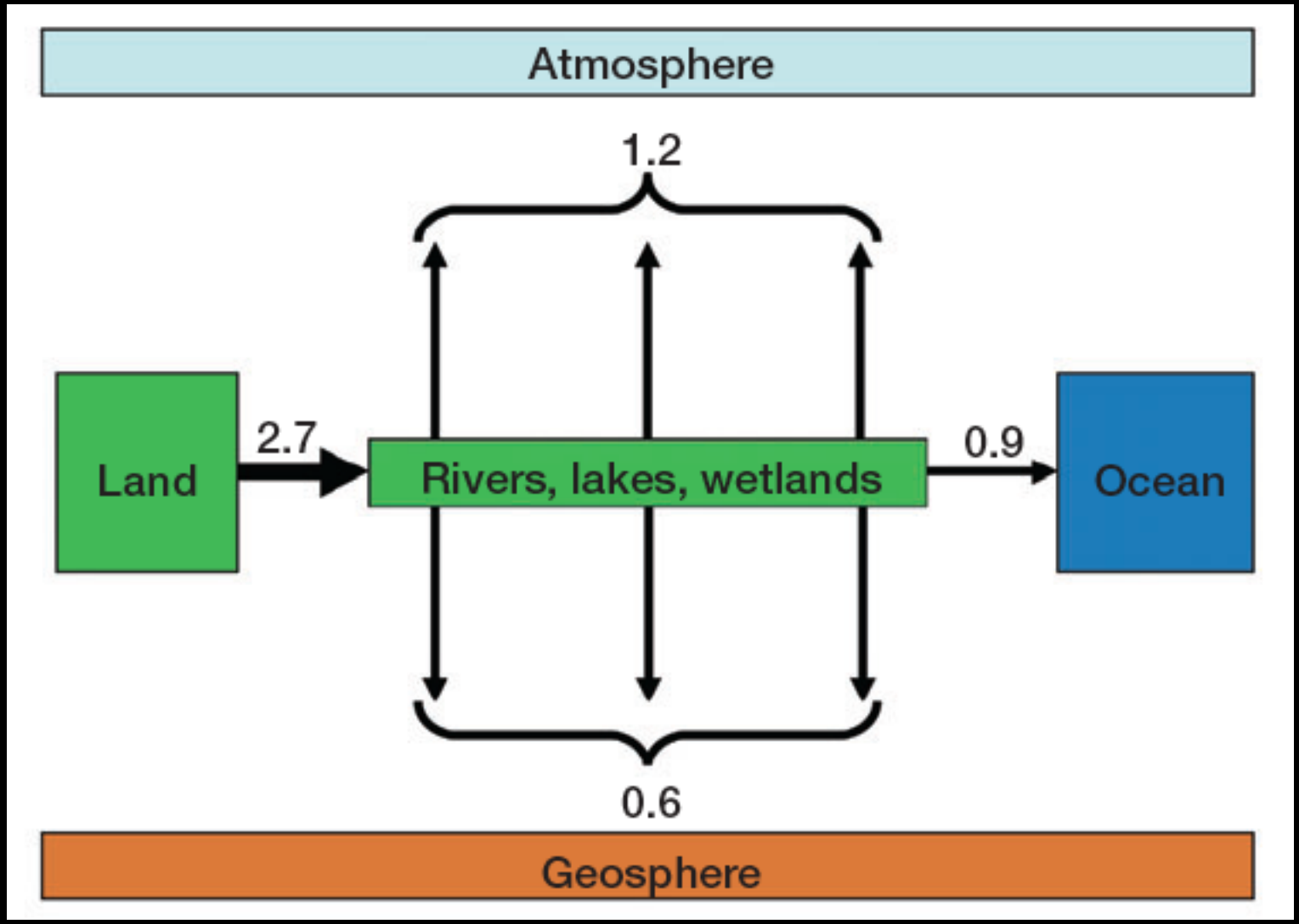
N:P ENRICHMENT STIMULATES WHOLE-STREAM HETEROTROPHIC RESPIRATION DESPITE A REDUCED CARBON BASE

J.S. Kominoski[1], J.P. Benstead[2], A.D. Rosemond[1], D.W.P. Manning[1]

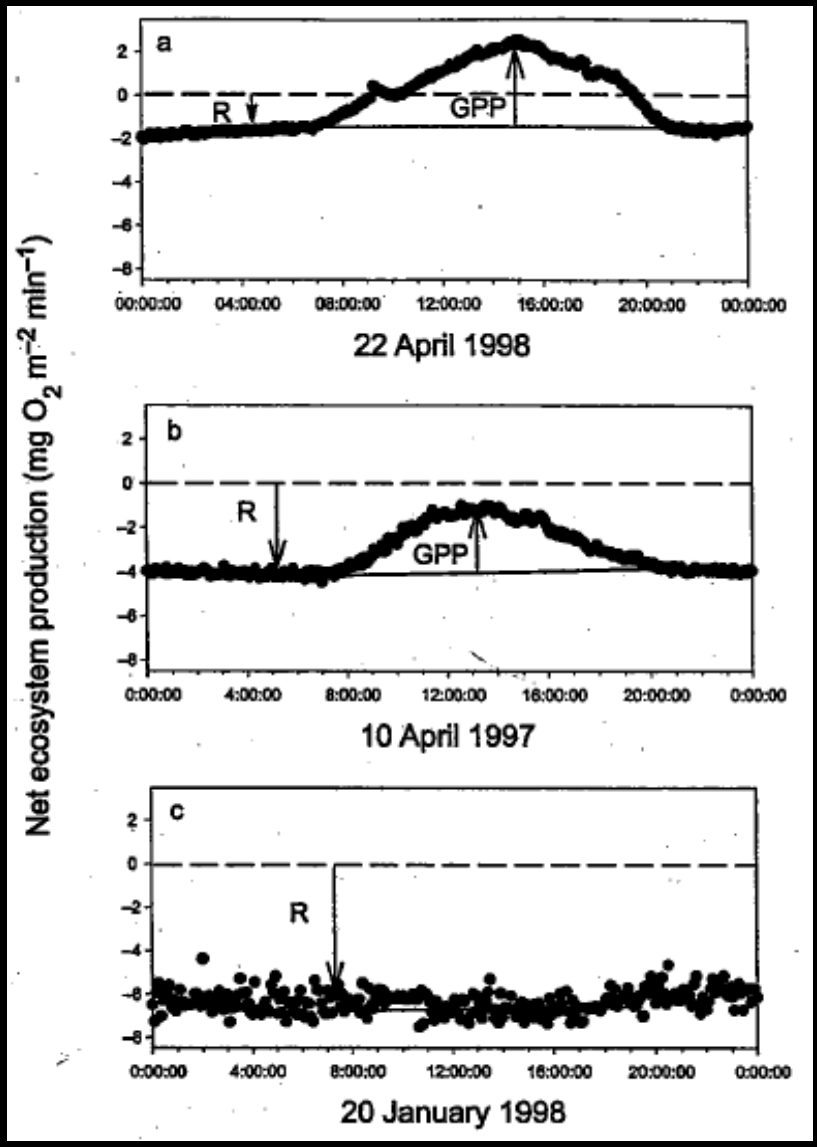
[1]*Odum School of Ecology, University of Georgia, Athens, GA 30602 USA*
[2]*Department of Biological Sciences, University of Alabama, Tuscaloosa, AL 35478, USA*

