THRESHOLDS IN N AND P CONCENTRATION AND RATIO DEFINED BY CARBON LOSS IN STREAMS

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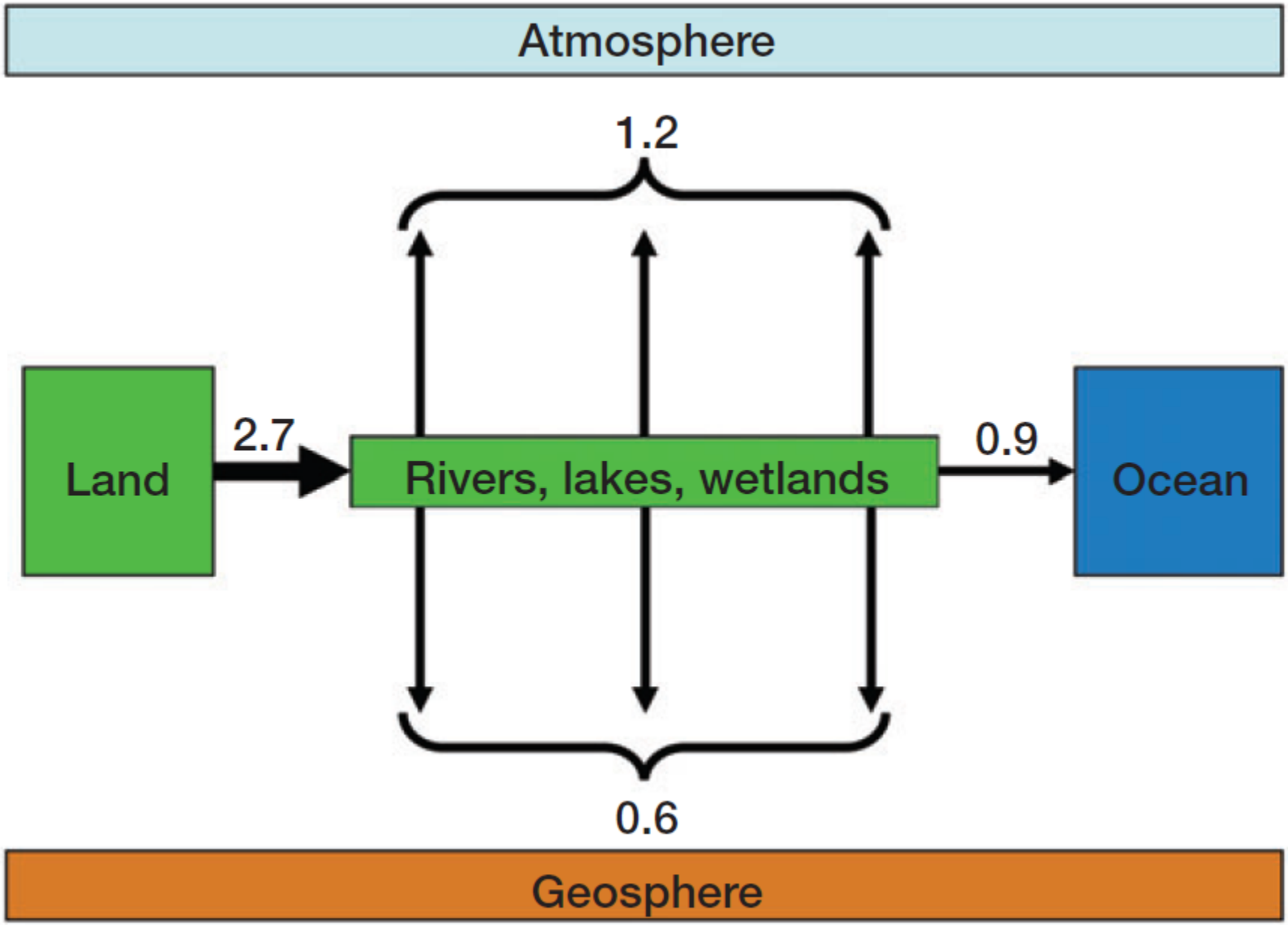
Detritivory dominates carbon flows (Cebrian and Lartigue 2004)

Is carbon loss stimulated by nutrients?

