



Effects of eutrophication and habitat heterogeneity on bacteria in lakes

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Bacterial communities central to aquatic ecosystem functioning

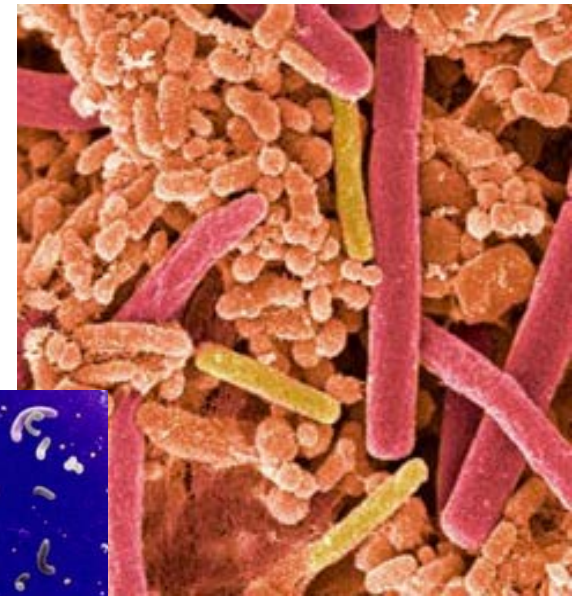


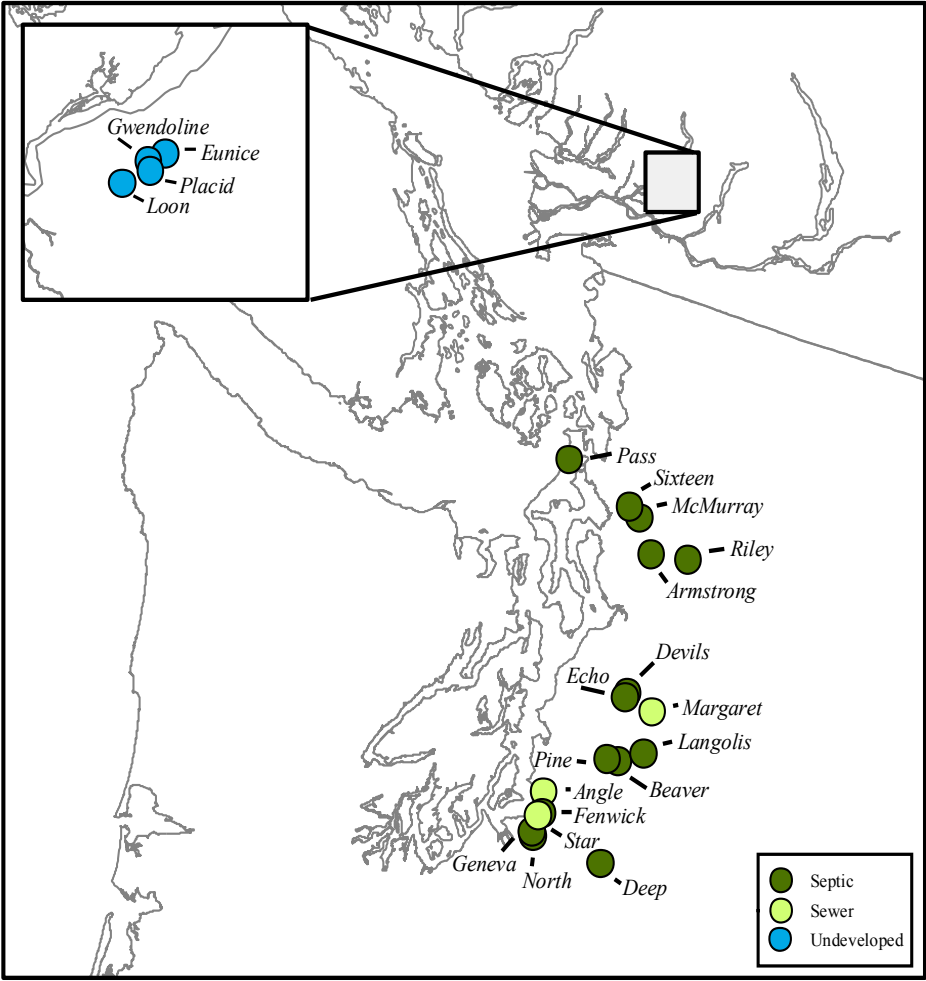
Photo: microbiologybytes.com

Photo: sciencedaily.com

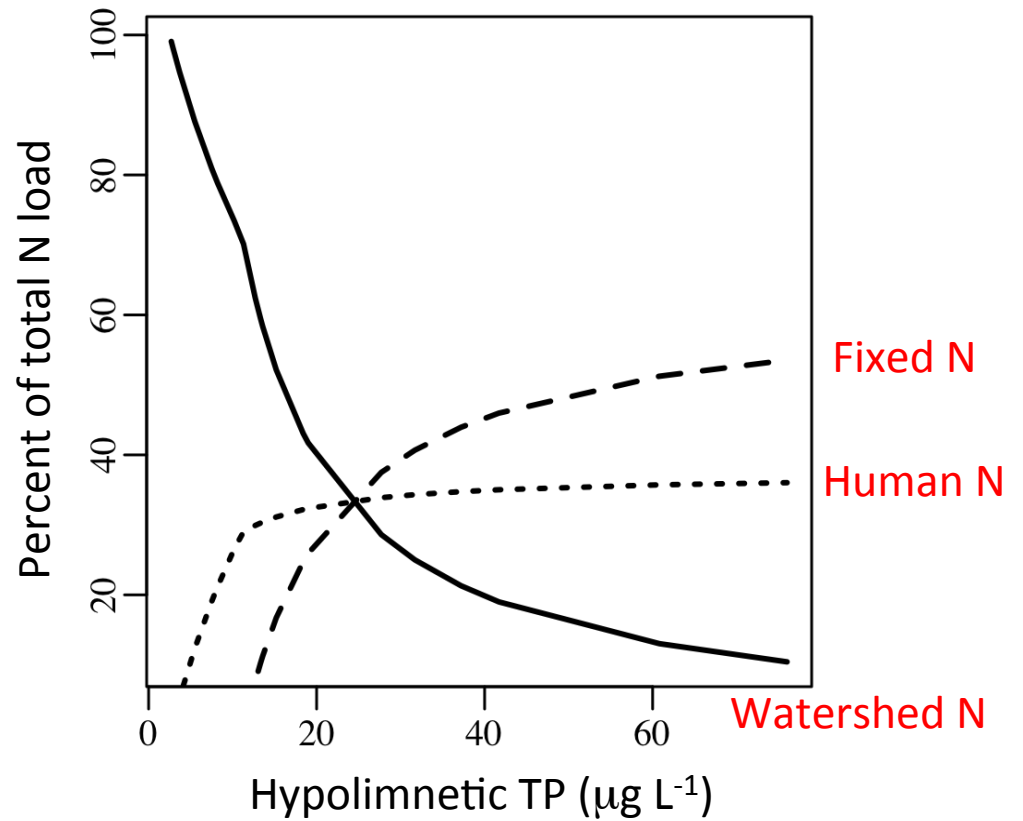
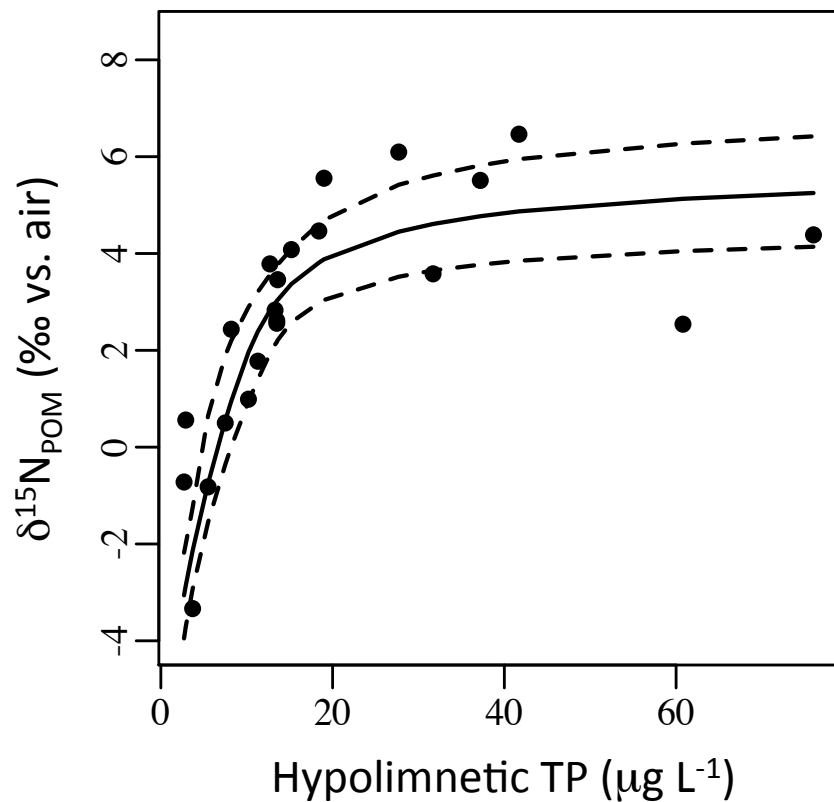