Carbon processing in aquatic ecosystems



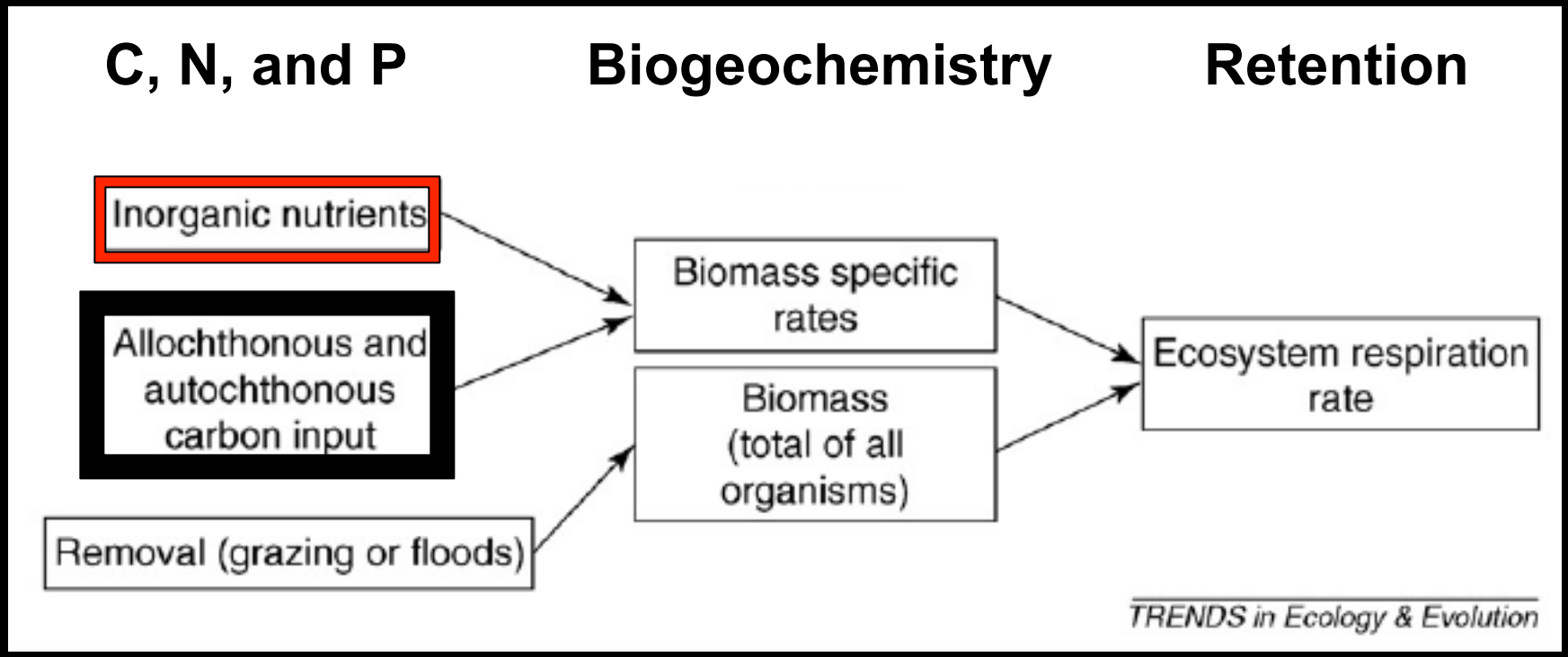
Aufdenkampe et al. 2011 *FEE*

Ecosystem metabolism in forested headwater streams



Mulholland et al. 2001 *Freshwat Biol*

Stream ecosystem heterotrophic state



Dodds et al. 2007 *TREE*

Ecosystem respiration drivers

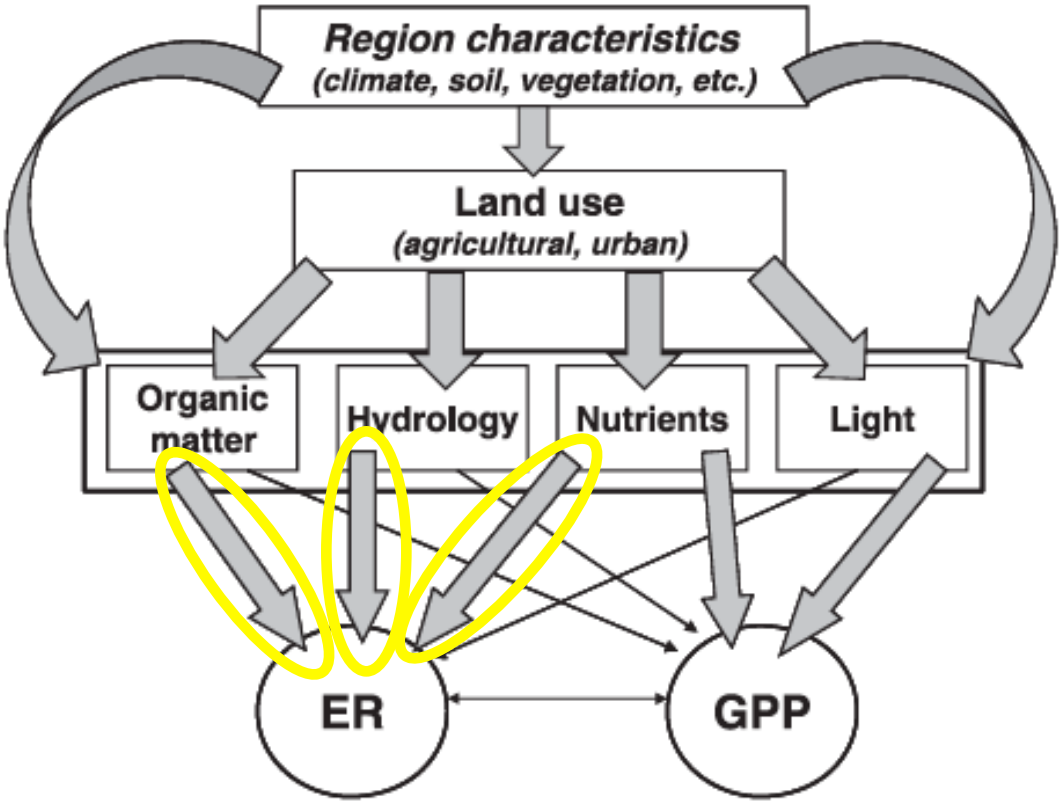
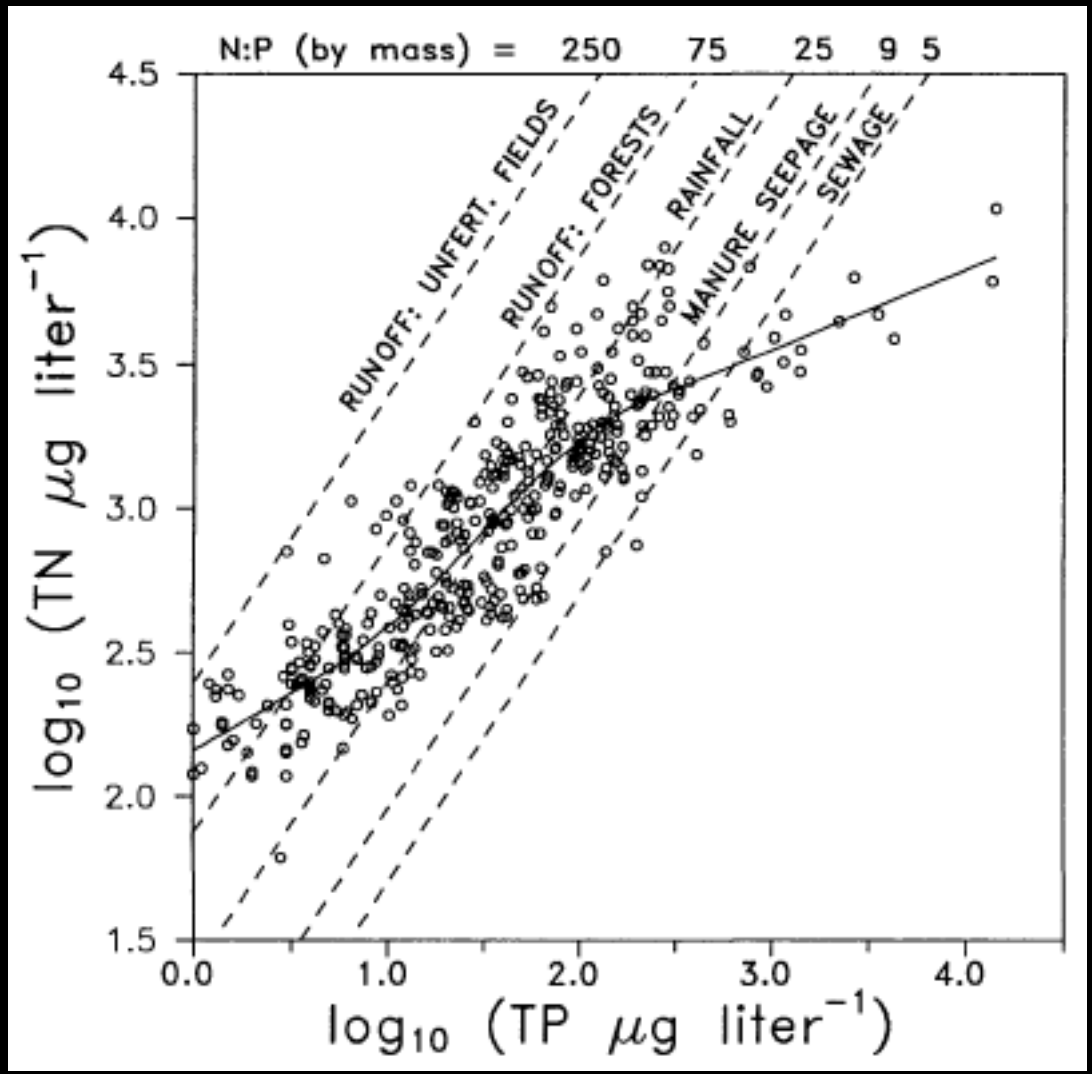


Fig. 1 Primary factors hypothesised to influence stream ecosystem respiration (ER) and gross primary production (GPP). Larger arrows indicate greater influence on rates of metabolism.

