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

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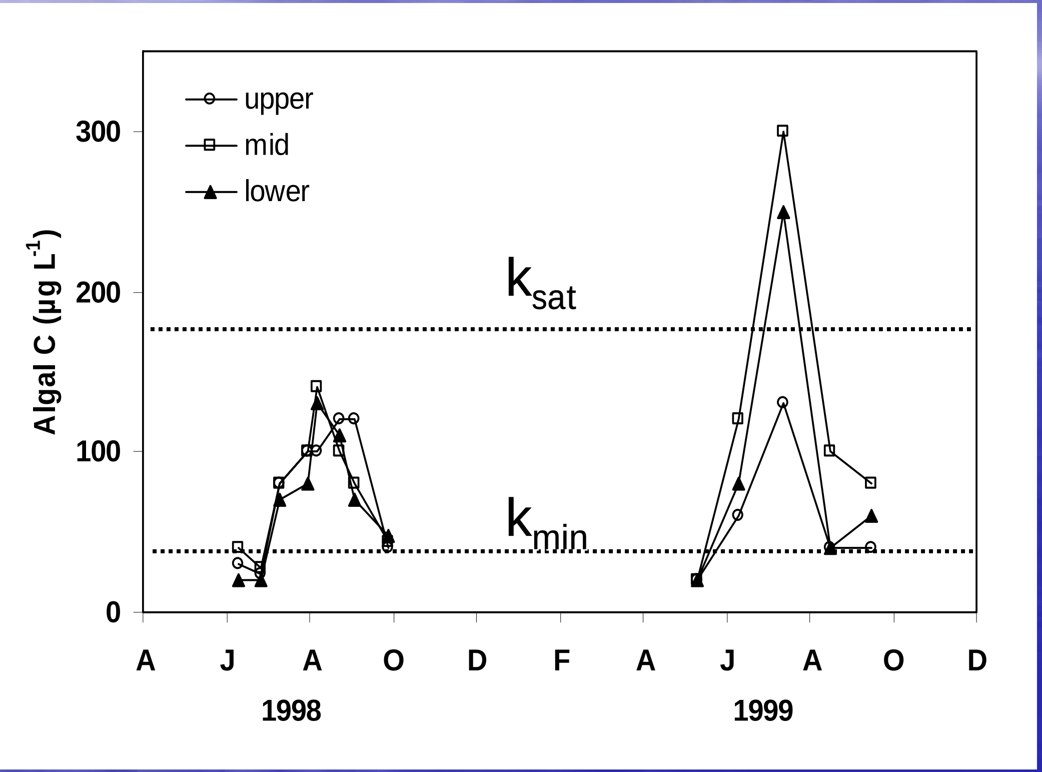
Importance of particulate matter in rivers:

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*).

