Habitat, water quality, nutrients, and tidal dispersion

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The Charge

- What are the effects of altered interior Delta flows on other parts of the ecosystem such as phytoplankton, zooplankton, and benthos?
- How do non-flow stressors such as ... physical habitat ... and water quality interact with interior Delta flows to affect [native fish]?
- What metrics ... are most useful to assess, predict and manage impacts to fish and the ecosystem?

Topics (with apologies)



Phytoplankton and zooplankton

Water quality and nutrients

Water depth and channel geometry

Clams

Drinking water quality

Topics

- Phytoplankton (zooplankton food)
- Nutrients
- Drinking water quality (Dissolved Organic Carbon and Bromide)

Cross cutting issues

- Residence time
- Tidal interaction with wetlands
- Flow, velocity, mixing, and channel geometry
- Benthos

Conclusions

Everything you change about flows.....
......changes the water and habitat quality

When flows change, we don't know enough to....

.....predict.....or model.....

......changes in water and habitat quality

We need to monitor the changes.....

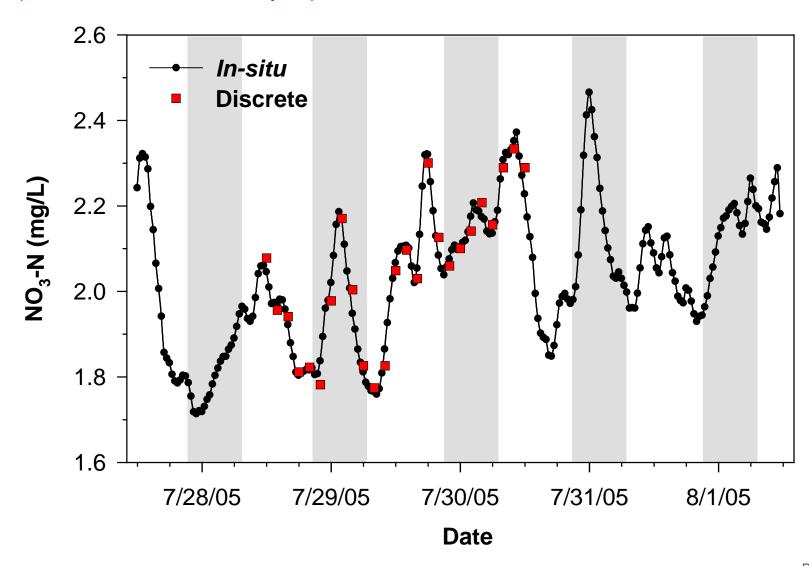
.....on the timescales over which changes occur

Nitrate Variability – San Joaquin River

Assessing nitrate variability in the San Joaquin River, Crows Landing, CA (Satlantic ISUS nitrate analyzer) 2.6 **Discrete** 2.4 NO₃-N (mg/L) 2.2 2.0 1.8 1.6 7/28/05 7/29/05 7/30/05 7/31/05 8/1/05 **Date**

Nitrate Variability – San Joaquin River

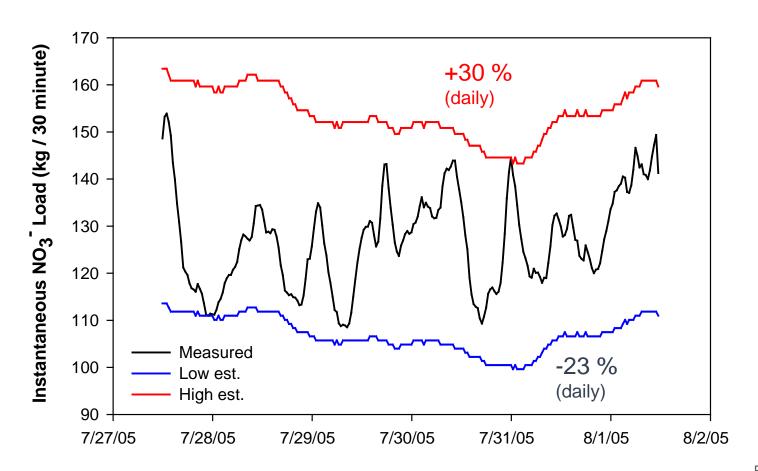
Assessing diurnal nitrate variability in the San Joaquin River, Crows Landing, CA (Satlantic ISUS nitrate analyzer)



