Mesocosm Experiments To Study Benthic-Pelagic Coupling in Shallow Waters: Effects of Resuspension

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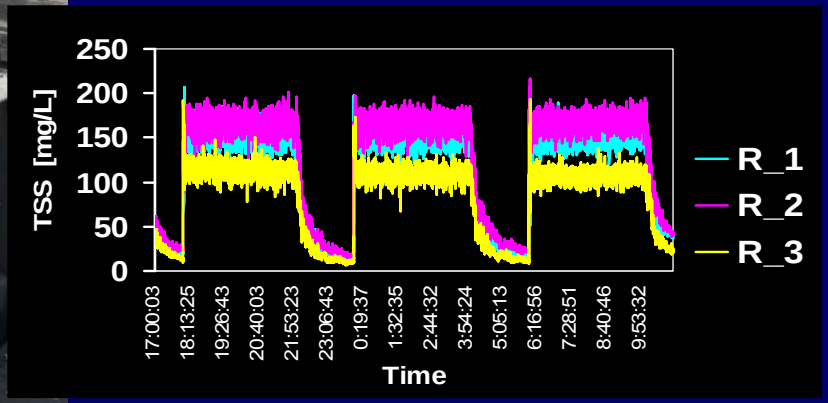
STURM facility at PEARL



Mixing and Data Control Center for STURM

Same water column turbulence

$q = 1.08\ cm\ s^{-1}$

$\varepsilon = 0.08\ cm^2\ s^{-3}$

BUT

Low bottom shear stress

High bottom shear stress

Non-Resuspension Tanks (NR)

Resuspension Tanks (R)

4h mixing on, 2h mixing off (tidal cycling)

Objectives

Determine the effect of sediment resuspension on water quality and ecosystem processes:

Effect of high bottom shear (i.e., resuspension) on:

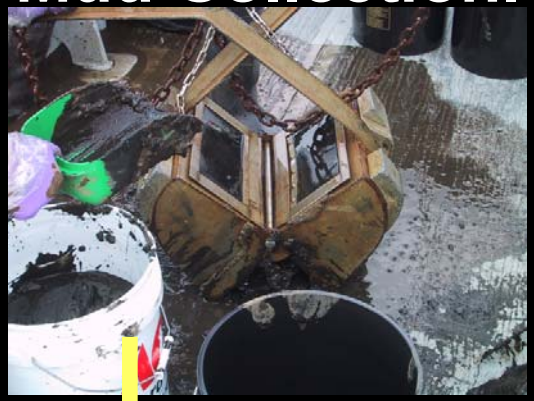
1. Seston quantity, phytoplankton, matter quality
2. The ecosystem: pigments, zooplankton
3. Particulate and dissolved nutrients
4. Light and microphytobenthos biomass
5. Sediment fluxes
6. Macrofauna

Do in controllable experimental ecosystem experiments with realistic shear & turbulence.

Experiment setup

Baltimore Harbor muddy sediment

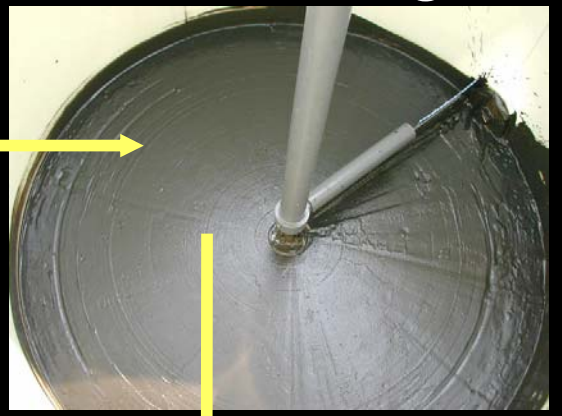
Mud Collection.



Homogenization.

Defaunation.

Smoothing.



Equilibration for 14d w. filtered water & partial water exchange

Add unfiltered water

START 4-wk EXPT

(Porter, Owens, Cornwell 2006 JCR)

During 4-Week Experiment

Water Column Measurements

e.g., TSS, chl *a*, mesozooplankton, DIN, light, sed. chl *a*, sed. nutrient fluxes, macrofauna

Before & at End of Expt:

D/L Flux Chamber Incubations

Results

Determine the effect of sediment resuspension on water quality and ecosystem processes:

Effect of high bottom shear (i.e., resuspension) on:

