Plankton dynamics in mesotrophic reservoirs of the Colorado River system, Texas

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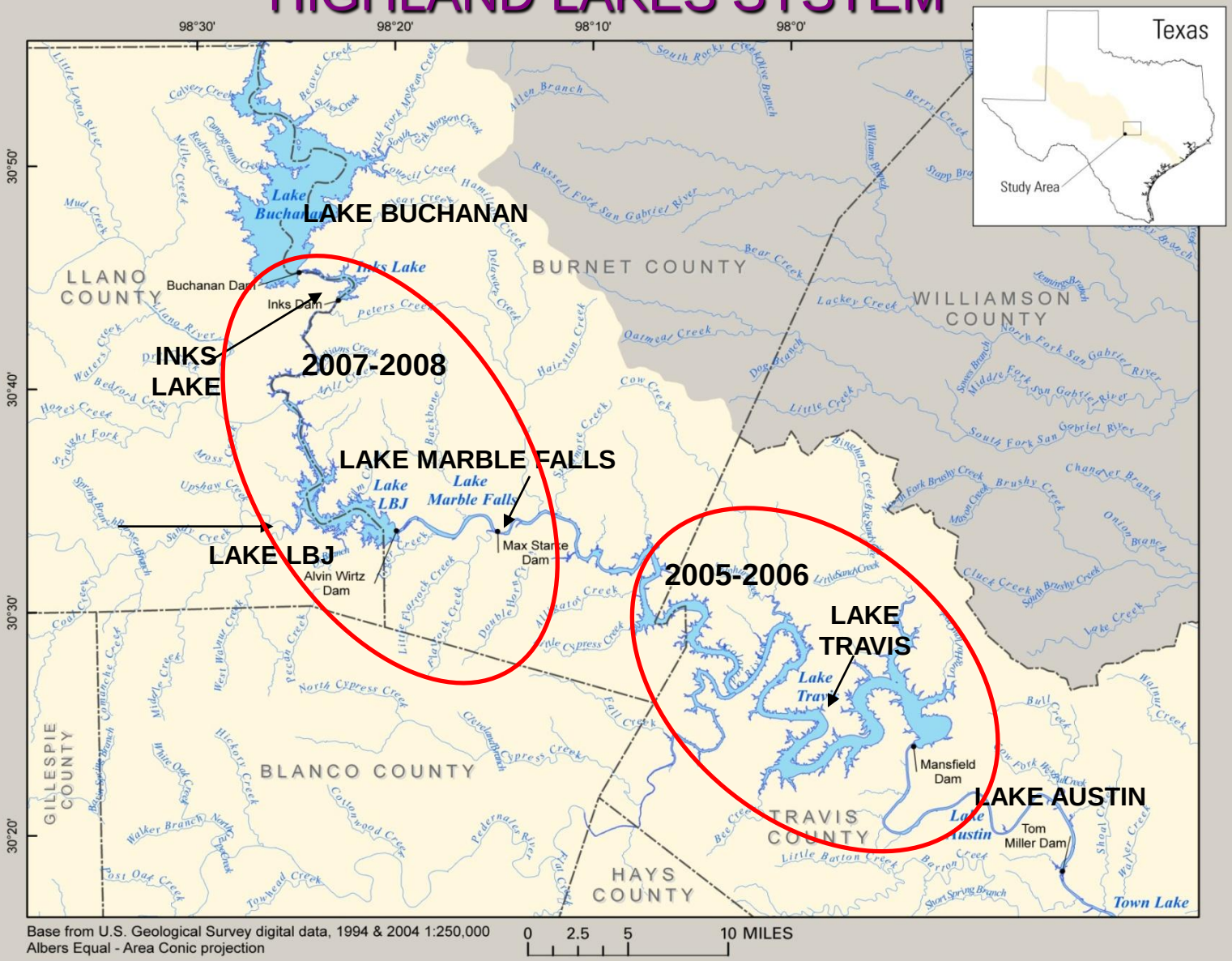
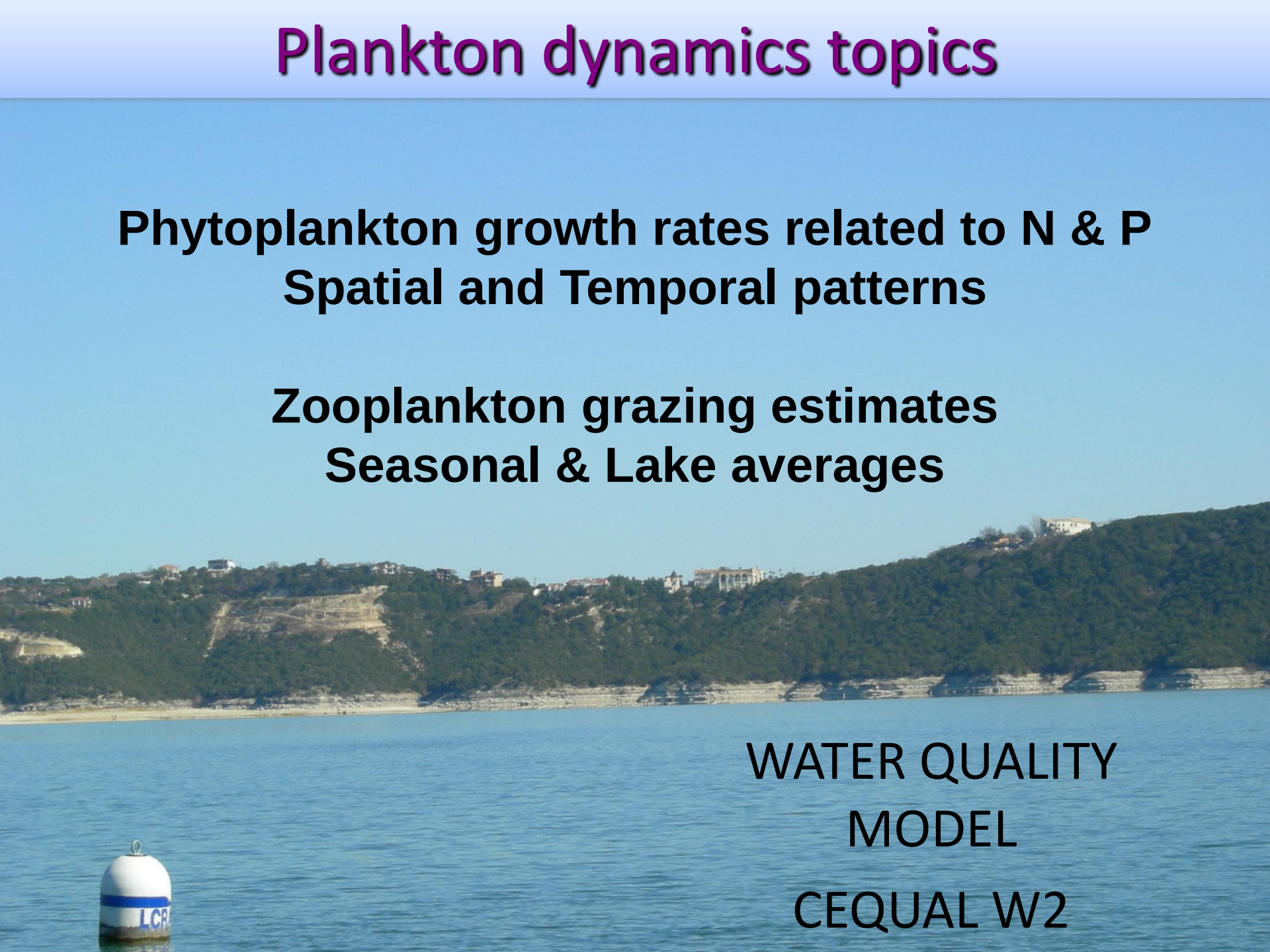
HIGHLAND LAKES SYSTEM