CO_2

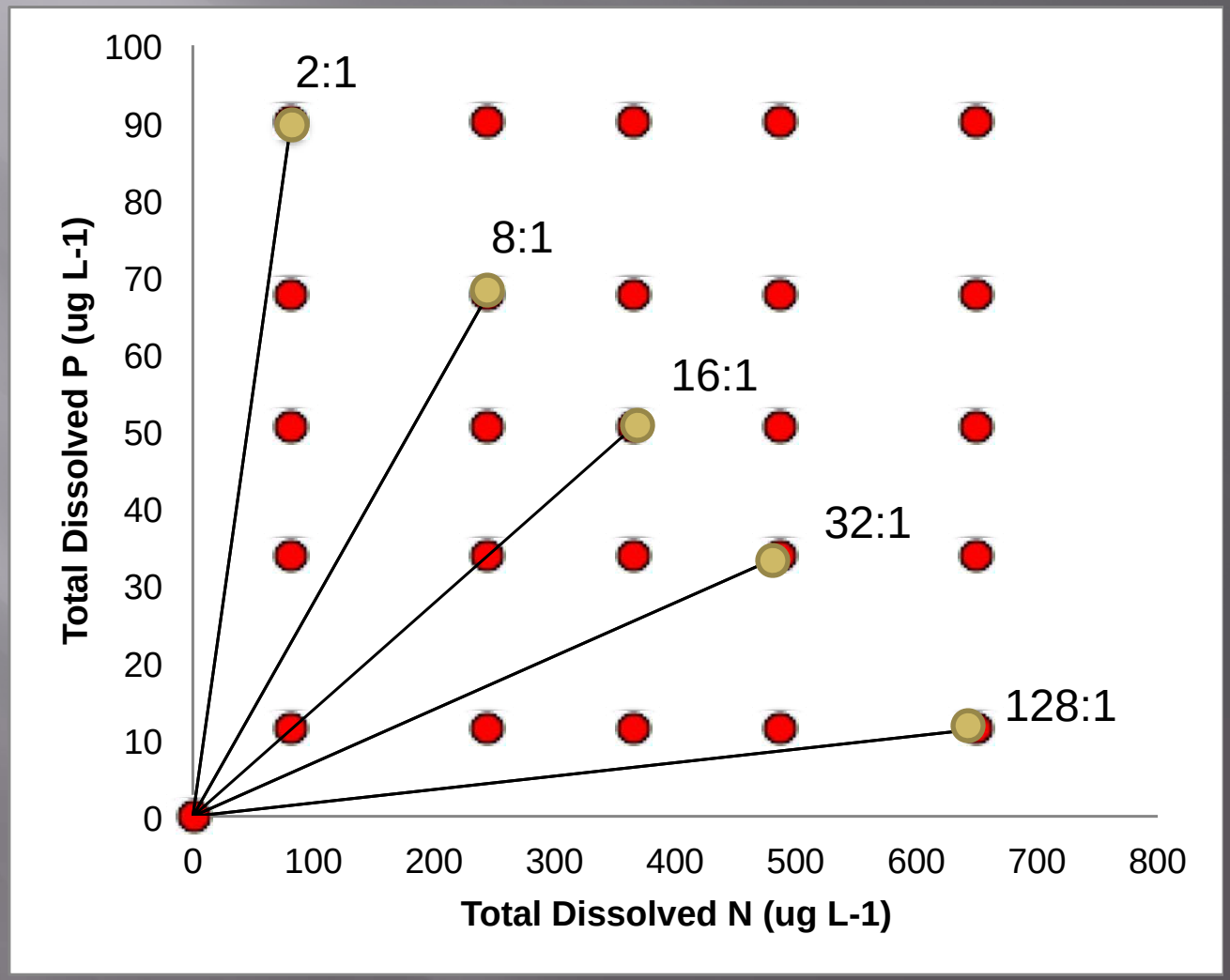
N, P

SEM: Mehring and Maret 2011 – *L&O*
Photo: A. Mehring



Aufdenkampe et al. 2011

What are threshold concentrations that stimulate C loss?



Experimental design

Control + 25 combinations of N,P

Control SRP = 5 µg L^{-1}, DIN = 53 µg L^{-1}

SRP µg L^{-1} \ DIN µg L^{-1}	81	244	366	488	650
11	16	49	74	98	128
34	5	16	24	32	42
51	4	11	16	21	28
68	3	8	12	16	21
90	2	6	9	12	16

Response variables: Litter breakdown rates, respiration rates, fungal biomass

Questions/hypotheses

N or P stimulate carbon loss (*k*)?

- Saturate?
- Co-limitation?
- N:P ratio important?
- Labile vs Recalcitrant carbon?
  Maple vs Rhodo

Model explanatory variables (BIC):

