Presented at

Great Rivers Reference Condition Workshop

January 10-11, Cincinnati, OH

Sponsored by

The U.S. Environmental Protection Agency and The Council of State Governments

U.S. EPA Office of Research and Development

Environmental Monitoring and Assessment Program

Characterizing suspended particulate matter in rivers – utility for monitoring and assessment.

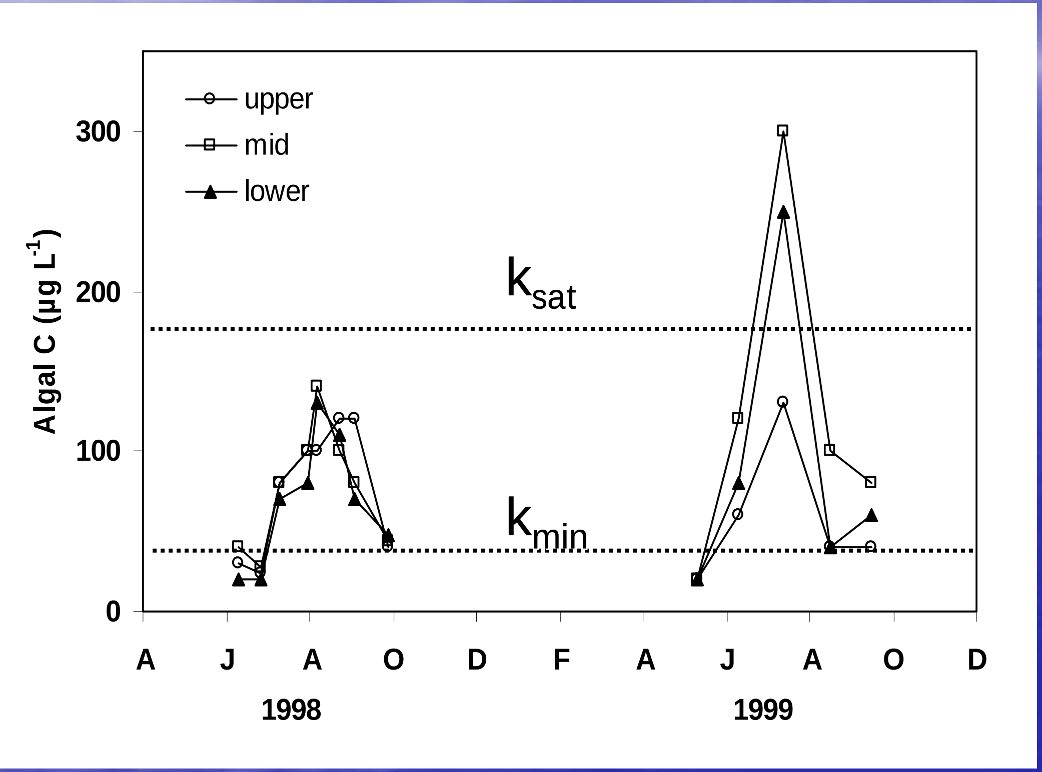
Paul A. Bukaveckas
Virginia Commonwealth University

Anthony K. Aufdenkampe
Stroud Water Research Center

Importance of particulate matter in rivers:

- Ecosystem metabolism – fuels respiration through microbial degradation of POM.
- Transparency – regulates photosynthetic production by algae and macrophytes.
- Food webs – principal food source for diverse array of benthic and pelagic consumers.

Particulate matter as a food resource:



Quantity Effects: are ambient concentrations sufficient to support individual or population growth ?

Seasonal variation in the algal fraction of POM for the McAlpine Pool (Ohio River) relative to minimum and saturating food thresholds for Bosmina (from Guelda et al. 2005, *River Research & Applications*).