Map by USGS

Plankton dynamics topics



Phytoplankton growth rates related to N & P
Spatial and Temporal patterns

Zooplankton grazing estimates
Seasonal & Lake averages

WATER QUALITY MODEL

CEQUAL W2

Phytoplankton Bioassays - Methods

Treatments:

1) Control (ambient)
2) Nitrogen (N),
3) Phosphorus (P)
4) N+P

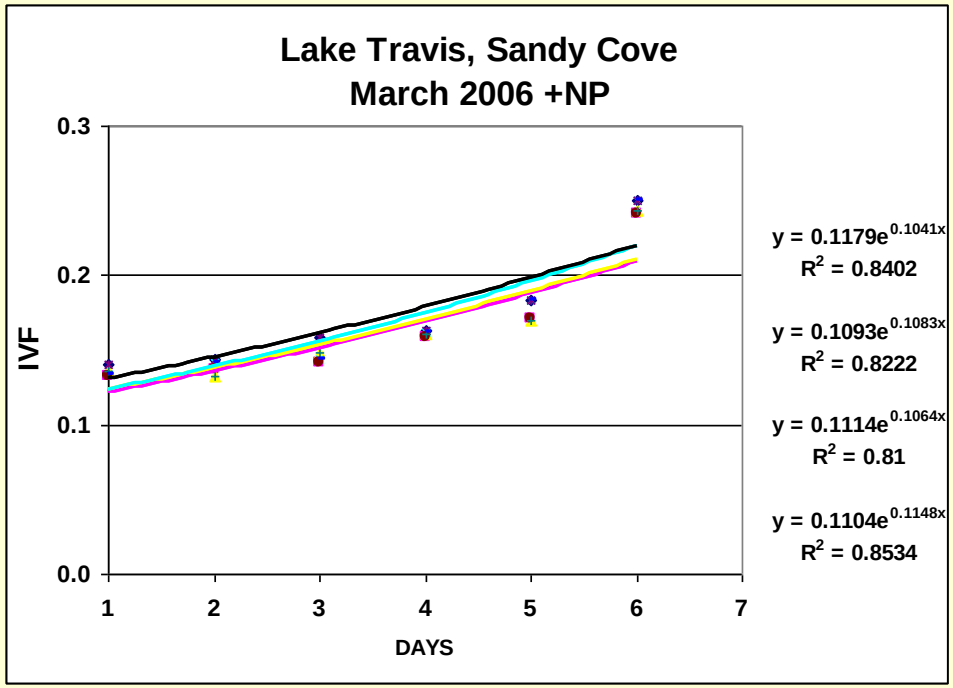
Measure Chl-a

- *In vivo* fluorescence (IVF)
- Initial & final Chl-a

Plot IVFs

$r = ln(final/initial)/ T$

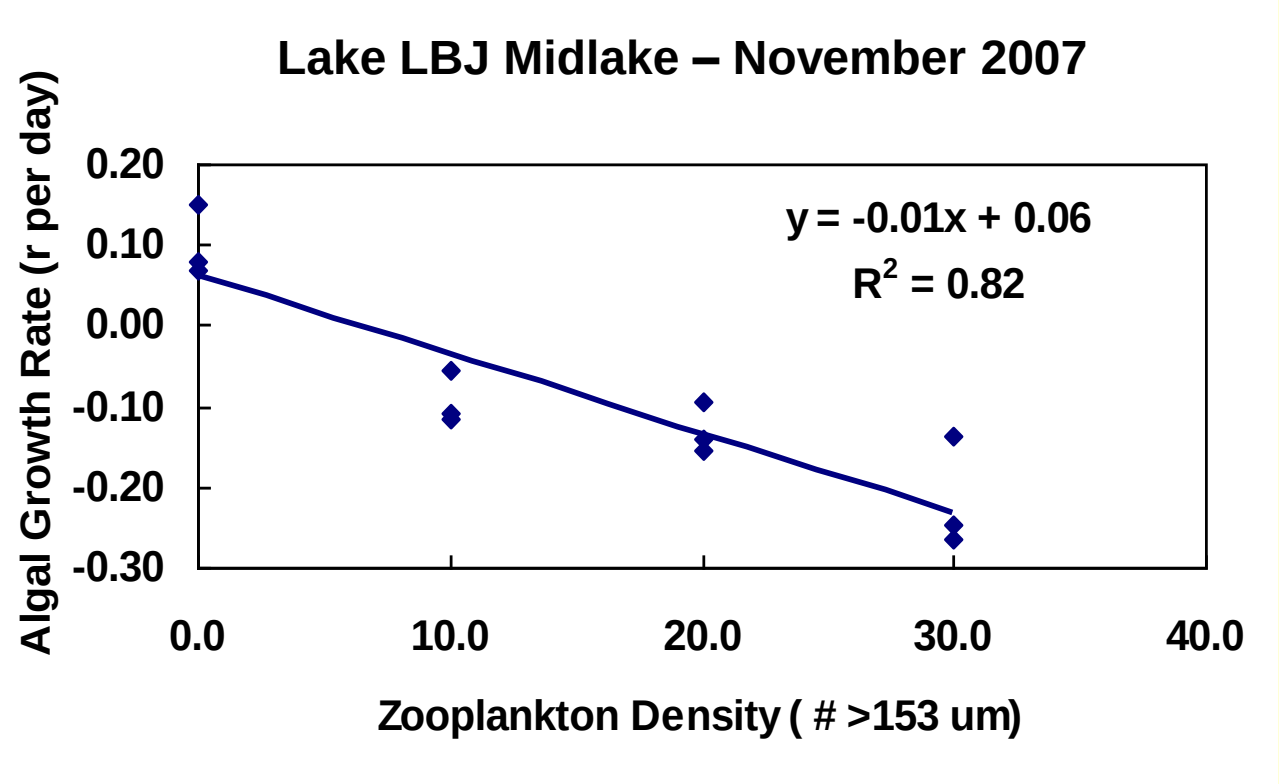
286 bioassays in 26 months at a total of 11 sites



IVF method (Leboulanger et al. 2006)

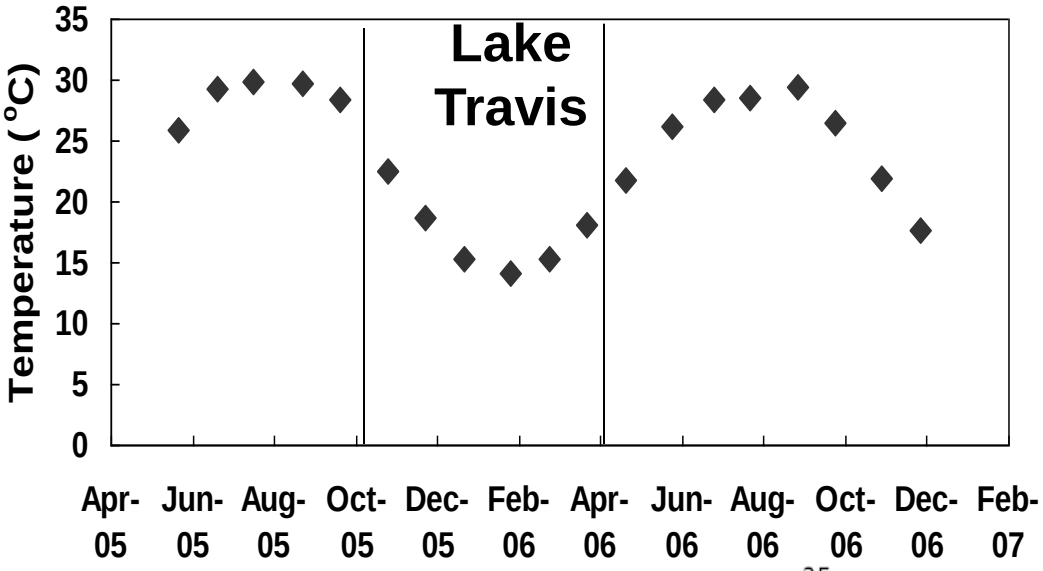
Zooplankton Grazing - Methods

- Collect seasonal zooplankton assemblages
- Prepare grazer density-gradient (copepod dominated)
- **Control** & **1-3X** (~10, 20, and 30 grazers)
- Initial & final Chl-a and IVF, short term (24 h) incubation