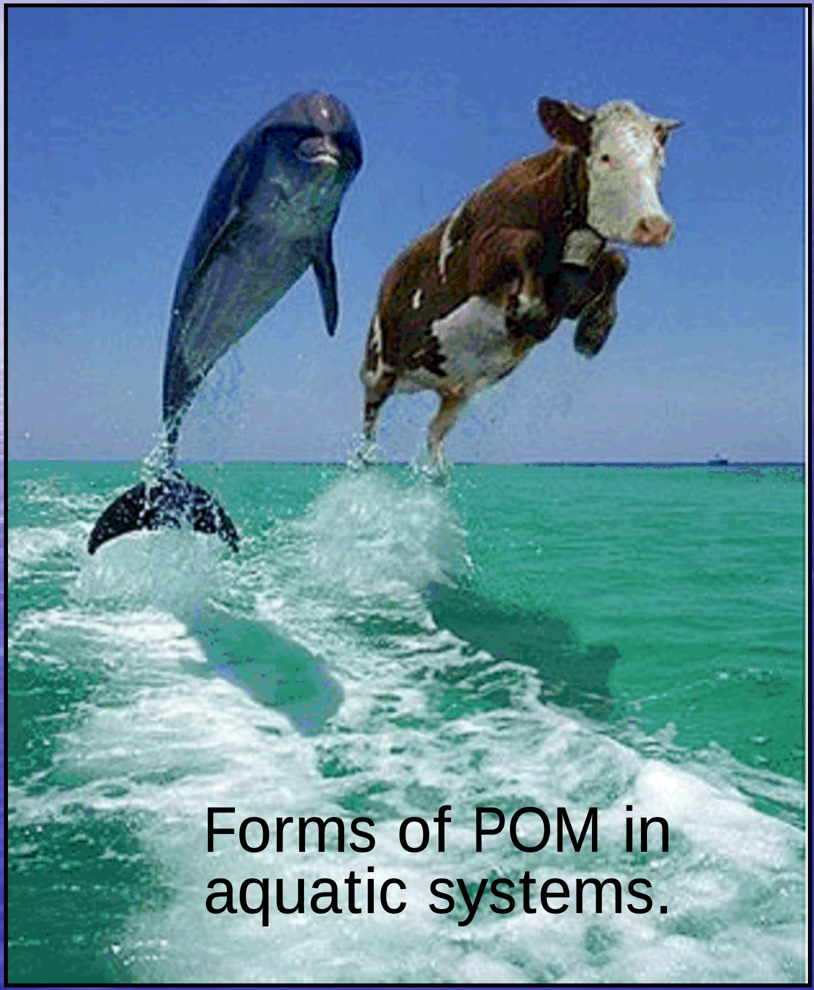
Particulate matter as a food resource:

	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).

