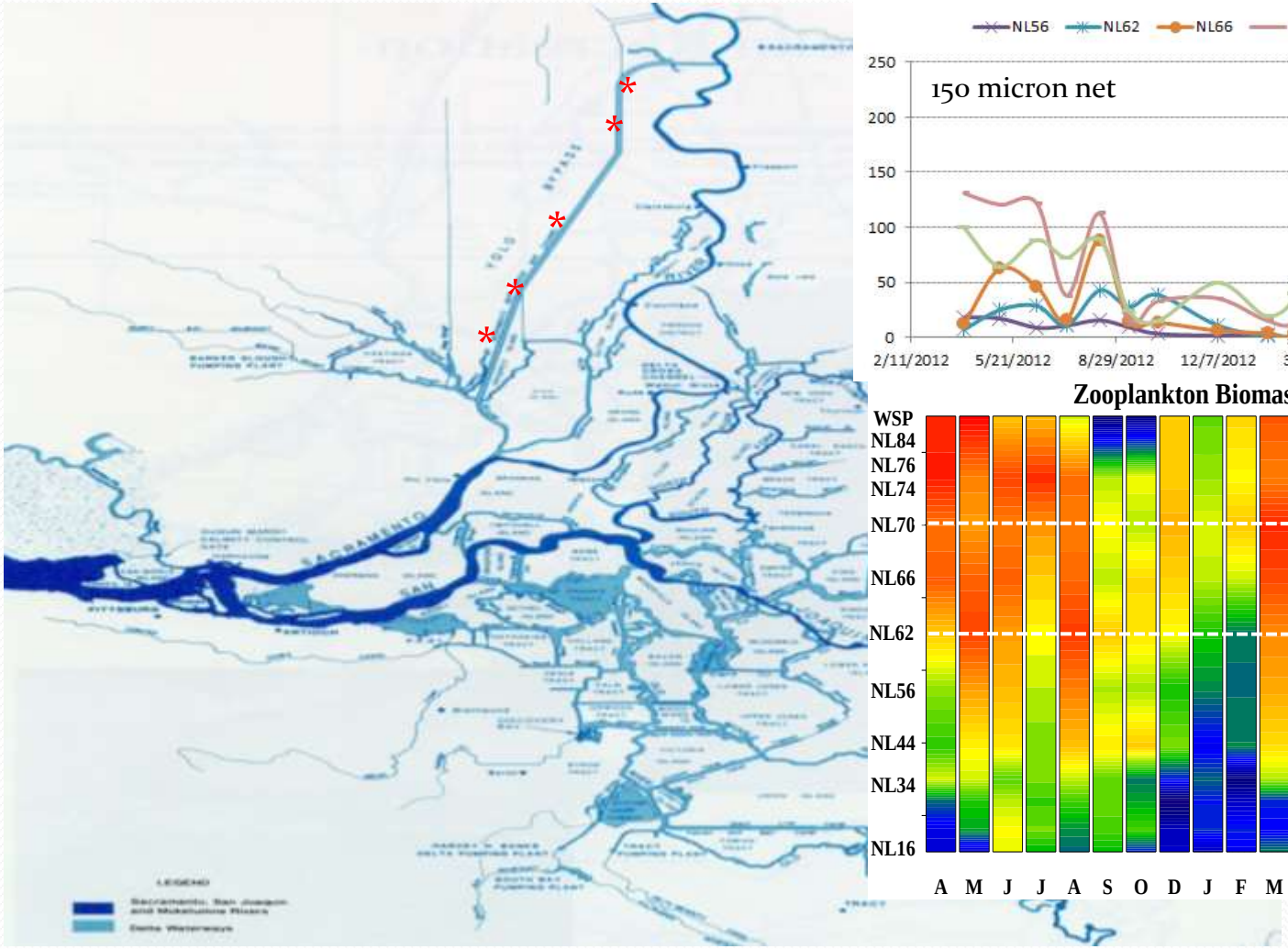
Low *Microcystis*

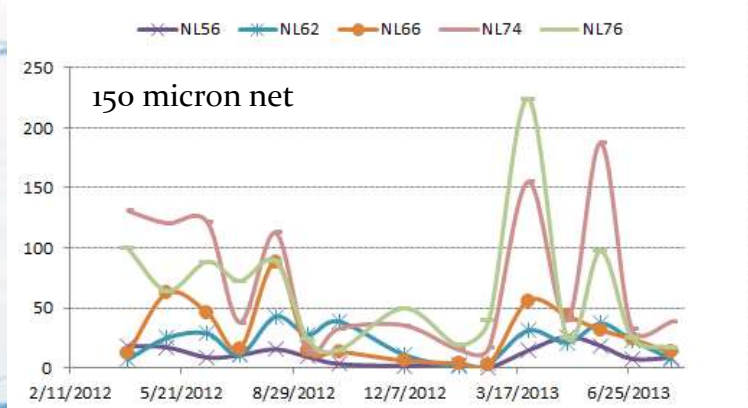
Anabaena, Microcystis

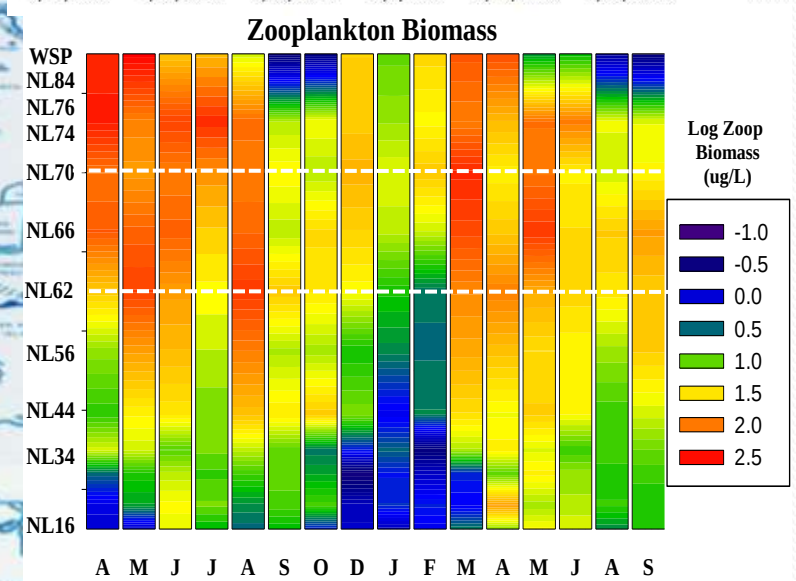
Rhodomonas, Chroomonas, Cryptomonas

Chlamydomonas, Coelastrum, Oocystis

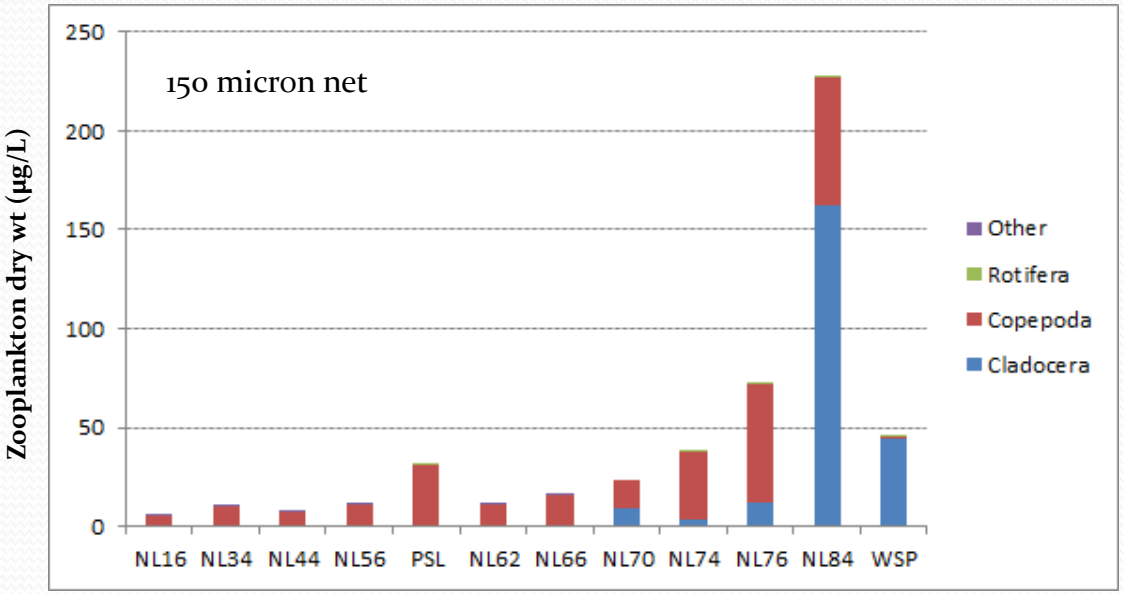