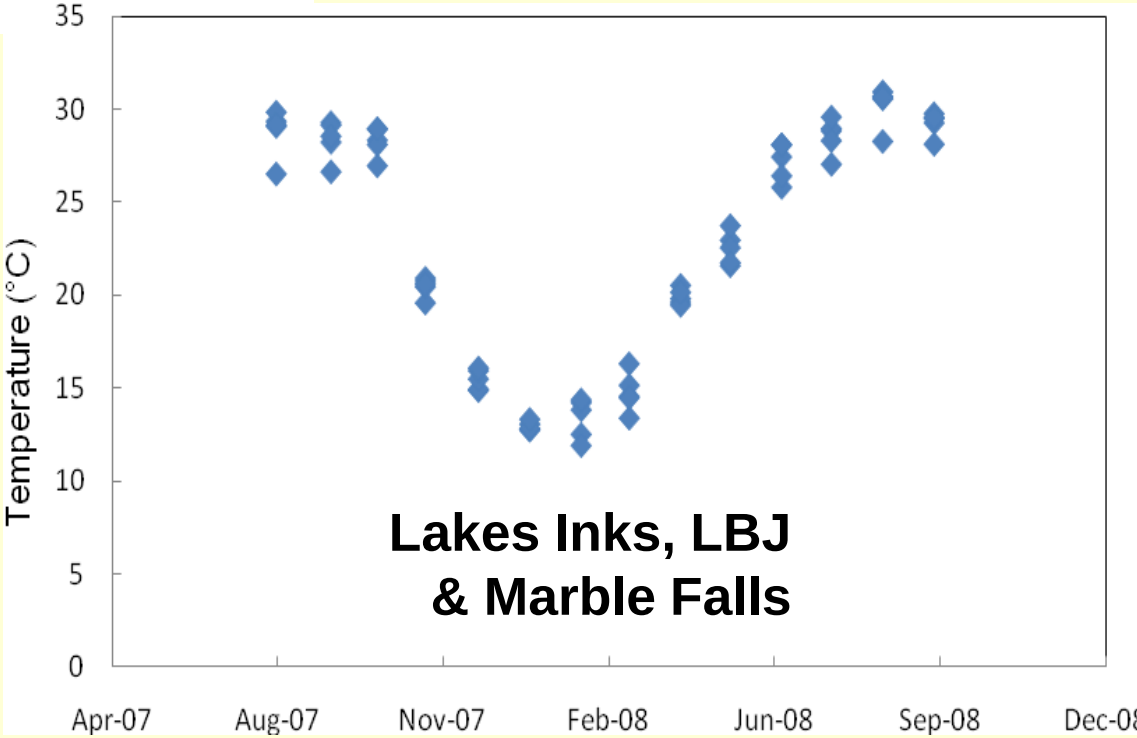


Grazing method (Lehman and Sandgren 1985)