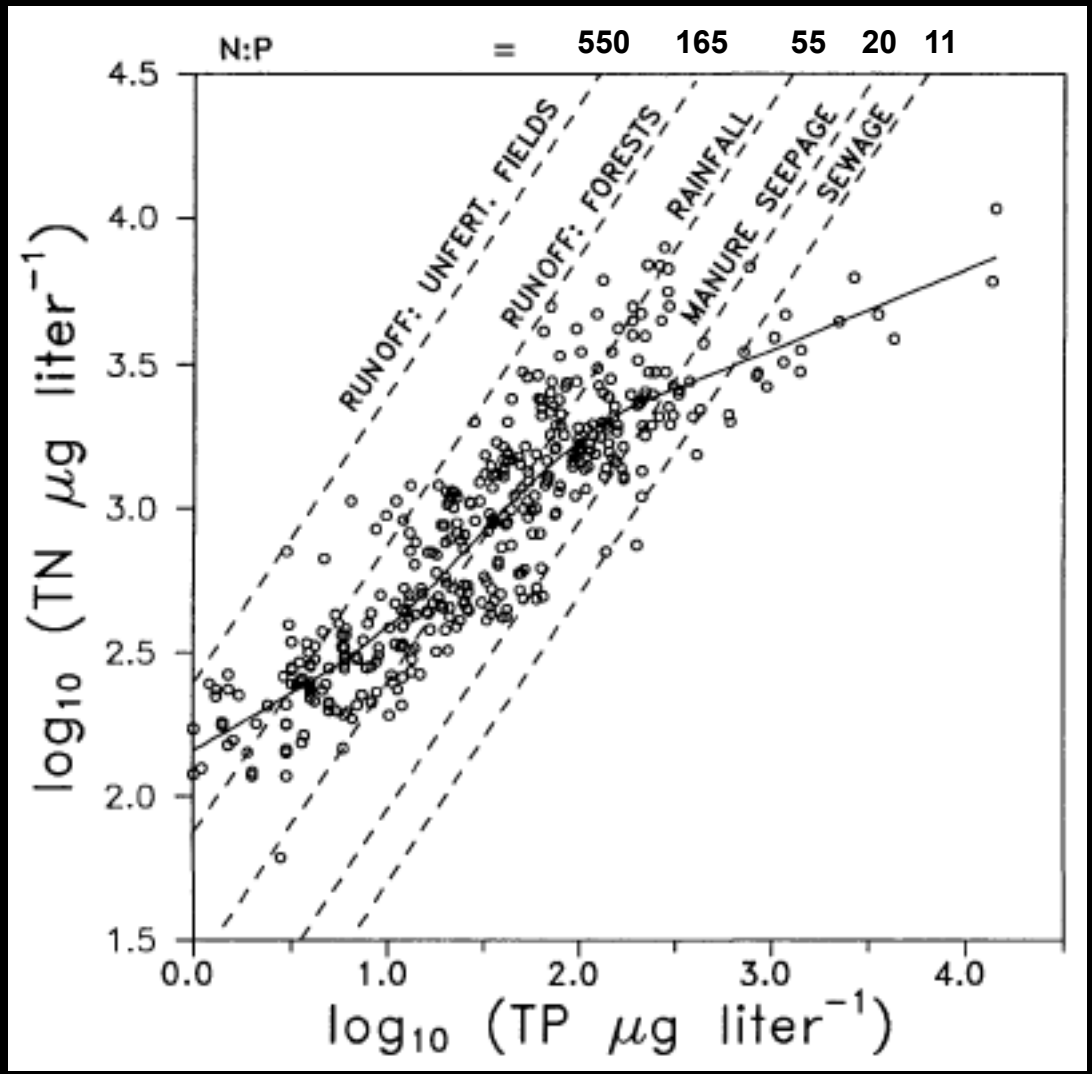
Bernot et al. 2010 *Freshwat Biol*

Nutrient loading in aquatic ecosystems



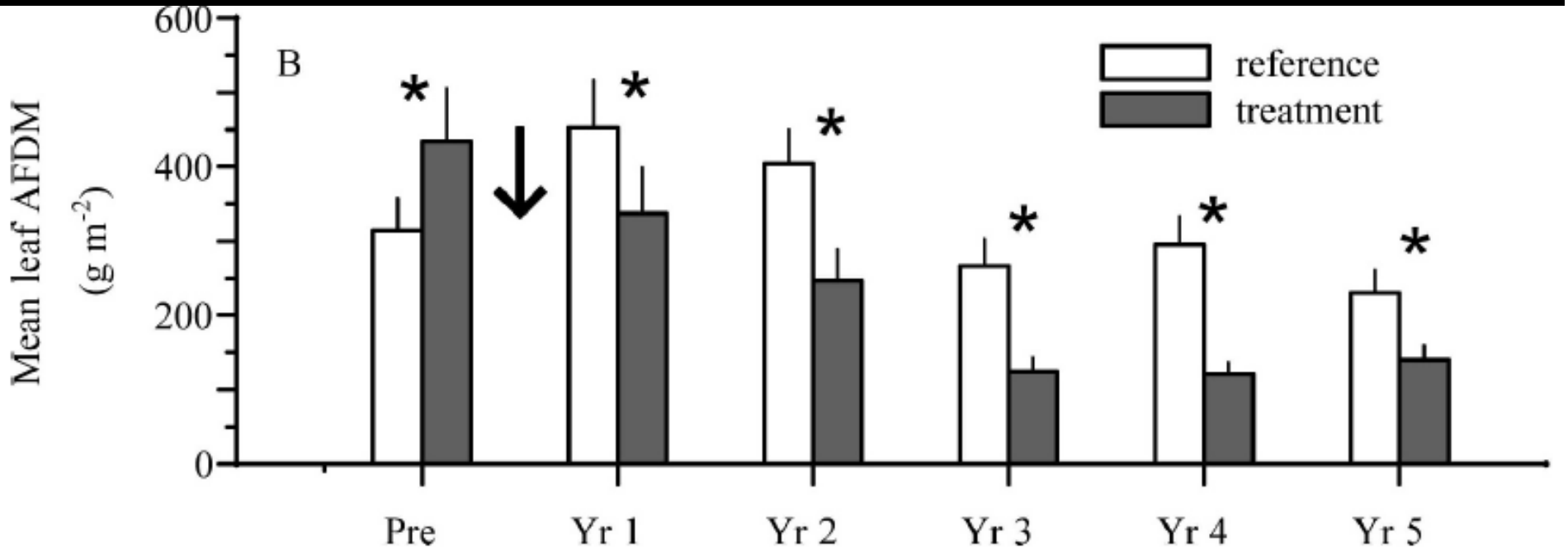
Downing and McCauley 1992 *L&O*

Nutrient loading in aquatic ecosystems

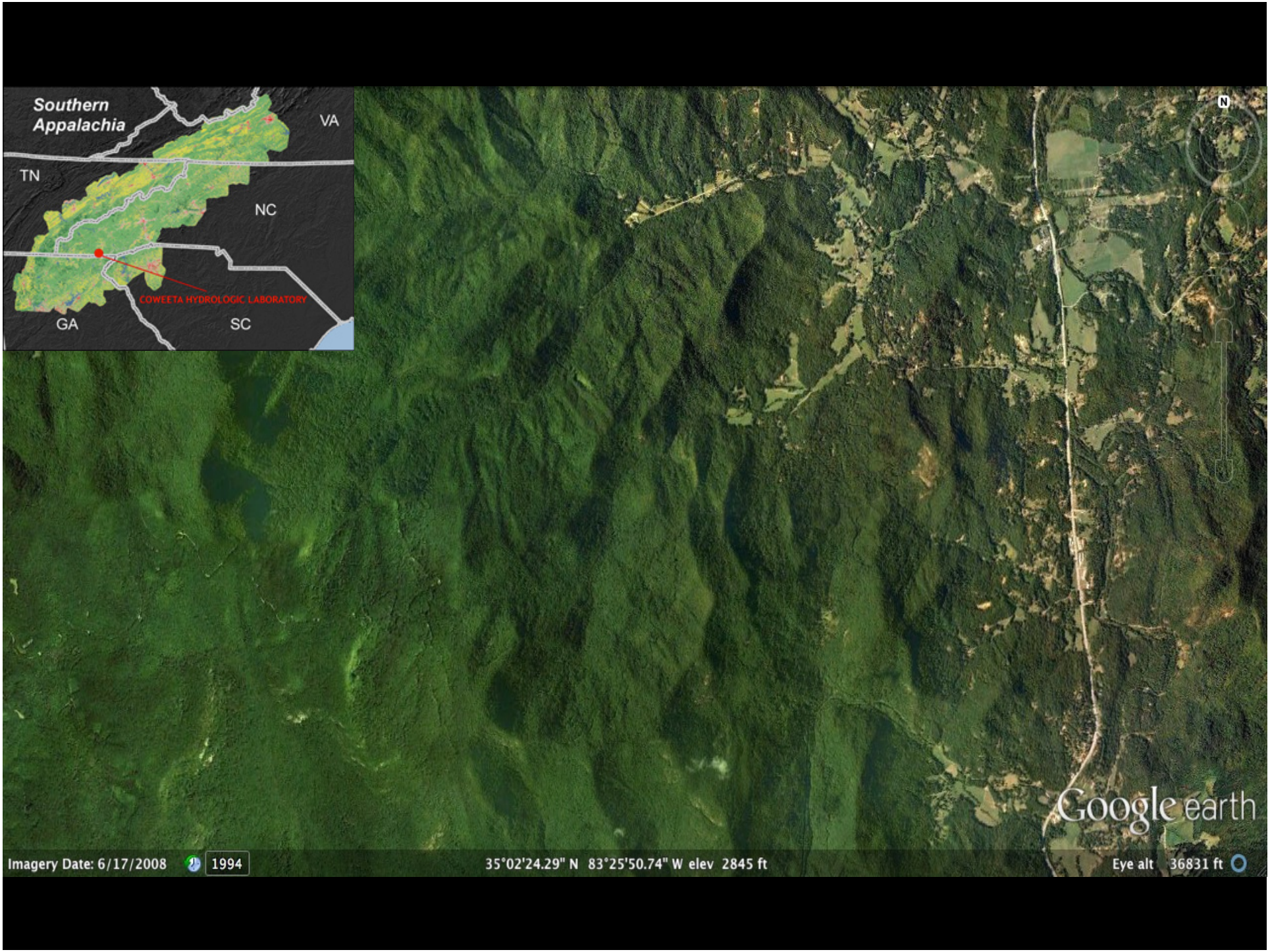


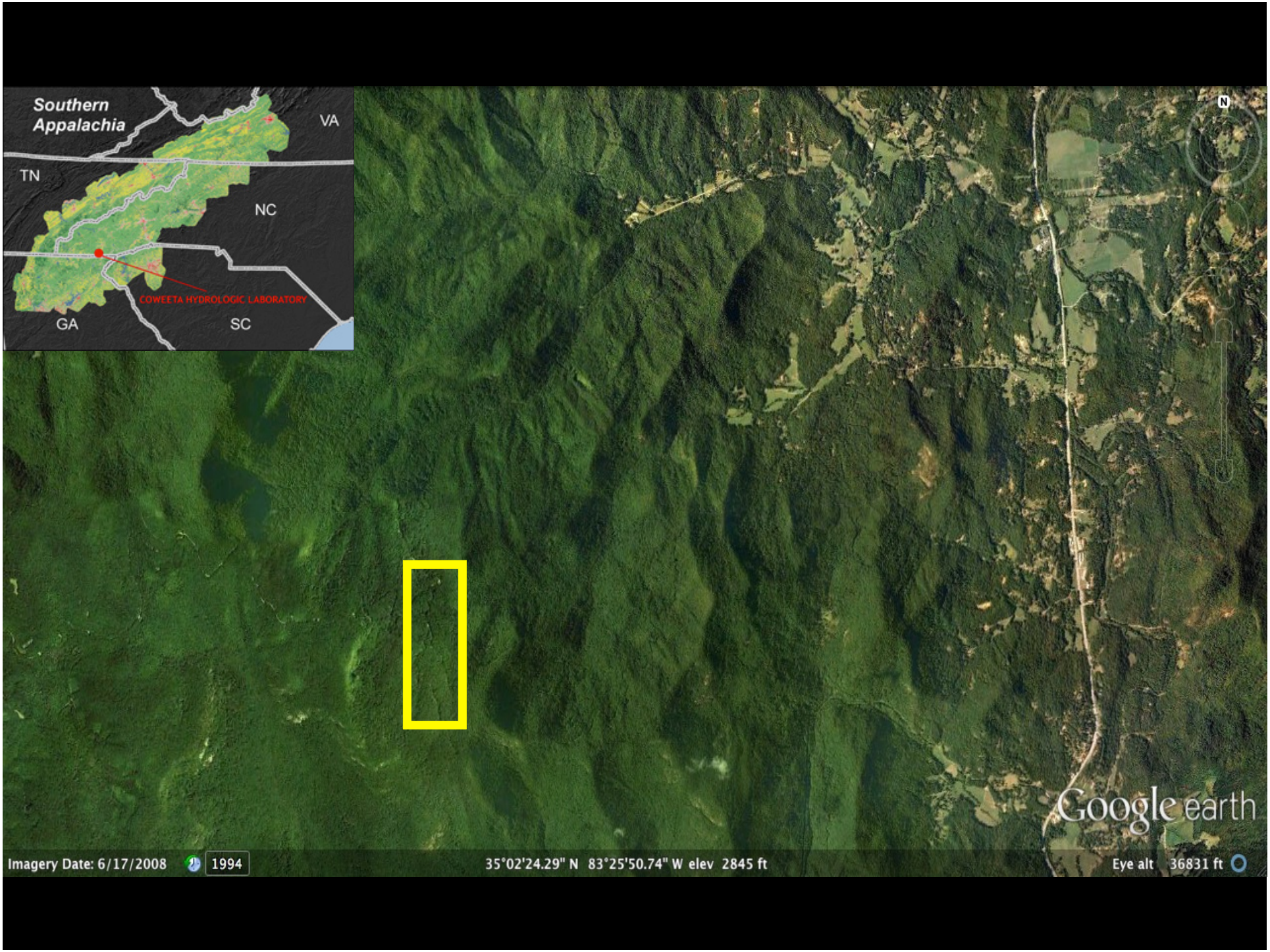
Downing and McCauley 1992 *L&O*

Nutrients reduce in-stream carbon stocks



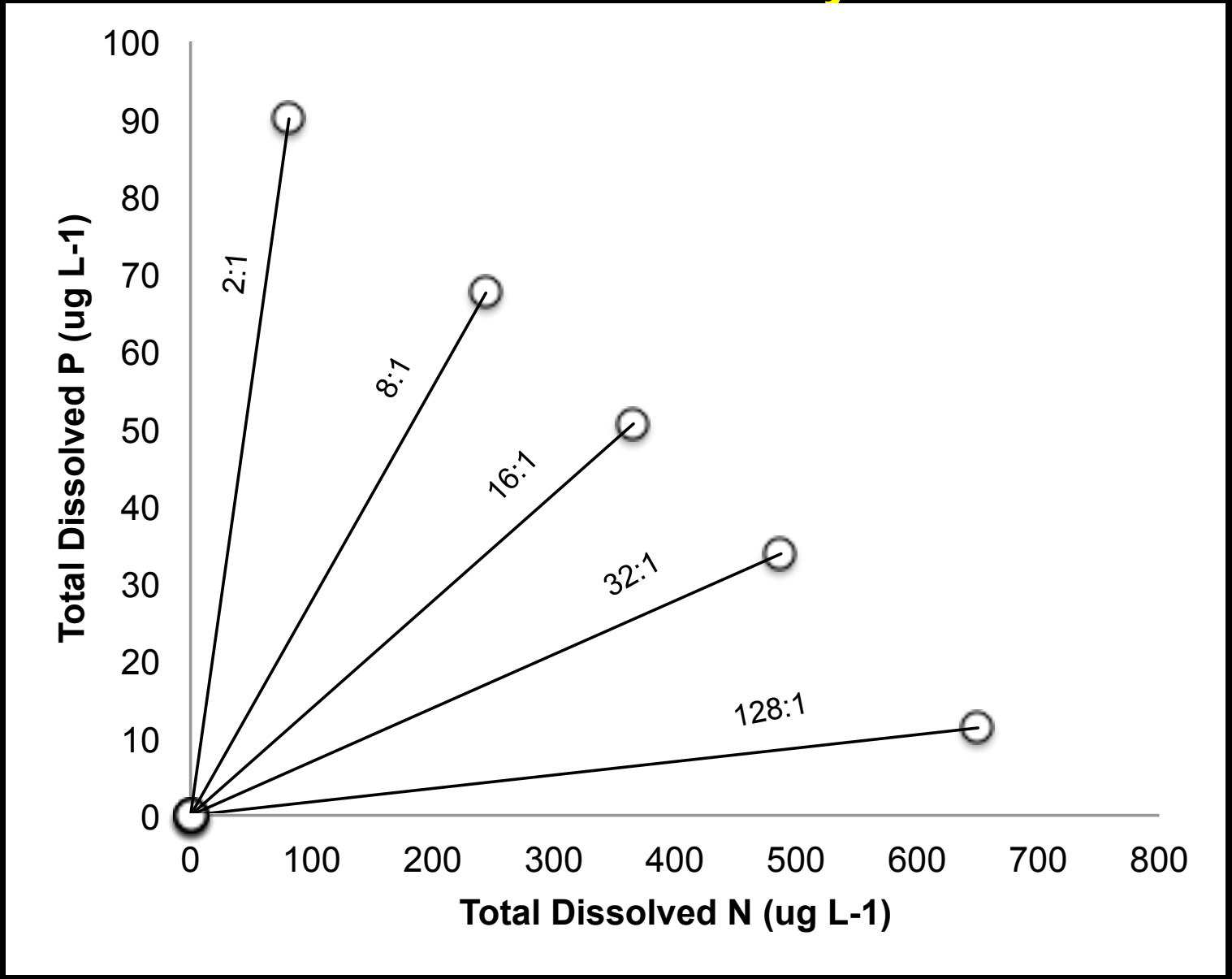
Suberkropp et al. 2010 *L&O*

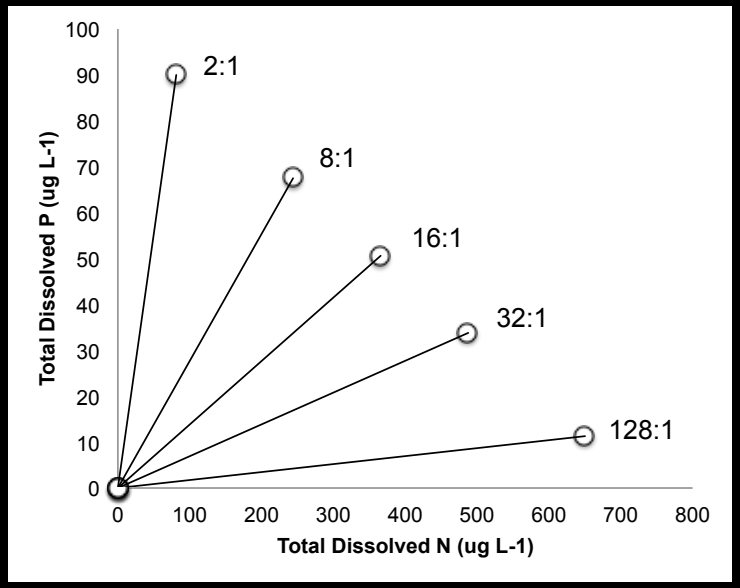

Southern Appalachia
VA
TN
NC
COWEETA HYDROLOGIC LABORATORY