Nitrate Loads – San Joaquin River

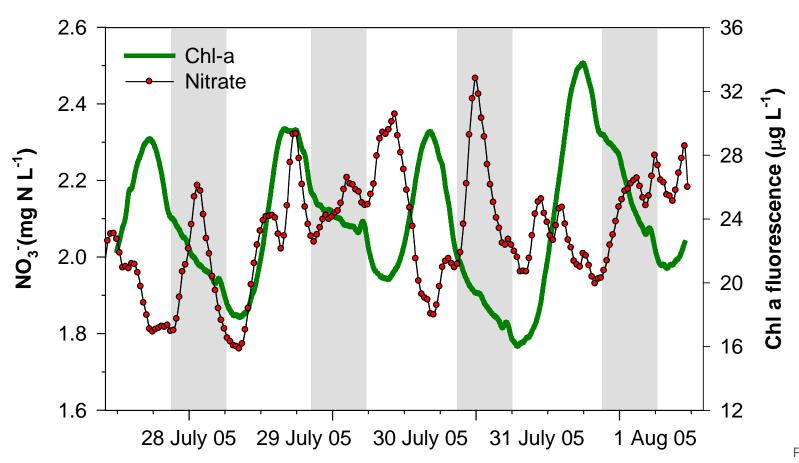
Difference in instantaneous and cumulative nitrate load at Crows Landing during the study period. Daily loads were -23 to +30 % relative to measured load using continuous data.

	Daily Load (kg nitrate / day)			% Difference	
	Measured	Low est.	High est.	Low est.	High est.
28-Jul	5875	5305	7631	-10	30
29-Jul	6563	5064	7284	-23	11
30-Jul	6160	4956	7130	-20	16
31-Jul	6047	5024	7228	-17	20

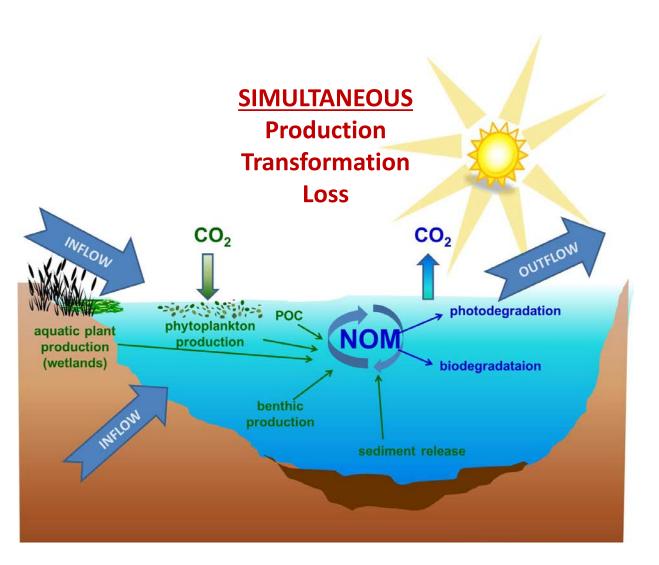


Drivers of nitrate variability - SJR

Combination of discrete and in situ data show high biological activity in the SJR (*right*); evidence for link between NO₃⁻ is not simple.



What affects biogeochemical processes?



Biology

Weather

Flow

Water depth

Tidal Exchange

Diurnal cycles

Temperature

Light

Nutrients

Sediment

Waste water content

Contaminants

Etc.

What you need to know about Phytoplankton

 Phytoplankton are not all equal -Different phytoplankton support different parts of the foodweb

- Affected by residence time
- Affected by clams
- Compete for nutrients with wetlands



Nutrients and Phytoplankton Production in the Delta Sacramento Gareta Bend WTP Sacramento Regional • Elk Grove Vacaville Kenady Landing Galt Credit: Alex Parker Vista • Isleton Confluence Qakley Light 14 Antioch Stockton Brentwood Stockton WTP Marsh Creek Discovery ALGAL CELLS Brandt Bridge millions/L Manteca Centric diatoms ennate diatoms From Pulse of the Cryptophytes Chlorophytes Estuary 2012; Based on Blue-green algae **Kress 2012** Flagellates

