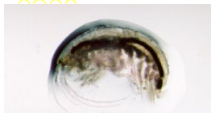
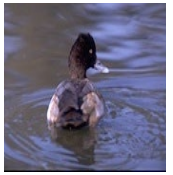
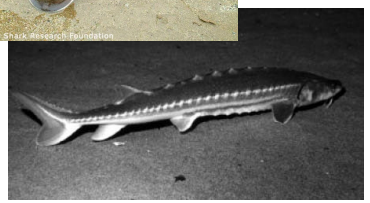
Benthic fauna relevant To the questions

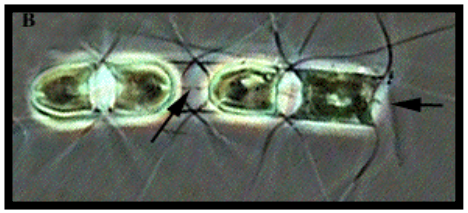


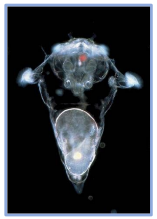
As prey



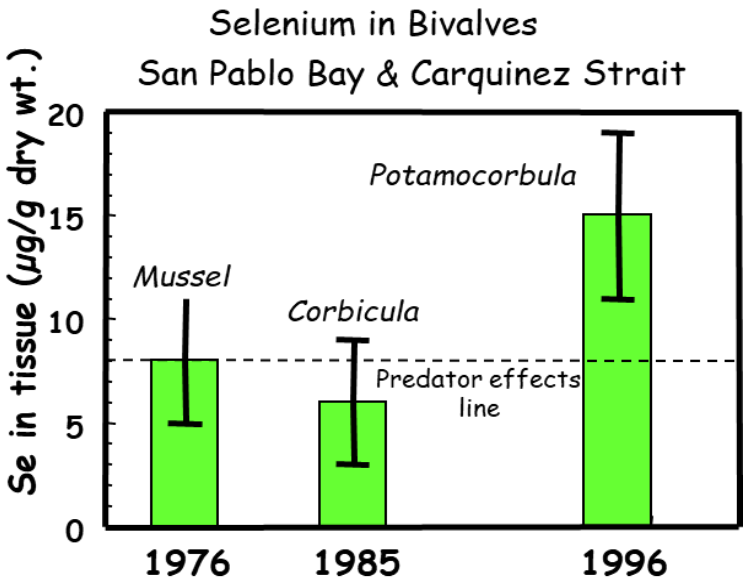


As grazer/predator





As contaminant vector



State of Science: Do we have the data to model the bivalve impact on food web for all scenarios?

- Can we estimate spatial and temporal bivalve grazing at the scale of numerical models?

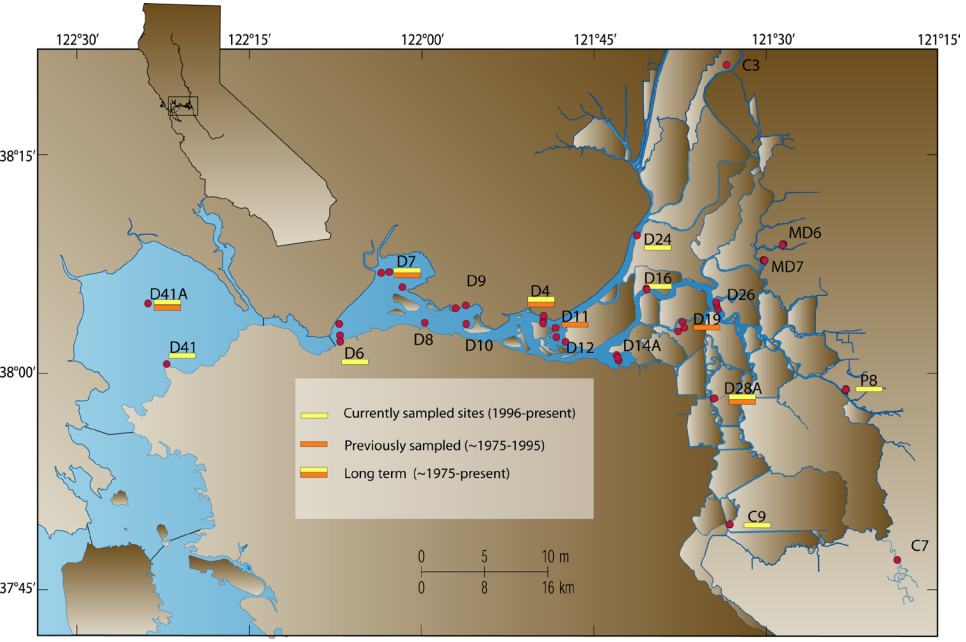
Recommendation that may help with discussions when we can't use a full numeric model.