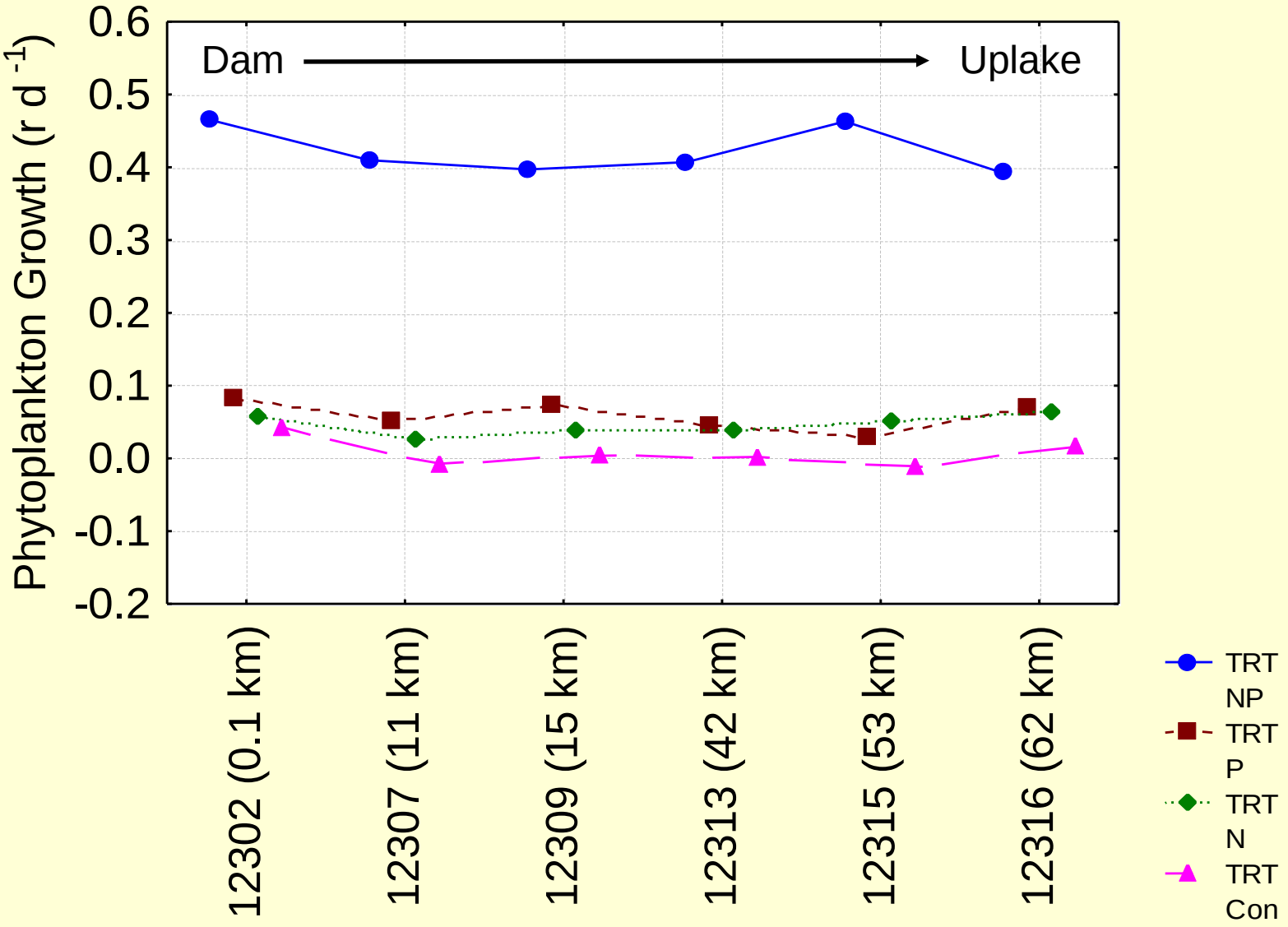
Reservoir Temperature 2005-08



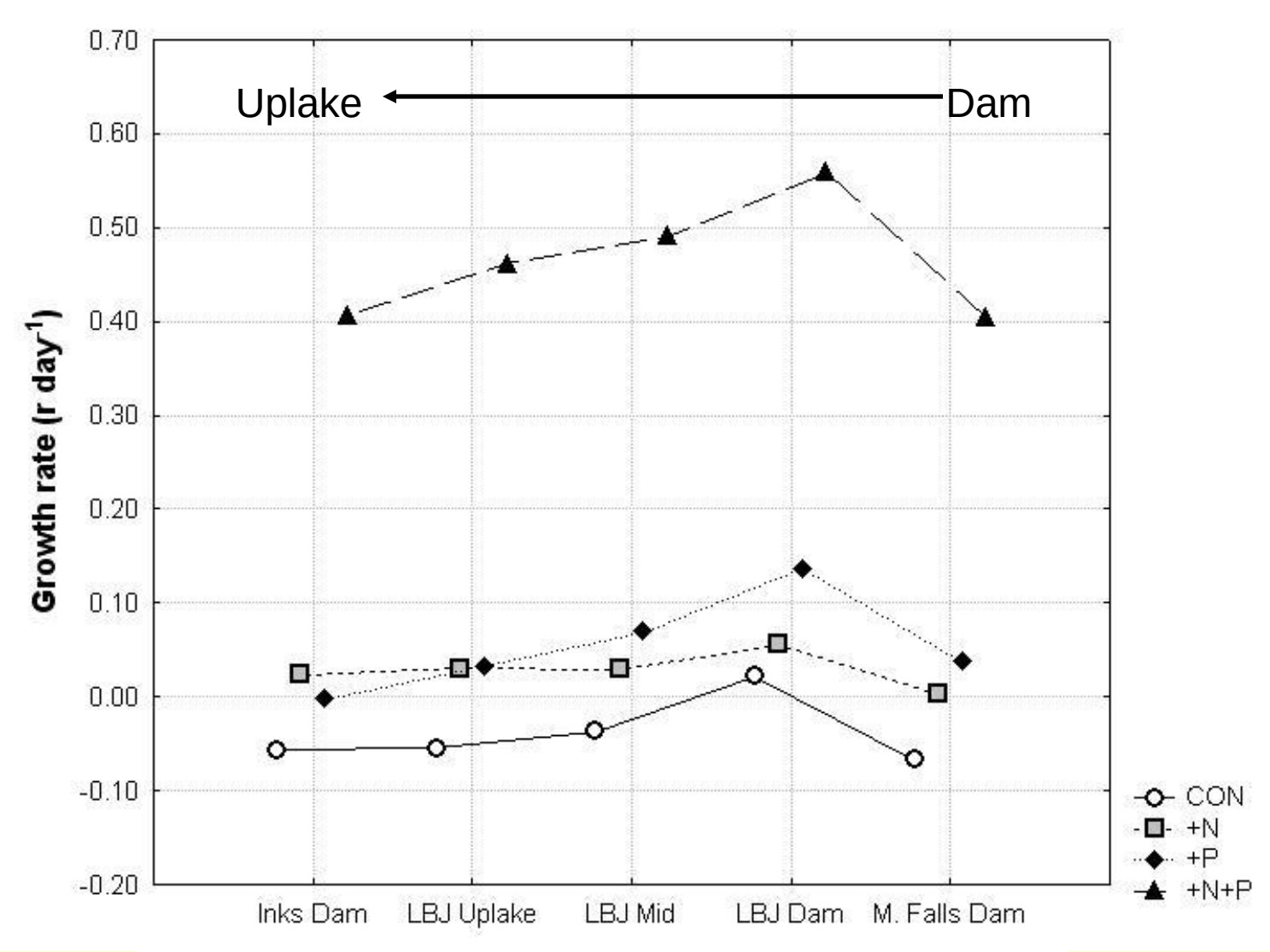
Lake turn-over pattern is monomictic



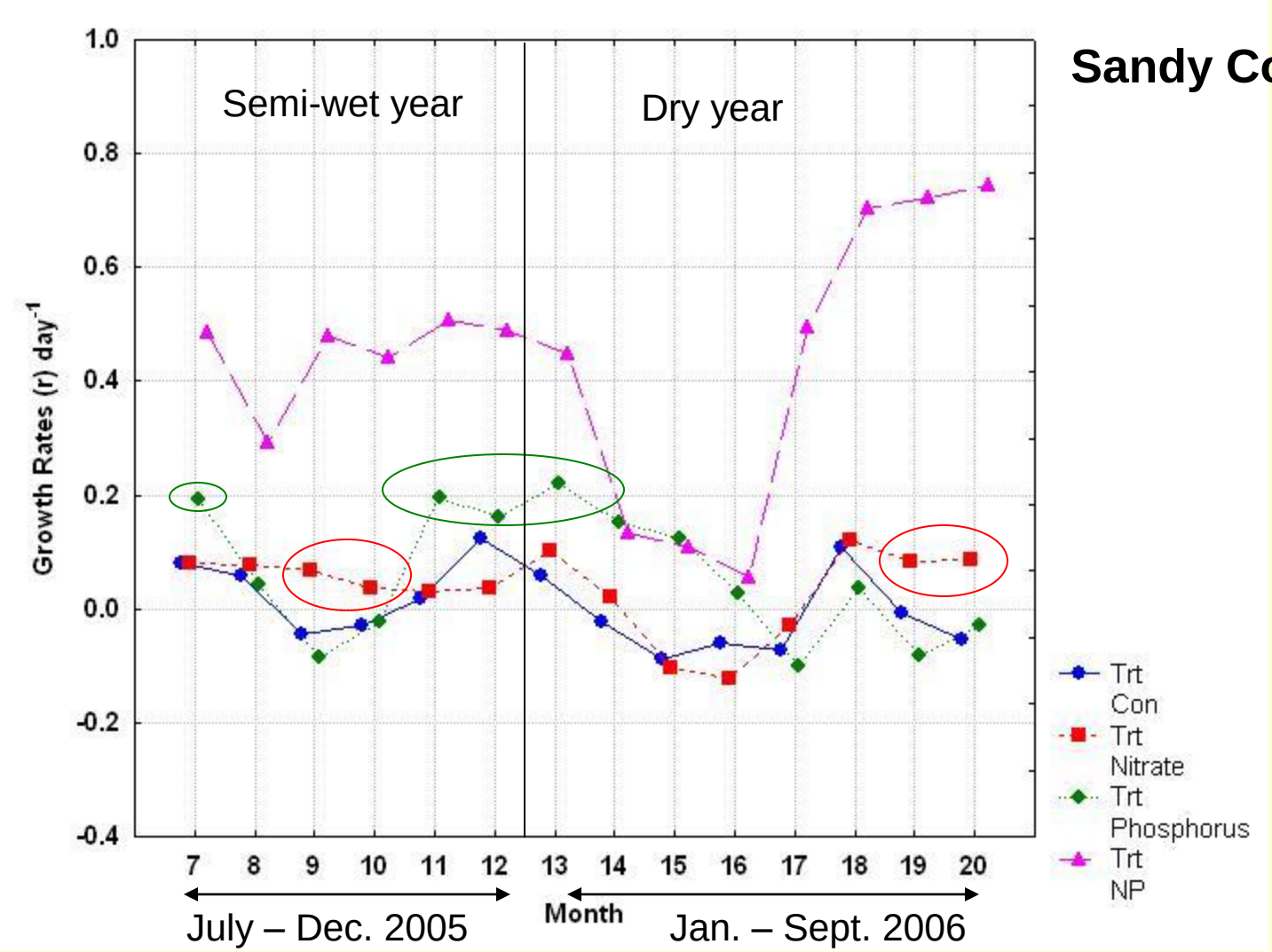
Spatial phytoplankton growth rates – Lake Travis