Melosira, Stephanodiscus, Cyclotella, Synedra, Cocconeis, Gyrosigma, Nitzschia, Stauroneis, Synedra, Epithemia, Eunotia, Pinnularia, Planothidium


YOLO
BYPASS
SACRAMENTO
SAN
LEGEND


NL56
NL62
NL66
NL74
NL76
150 micron net
250
200
150
100
50
0
2/11/2012
5/21/2012
8/29/2012
12/7/2012
3/17/2013
6/25/2013


Zooplankton Biomass
WSP
NL84
NL76
NL74
NL70
NL66
NL62
NL56
NL44
NL34
NL16
A M J J A S O D J F M A M J A S
Log Zoop Biomass (ug/L)
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5

Common macro-zooplankton genera



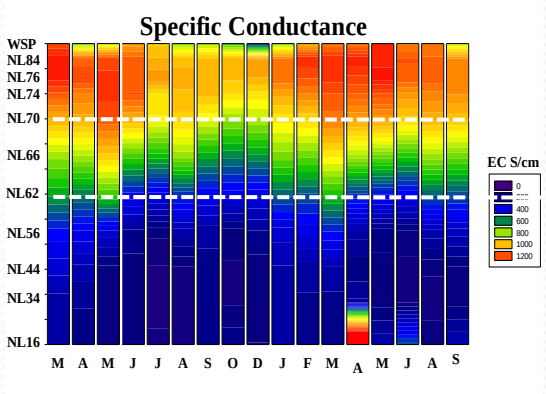
Veligers

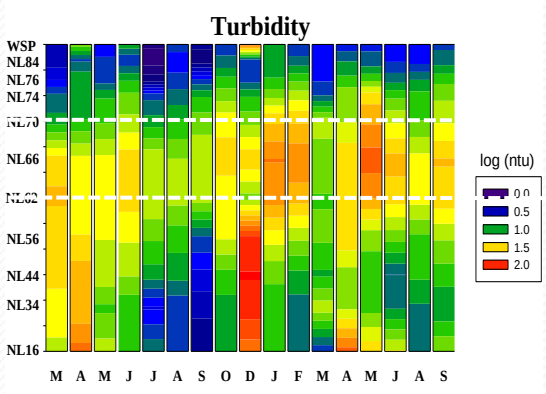
Conochiloides, Lecane, Polyarthra, Brachionus