15 Miles

What you need to know about Nutrients

- Nutrients needed for phytoplankton production
- Nutrients needed for wetland production
- Too many nutrients leads to eutrophication, HABs, DO problems
- Too few nutrients lead to fewer phytoplankton

Nutrients can change the foodweb

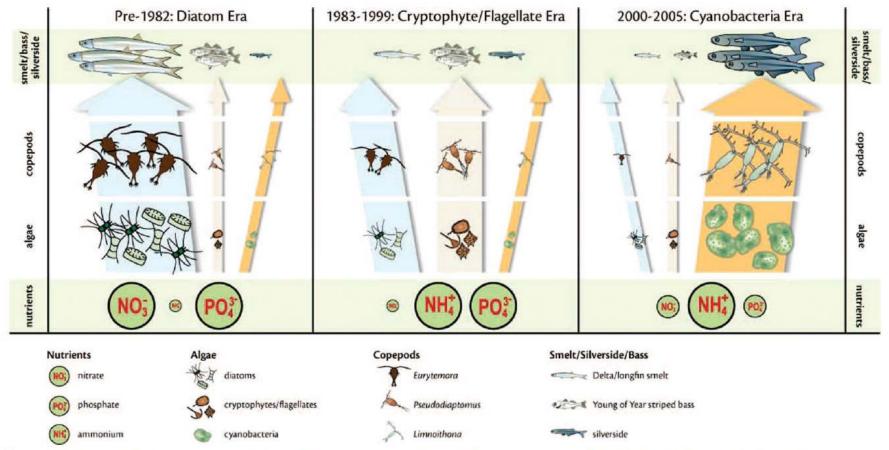
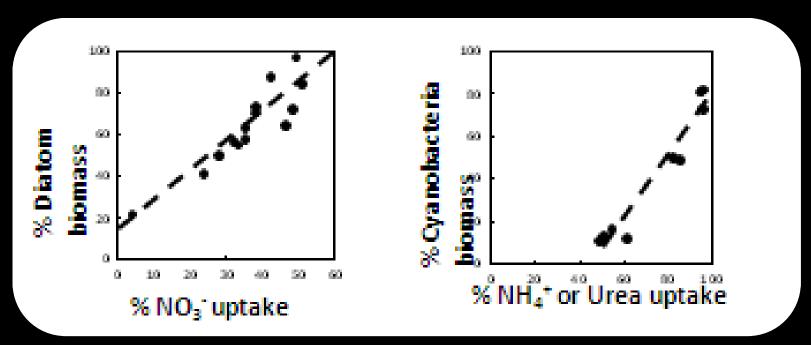


Figure 23 Conceptual diagram of some of the hypothesized changes in the food chain from phytoplankton to fish that have occurred in the Sacramento-San Joaquin Estuary over the past 30 years. Each of these hypothesized food chains has different dominant nitrogen forms or amounts relative to phosphorus. This conceptual model is intended simply to highlight some of the major flows of energy and materials and does not include all organisms, pathways or flows. The size of the symbols is meant to infer relative importance.

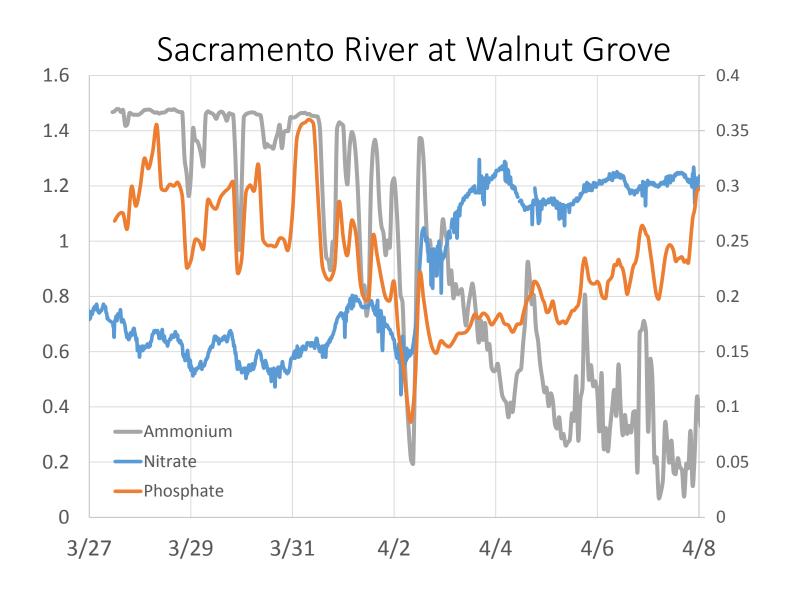
Nutrients and Phytoplankton Production in the Delta