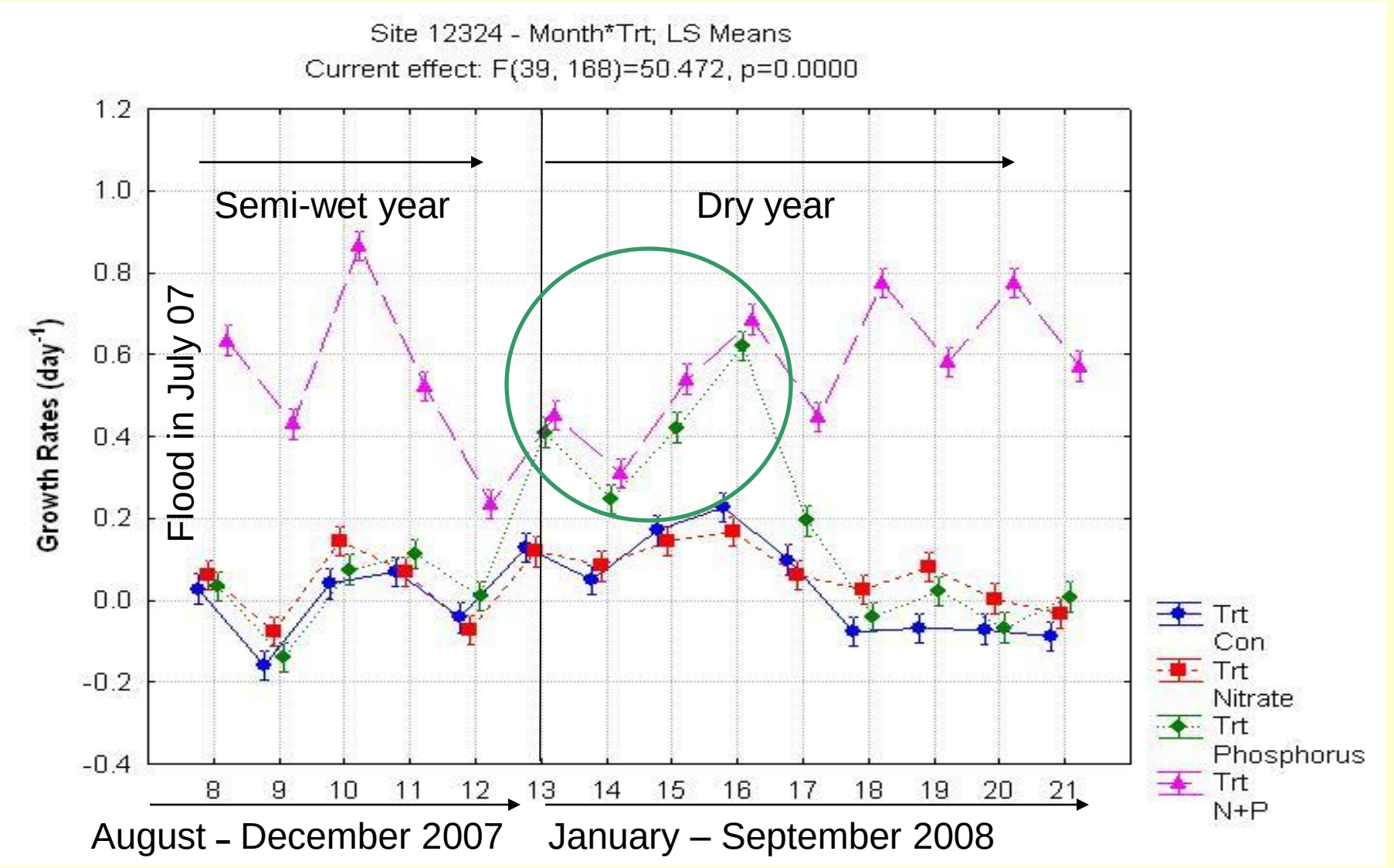
Spatial phytoplankton growth rate patterns – Upstream lakes



Temporal nutrient patterns – Lake Travis



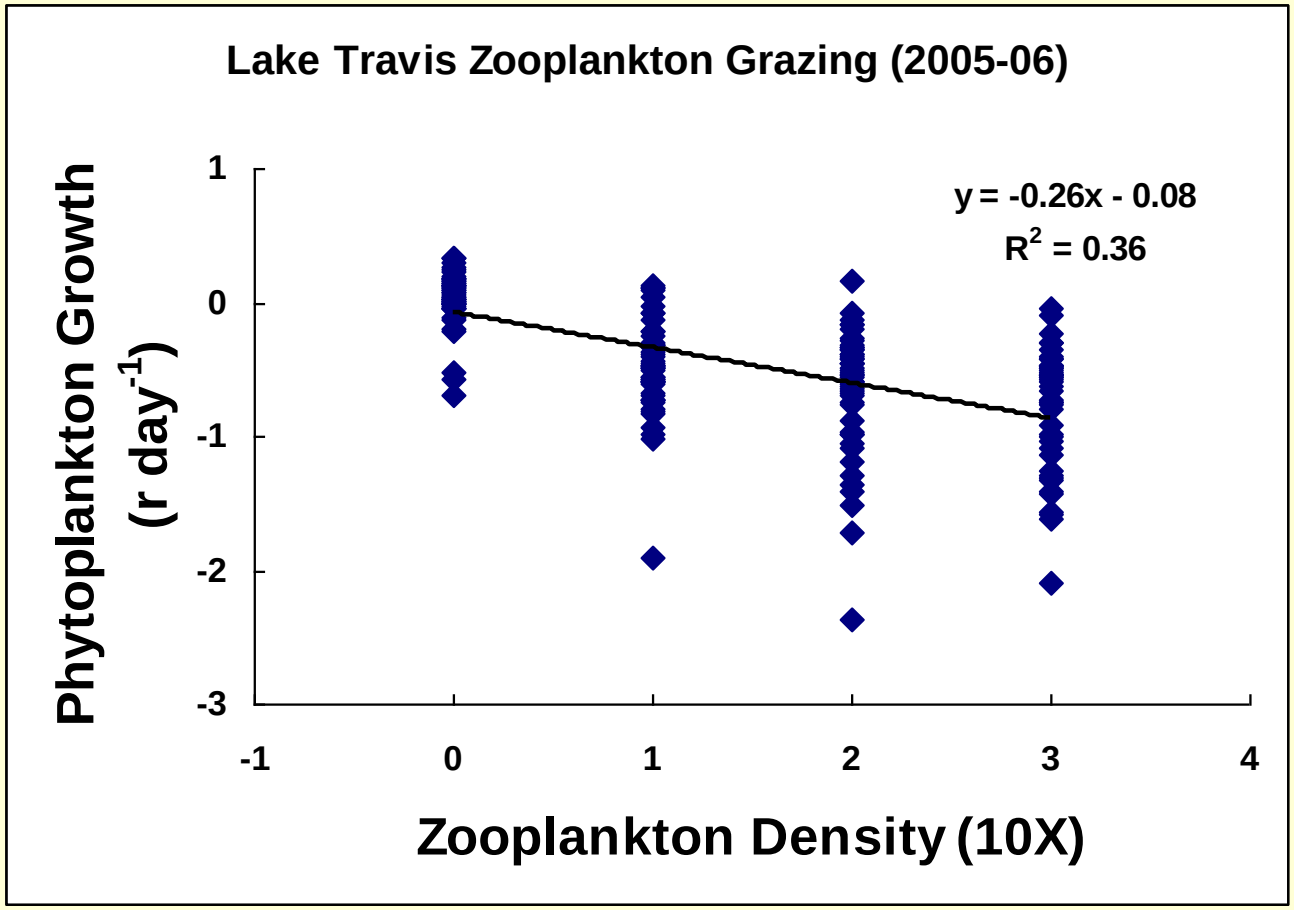
Temporal nutrient patterns – Upstream lakes