- Can we estimate where grazing dominates phytoplankton growth in "simpler models"

EMP DWR Benthic Sampling

Temporal Studies - Monitoring

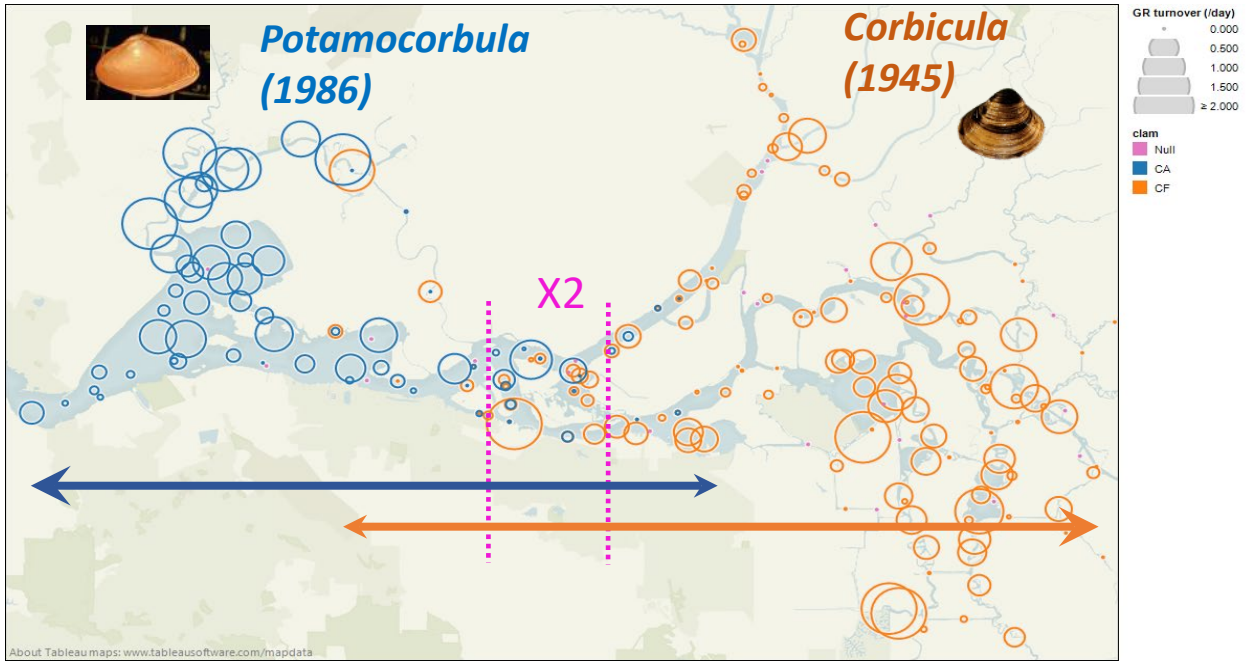
1975-current



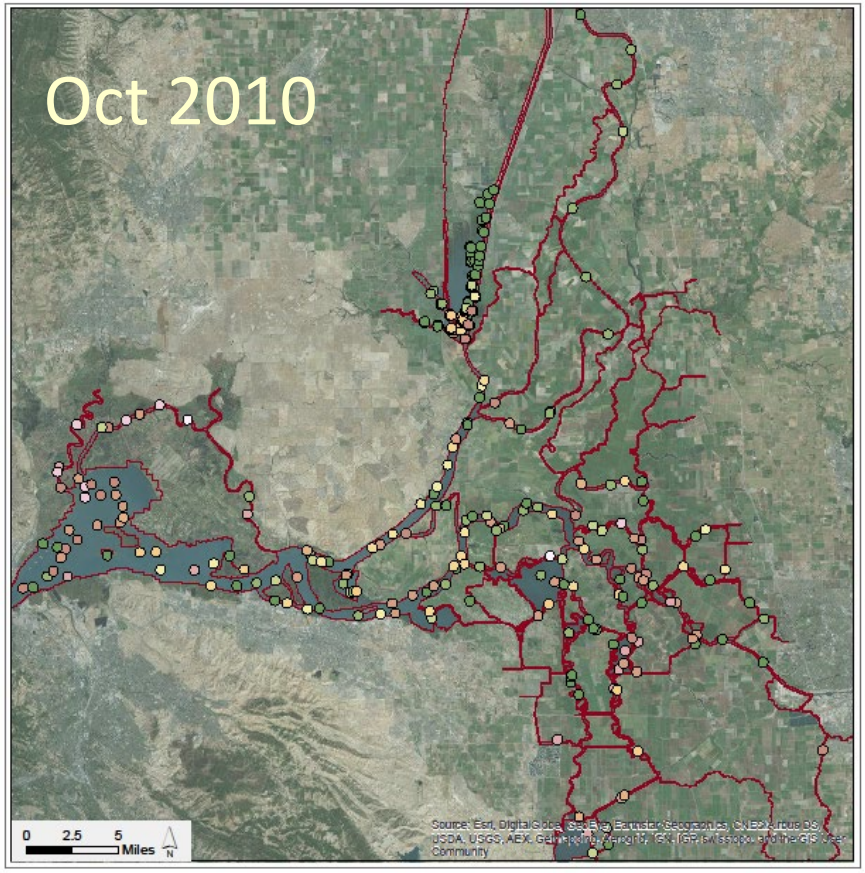
Loss Rate to Clams (/day)