Photo: WFFF Colchester, VT

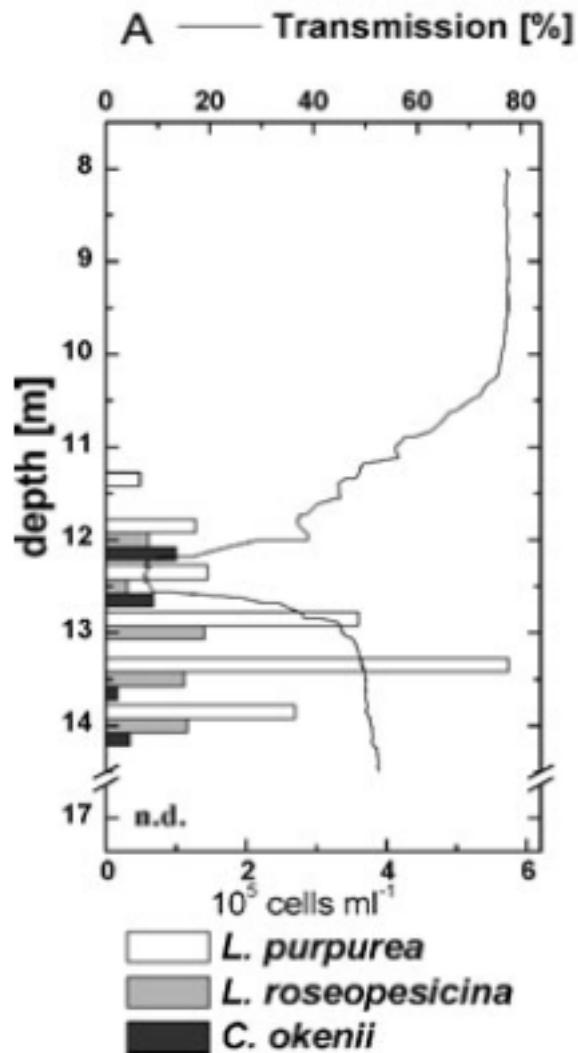
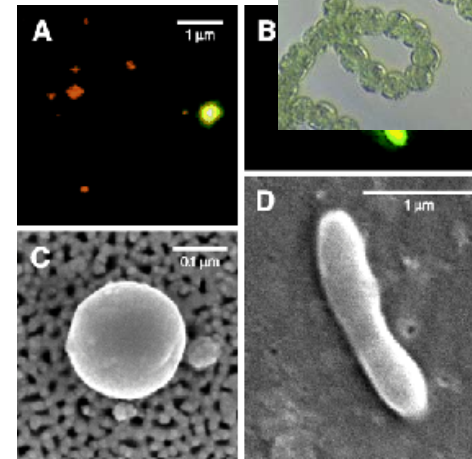
What's happening in lakes of the Puget Sound watershed?