GA
SC
N
Google earth
Imagery Date: 6/17/2008
1994
35°02'24.29" N 83°25'50.74" W elev 2845 ft
Eye alt 36831 ft


Southern Appalachia
VA
TN
NC
COWEETA HYDROLOGIC LABORATORY
GA
SC
N
Google earth
Imagery Date: 6/17/2008
1994
35°02'24.29" N 83°25'50.74" W elev 2845 ft
Eye alt 36831 ft

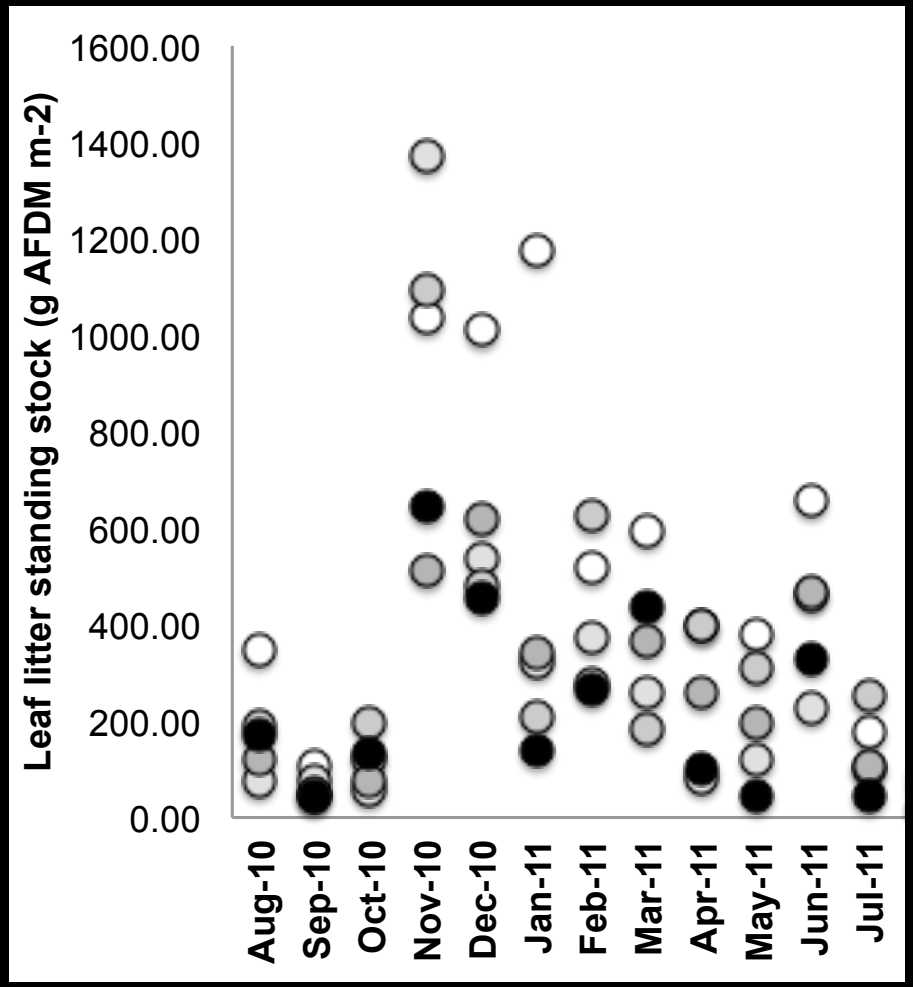

Reynolds Gap
Jump Branch
8:1
Cold Springs Cove
North Fork
2:1
Indian Branch
16:1
Devils Ball Alley Cliff
128:1
421 A
421 2
32:1
imagery Date: 6/17/2008
1994
35°02'24.29" N 83°25'50.74" W elev 2845 ft
Google earth
Eye alt 36831 ft