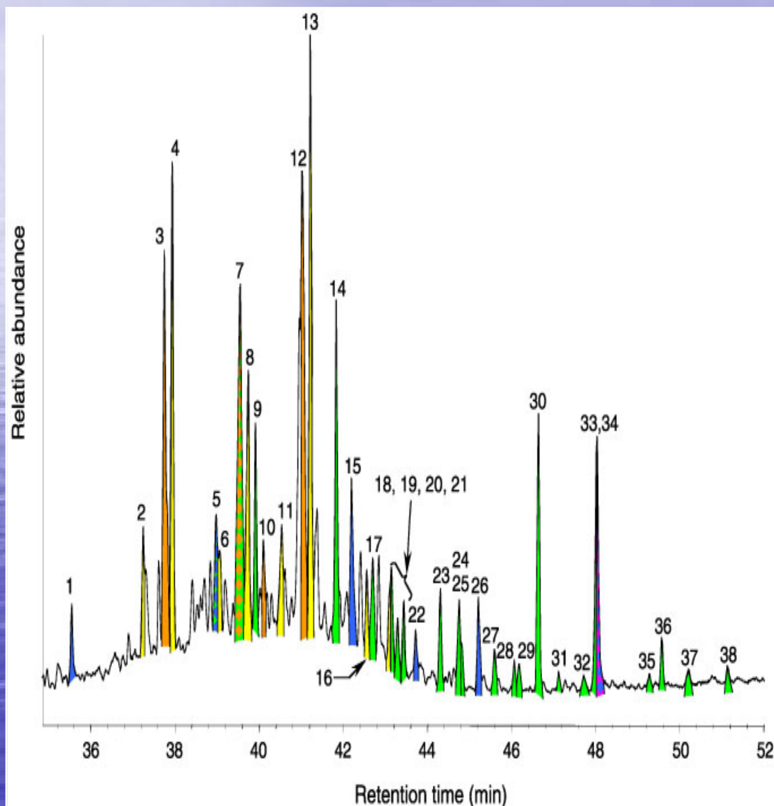
Characterizing River Particulate Matter



Total Suspended Solids
Particulate Organic C
Turbidity

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

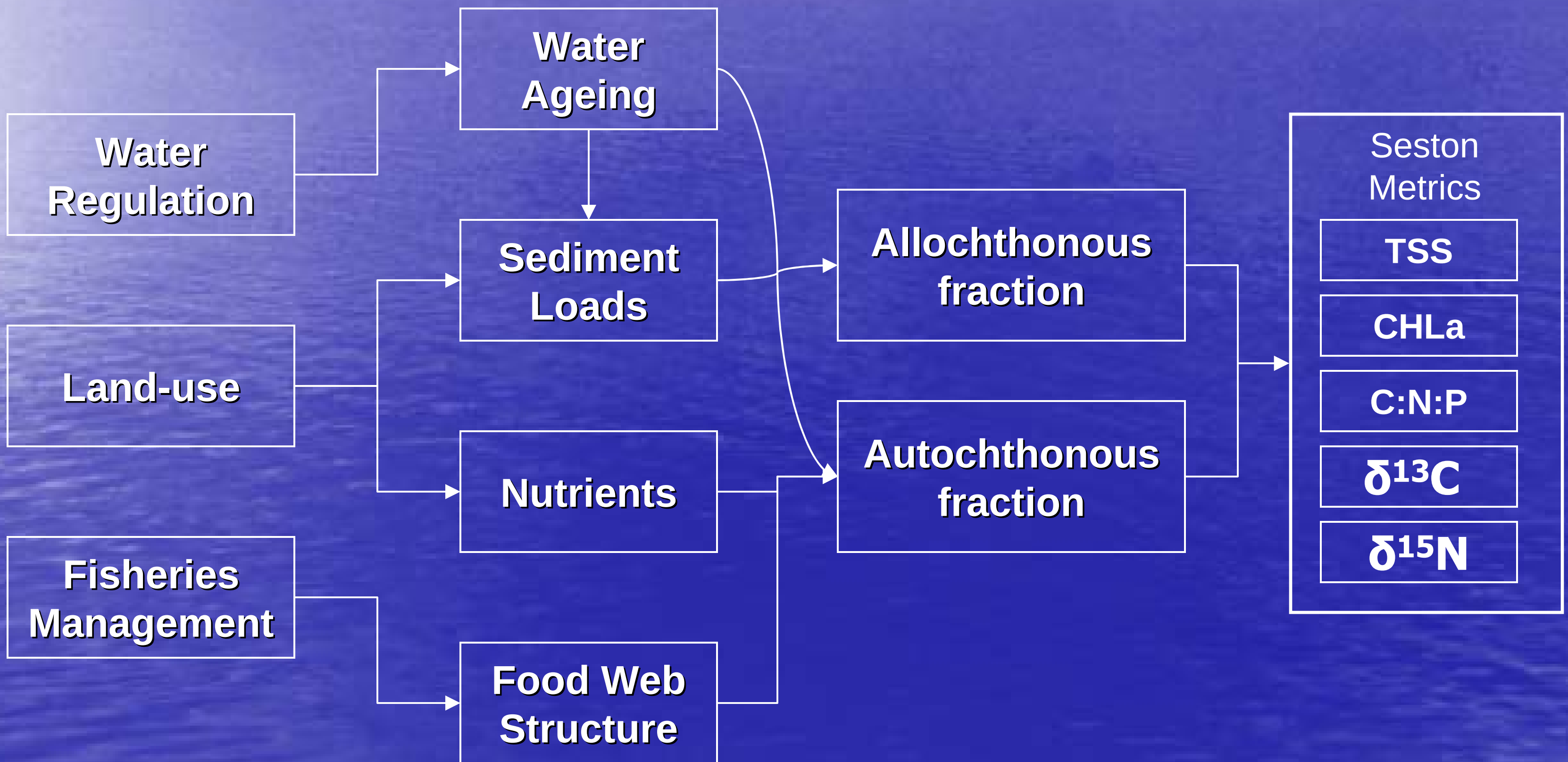
Characterizing River Particulate Matter