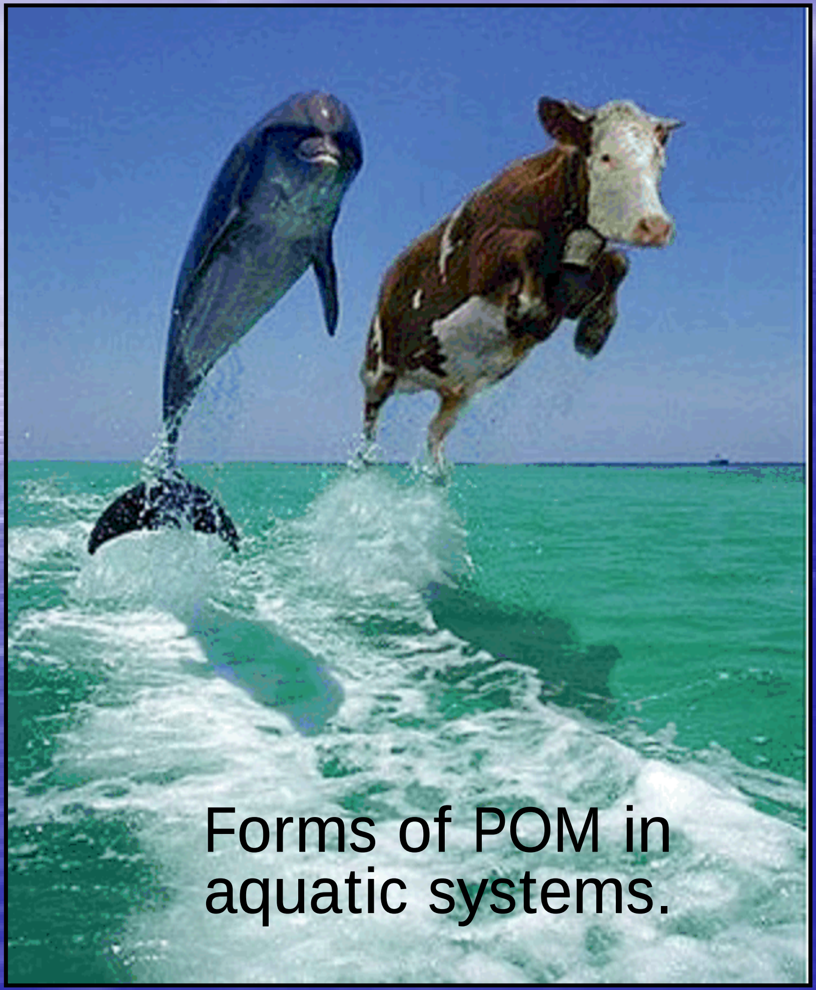
Particulate matter as a food resource:

	Low Q	High Q
POC (mg/L)	3	25
CHLa (µg/L)	20	2
Algal %	5%	0.5%
C:P	175	700
C:N	12	20
Growth (d^{-1})	0.55	0.38

Quality Effects: is POM nutritional sufficient to support individual or population growth ?

Food conditions and Bosmina growth rates in the Ohio River as a function of discharge (from Acharya et al. *Limnology & Oceanography*, in review).