Nutrient enrichment and stream ecosystem metabolism

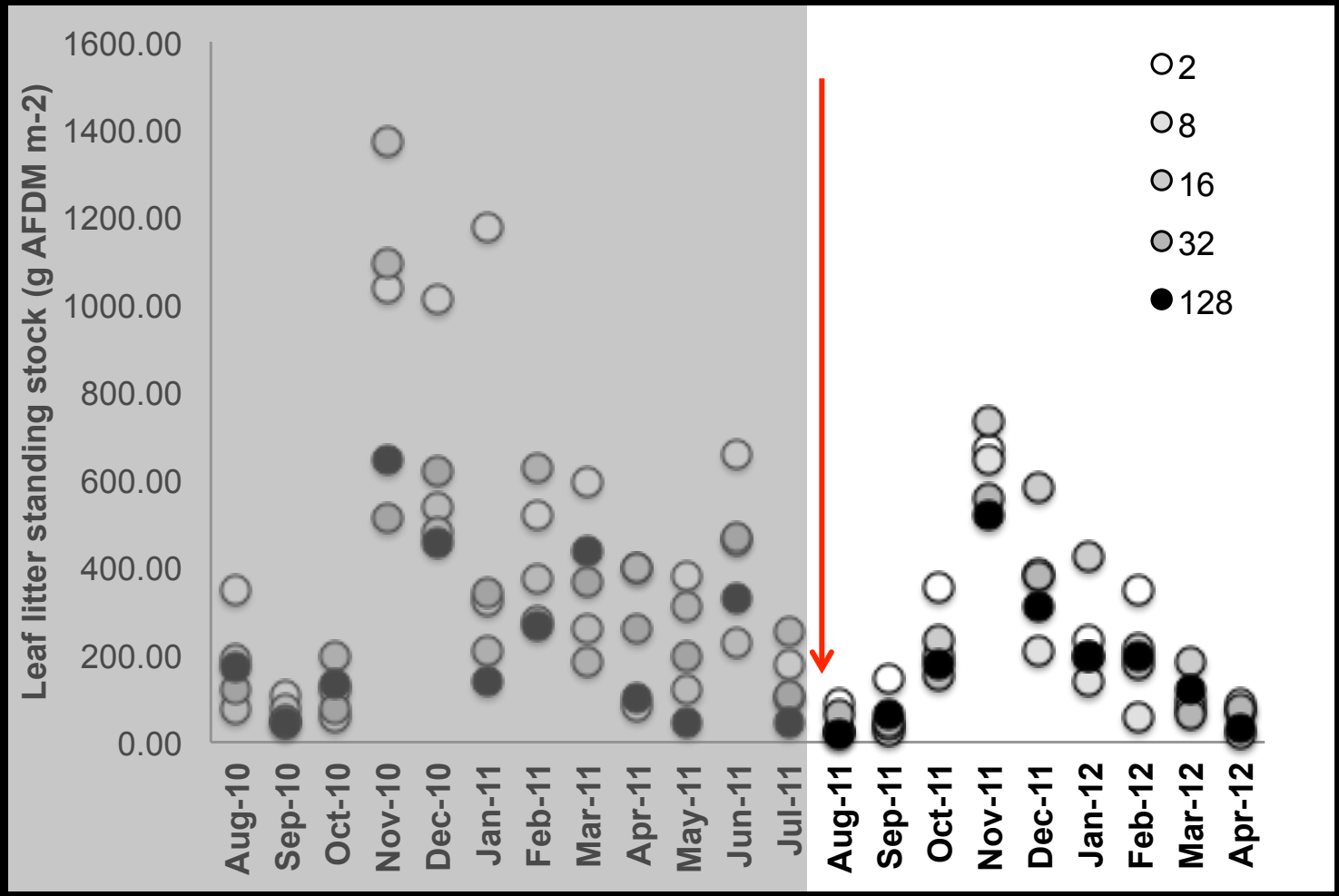



100
90
80
70
60
50
40
30
20
10
0
Total Dissolved P (ug L-1)
2:1
8:1
16:1
32:1
128:1
0
100
200
300
400
500
600
700
800
Total Dissolved N (ug L-1)

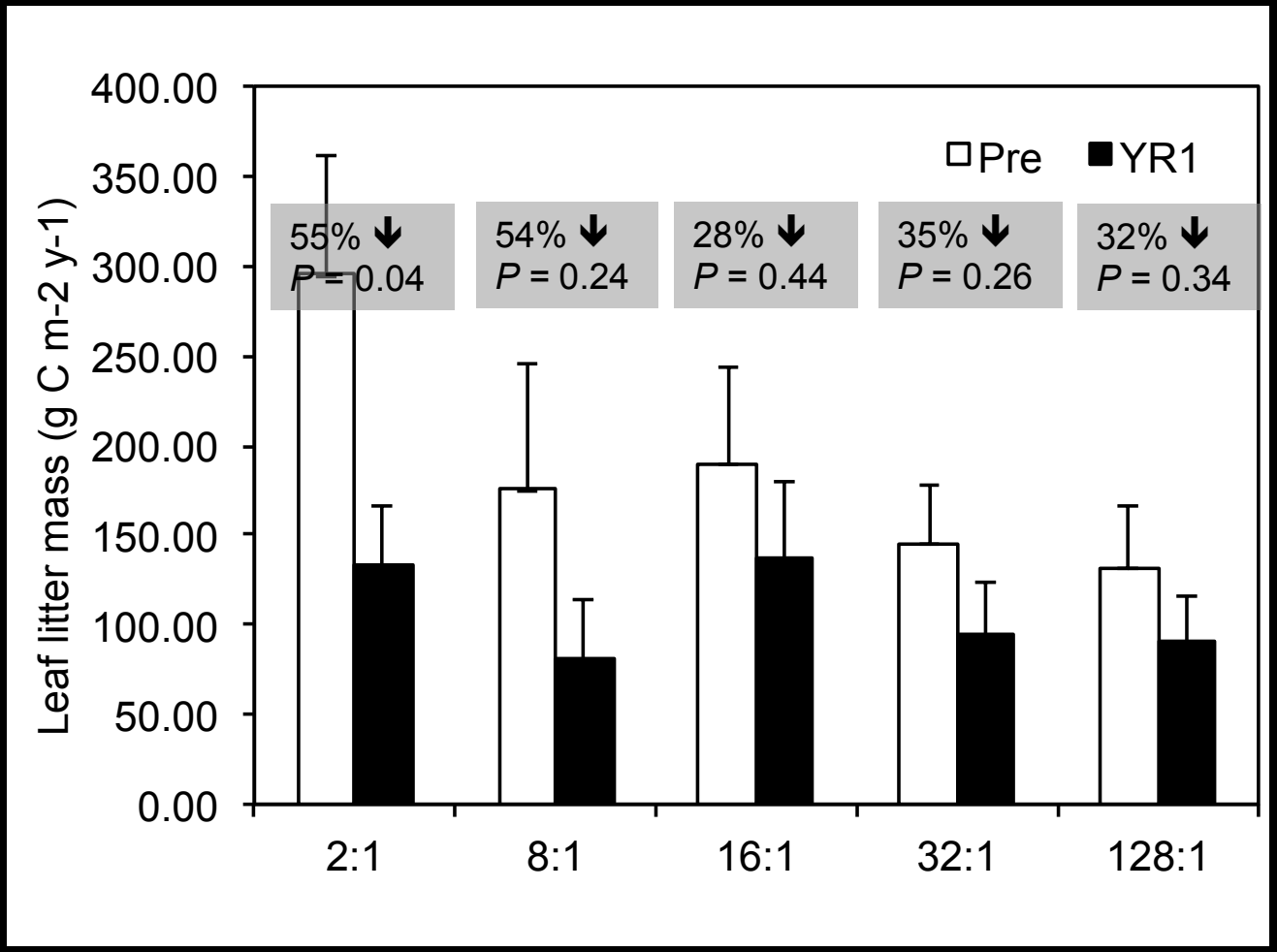
Nutrient enrichment and stream carbon stocks