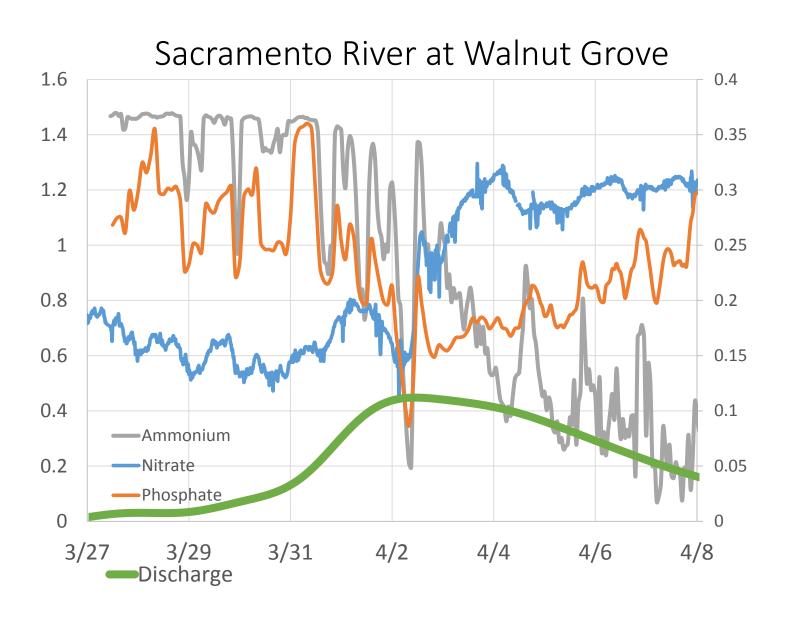
Heil, Revilla, Glibert, Murasko

Credit: Alex Parker

Nutrient concentrations and ratios change rapidly



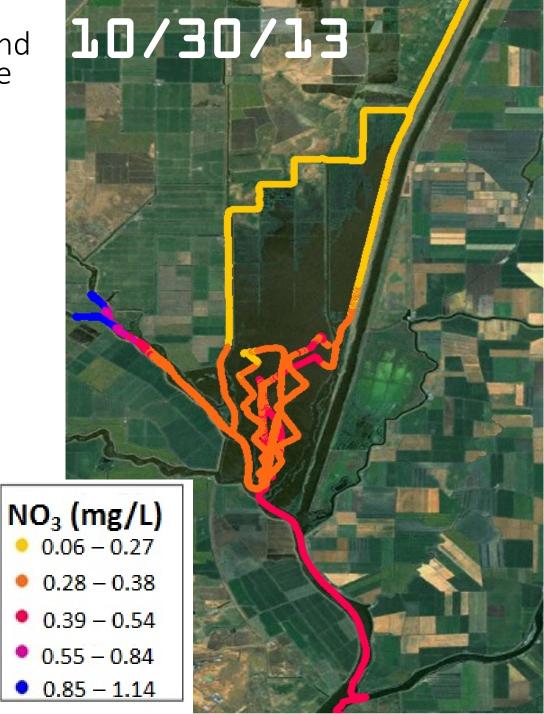
Nutrient concentrations and ratios change rapidly