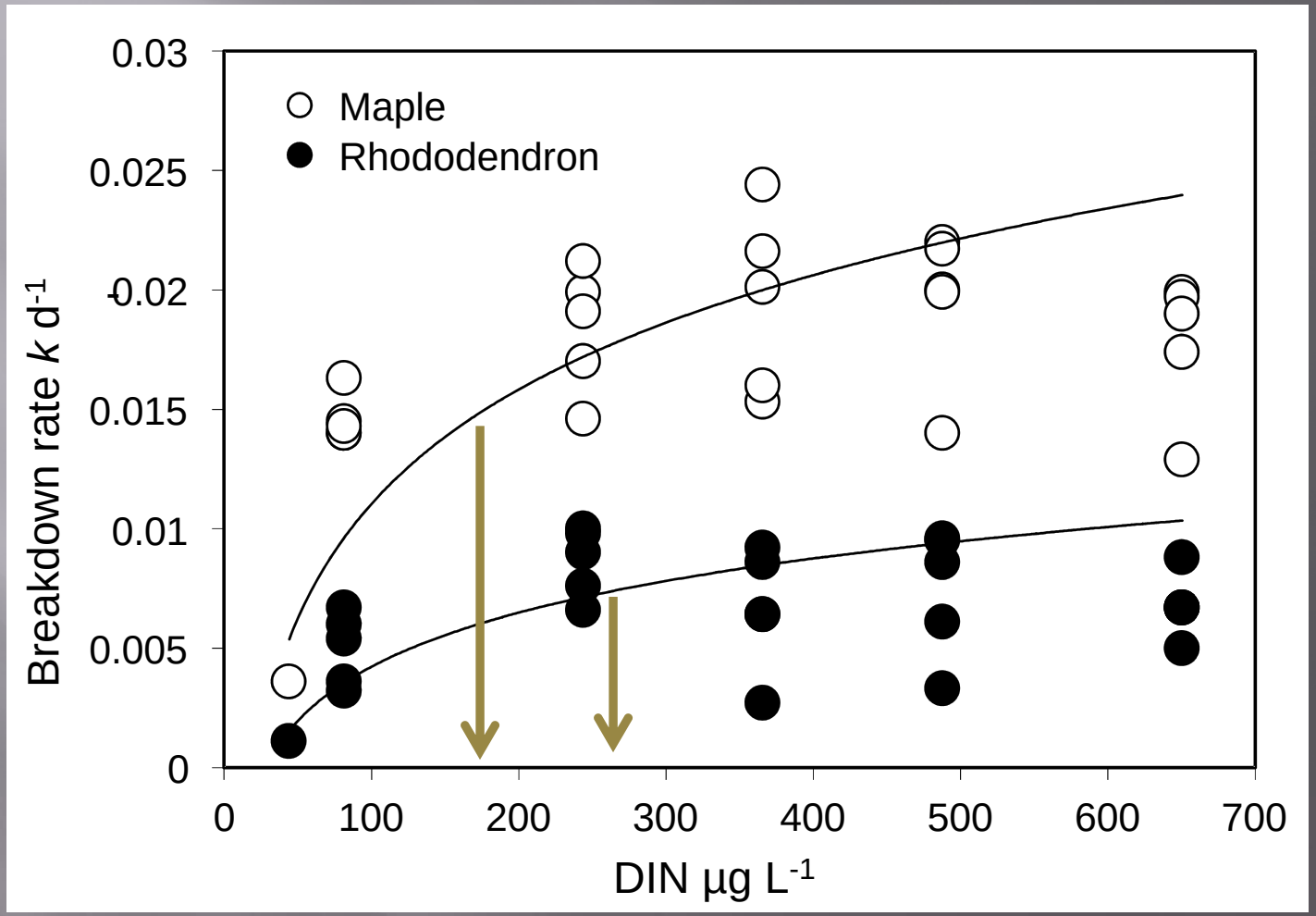
Concentrations (N, P)
NxP interaction
N:P ratio
Litter species

Model results: *k*

Litter Breakdown	BIC	
		Adj R^2
N, N:P, NxP, Species	-455.9	0.84
N, P, Species	-454.7	0.83
N, P, N:P, NxP, Species	-453.1	0.84
N, P, N:P, Species	-452.4	0.83
N, P, NxP, Species	-451.8	0.83
N, N:P, Species	-451.0	0.82