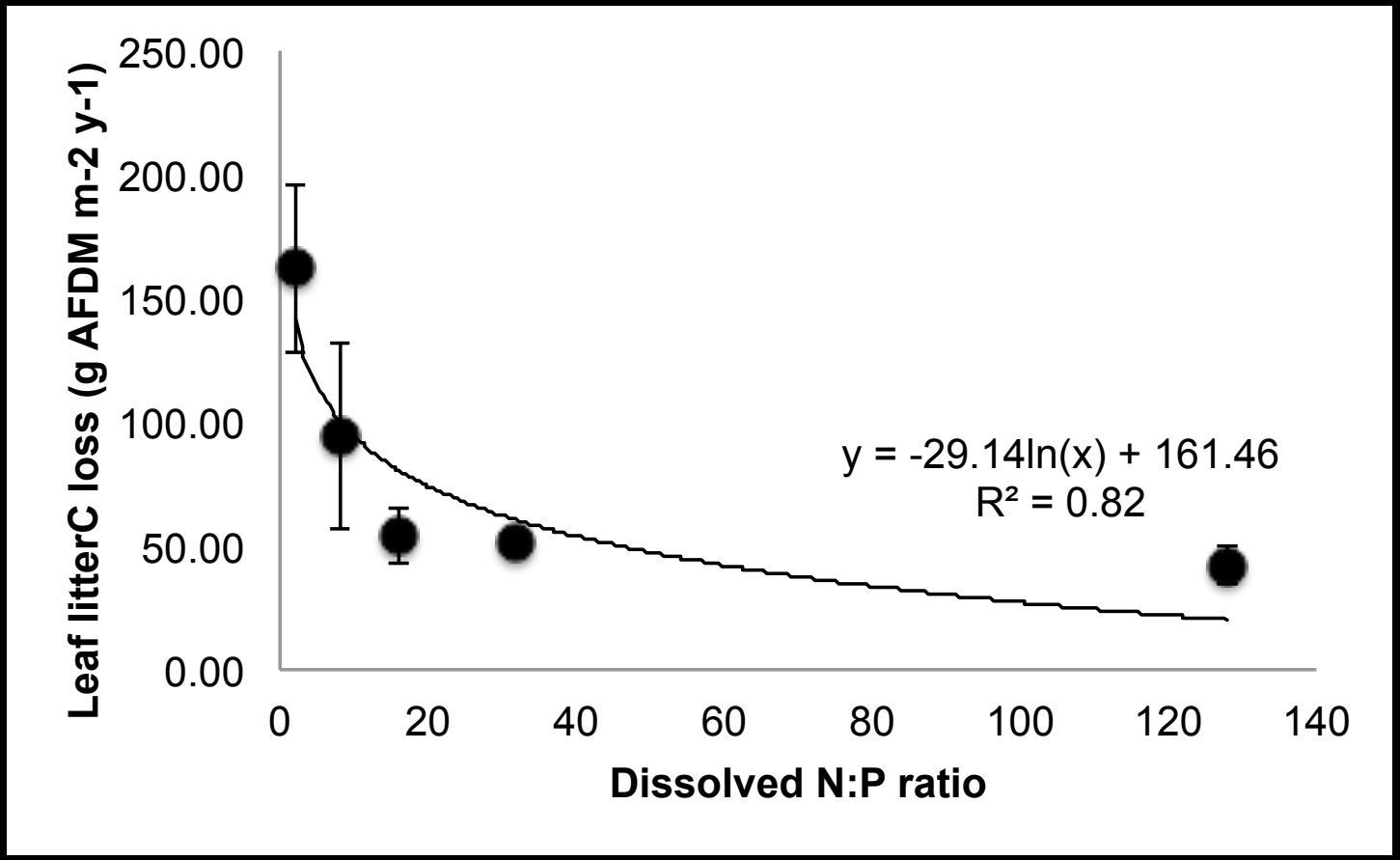
Nutrient enrichment and stream carbon stocks