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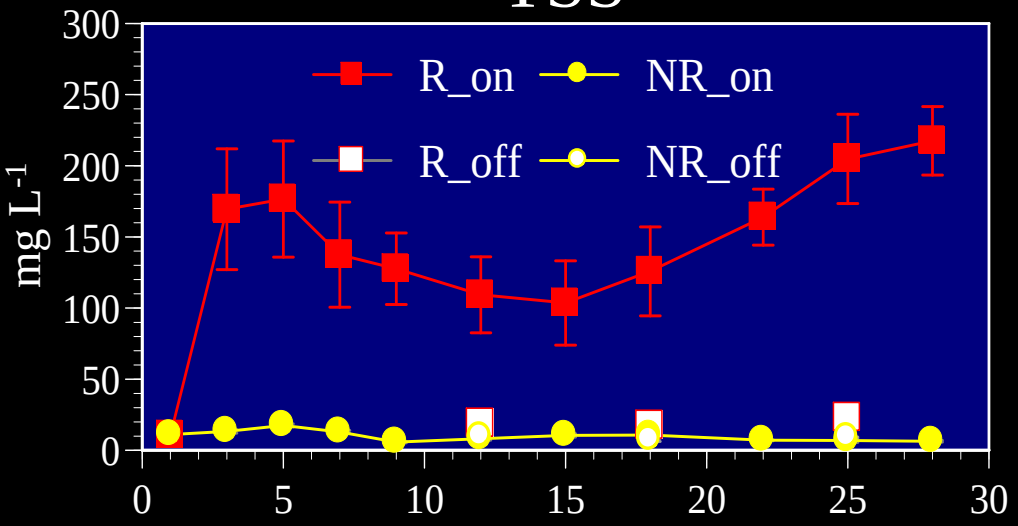
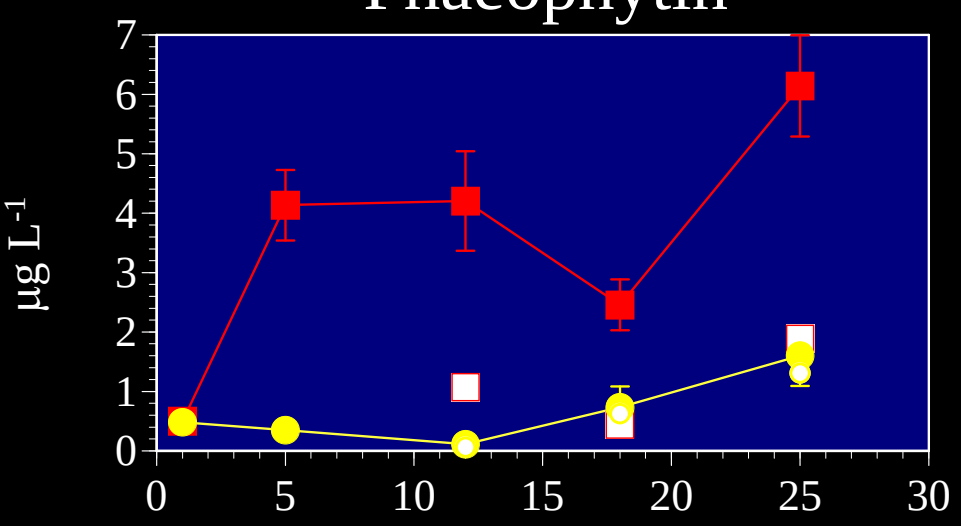
1. Effect on seston quantity, chl *a*, matter quality