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

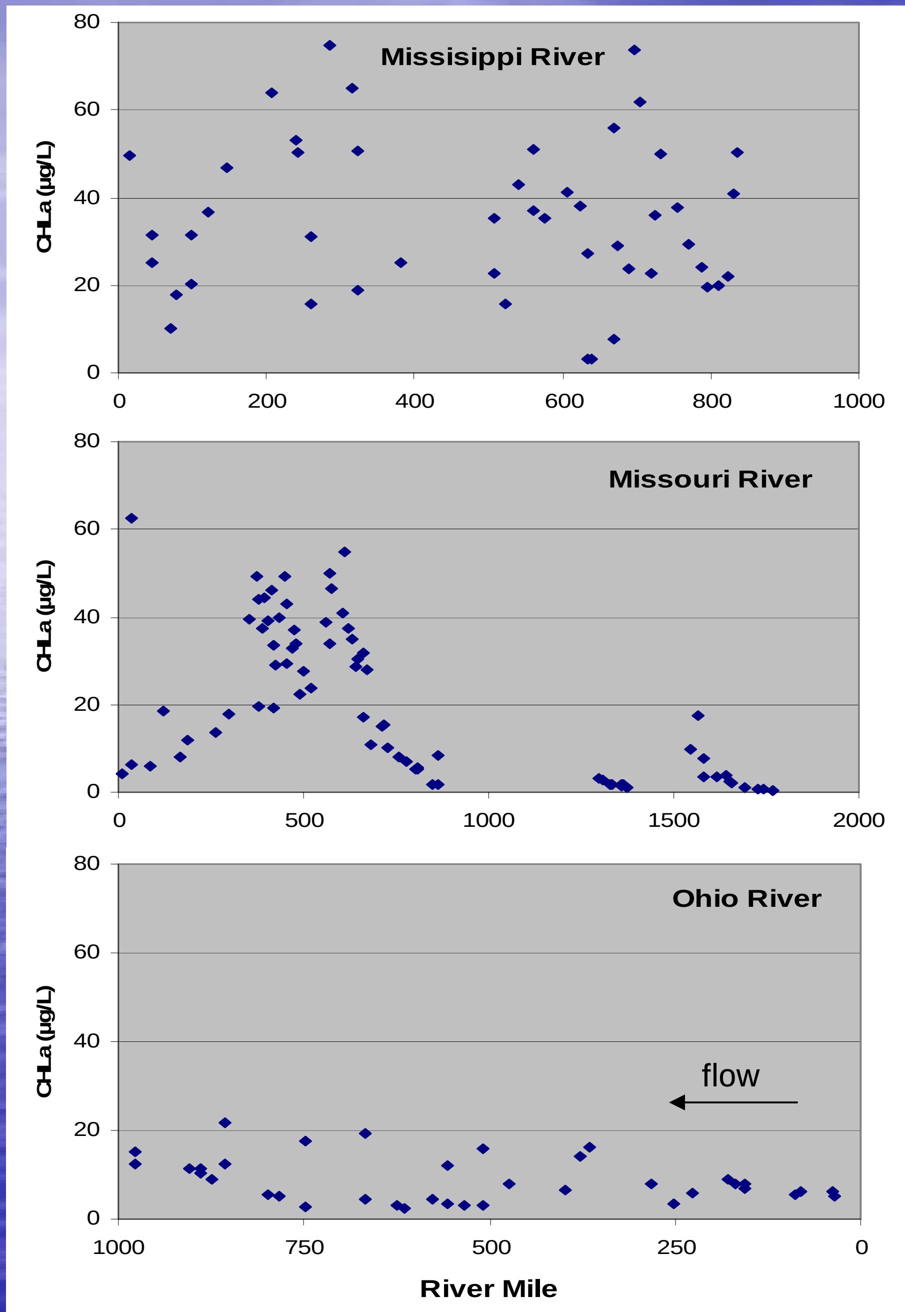
- Isotopes (^{13}C, ^{14}C, ^{15}N)
- Stoichiometry (nutrient, protein, lipid content)
- Biomarkers (fatty acids)

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:

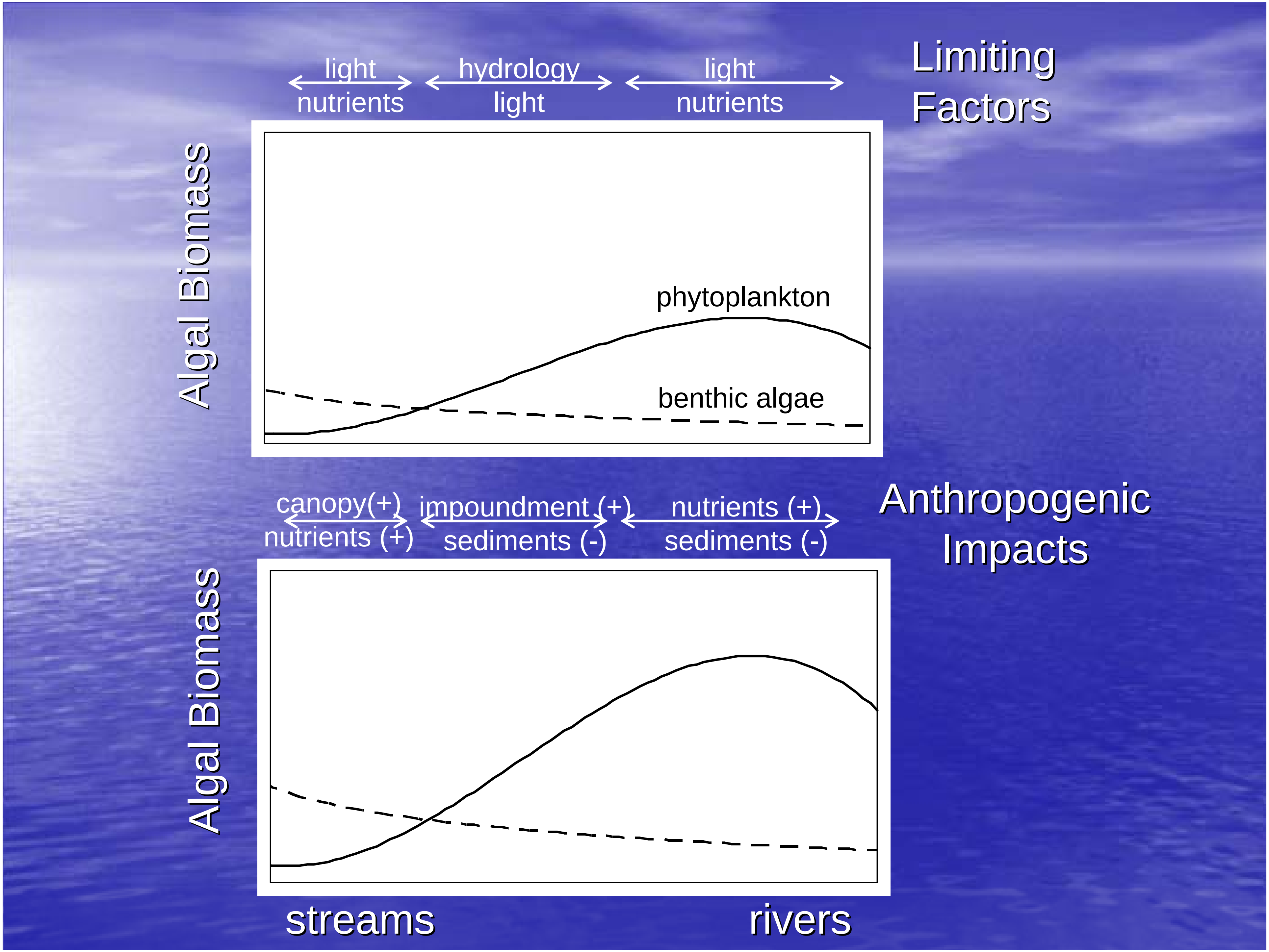
CHLa concentrations in the Mississippi, Missouri and Ohio Rivers during 2004 EMAP sampling.