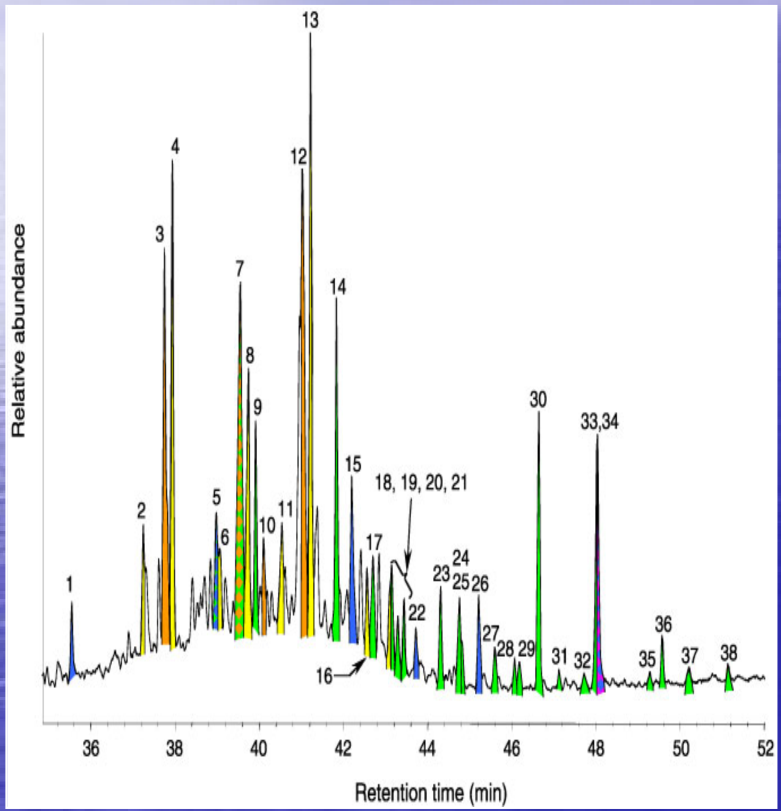
Characterizing River Particulate Matter



Total Suspended Solids
Particulate Organic C
Turbidity

Bulk properties do not reveal much about sources or composition – limited value for monitoring and assessment.