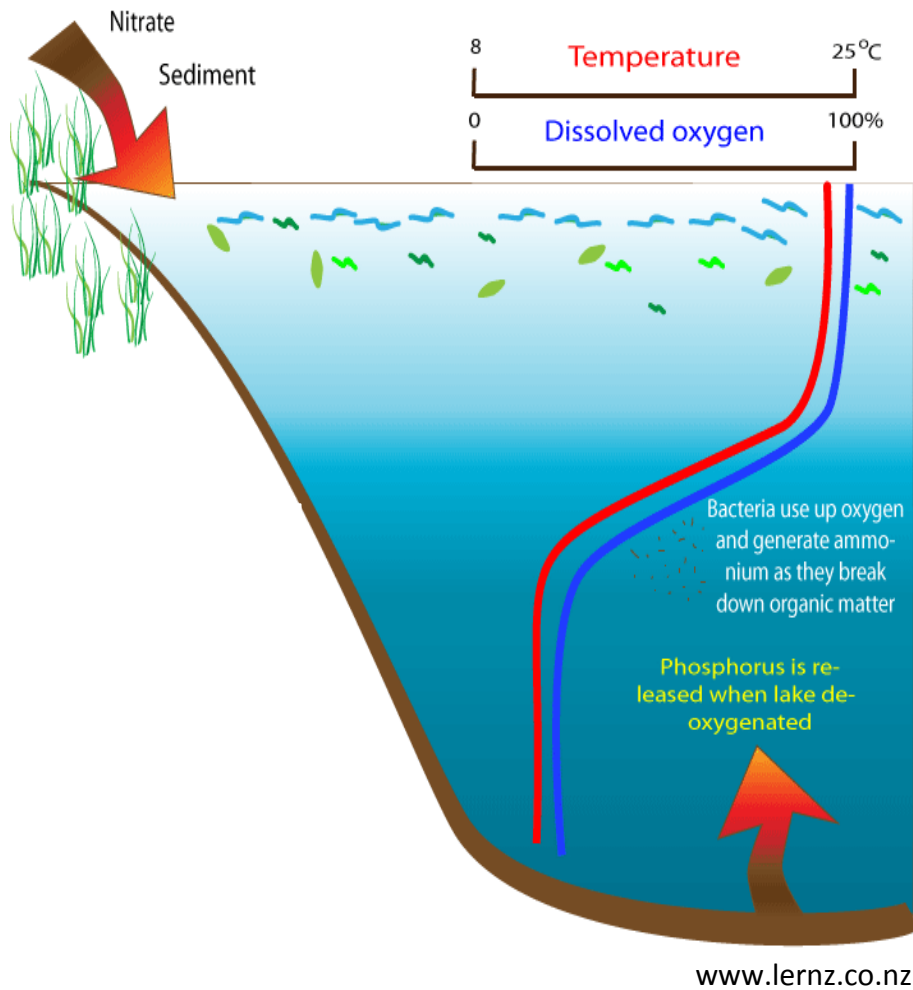
Major changes in several ecosystem functions as a result of eutrophication – such as the N cycle