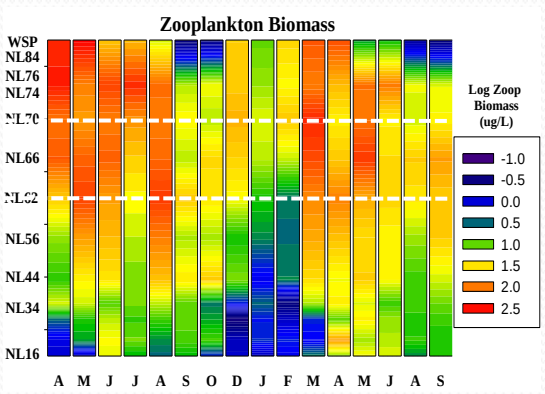
Sinocalanus, Pseudodiaptomus, calanoid

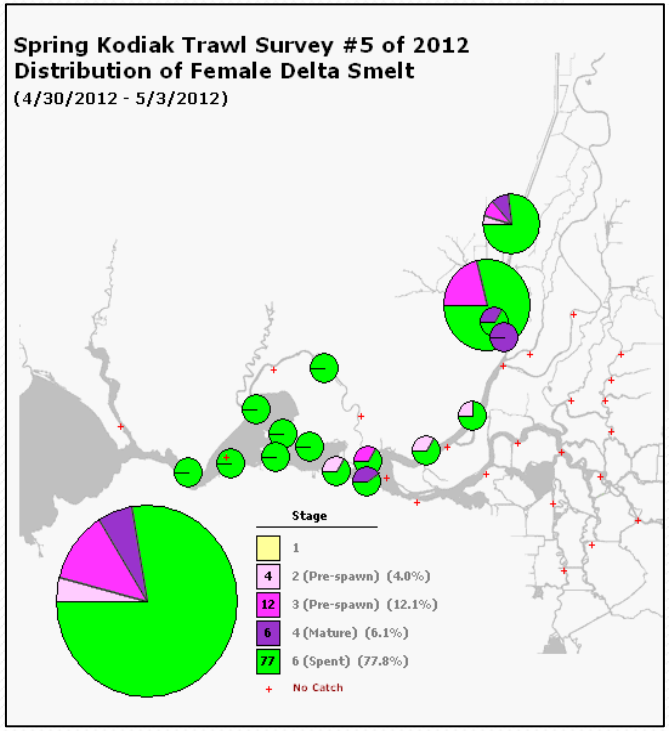
Ceriodaphnia, Daphnia, Diaphanasoma

July 12, 2012


Specific Conductance
WSP
NL84
NL76
NL74
NL70
NL66
NL62
NL56
NL44
NL34
NL16
M A M J J A S O D J F M A M J A S
EC S/cm
0
400
600
800
1000
1200