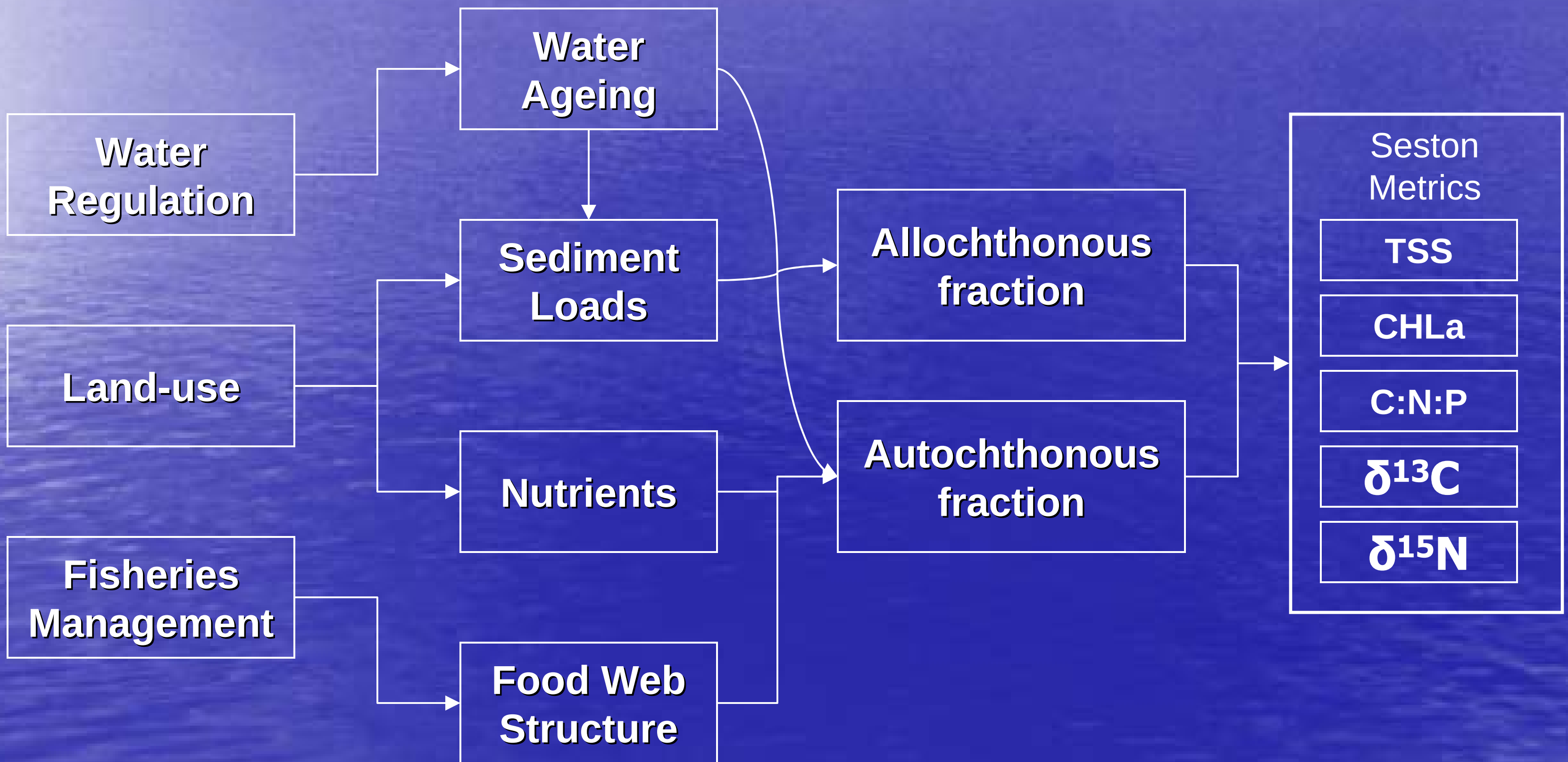
Characterizing River Particulate Matter



The molecular complexity of POM offers a wealth of information about sources and nutritive value.