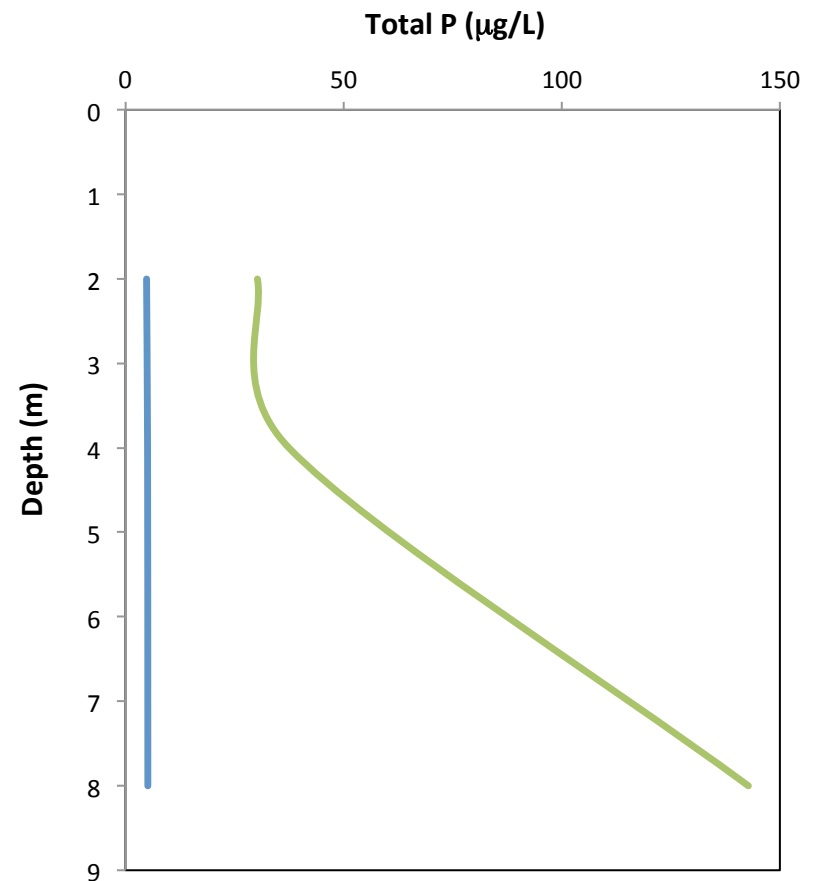
How do bacteria respond to eutrophication?



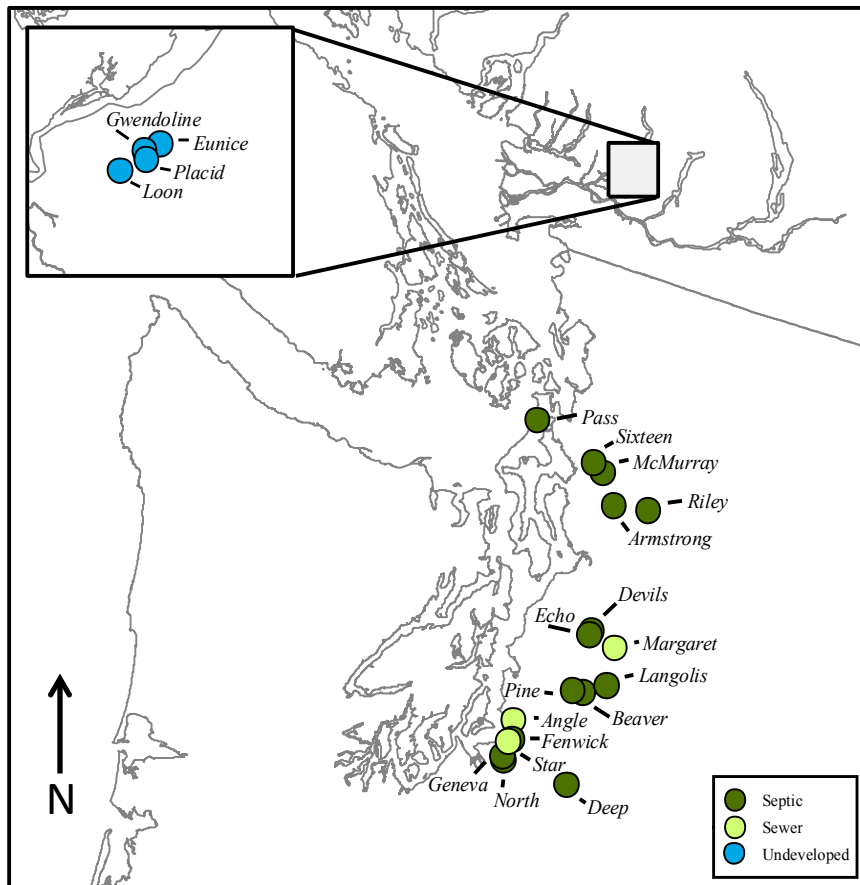
- Not just the cyanobacteria (Zehr et al. 2007)
- Not just in the surface layer (Halm et al. 2009)