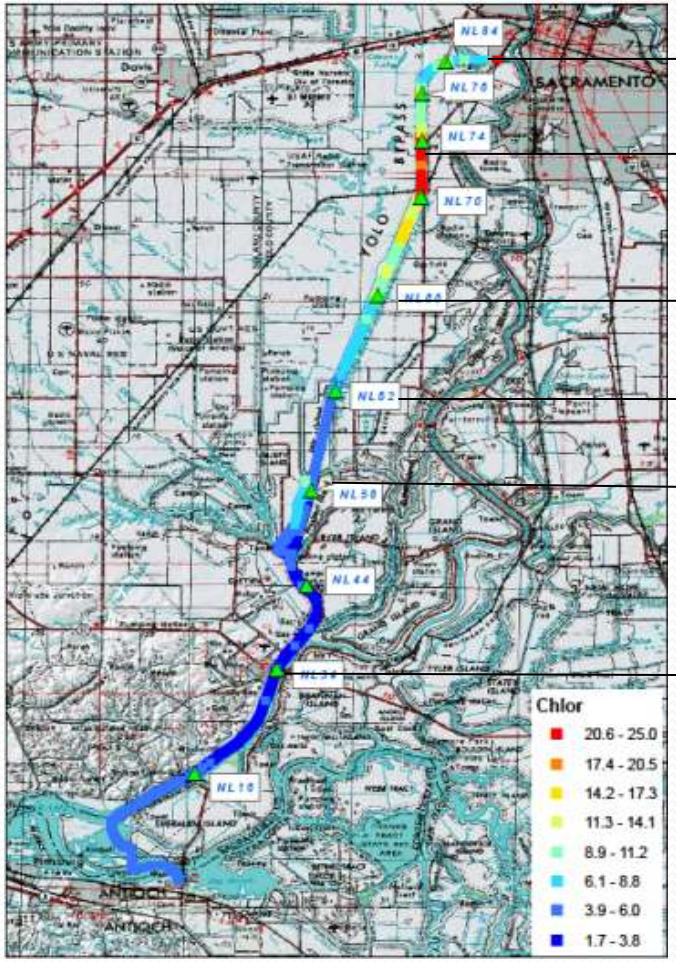

Turbidity
WSP
NL84
NL76
NL74
NL70
NL66
NL62
NL56
NL44
NL34
NL16
M A M J J A S O D J F M A M J A S
log (ntu)
0.0
0.5
1.0
1.5
2.0


Zooplankton Biomass
WSP
NL84
NL76
NL74
NL70
NL66
NL62
NL56
NL44
NL34
NL16
A M J J A S O D J F M A M J A S
Log Zoop Biomass (ug/L)
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5


Spring Kodiak Trawl Survey #5 of 2012
Distribution of Female Delta Smelt
(4/30/2012 - 5/3/2012)
Stage
1
4 2 (Pre-spawn) (4.0%)
12 3 (Pre-spawn) (12.1%)
6 4 (Mature) (6.1%)
77 6 (Spent) (77.8%)
No Catch

Smelt Cam

Food export experiments



Port

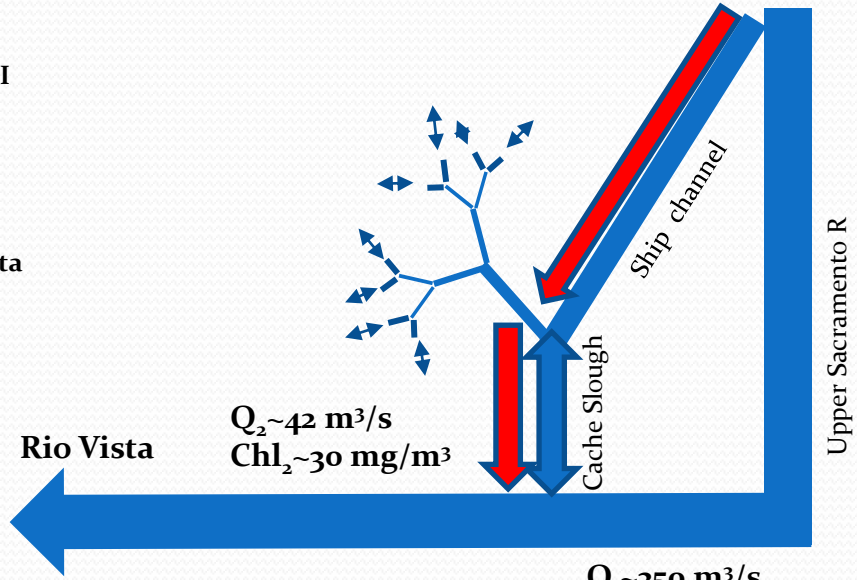
ADCP/YSI

ADCP/YSI

ADCP/YSI

ADCP/YSI

Rio Vista



Chl_3~6 mg/m³

$C_3 = (Q_1C_1 + Q_2C_2)/(Q_1+Q_2)$

Conclusions

- Limnologically interesting
- Longitudinal/seasonal variation
- Nitrogen-deficient
- Chl ~10 ug/L threshold
- High zooplankton abundance
- High value for delta smelt studies
- Tool for boosting Delta food supply

Questions?

Photos by Mark Gowdy