All top models included N, Species and either P or N:P

N stimulates C loss



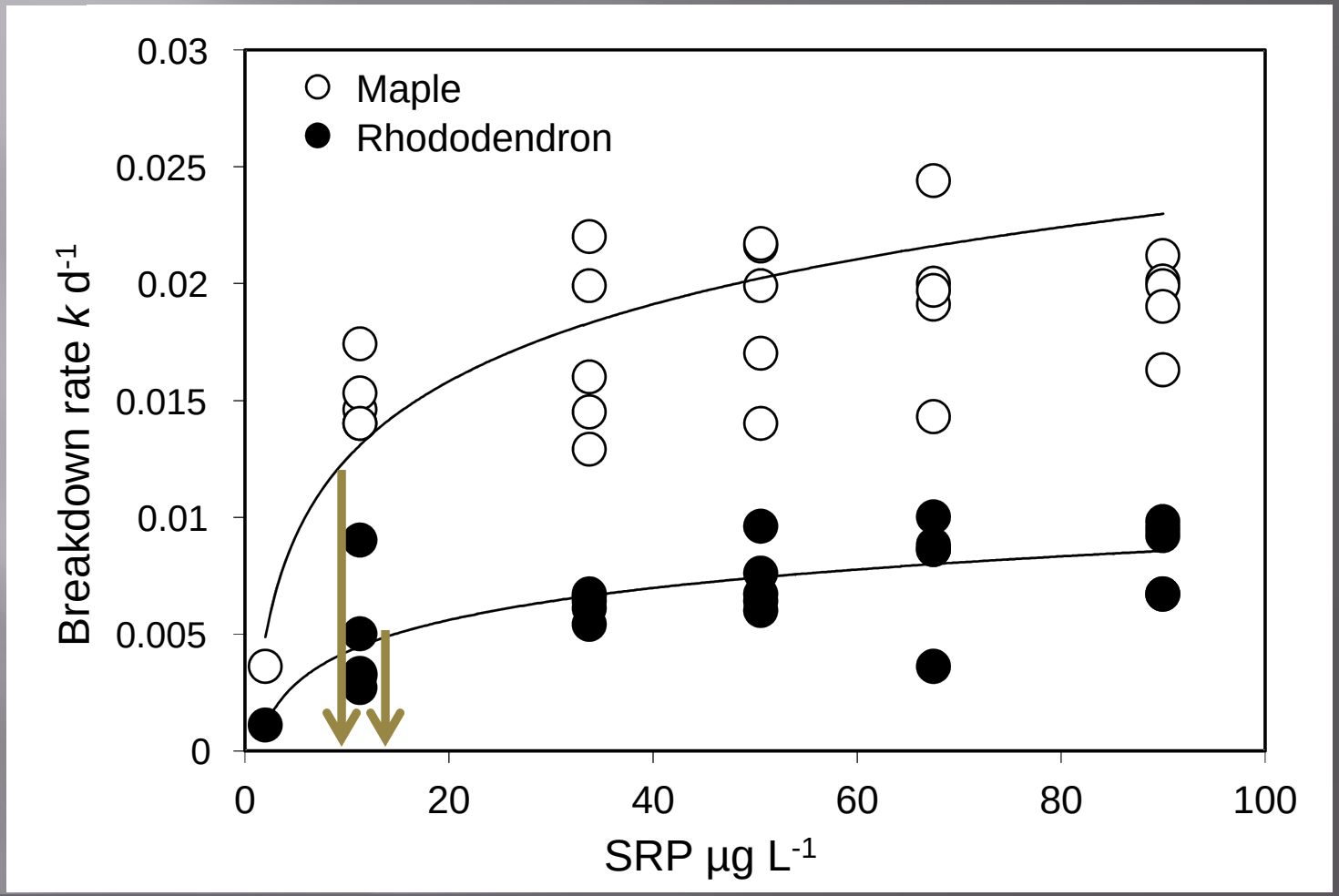
K_m Maple = 183 µg L^{-1}

K_m Rhodo = 261 µg L^{-1}

M-M fit, Maple R^2 = 0.54

M-M fit, Rhodo R^2 = 0.49

P stimulates C loss