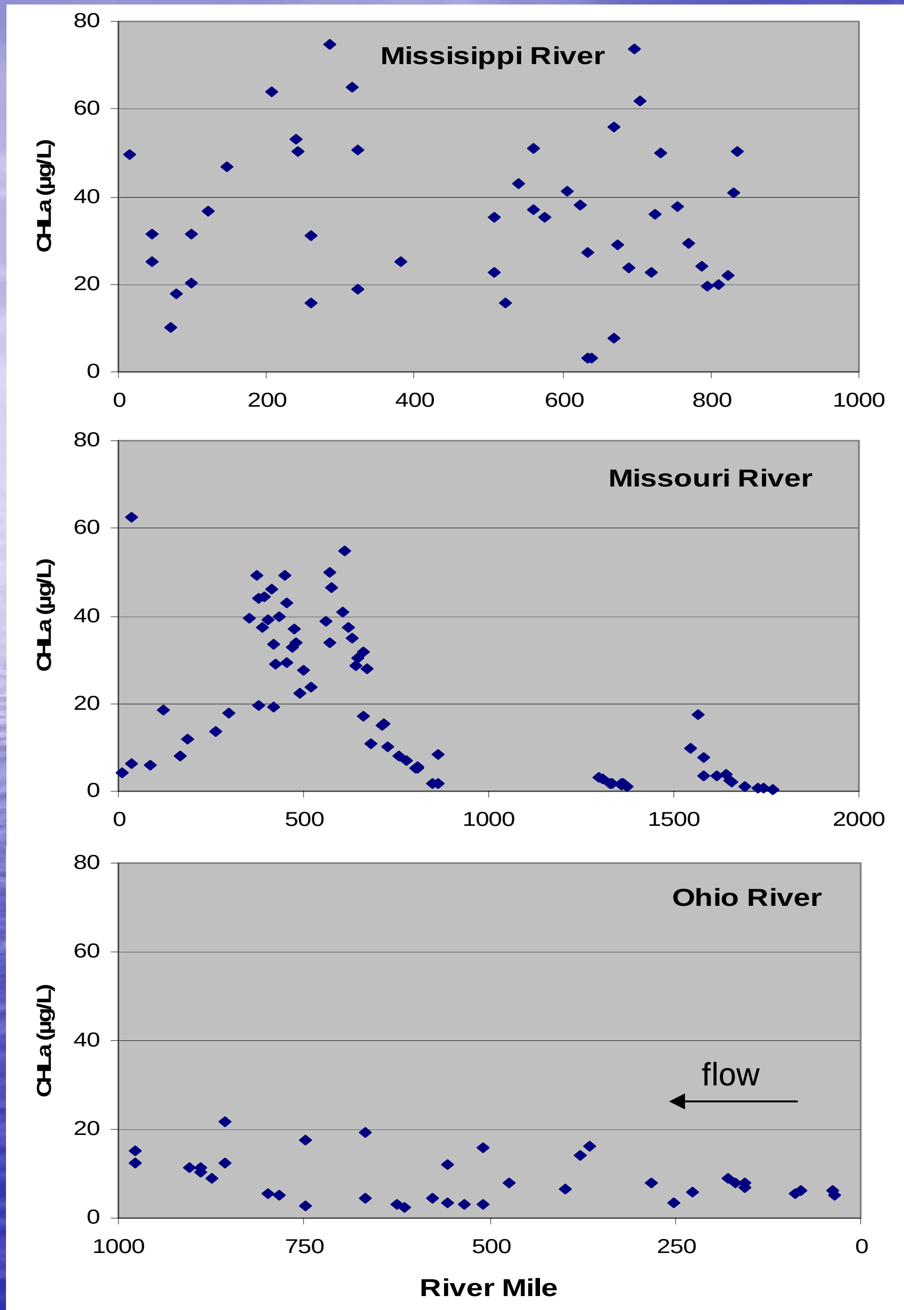
- Isotopes (^{13}C, ^{14}C, ^{15}N)
- Stoichiometry (nutrient, protein, lipid content)
- Biomarkers (fatty acids)