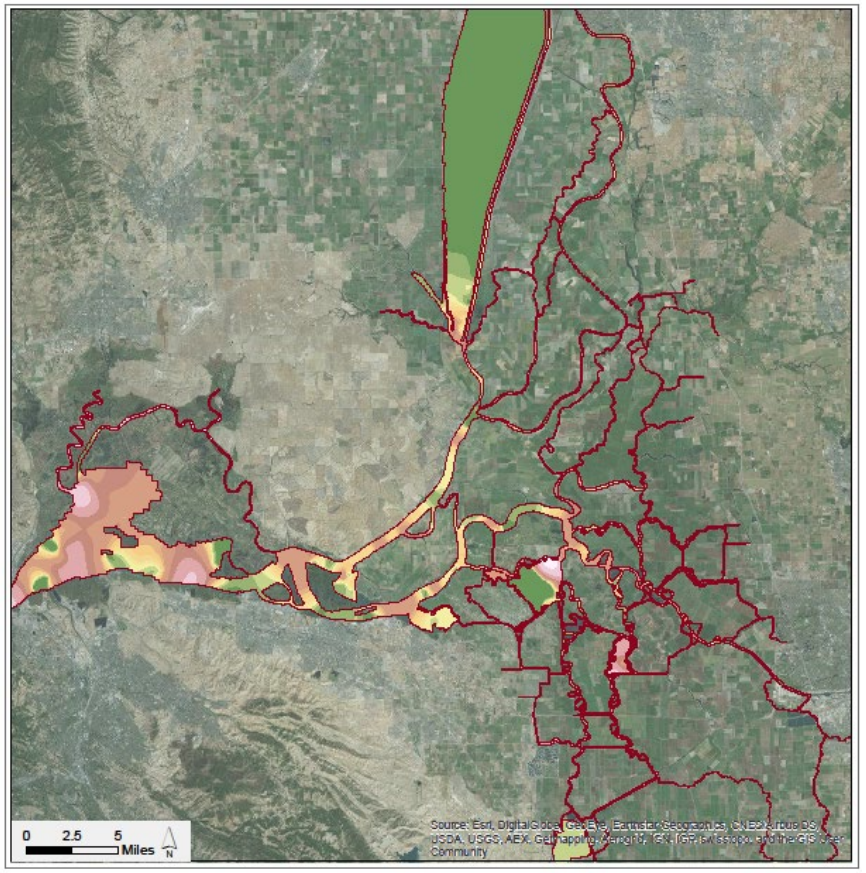
Spatial Studies - GRTS

2007-2018



Bivalve grazing rate from the spatially intensive sampling has been used in a numerical model, but it may not be feasible to do so in the future.