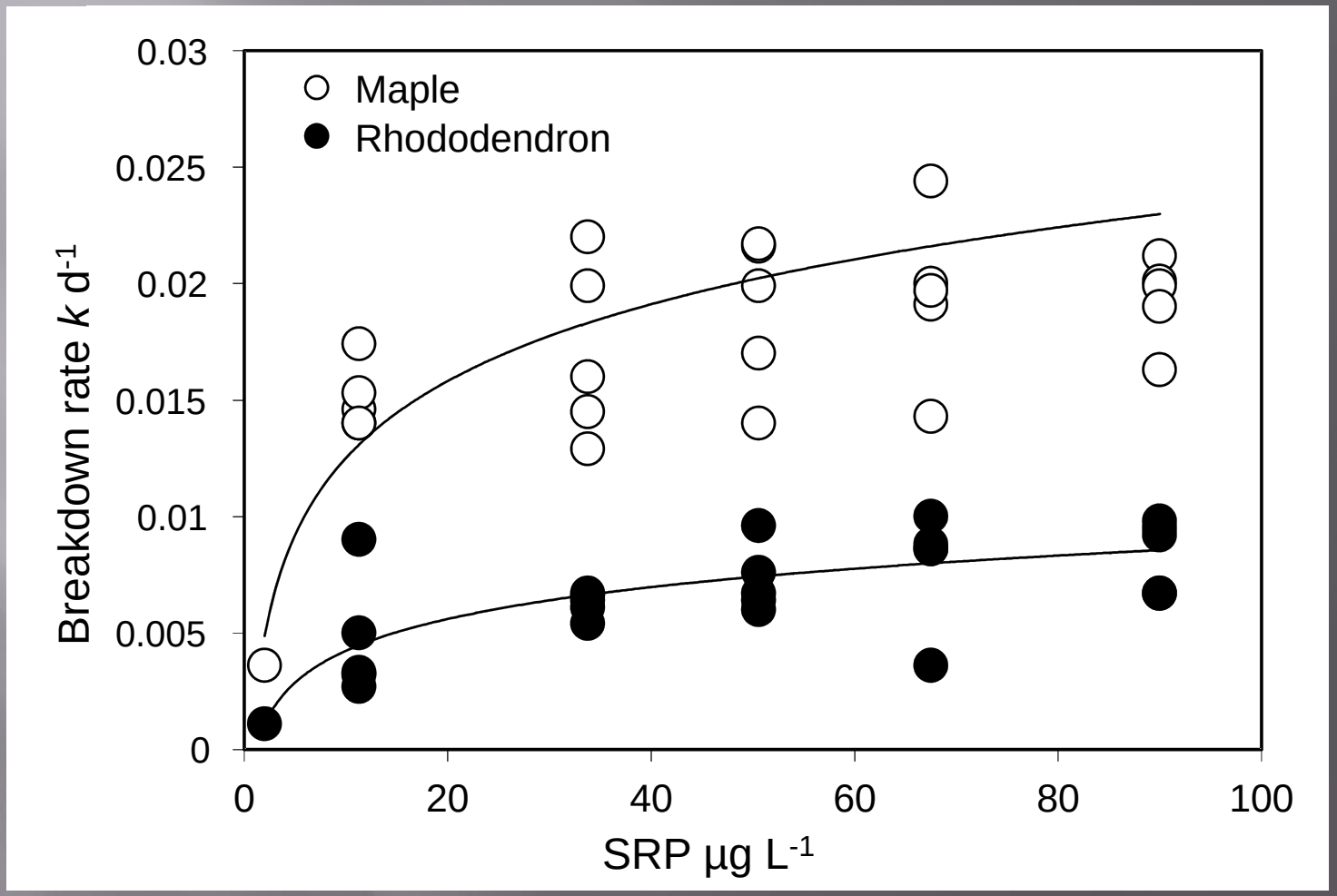
K_m Maple = 10.3 µg L^{-1}

K_m Rhodo = 14.1 µg L^{-1}

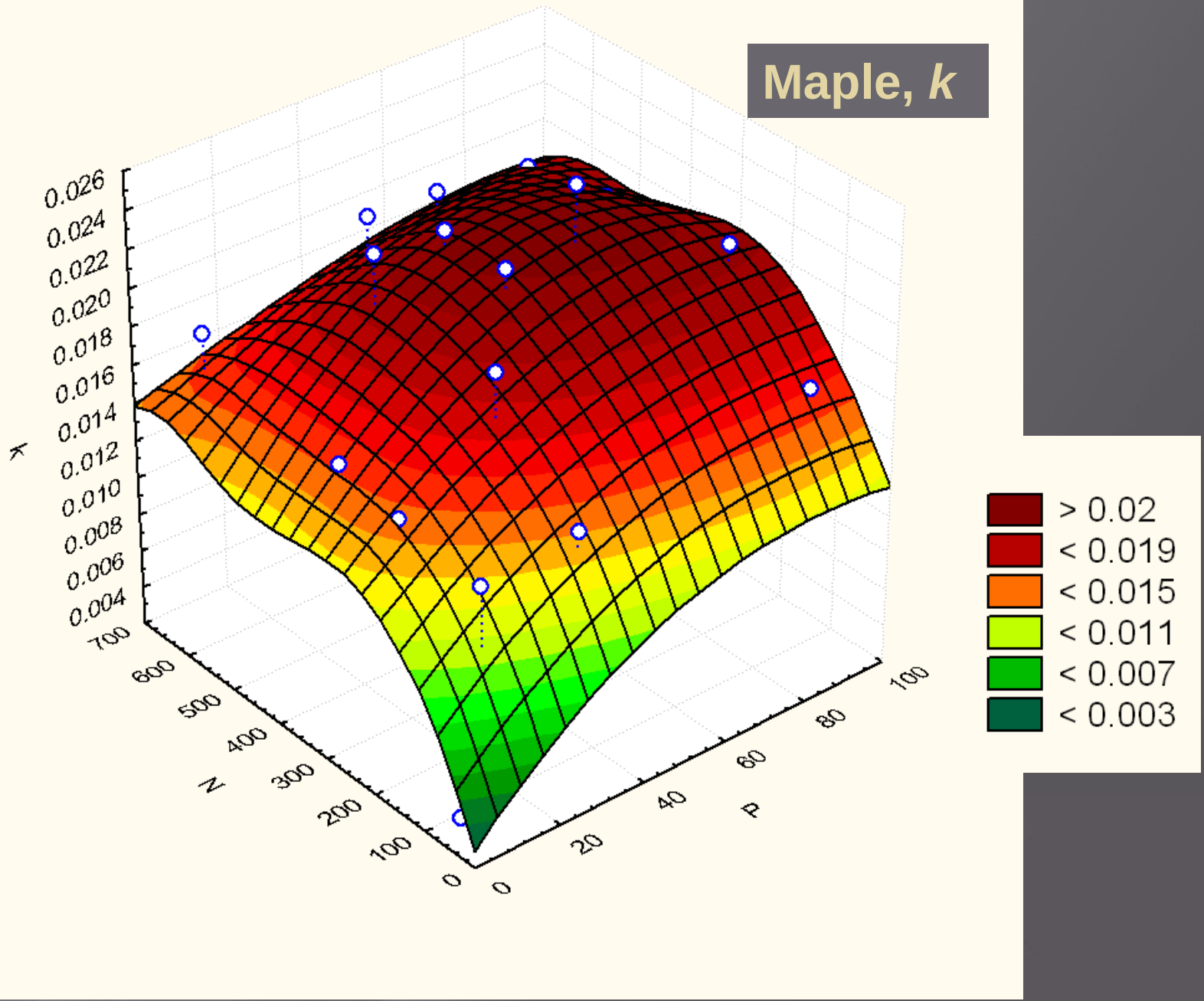
M-M fit, Maple R^2 = 0.93

M-M fit, Rhodo R^2 = 0.89

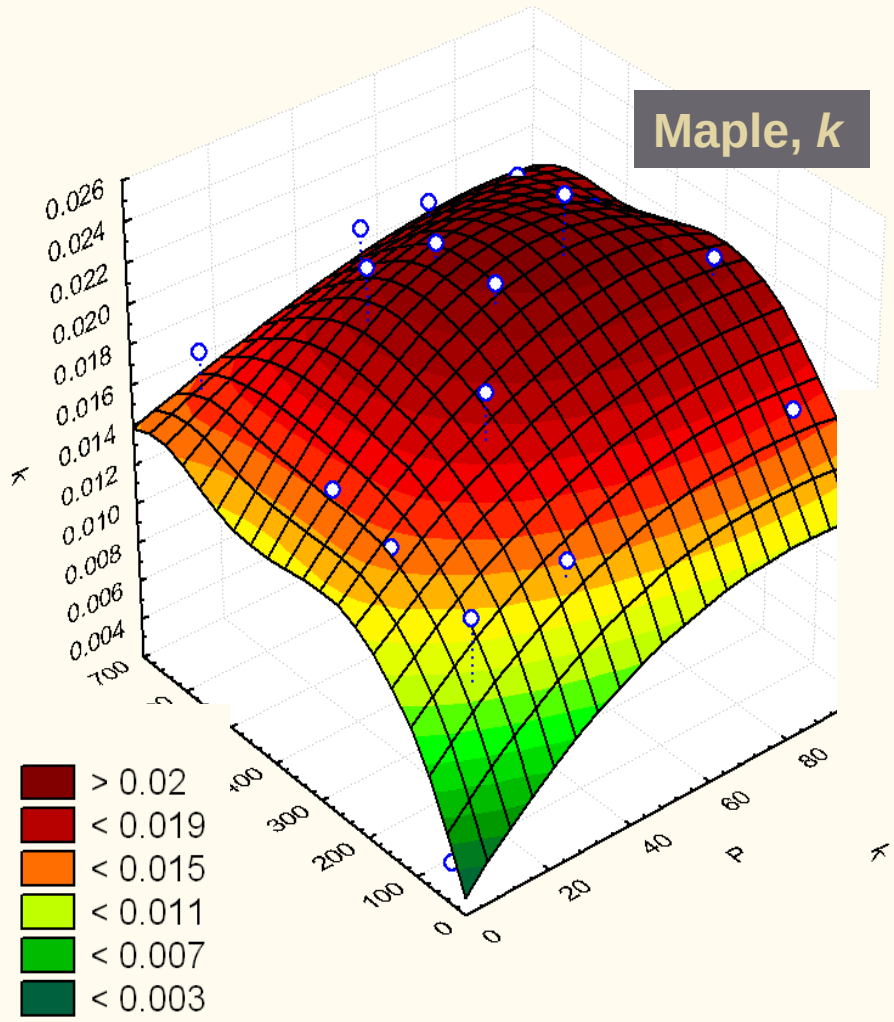