Key Challenge: finding metrics responsive to anthropogenic stressors.



Research Questions:

1. Can we relate inter-river and longitudinal variation in autochthonous contributions to underlying environmental processes (light, nutrients, grazers) ?
2. Can we link isotopic/biochemical markers to riverine (autochthonous) and watershed (allochthonous) processes ?
3. Which seston metrics provide the most useful information for monitoring and assessment purposes ?



Results:

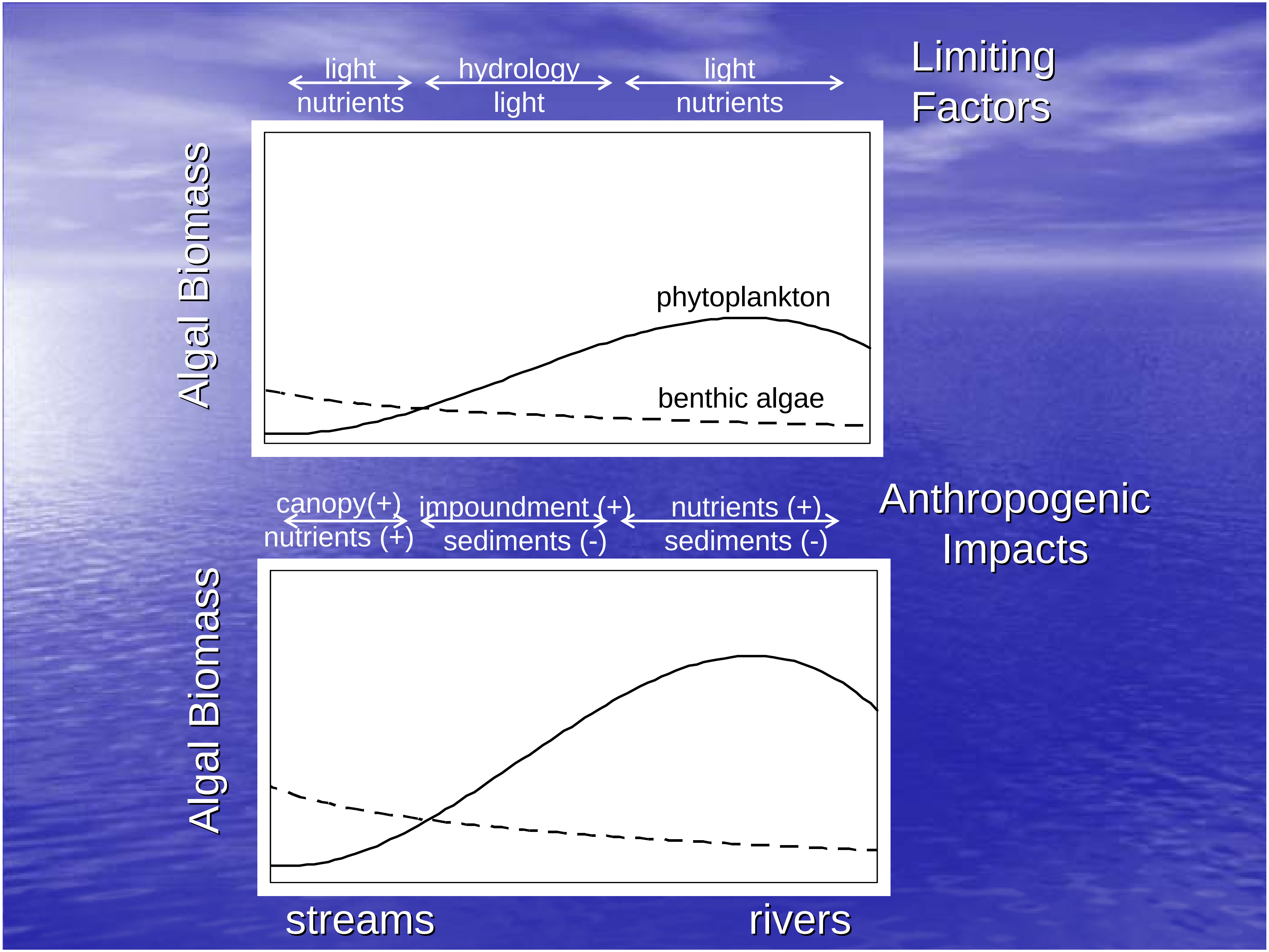
CHLa concentrations in the Mississippi, Missouri and Ohio Rivers during 2004 EMAP sampling.