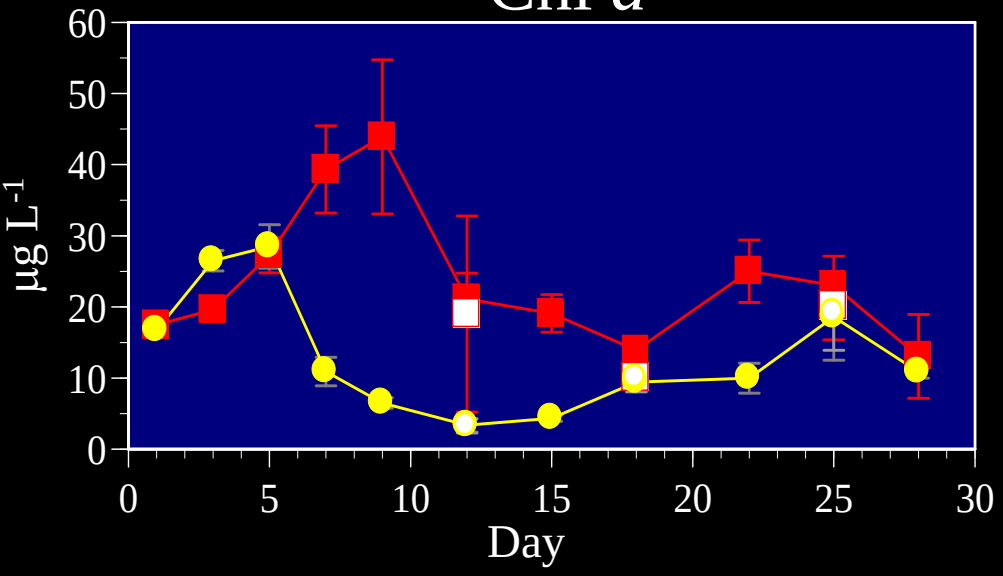
TSS



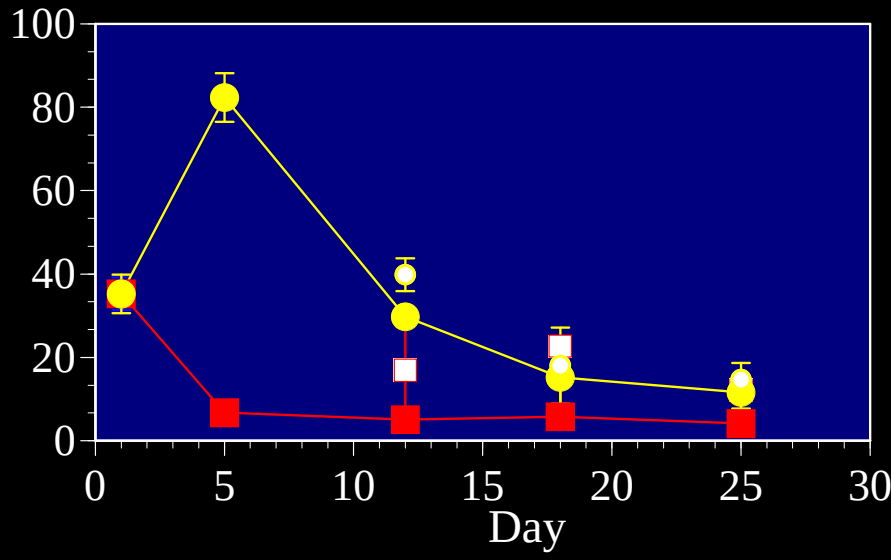
Phaeophytin



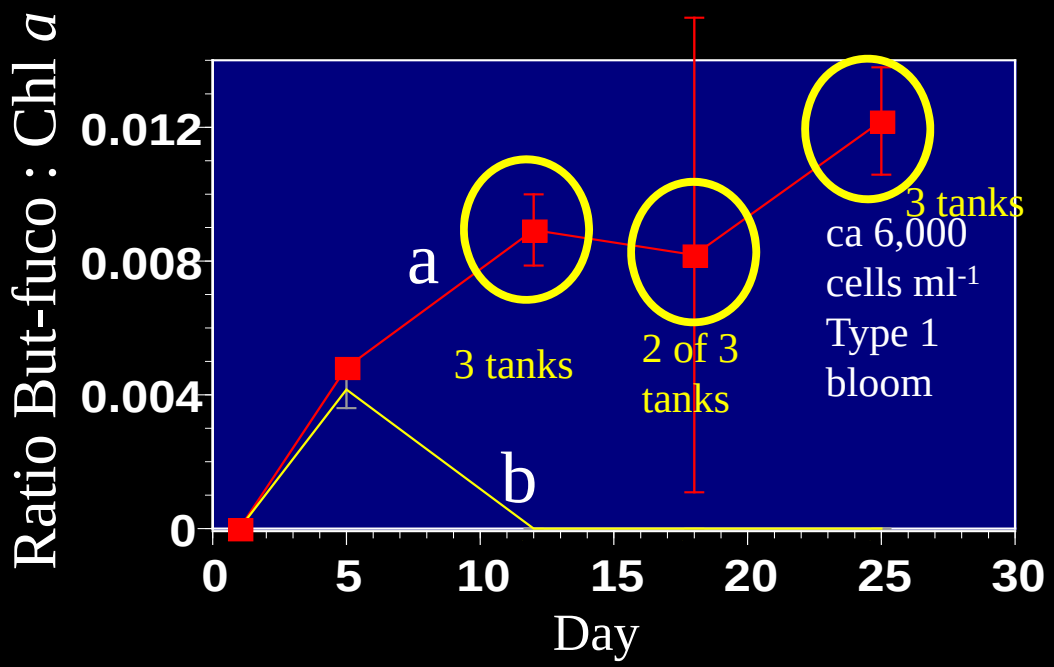
Chl *a*



Ratio Chl *a* : Phaeophytin



2. Effect of resuspension on the ecosystem: pigments, zooplankton



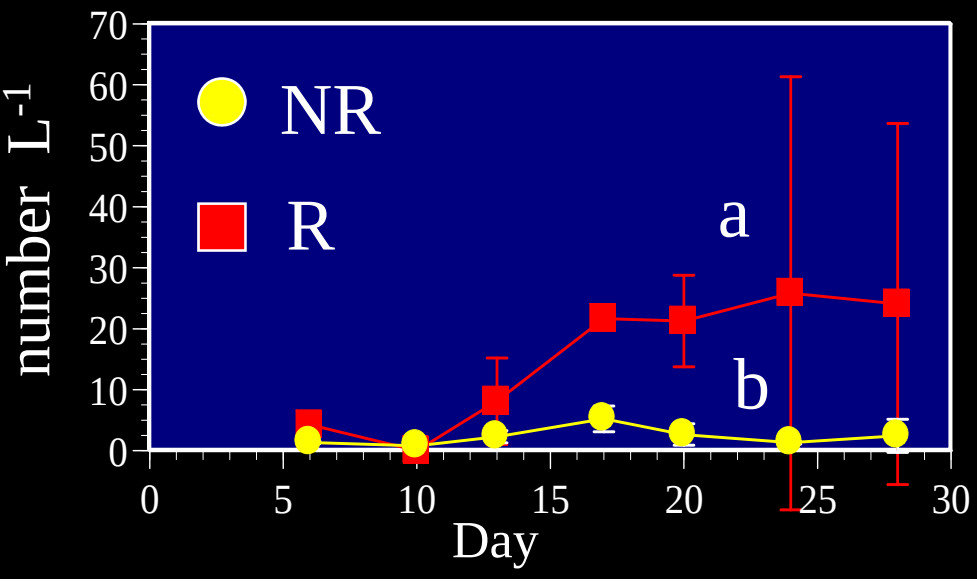
Brown tide,