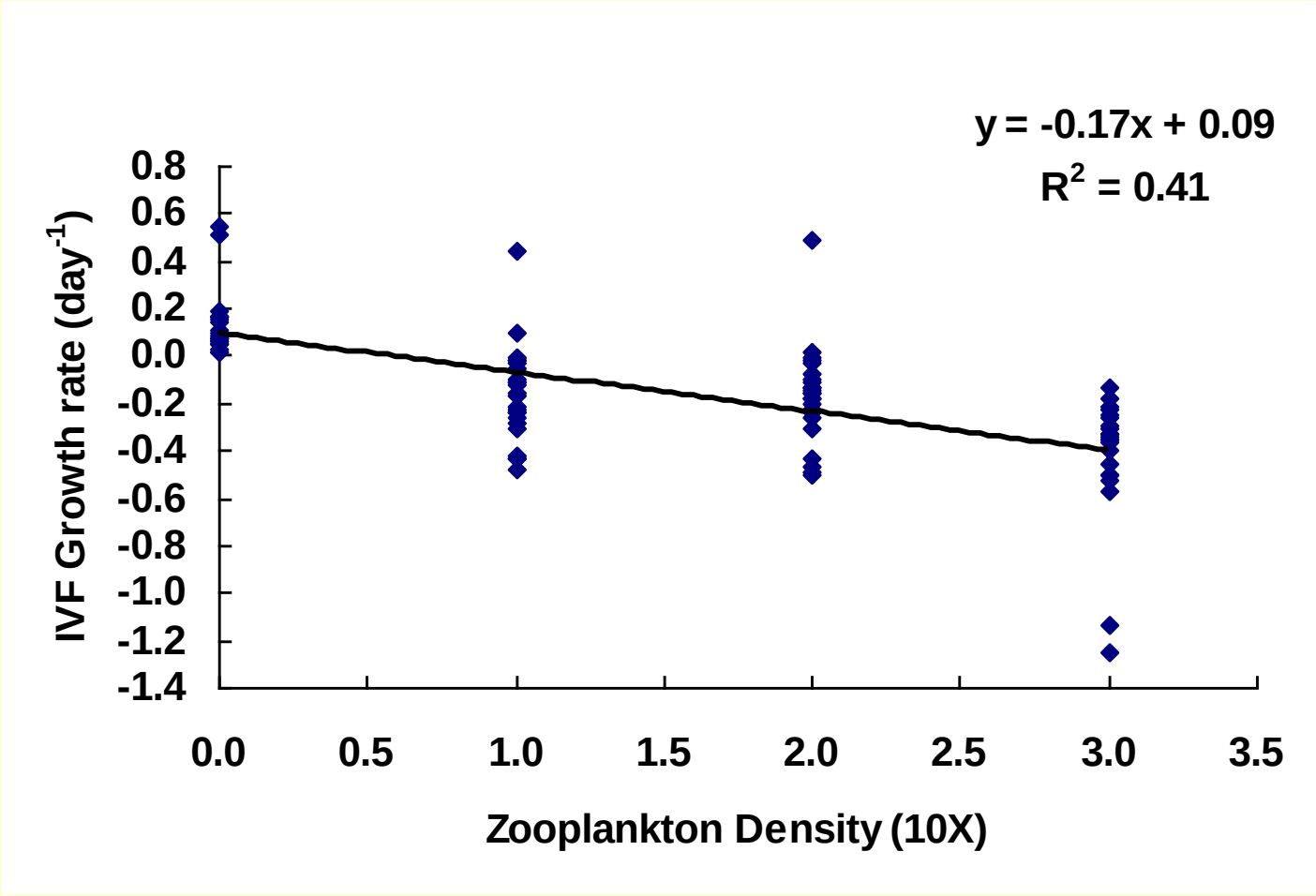
Phytoplankton limitation patterns Upstream lakes

- Simultaneous & biochemical co-limitation as N, P, & NP (Arrigo 2005): 21.4%
- N & NP limitation: 26.8% (Summer)
- P & NP limitation: 26.8% (Winter, early spring)