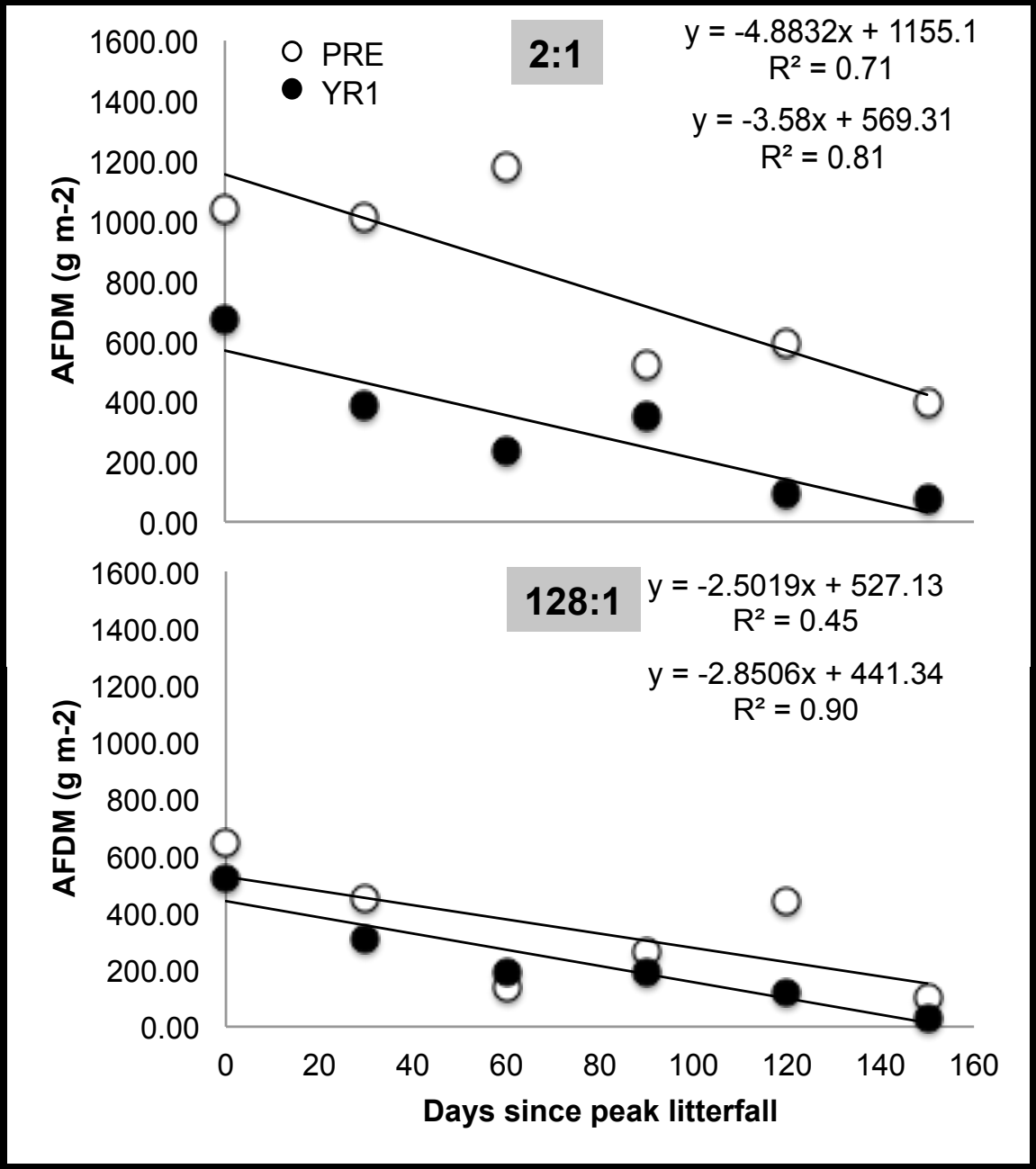
N:P influences stream carbon stocks



N:P differentially reduces stream carbon stocks



N:P differentially reduces stream carbon stocks

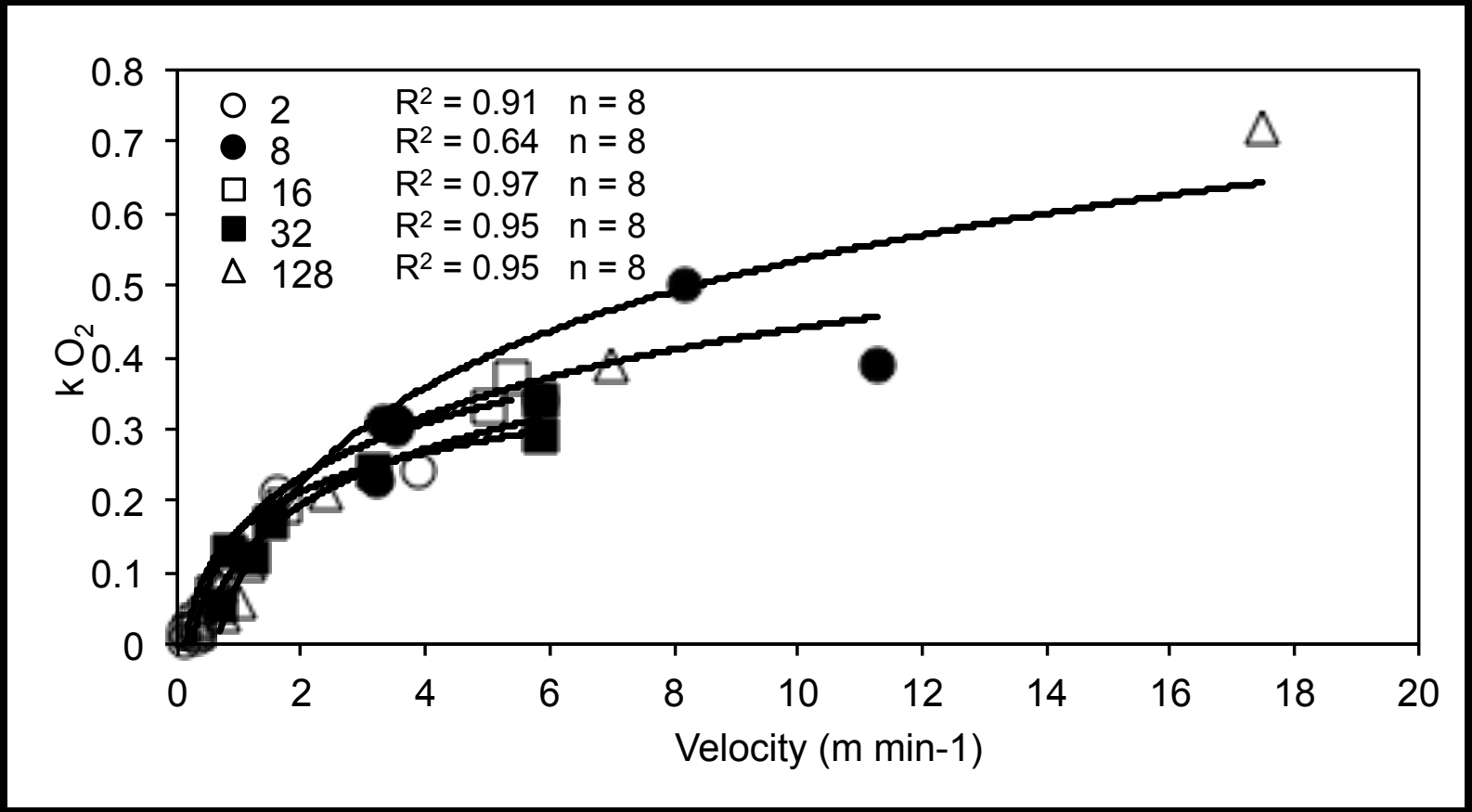


Stream ecosystem metabolism

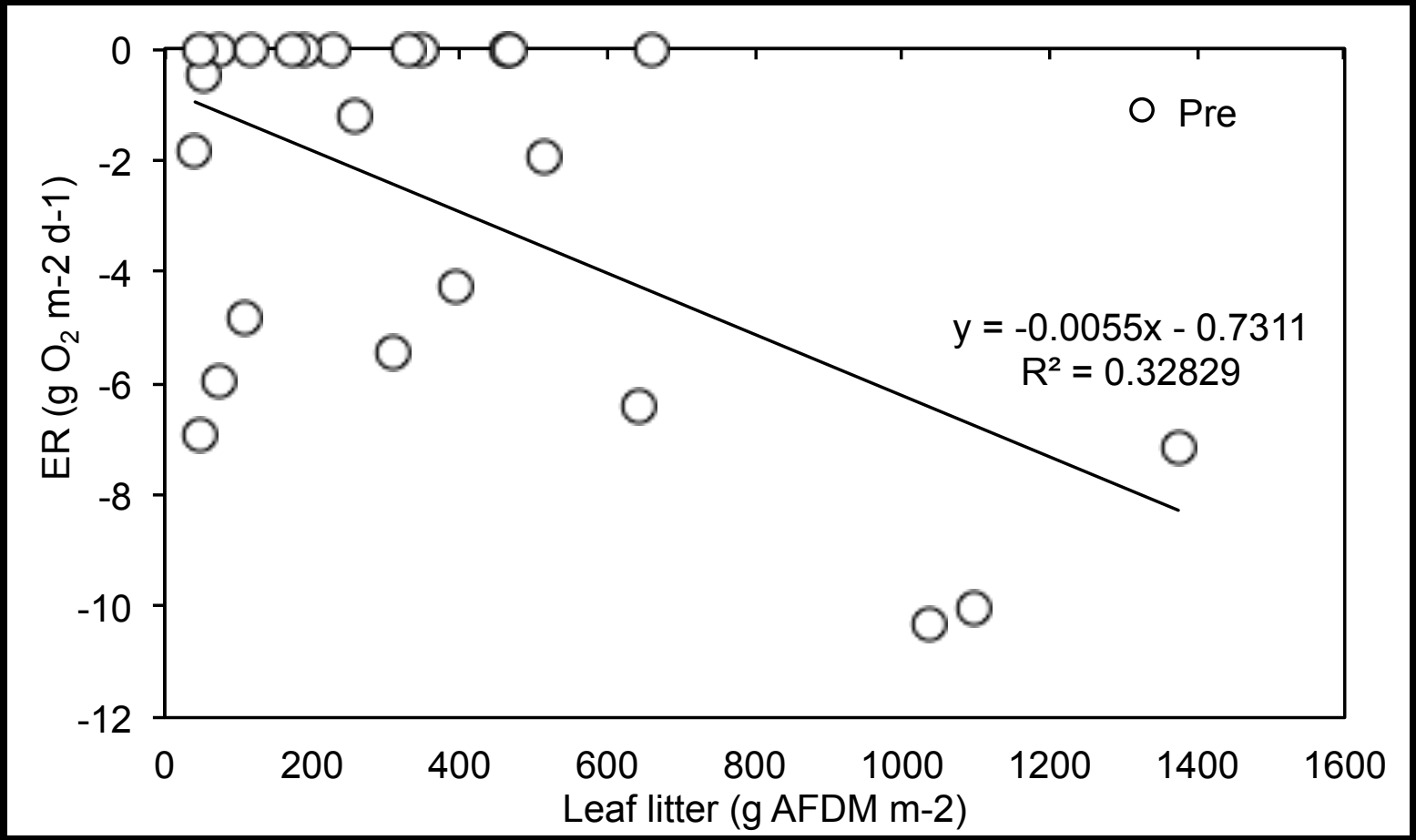
24-h DO: 2-station method

Reaeration: SF_6 tracer gas (plateau)

Stream ecosystem metabolism: *reaeration vs velocity*



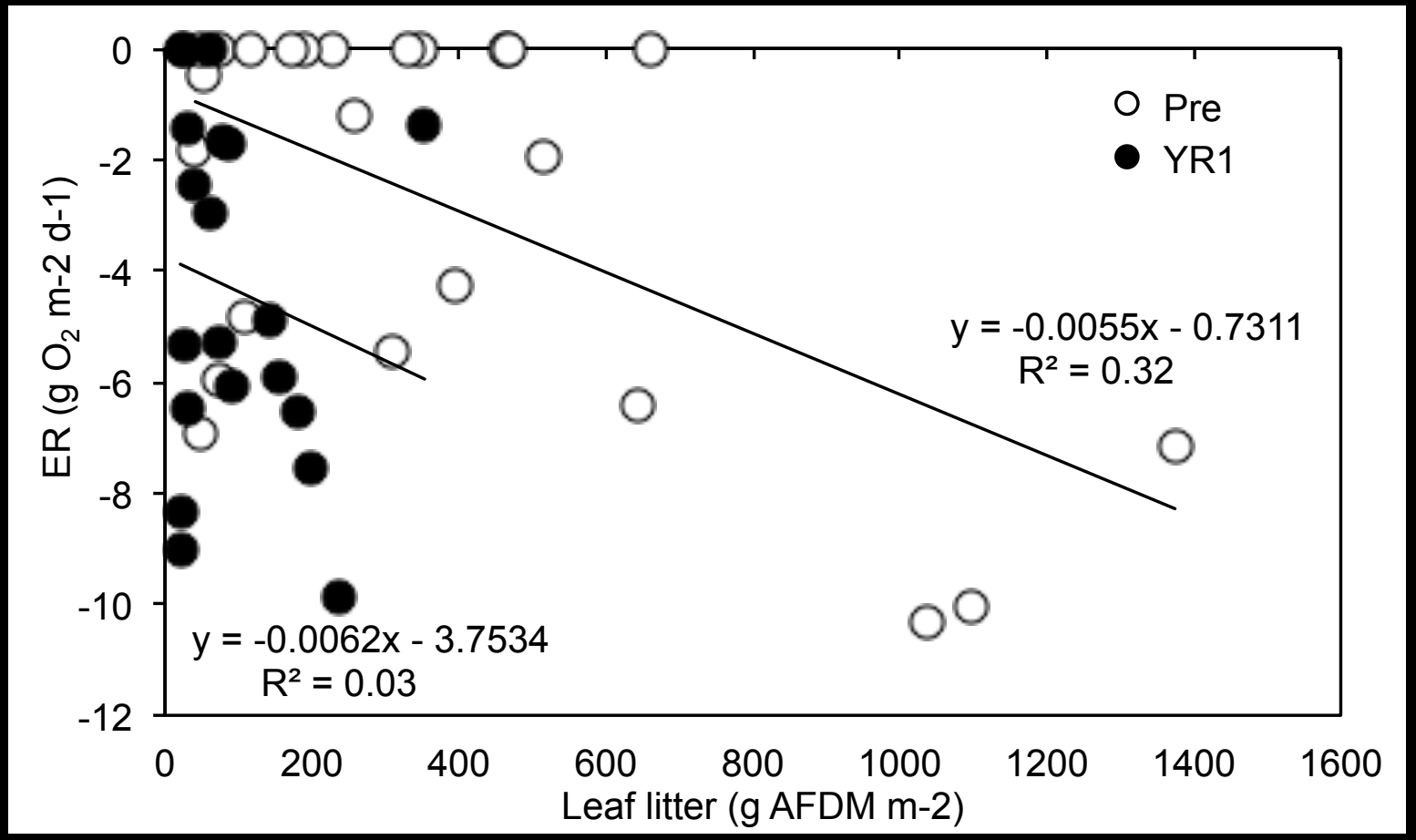
Metabolic rates per g AFDM



Bernot et al. 2010 *FWB*

NEP: -5.2 to -2.1 g O_2 m^{-2} d^{-1}

5x higher metabolic rates per g AFDM



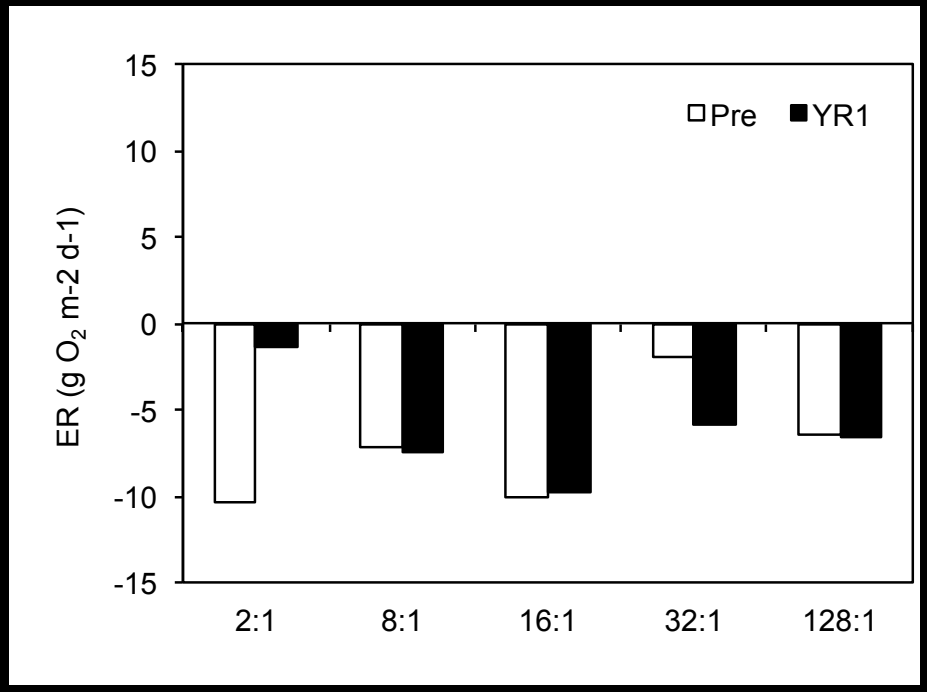
ANCOVA: AFDM $P = 0.001$, NP $P = 0.004$