Aureococcus anophagefferens

19'-butanoyloxyfucoxanthin (but-fuco) = marker pigment for brown tide organisms *Aureococcus anophagefferens* (Trice et al. 2004).

Aureococcus anophagefferens

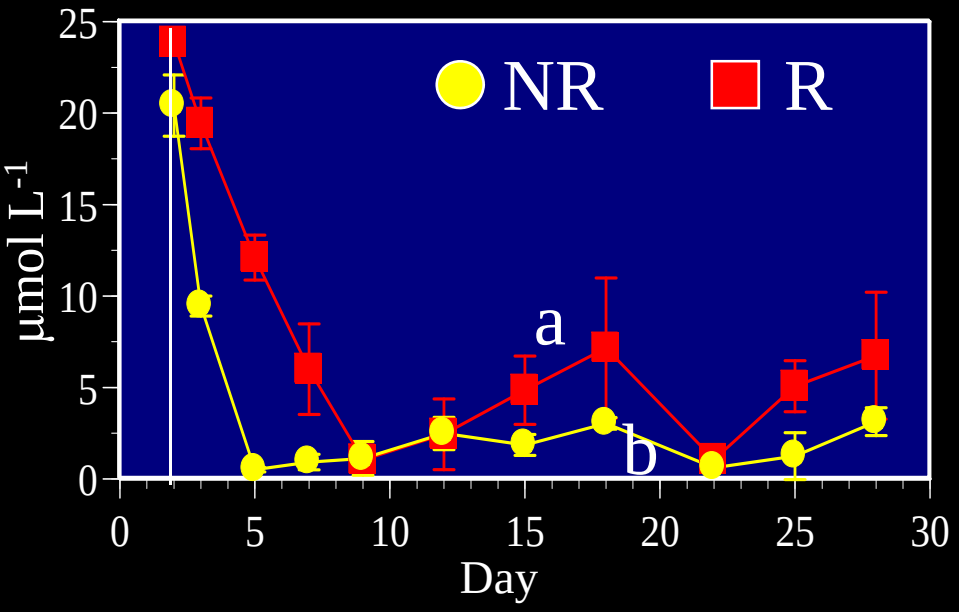
→ if Gyroxanthin diester is absent and if 19' Hexanoylofucoxanthin is absent.