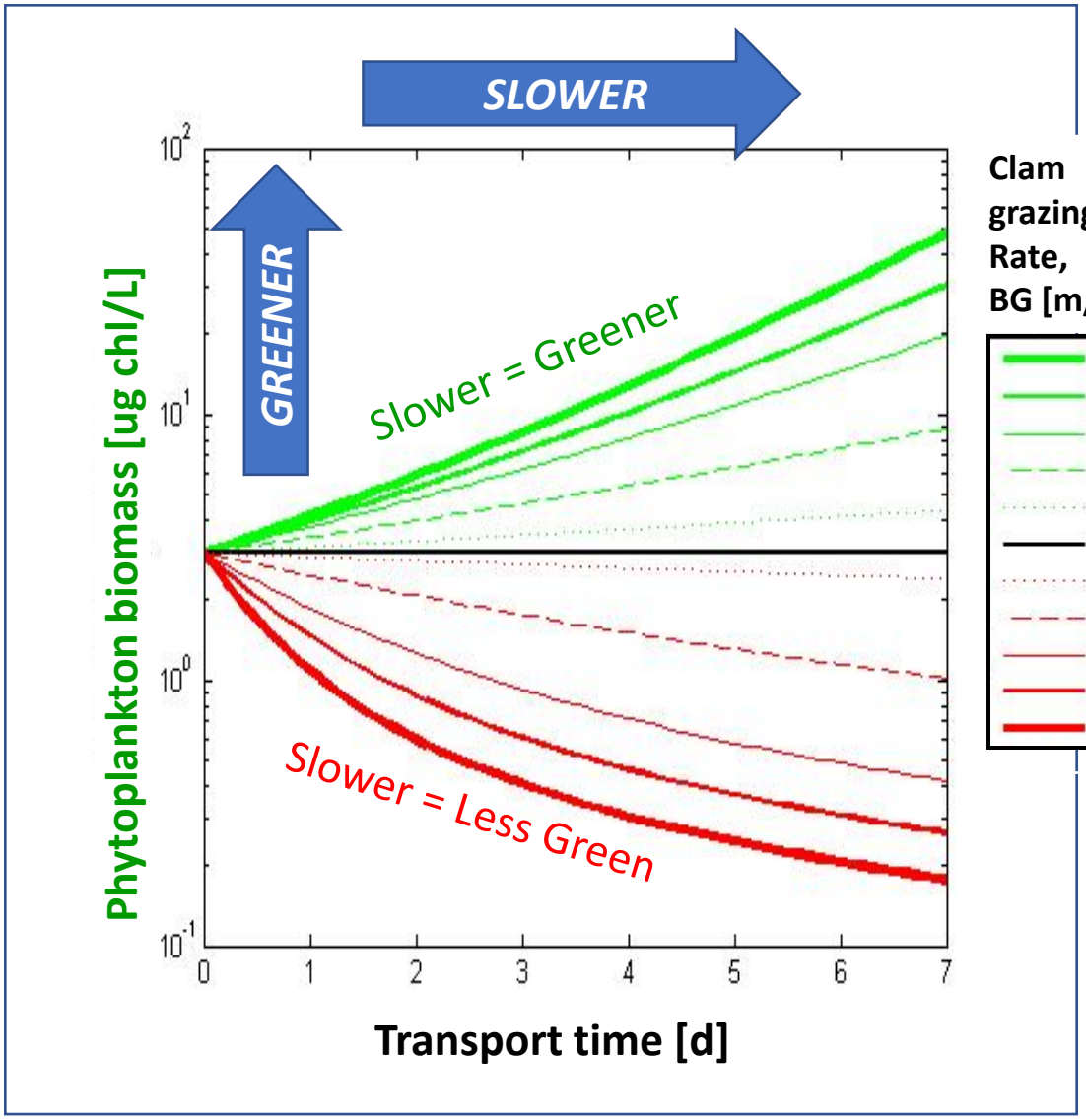


Benthic grazing rate point data

- 0
- 0.1
- 0.2
- 0.3
- 0.4
- 0.5 - 0.6
- 0.7 - 0.8
- 0.9 - 1
- 1.1 - 2
- 2.1 - 3
- 3.1 - 5
- 5.1 - 10
- 10.1 - 31.3

Benthic grazing rate interpolation

- -2.42 - 0
- 0.01 - 0.1
- 0.11 - 0.2
- 0.21 - 0.3
- 0.31 - 0.4
- 0.41 - 0.6
- 0.61 - 0.8
- 0.81 - 1
- 1.01 - 2
- 2.01 - 3