Eutrophication increases spatial variation in bacterial resources

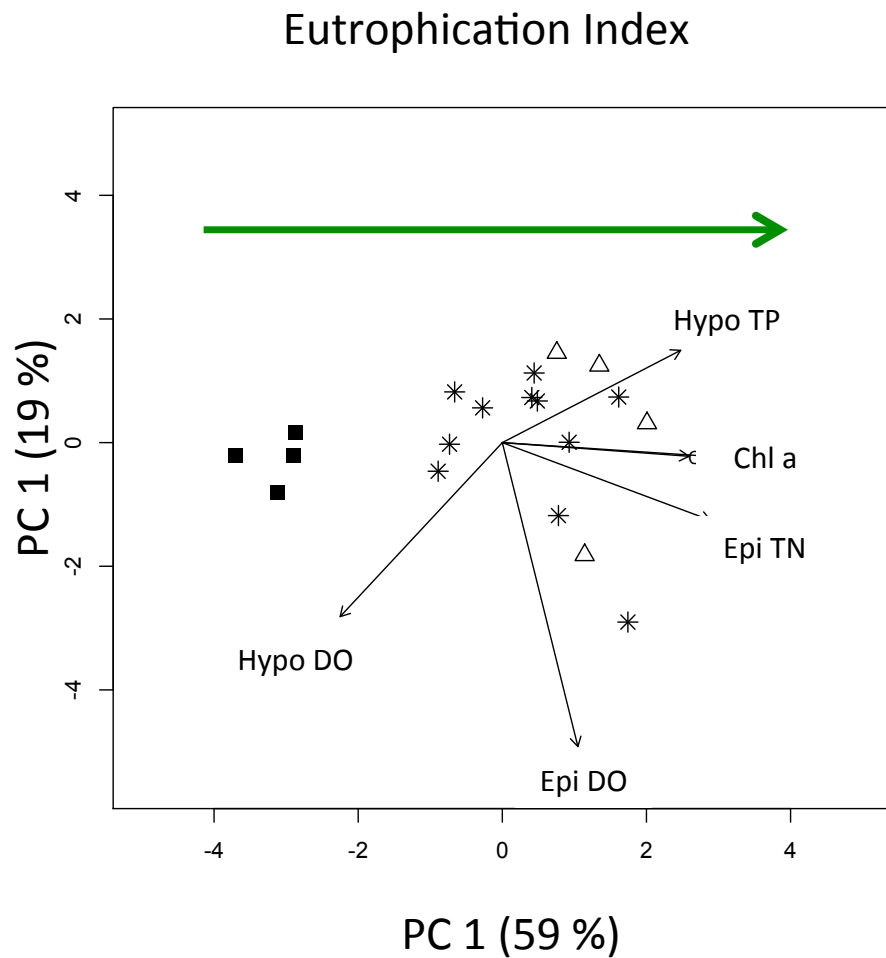


How do bacterial communities respond to lake eutrophication?