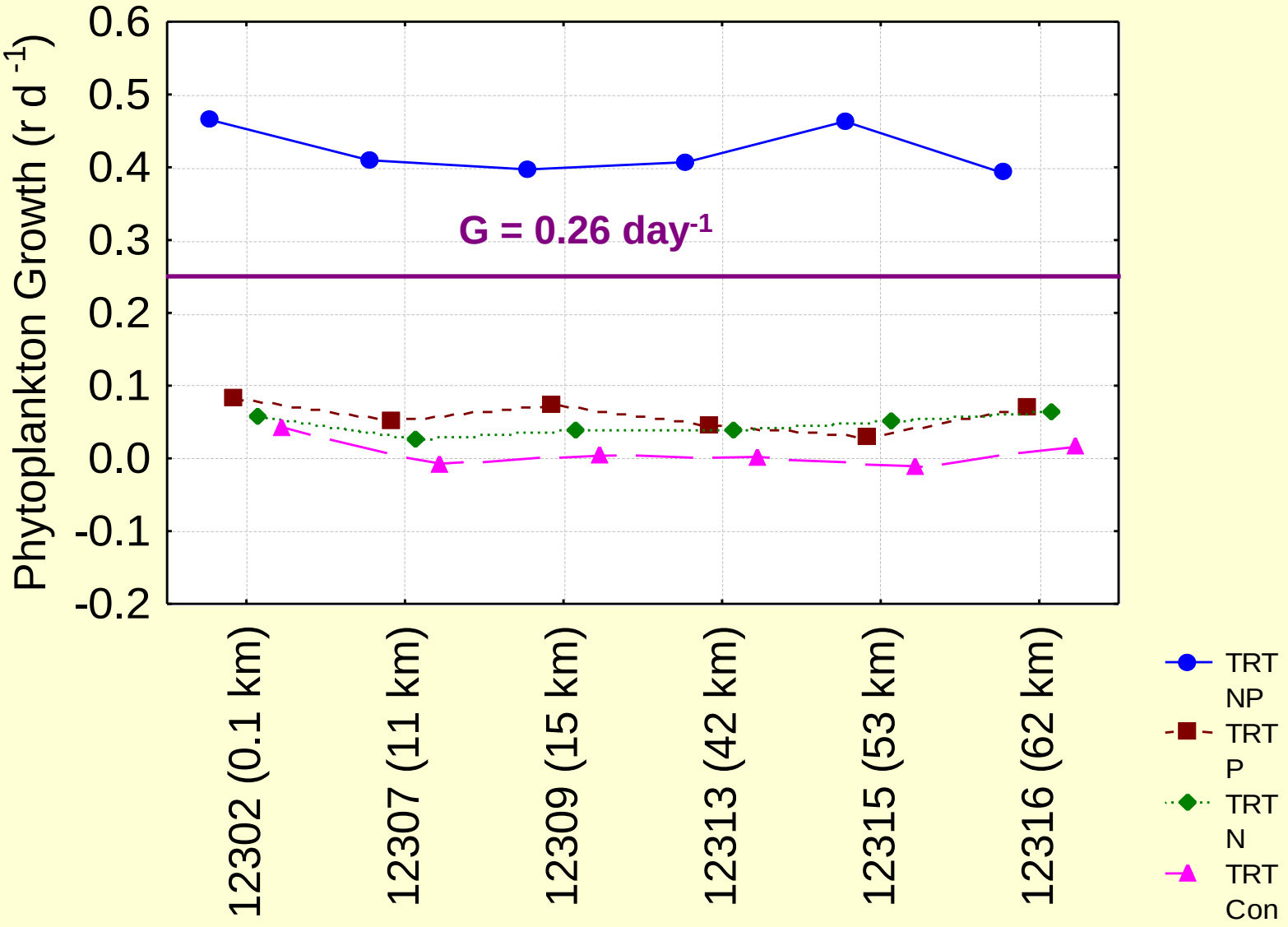
Lake Travis zooplankton grazing rate



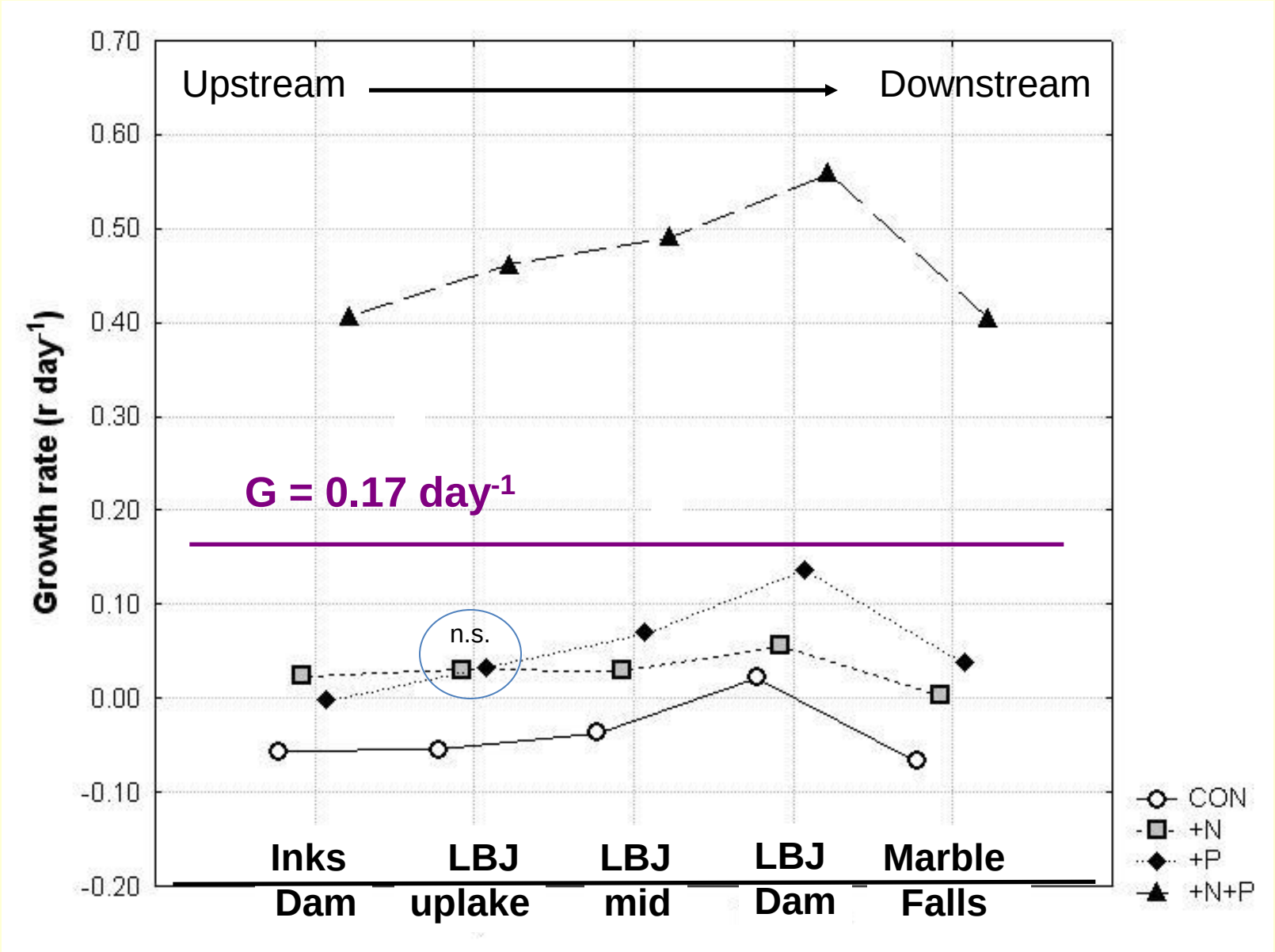
Lakes Inks, LBJ & Marble Falls Zooplankton grazing rate



Lake Travis growth site averages with zooplankton grazing rate



Upstream reservoirs growth rate site averages with grazing rate

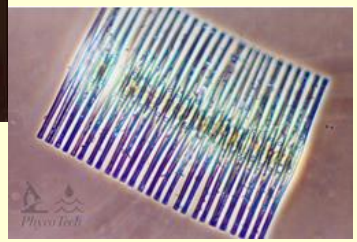


Growth & Grazing Seasonal Dynamics

- By comparing the mean control growth rate in the grazing expt's to its respective grazing rate
- U:G in a 1:1 plot (diagonal line)

