

Role of Labile DOC in Phosphate Uptake In Plankton Communities

Bob Heath

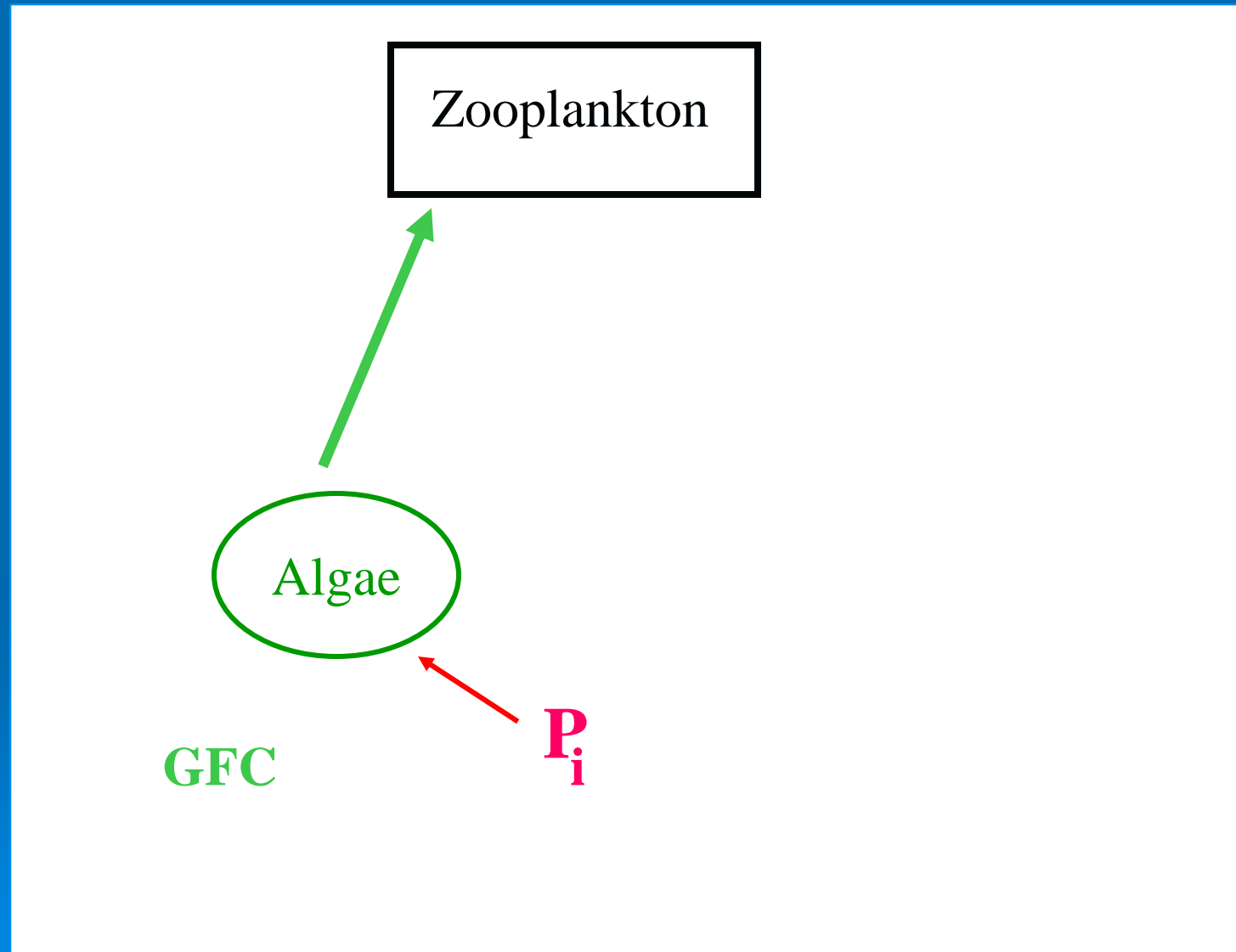