P stimulates C loss



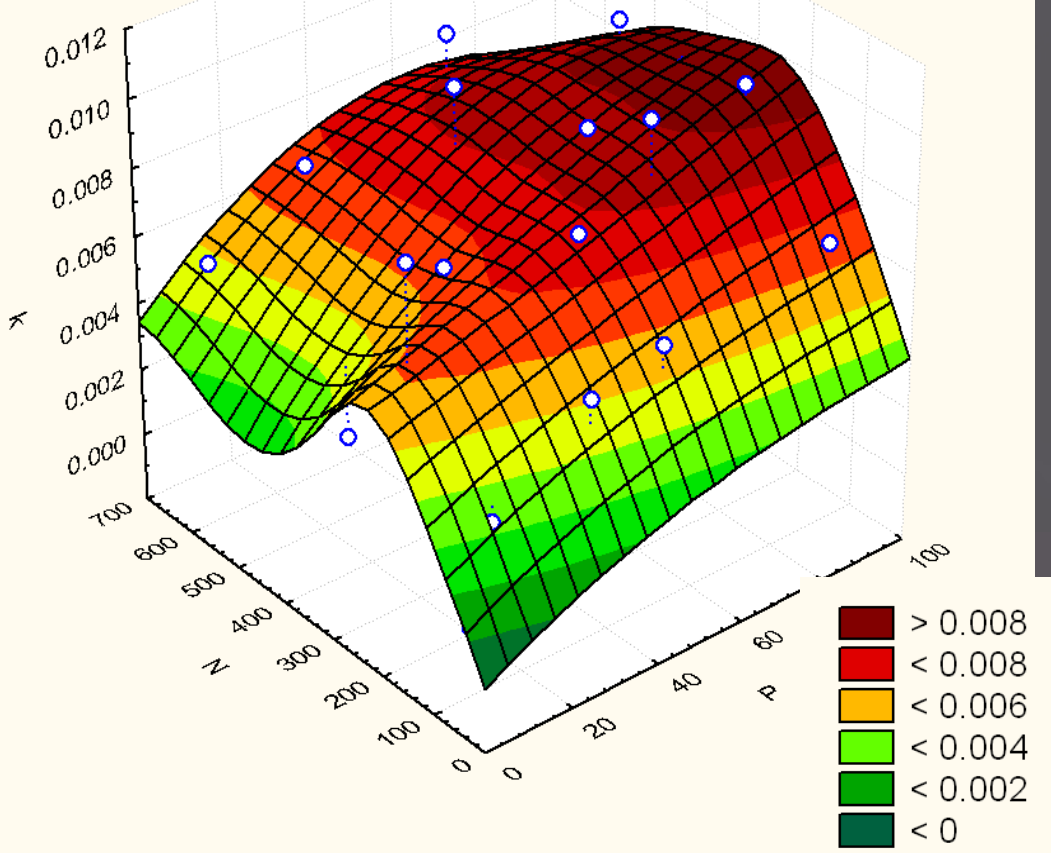
Maple, *k*


k
0.026
0.024
0.022
0.020
0.018
0.016
0.014
0.012
0.010
0.008
0.006
0.004
N
700
600
500
400
300
200
100
0
P
0
20
40
60
80
100
> 0.02
< 0.019
< 0.015
< 0.011
< 0.007
< 0.003