Nutrient concentrations and ratios change vary in space

Cache Slough Complex

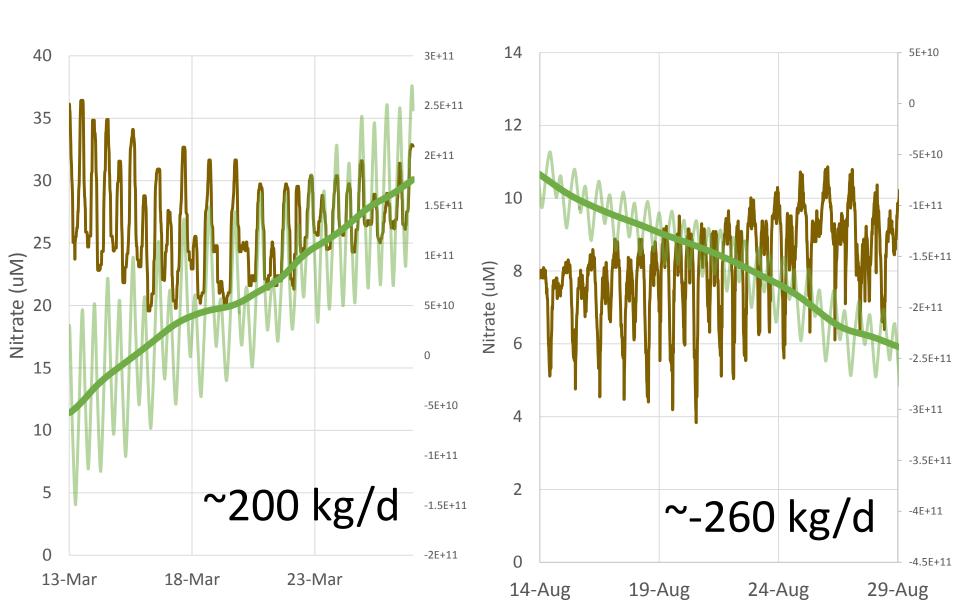
What long residence time does to nutrients



What you need to know about wetlands

- Wetlands can be sources or sinks of nutrients
- Wetlands can be sources or sinks of phytoplankton and zooplankton
- Wetlands can switch from a source to a sink rapidly and unpredictably

Liberty Island Nitrate Flux

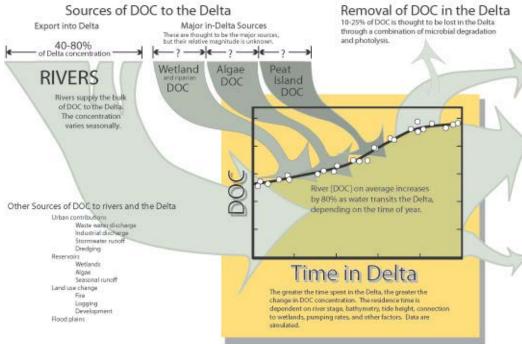


What you need to know about Drinking Water Issues (Dissolved Organic Carbon)

- DOC is problematic in drinking water treatment
- DOC doubles in transit across Delta
- Sources wetlands and islands
- Higher residence times lead to higher concentrations
 Source and fate of DOC in Delta Water

SIDE NOTE:

 Salt trapping
 has potential
 to lead to
 higher
 bromide



FATE of DELTA DOC

Beneficial

DELTA ECOSYSTEM

information to estimate its importance.

SAN FRANCISCO

comes from Delta DOC.

Concerns related to DOC:

TOC/DOC concentration

Membrane fouling

Evidence suggests the Delta Ecosystem is supported

ESTUARY ECOSYSTEM

Most DCC flows into the San Francisco Estuary where it supports microbial productivity, the base of the foodweb.

Problematic

60-80% of the energy used by the SF Bay ecosystem

DRINKING WATER

quality of the drinking water produced.

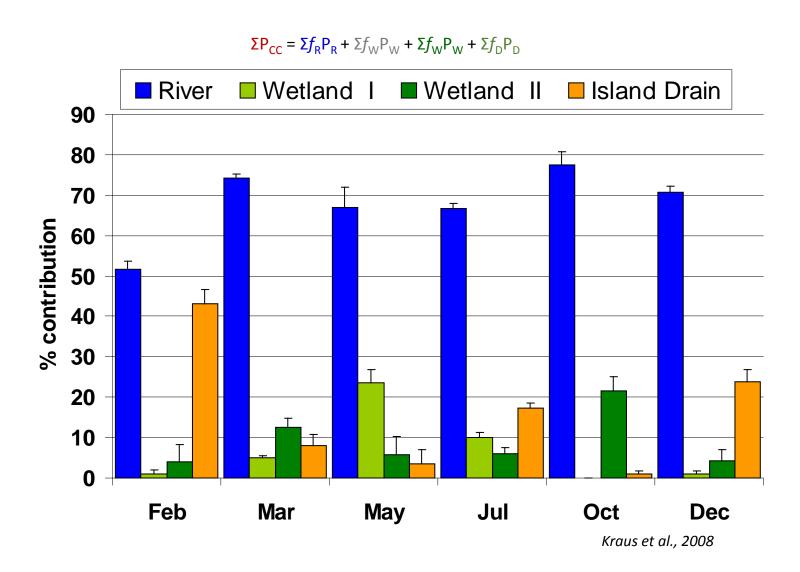
Some Delta water is used for drinking water supply.