Water Resources Research Institute

Kent State University

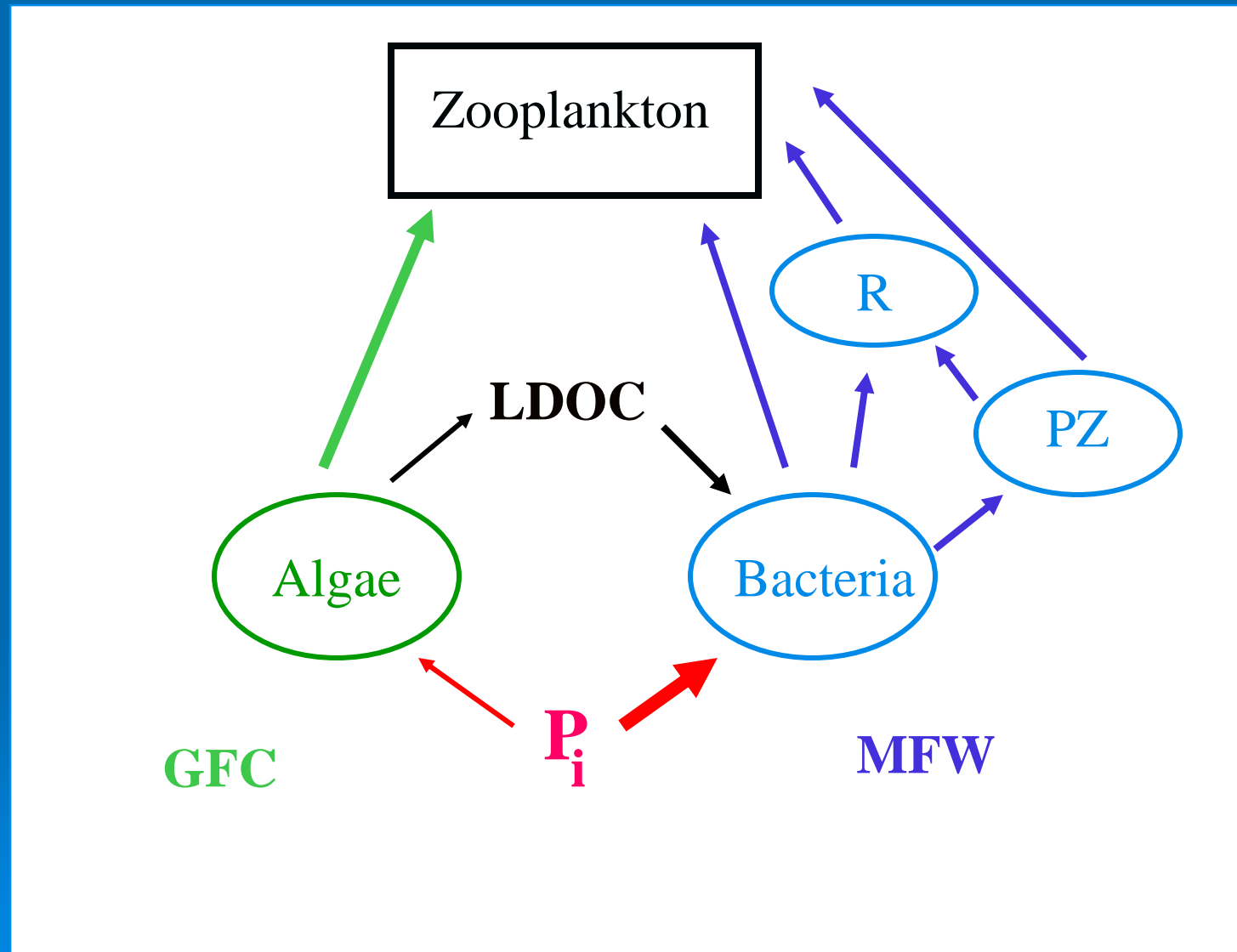
IJC – Council of Great Lakes Research Managers