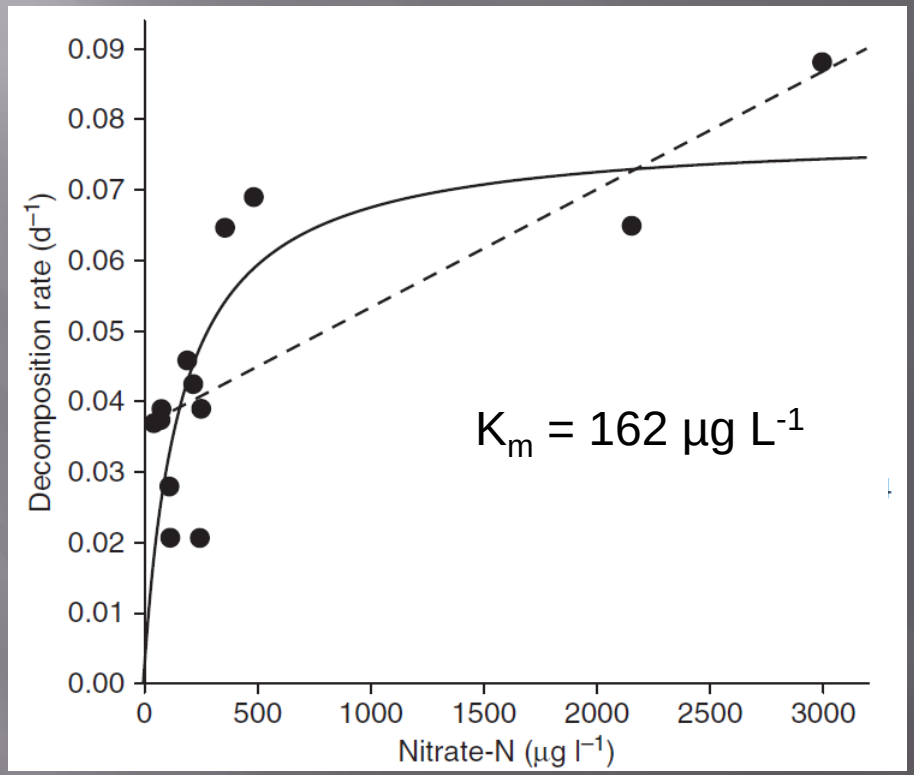
Maple, *k*



Rhododendron, *k*

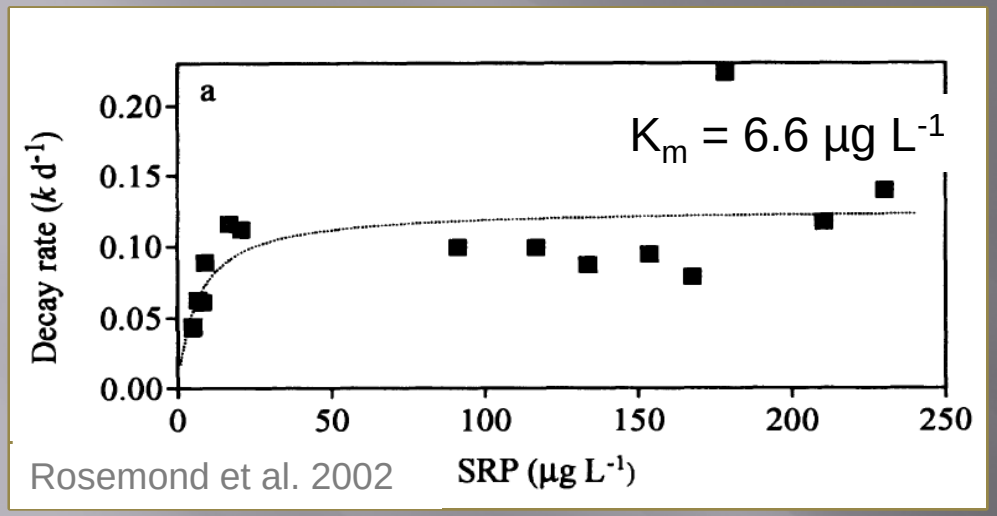


Similar K_m's from other studies, N



Gulis et al. 2006a

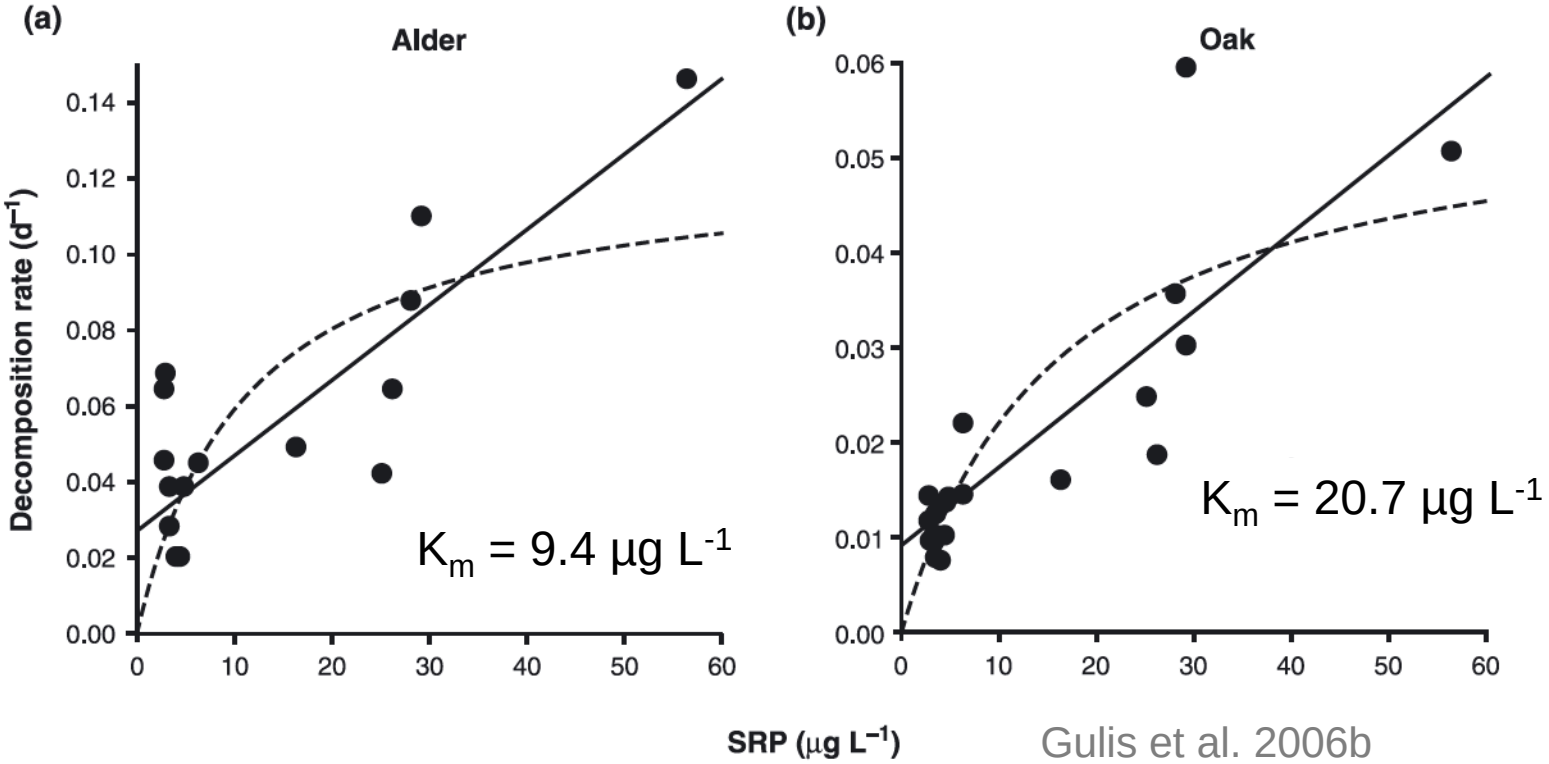
This study: 183, 261 µg L^{-1}



Rosemond et al. 2002

1. Similar K_m's from other studies, P (7, 9, 21 ~ 10, 14)

2. $K_{m\text{-Recalcitrant}}$ > $K_{m\text{-Labile}}$



Gulis et al. 2006b

Responses of Maple vs Rhododendron

	Maple	**Rhododendron**
k Control vs Enriched	↑ 6.7x	↑ 9.1x
K_m P µg L^{-1}	10.3	14.1
K_m N µg L^{-1}	183	261

Contributions to stressor-response relationships for nutrient criteria

N, P co-limit carbon loss

Saturate at low concentrations, similar to published values

Recalcitrant carbon sources:

- greater response to enrichment
- saturate at higher concentrations

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