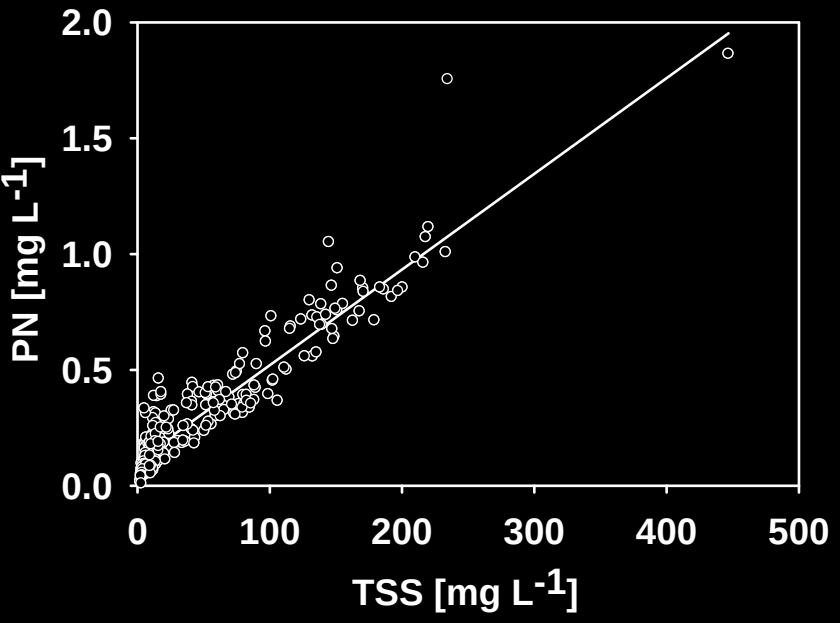
Polychaete larvae

3. Effect of resuspension on particulate & dissolved nutrients. N desorption from particles!

DIN

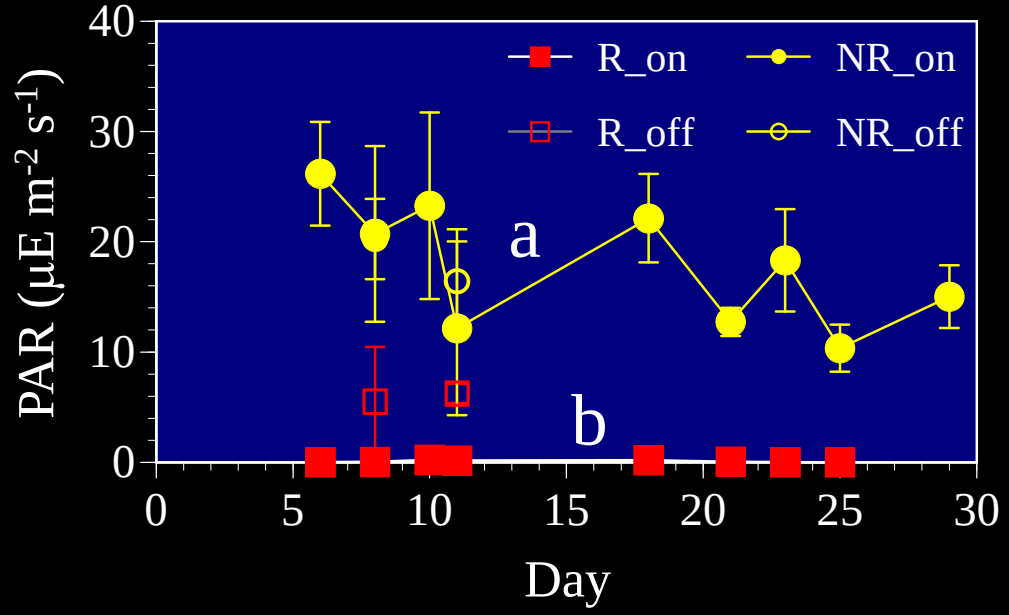


Particulate nutrients

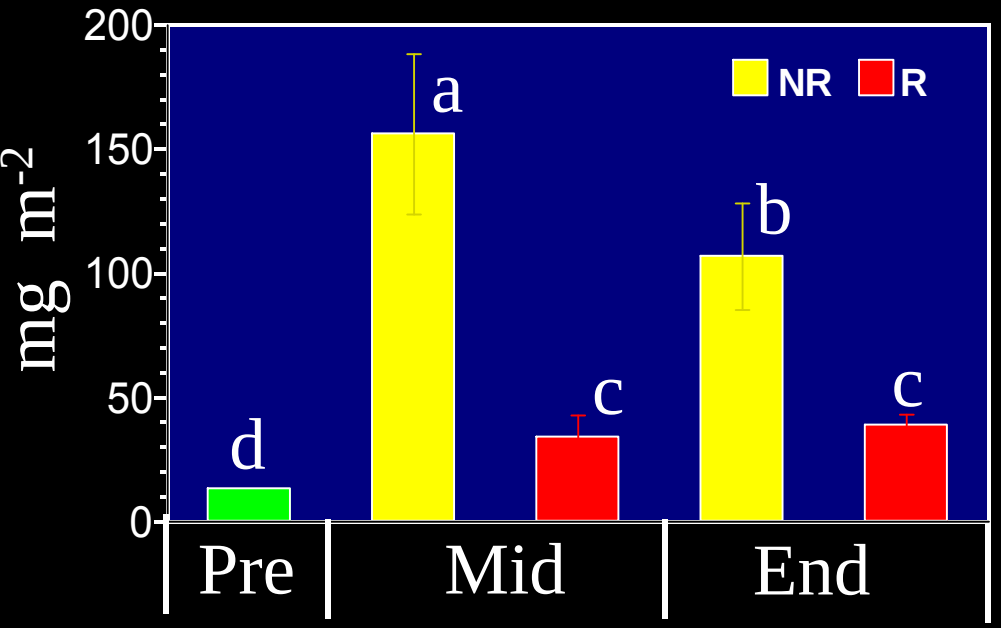


	NR (µmol L^{-1})	R (µmol L^{-1})	*p*-value
DIN	1.8 ± 0.2	**4.3 ± 1.4**	0.0260
DON	**19.6 ± 0.5**	15.5 ± 1.2	0.0126
PO_4^{3-}	0.093 ± 0.008	**0.149 ± 0.030**	0.0227