- 3.01 - 5
- 5.01 - 10
- 10.01 - 31.55



I suggest a simpler model to help conceptual understanding and planning for studies

Assuming steady state plug flow (3m)

$$\mu_{eff} = \overline{\mu_{net}} - BG/H - ZP$$

$$B(x) = B_{in} \exp(\mu_{eff}/u)x$$

…integrate over length

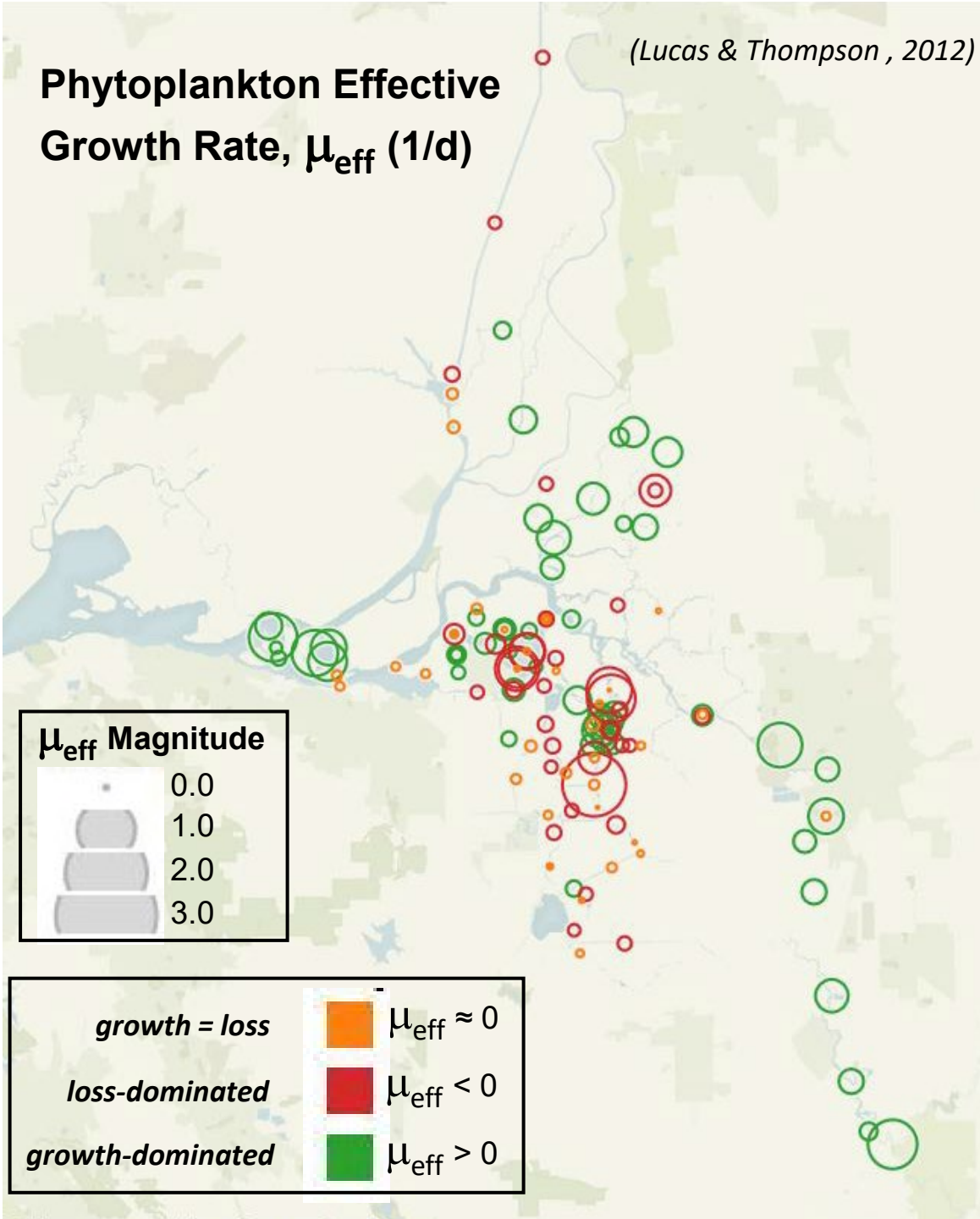
(Lucas & Thompson , 2012)