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Phosphate Uptake by Algae



Phosphate Uptake by Algae and Bacteria



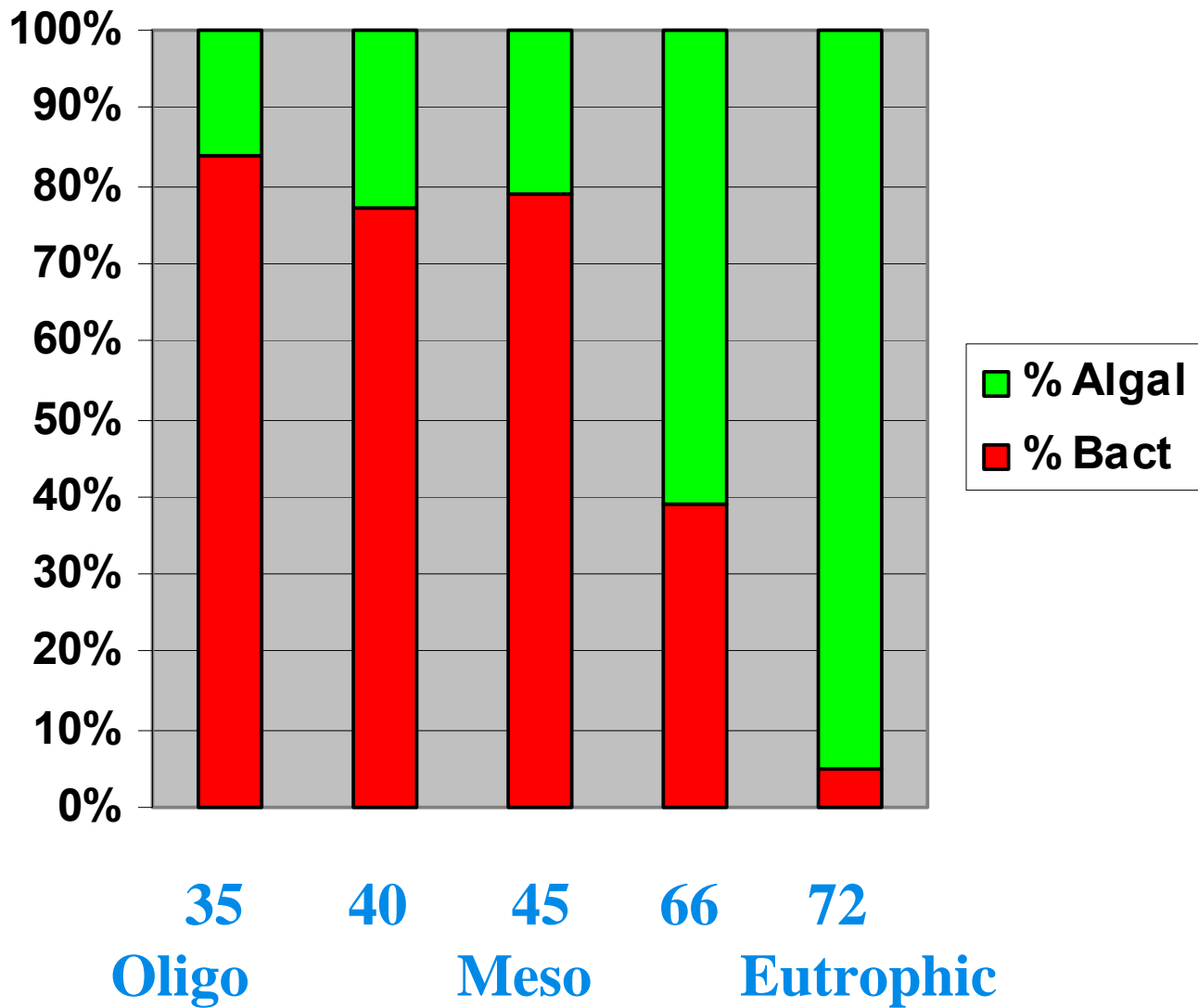
Premise

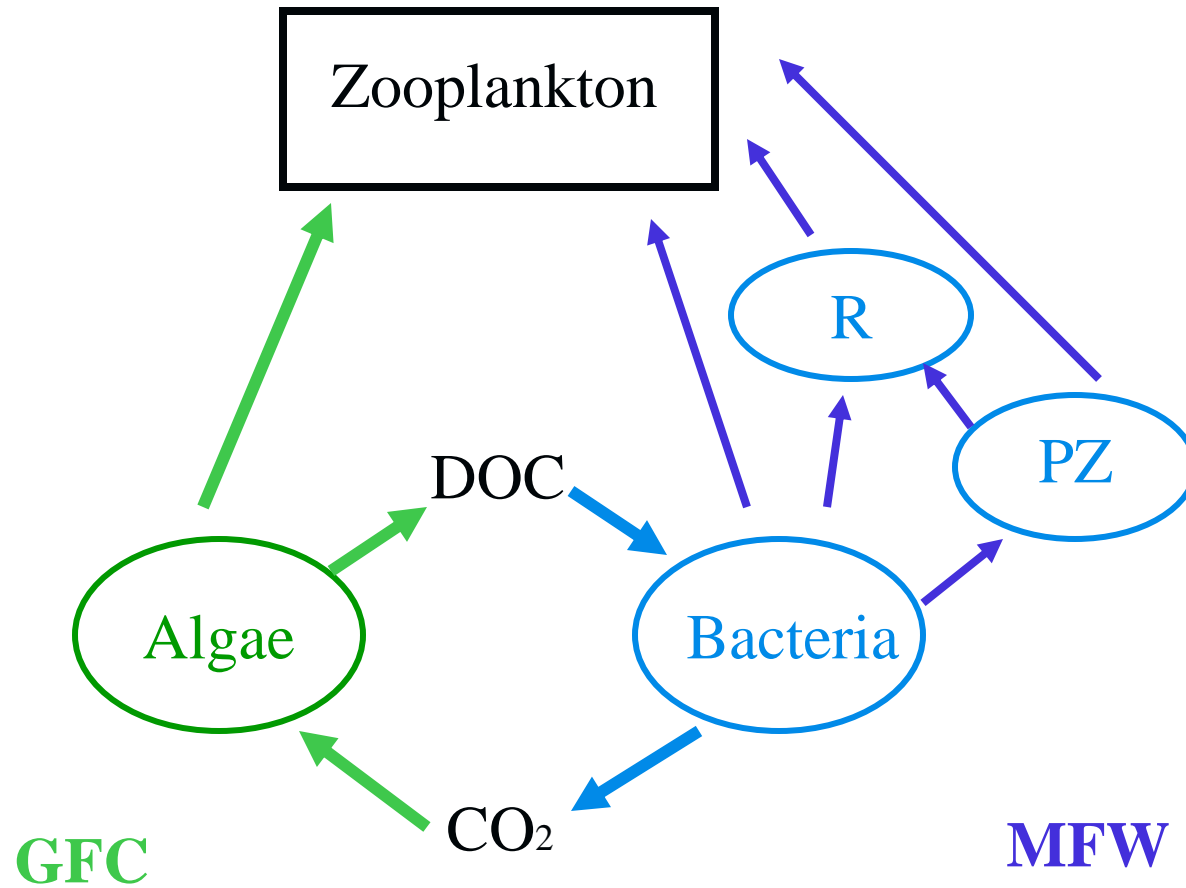
G-Y Rhee (1972):