Constraints on Autochthonous Production:

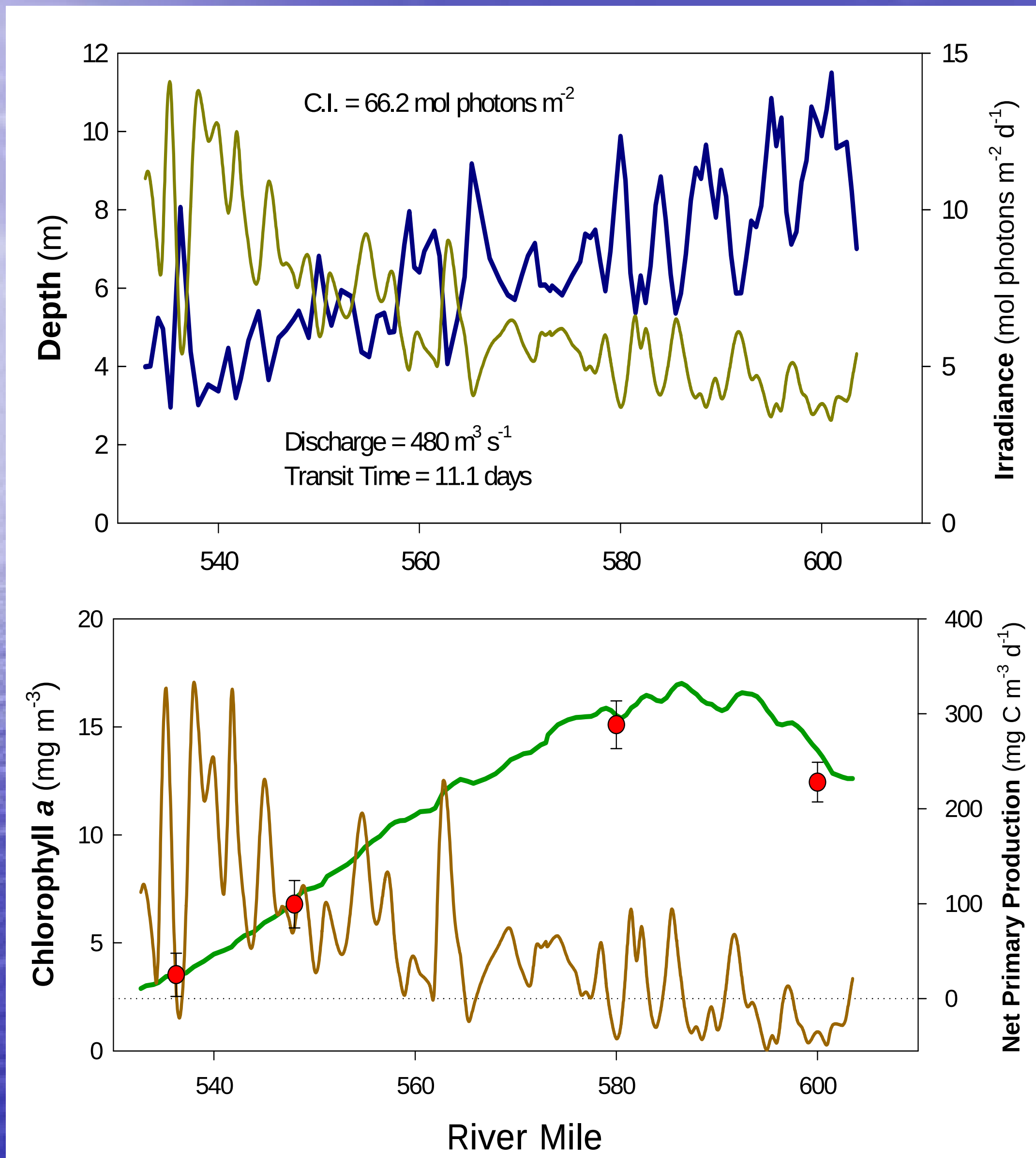
	OH	MO	MS
Depth (m)	6.1	2.7	3.9
Kd* (m^{-1})	2.07	5.39	3.40
PAR# (µmol photons/m^2)	200	490	273
Velocity (m/s)	0.62	1.16	0.68
PAR (dose/m)	396	558	1013
CHLa (µg/L)	8.7	20.1	34.9

Water clarity and channel morphometry account for inter-river differences in CHLa (2004 mean values).

*Light attenuation coefficient (Kd) inferred from measured turbidity.
#Average water column irradiance calculated from Kd and x-sec depth.



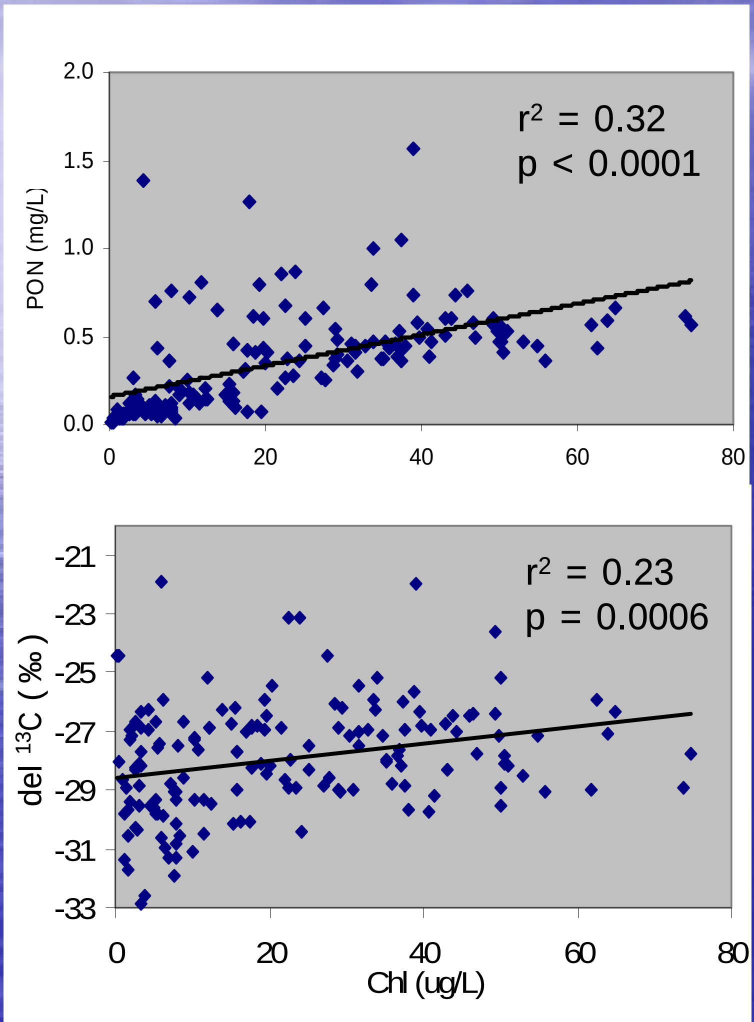
Limiting Factors
light
nutrients
hydrology
light
light
nutrients
Algal Biomass
phytoplankton
benthic algae
Anthropogenic Impacts
canopy(+)
nutrients (+)
impoundment (+)
sediments (-)
nutrients (+)
sediments (-)
Algal Biomass
streams
rivers