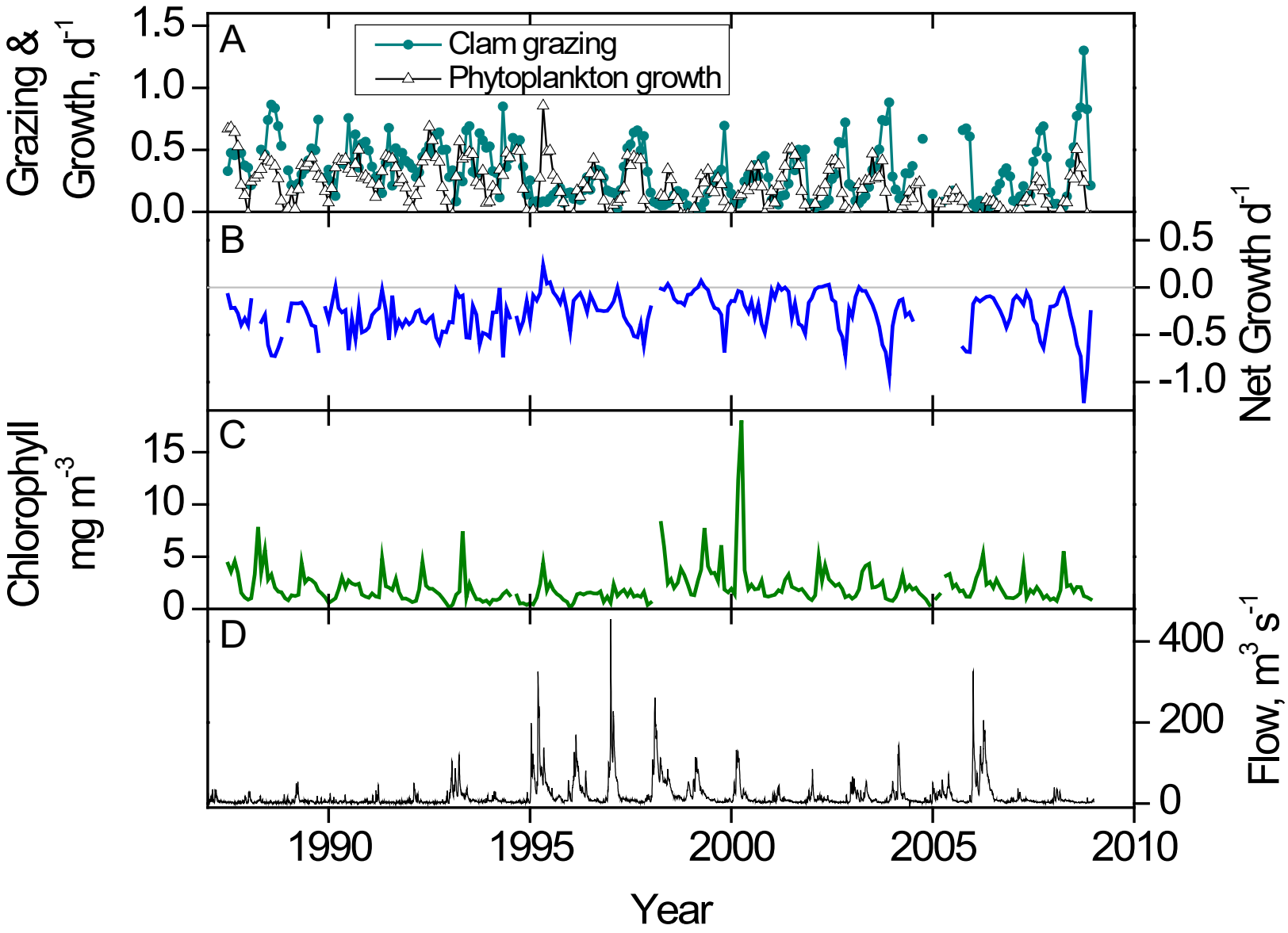
A snap shot of phytoplankton effective growth rate and consumption:

---assumes intrinsic phytoplankton growth rate (μ) is purely light-limited (no nutrient effects)

---based on measurements of benthic biomass, turbidity & irradiance, depth, ZP (=1/d) Spring-Summer 2001-2003

---important : chlorophyll *a* data collected at all locations and all data is synoptic





(Kimmerer & Thompson , 2014; fig 7)

My assumptions of what is needed today

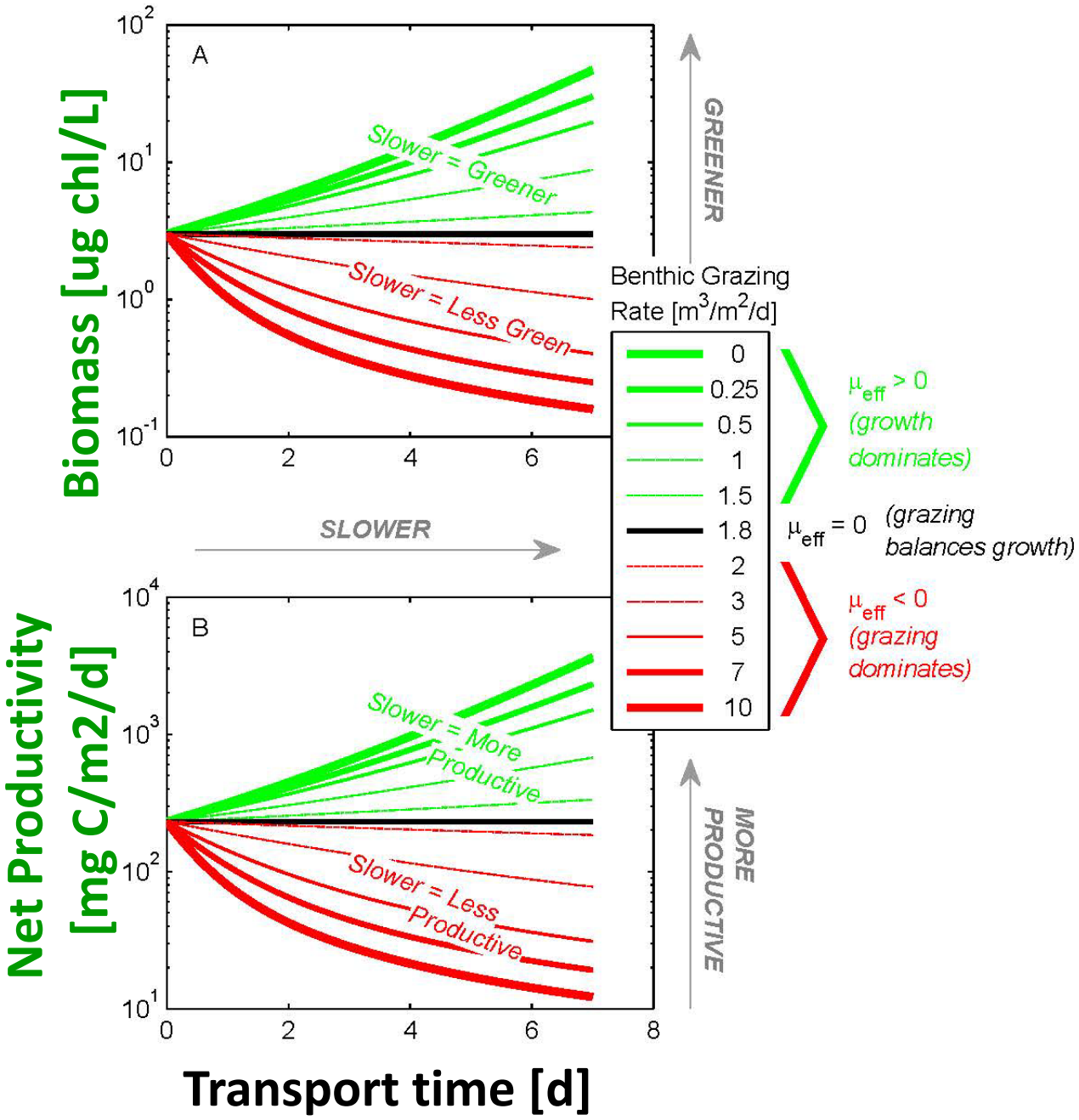
- How can we estimate bivalve grazing in numerical models
- Can we estimate where grazing dominates phytoplankton growth in “simpler models”