- Bacteria compete with phytoplankton for P_i , altering the P-available to phytoplankton
- Phytoplankton could NOT compete with bacteria for available P

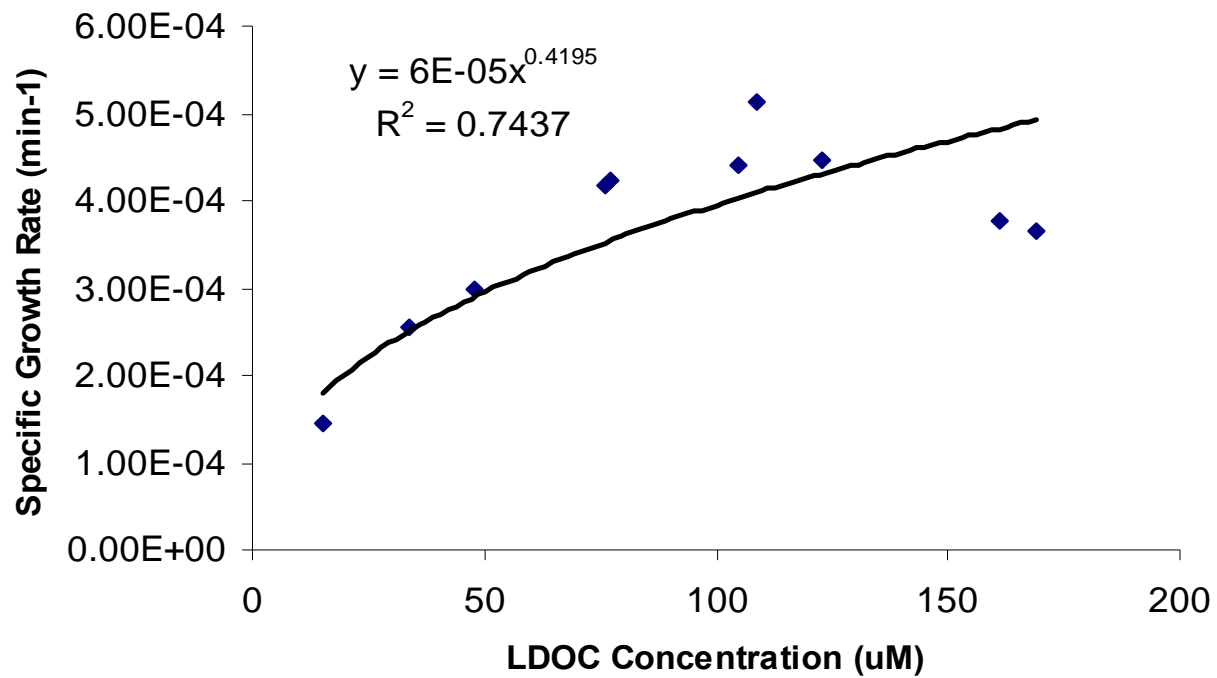
Implies: P_i allocation may vary according to bacterial presence or status.