The quality and amount of DOC affect the cost and

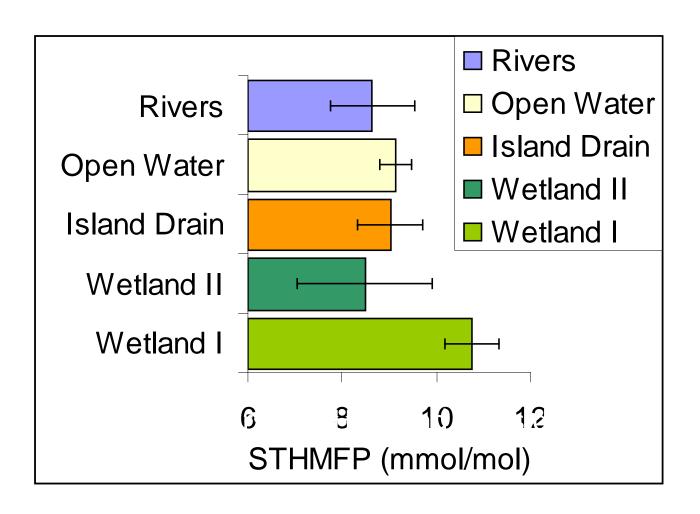
Ozone demand and Ozonation byproduct formation Disinfection byproduct formation (THM, HAA, TOX)

by river and in-Delta sources of DOC, but there is insufficient

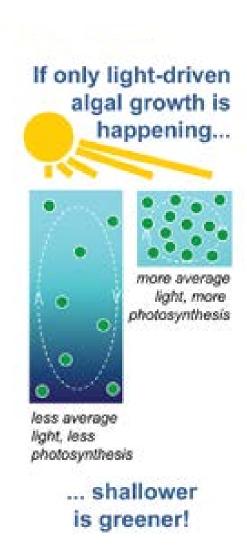
Chemical Fingerprinting Relative DOC Contributions to Export Water



Wetland DOC forms more of some DBPs

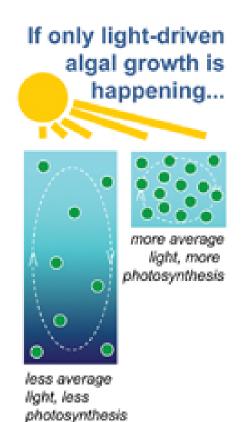


What you need to know about channel geometry



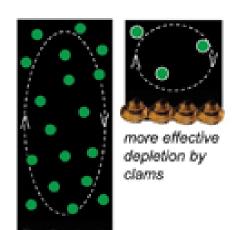
Credit: Lisa Lucas

What you need to know about clams



... shallower is greener!

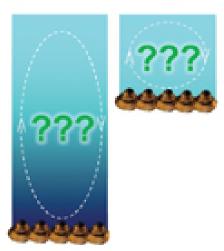
If only clam grazing is happening...



less effective depletion by clams

> ...shallower is LESS green!

In reality (and in the model), growth and grazing happen simultaneously...



...shallower may be more or less green! (It's not so simple)

Credit: Lisa Lucas

Conclusions

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Recommendations for monitoring

NETWORK OF HABITAT INDICATOR MONITORS

- Located in flow network
- Within tidal distance of each other PHYTOPLANKTON INDICATORS
 - Pigment concentrations
 - Basic phytoplankton taxonomy
 - Biogeochemical variables
 DO, CO₂, pH, nutrients, light

FISH HABITAT INDICATORS

- Visual range and contrast
- Temperature profile
- Particle size distribution

WATER QUALITY INDICATORS

- Conductivity
- DOC