Most Important Stressors on Listed Species

Food, Temperature, Salinity: all a function of FLOW

Do we have the data to model the bivalve impact on food for all scenarios and if not, how do we get it.

- Can we estimate spatial and temporal bivalve grazing in numerical models?
- Can we estimate where grazing dominates phytoplankton growth in “simpler models”


A
B
Biomass [ug chl/L]
Net Productivity [mg C/m2/d]
Transport time [d]
Slower = Greener
Slower = Less Green
Slower = More Productive
Slower = Less Productive
GREENER
MORE PRODUCTIVE
SLOWER
Benthic Grazing Rate [m3/m2/d]
0
0.25
0.5
1
1.5
1.8
2
3
5
7
10
μeff > 0 (growth dominates)
μeff = 0 (grazing balances growth)
μeff < 0 (grazing dominates)

New Science to Enable Better Management

- Expand research on Yolo Bypass as a food source for fish
  - Can it supply the right order of magnitude of food for all flow conditions?
    - Requires more field studies.
  - How will it work if flow isn't sufficient to top Fremont Weir? Can Cache Complex supply sufficient fish to make it cost effective?
    - Requires more field studies with flow from sources other than Fremont weir.
  - Do we know enough about the hydrodynamics to understand if there is a threshold of flow to support enough production of food to make cost effective?
    - Require more field studies and model studies on hydrodynamics

Upper Watershed

Mostly outside of my expertise---

Increased understanding of how wildfire effects the tributaries and the delta/bay.

Old and Middle River Management

- Fish are monitored at the pumps but not the lower food web
- As shown first by Jassby ( ) the pumps are the biggest grazer of phytoplankton in the southern Delta. Unless there is a total re-engineering of the system this will always be a problem.

Summer-Fall Habitat Action

- Suisun Marsh: at present Corbicula are only found in major sloughs in relatively deep water. As long as that doesn't change, freshening the marsh will not have any increase in the bivalves
- Bivalves collected during the Fran???? Study did not seem to accumulate in problematic areas. There may always be a problem with export of primary producers and carbon out of the marsh and into the bay. The Potamocorbula do migrate to food so the seasonal salinity cycle must be considered (recruits need salinity of 5 but adults can survive 0 for months so if the recruits arrive in spring and grown into adults in summer and fall there could be a grazing loss).