Percent PO₄ Uptake

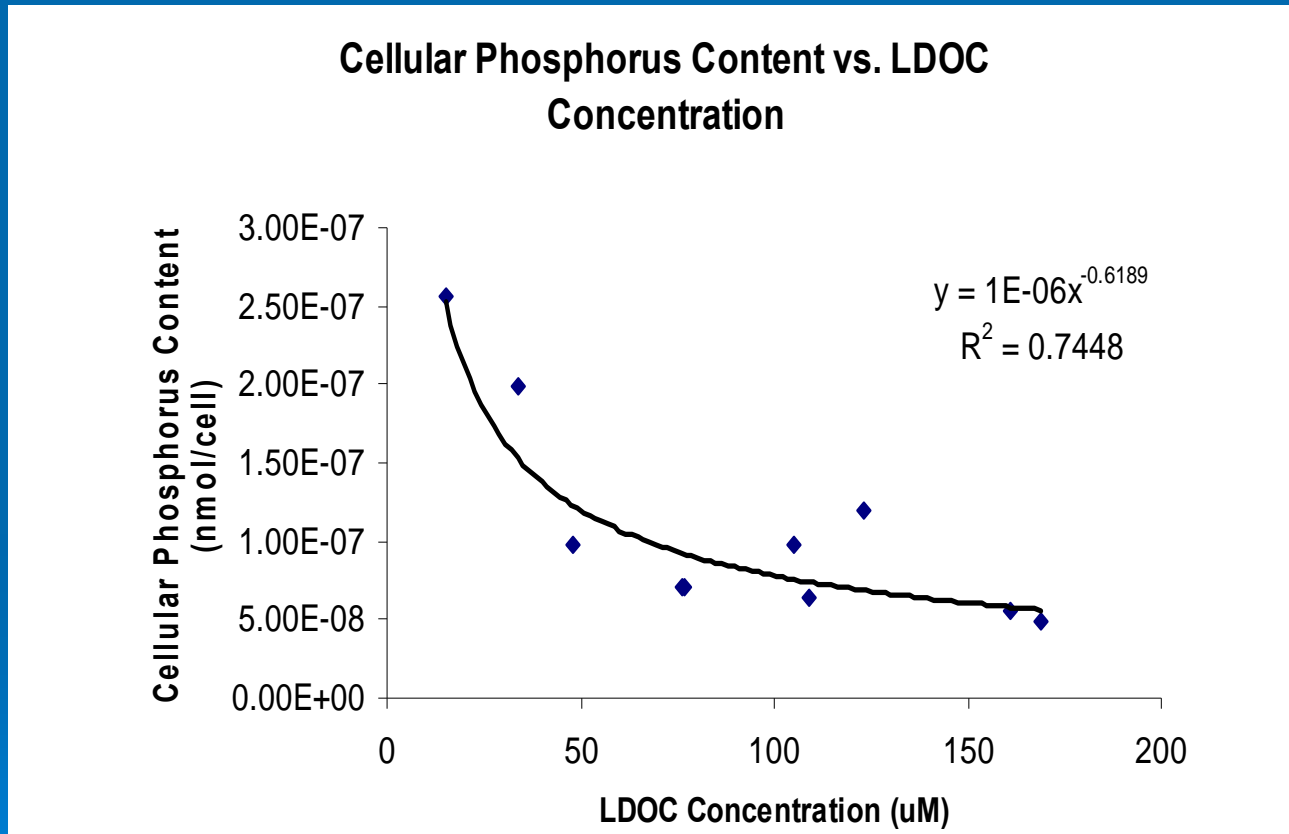




Specific Growth Rate vs. LDOC Concentrations

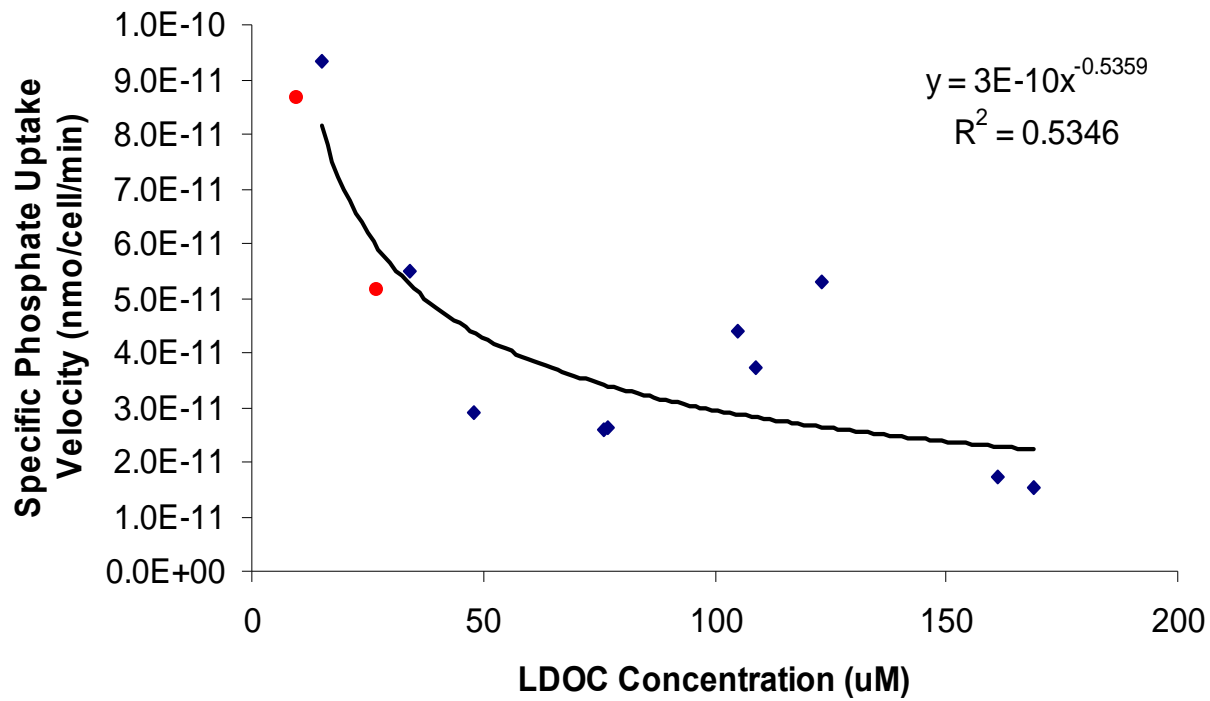


LDOC controls bacterial cell P content and uptake rate of P_i