Can light and morphometry account for small (reach-scale) variation in CHLa ?

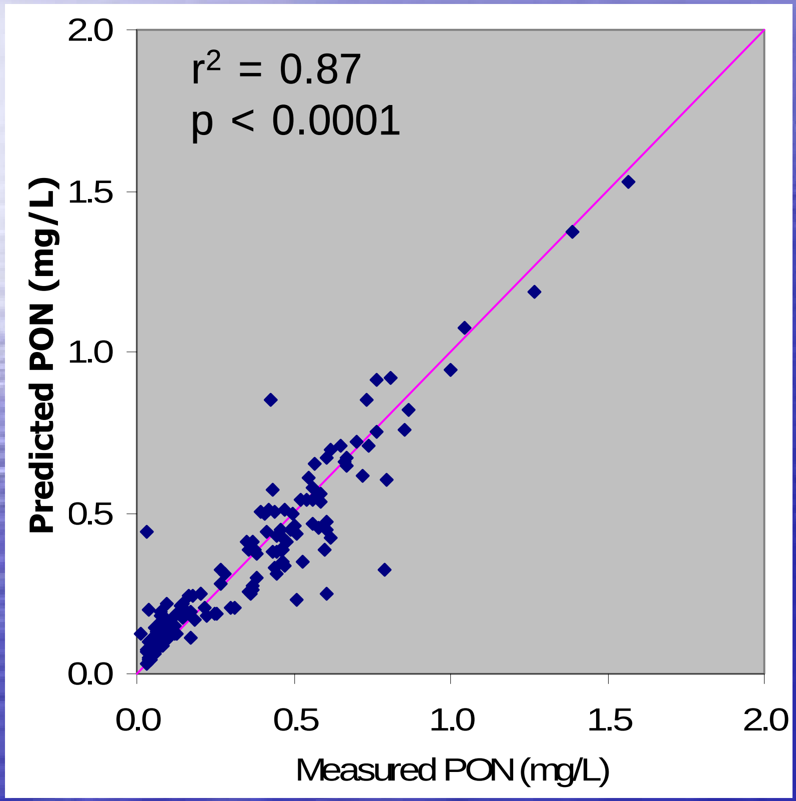
From: Sellers & Bukaveckas (2003) *Limnology & Oceanography*.

Stoichiometric and Isotopic Composition



Autotrophic production is associated with enriched N and altered C isotope composition of particulate matter (EMAP 2004 data pooled for all rivers).

Prediction of river part-N load:



Particulate Nitrogen modeled as a multivariate function of:

- Total Suspended Solids
- CHLa
- % Organic Carbon

Because TSS is largely derived from land, this suggests autotrophic production is an important source of particulate N to higher trophic levels

Metrics and Stressors