4. Effect of resuspension on light and microphytobenthos biomass

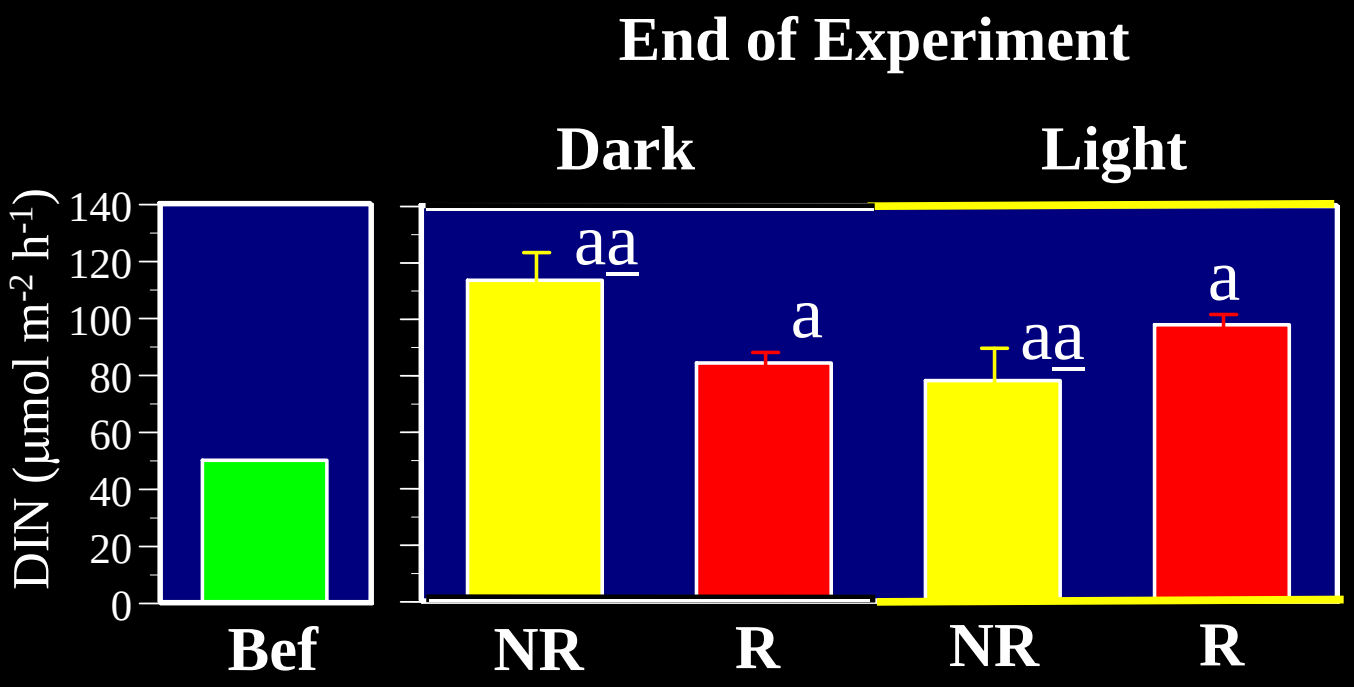


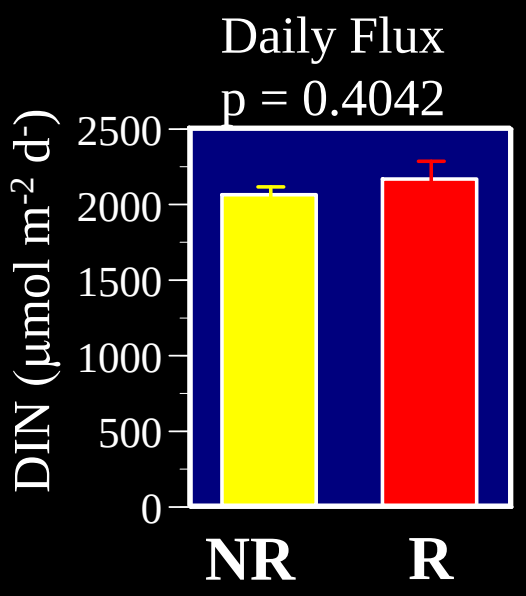
Light at the sediment



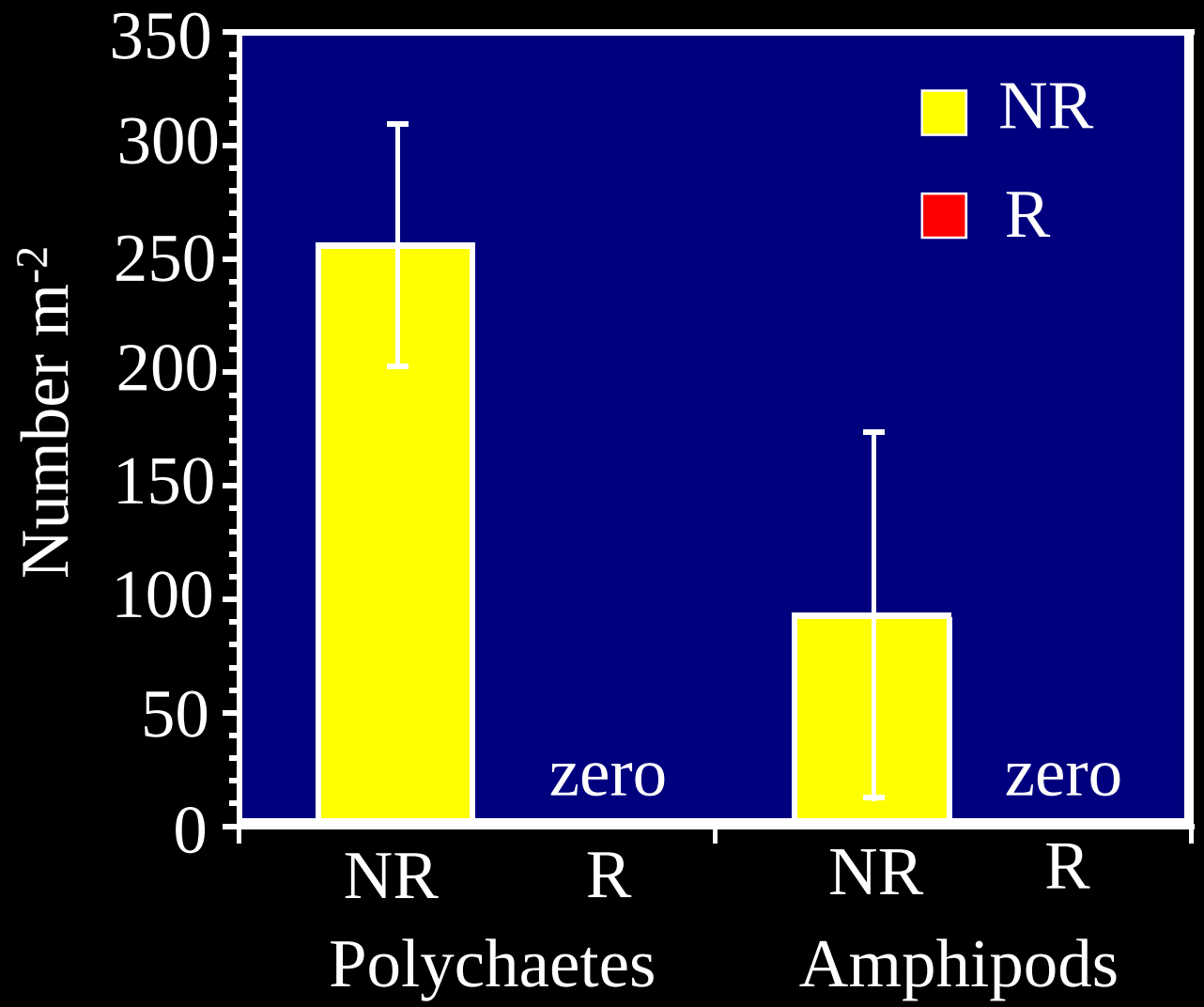
Sediment Chl *a*

5. Effect of resuspension on fluxes





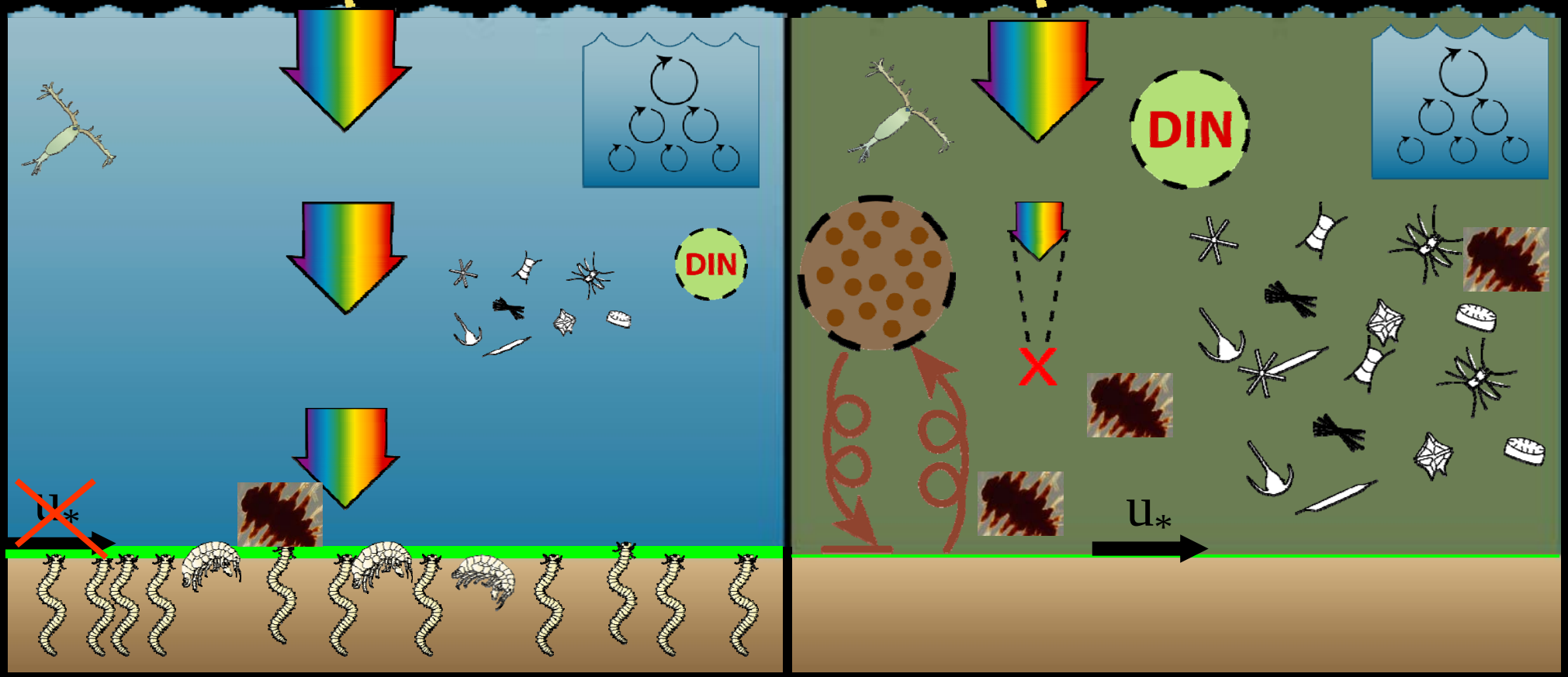
6. Effect of resuspension on macrofauna



Synthesis NR vs R

NR

R



High bottom flow/shear/tidal resuspension affected the ecosystem profoundly, often through indirect processes.

Conclusions

High bottom shear (i.e., tidal resuspension):

1. Enhanced seston quantity, enhanced phytoplankton biomass (higher in R!), decreased matter quality.
2. Affected the ecosystem: brown tide, zooplankton dynamics; polychaetes.
3. Enhanced particulate and dissolved nutrients: desorption of N from particles.
4. Decreased light, lower microphytobenthos biomass.
5. Sediment fluxes not significantly different.
6. Macrofauna in NR but not in R (too unstable, no food)

Overall: High bottom shear/tidal resuspension affected the ecosystem profoundly, often through indirect processes.

Other 4-Wk STURM Resuspension Expts

- Effects of Shear Stress and Hard Clams on Seston, Microphytobenthos, and Nitrogen Dynamics in Mesocosms With Tidal Resuspension.

  2013 MEPS 479: 25-45

- Effect of Oyster Biodeposit Resuspension On Nutrient Dynamics and Ecosystem Processes.