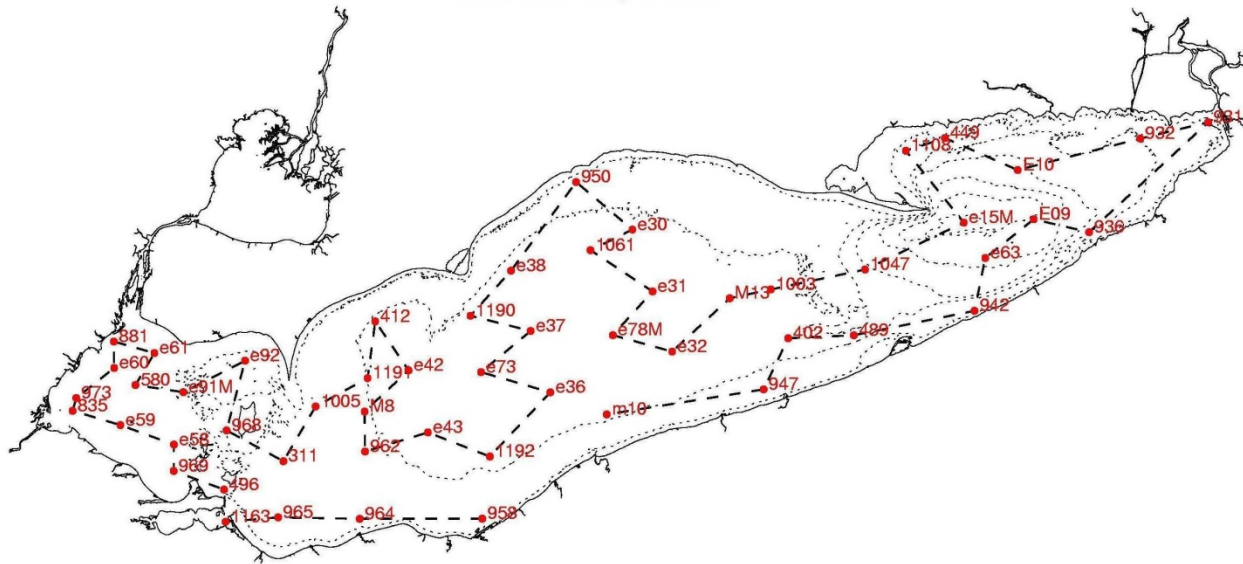


Gao, X. and RTH (2005) JGLR Special Issue on L/E Trophic Status

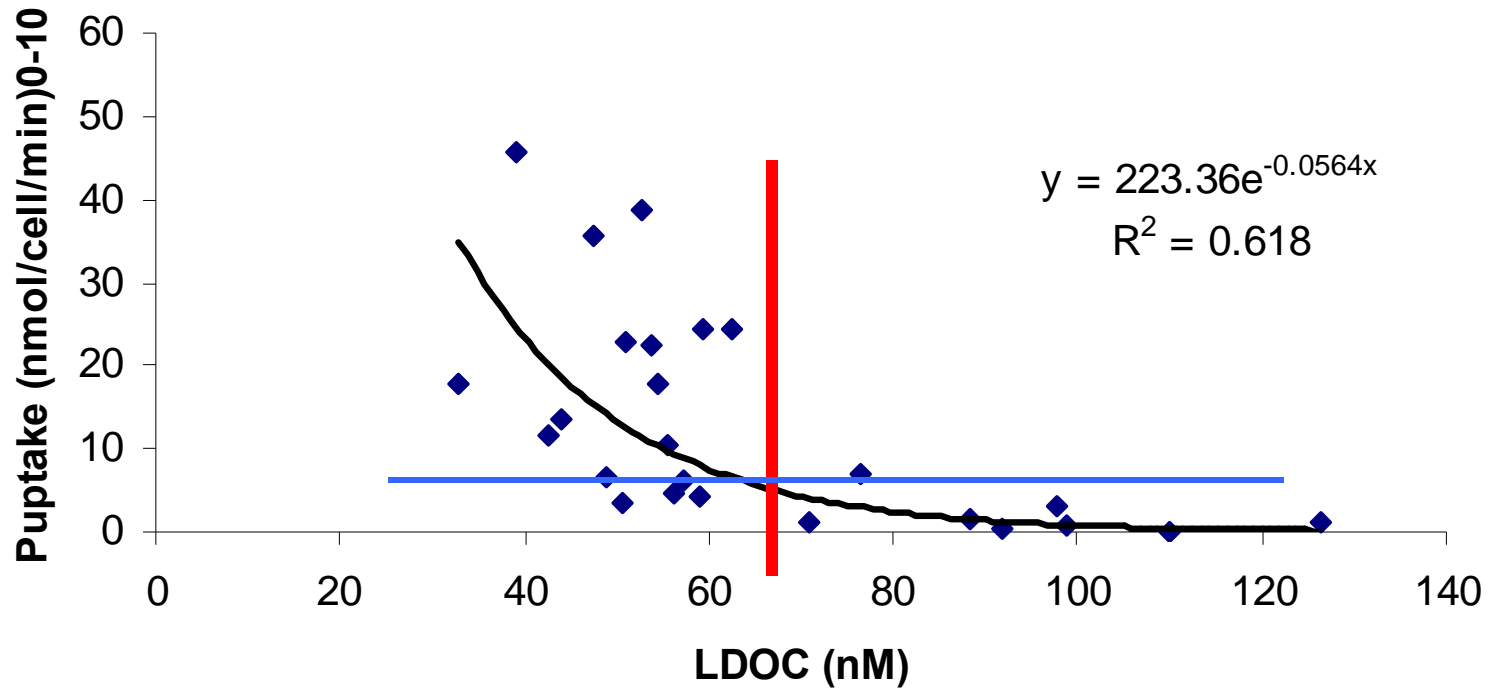
Specific Phosphate Uptake vs. LDOC Concentration



IFYLE 2005
Lake Erie July cruise



LDOC vs. Phosphate Uptake - Summer 2004



TDOC (μM)	LDOC (μM)	K_m (nM)	V_{max} (fmol/cell/h)
534 \pm 3	109 \pm 6	33 \pm 5	0.066 \pm 0.006
230 \pm 15	15 \pm 3	14 \pm 7	0.120 \pm 0.010

as LDOC increases:

- K_m increases and V_{max} decreases
- **Phosphate uptake velocity decreases**

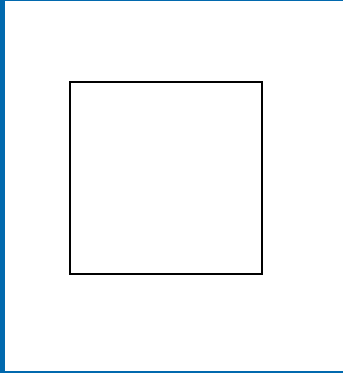
Nutrient Use Efficiency

Low L D O C

- High cell-P content
- Rapid P_i uptake
- Most P_i goes to bacteria
- Bacterial growth slow

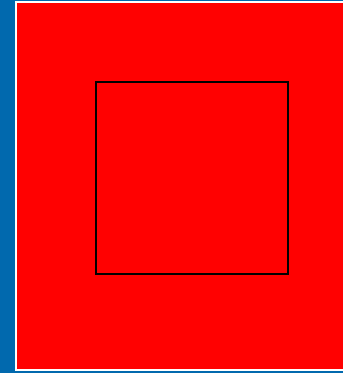
High L D O C

- Low cell-P content
- Slow P_i uptake
- Much P_i goes to algae
- Bacterial growth fast



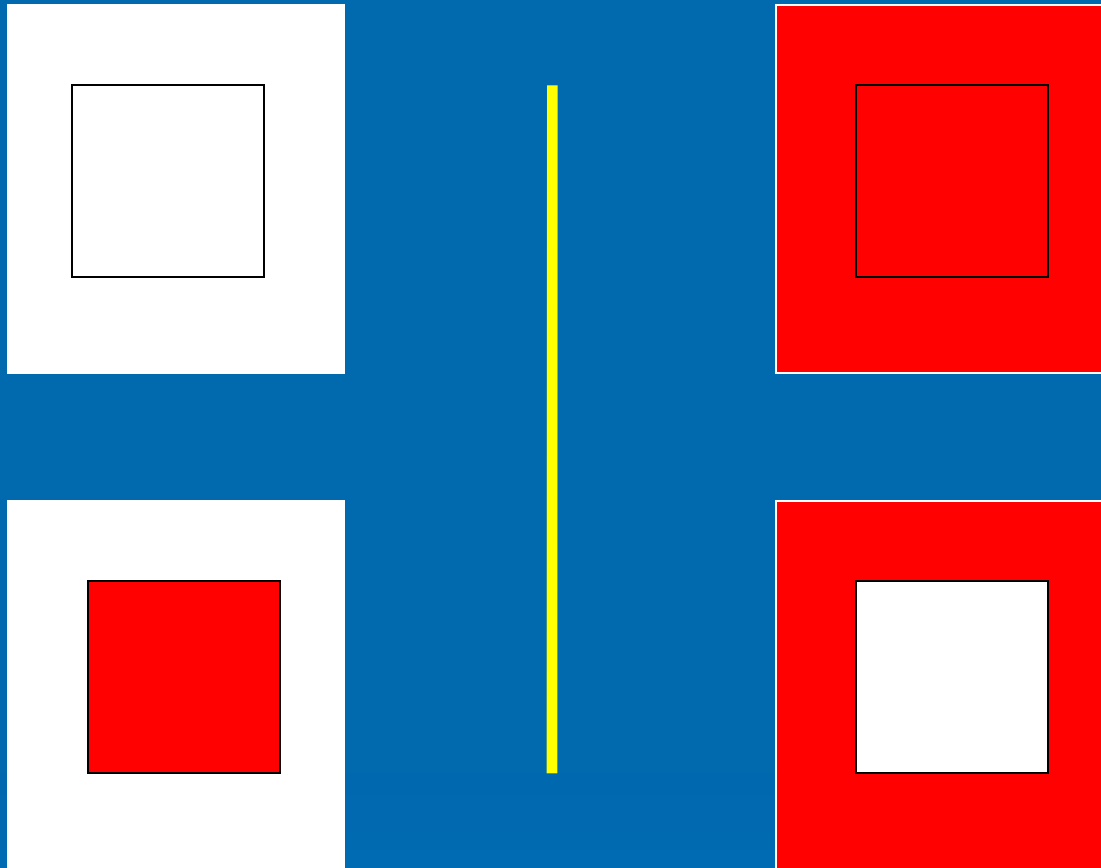
Low LDOC

**Rapid P-up
High P-quota**



High LDOC

**Slow P-up
Modest P-quota**



Dialyzed assemblage vs. filtered water – 24 Hrs
Determined P-uptake and P-quota

Take-home lessons . . .

- **Bacteria control apportionment of P to phytoplankton**
- **LDOC controls bacterial P-uptake rate**
- **Physiological response not a taxonomic characteristic**