Bernot et al. 2010 *FWB*

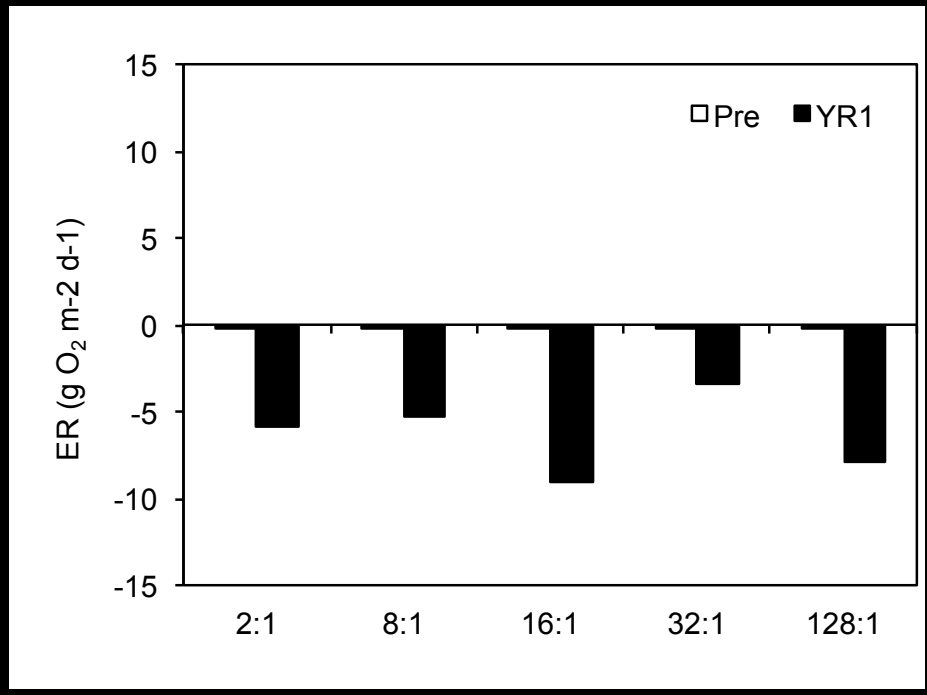
NEP: -5.2 to -2.1 g O_2 m^{-2} d^{-1}

Higher heterotrophic metabolism – reduced seasonality

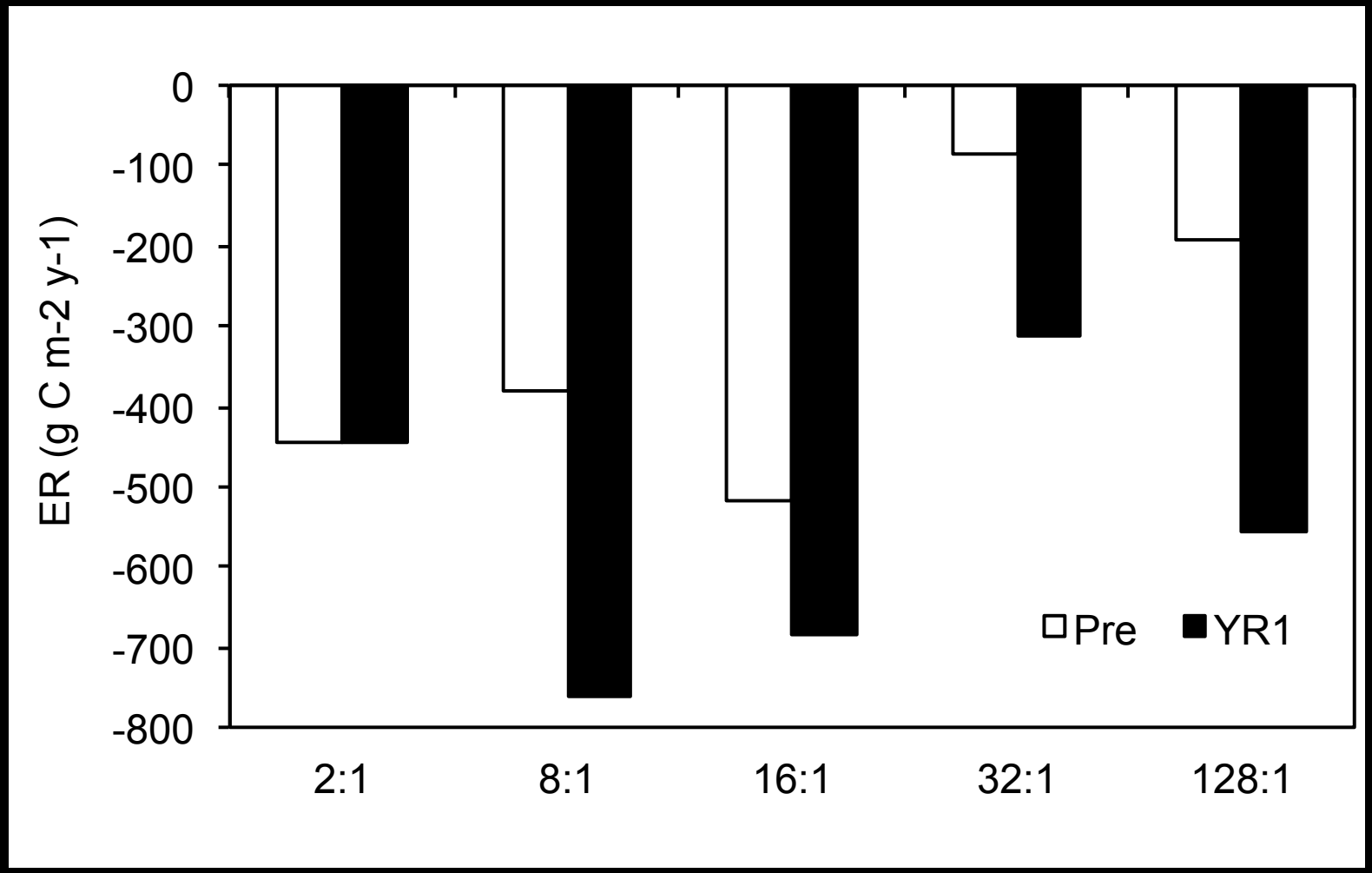
Autumn



Summer



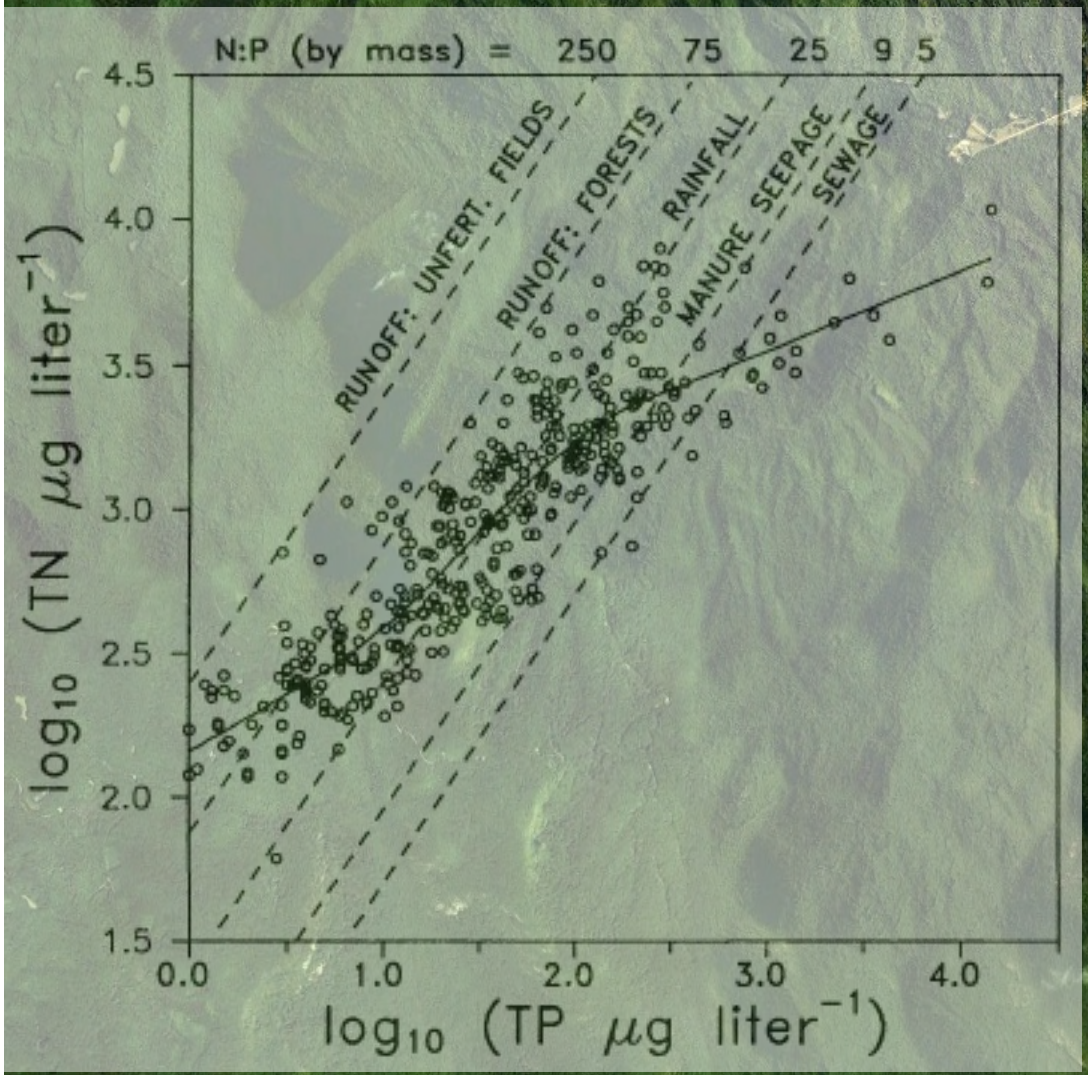
Decreasing stream carbon retention, increasing ER



Hagen et al. 2010 *Hydrobiol*

NEP: -350 to -240 g C m^{-2} y^{-1}

Carbon processing in river networks – landscape N:P



Acknowledgements

NSF DEB-0918894 to Rosemond, Benstead, Gulis, Maerz

University of Alabama
Chau Tran, Mick Demi, Bob Findlay

University of Georgia
Ivan Vargas, Emmanuel Obi, Caitlin Ward, Charlotte Barat, Andy Smith, Christian Fox, Jason Coombs