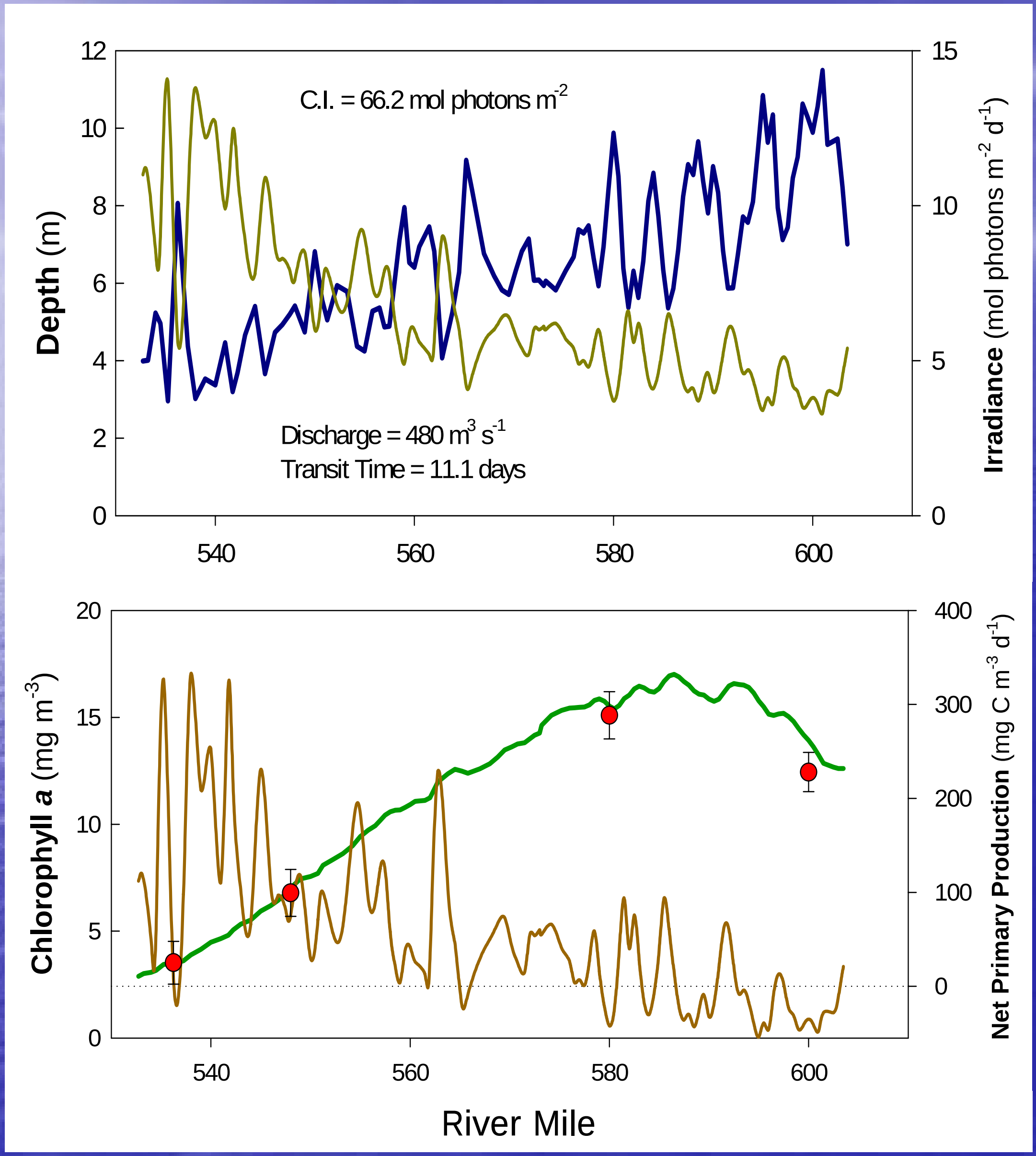
Constraints on Autochthonous Production:

	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.