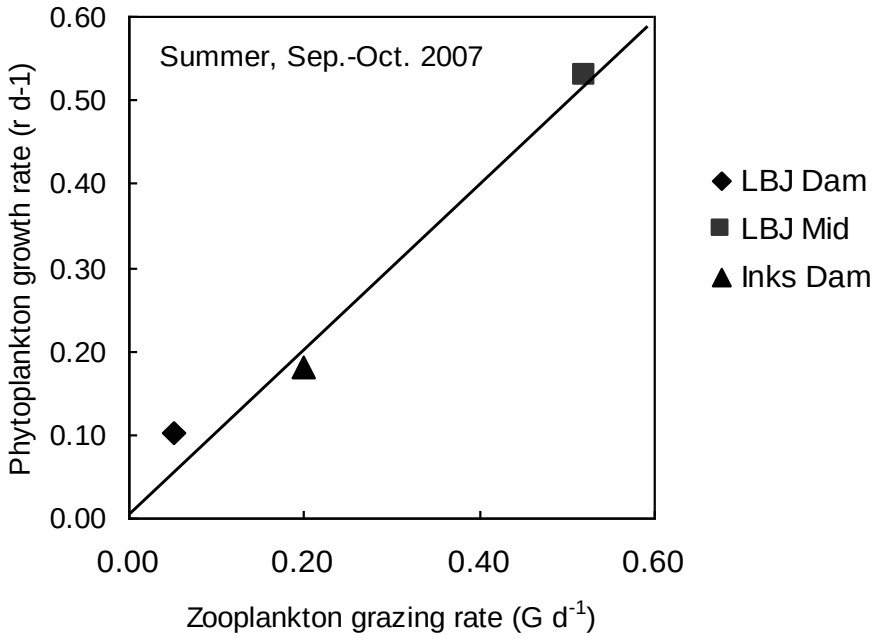
Grazing

Growth

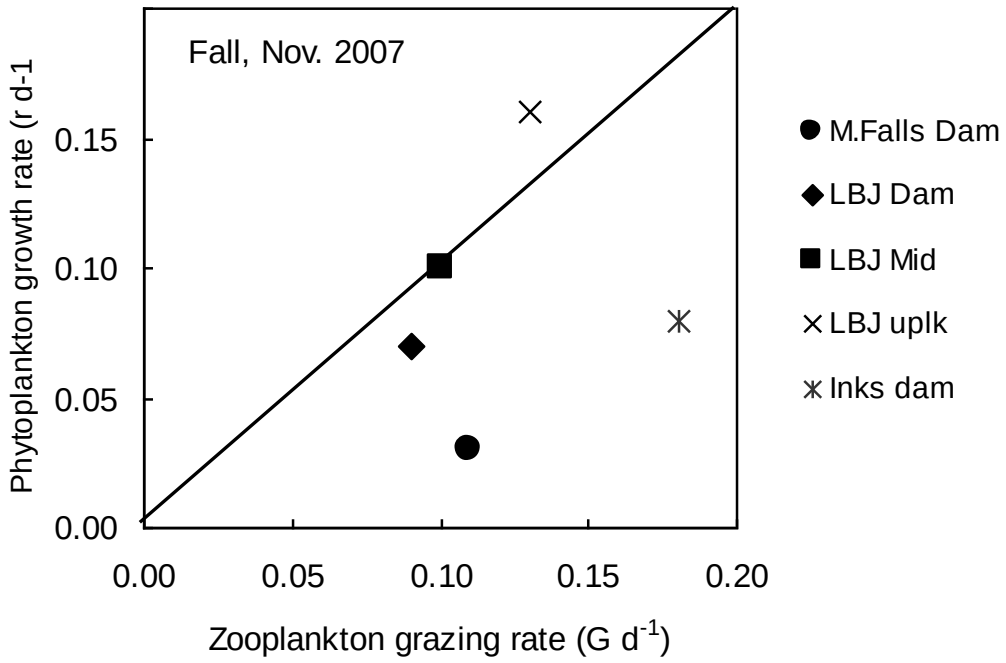


Growth and Grazing by site & season, upstream reservoirs

Summer 2007

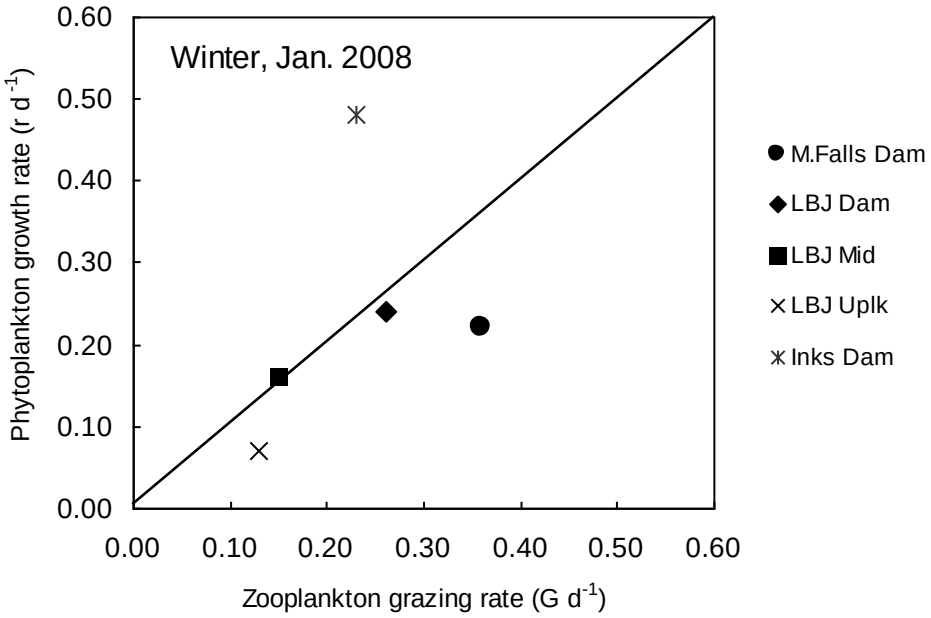


Fall 2007

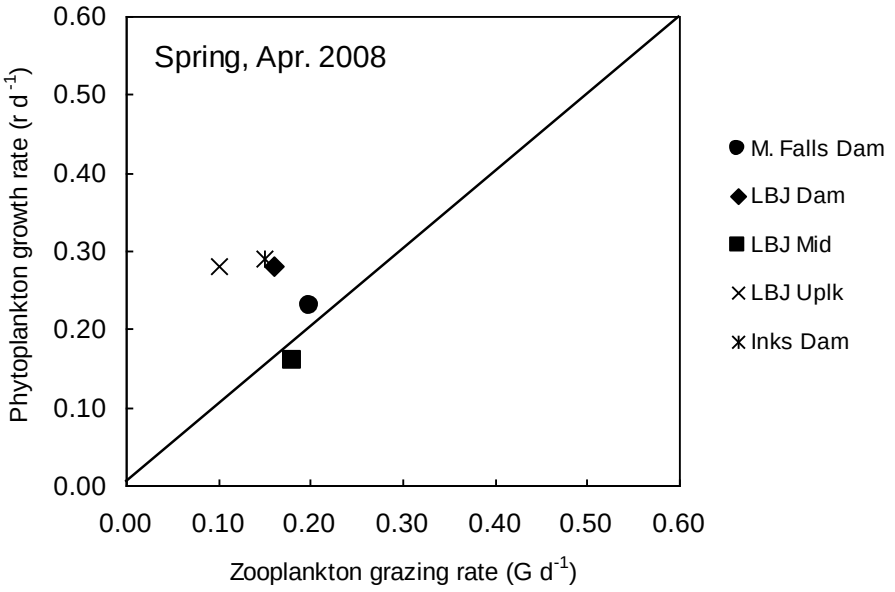


Growth and Grazing by site & season, upstream reservoirs

Winter 2008

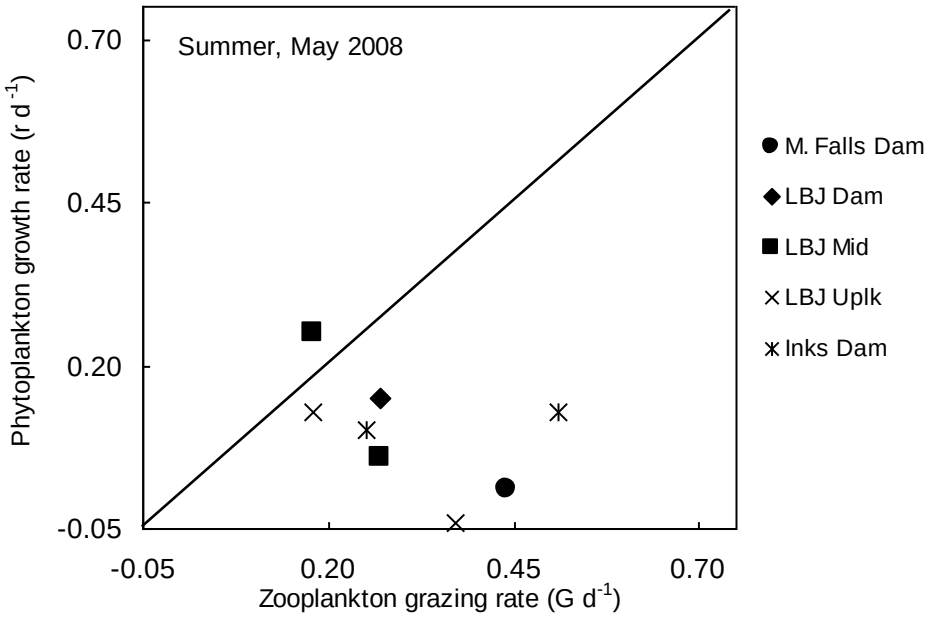


Spring 2008

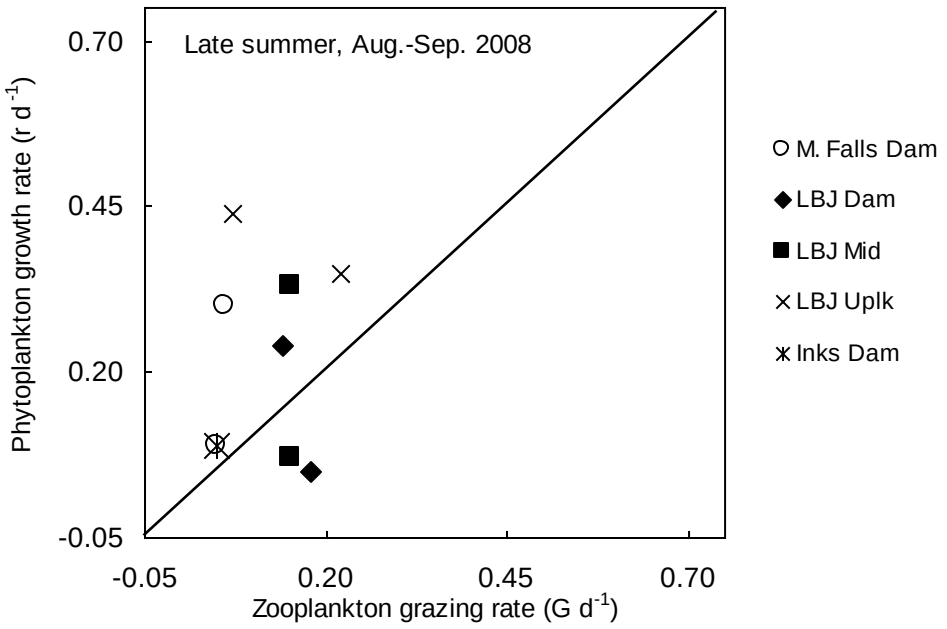


Growth and Grazing by site & season, upstream reservoirs

Early summer 2008



Late summer 2008



Conclusions

Bioassays:

- Phytoplankton growth is nutrient co-limited
- Significant 4-fold increase in growth rate with NP

Grazing:

- Significant zooplankton grazing pressure

Reservoir patterns:

- Phytoplankton growth is nutrient co-limited
- Copepod grazing effects include nutrient recycling & N-export

ACKNOWLEDGEMENTS

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USGS Texas Water Science Center

LCRA