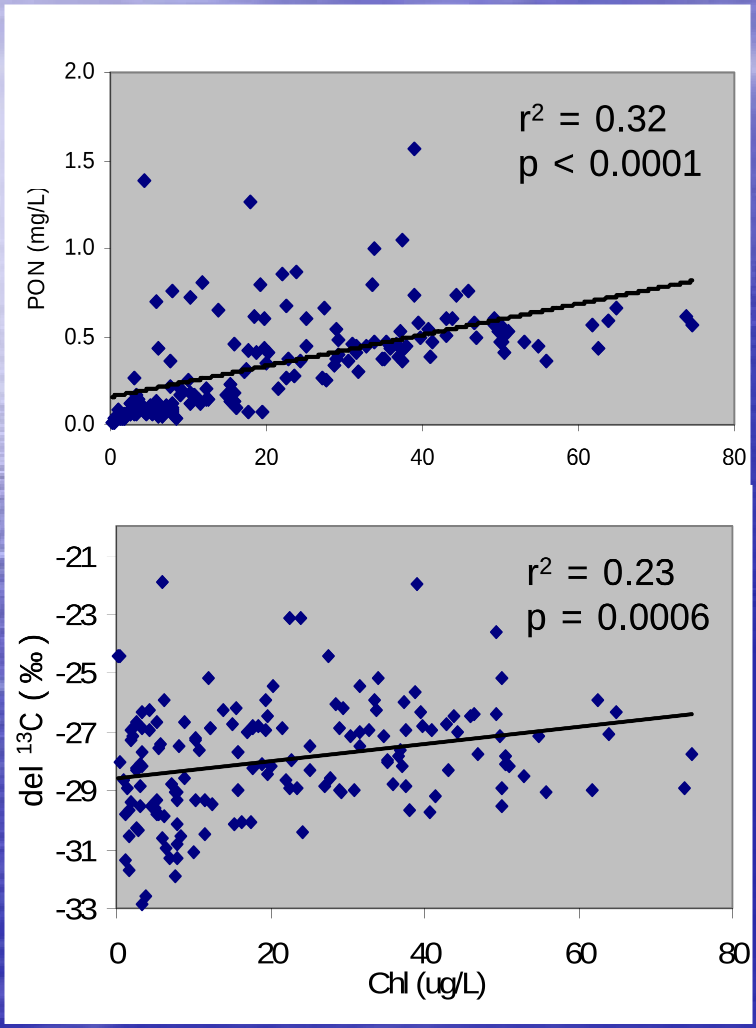

Limiting Factors
light nutrients
hydrology light
light nutrients
Algal Biomass
phytoplankton
benthic algae
Anthropogenic Impacts
canopy(+) nutrients (+)
impoundment (+) sediments (-)
nutrients (+) sediments (-)
Algal Biomass
streams
rivers



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

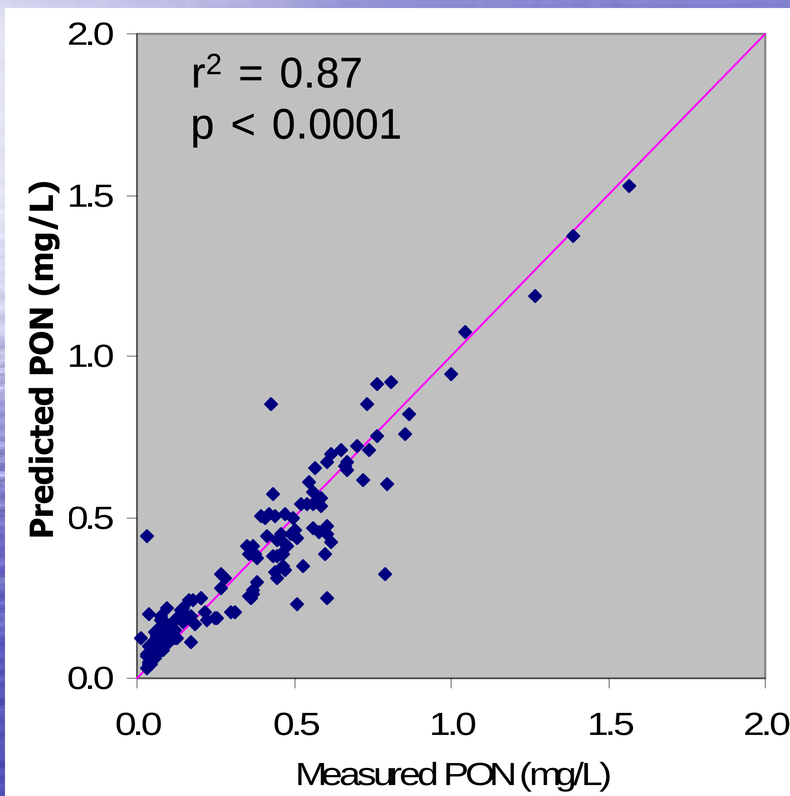
From: Sellers & Bukaveckas (2003) *Limnology & Oceanography*.

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