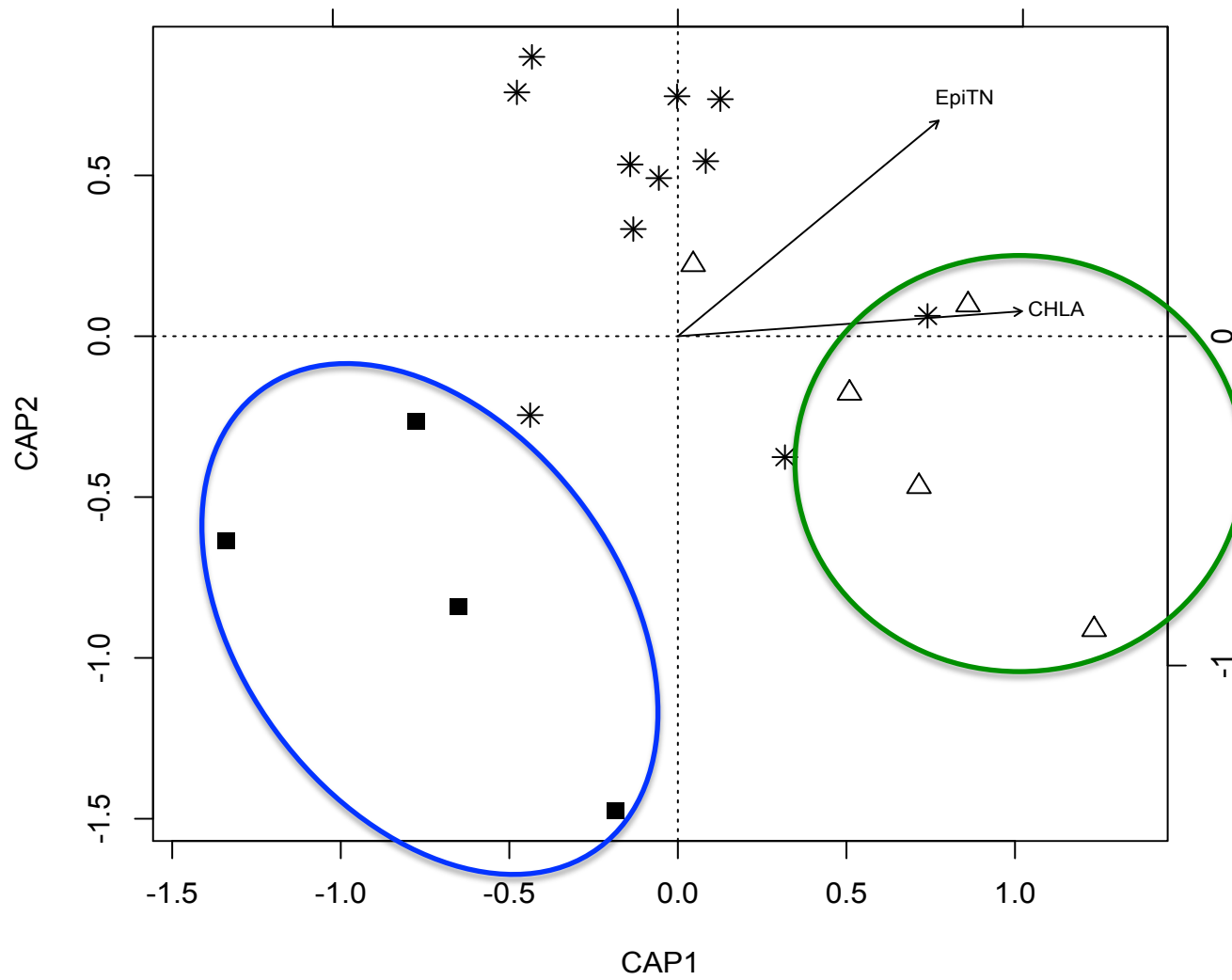
- 21 lakes across a gradient of nutrient loading
- Surveyed bacterial community abundance, richness and composition
- Evaluated communities throughout the water column: epi-, meta- and hypolimnion

Effects of eutrophication and habitat heterogeneity



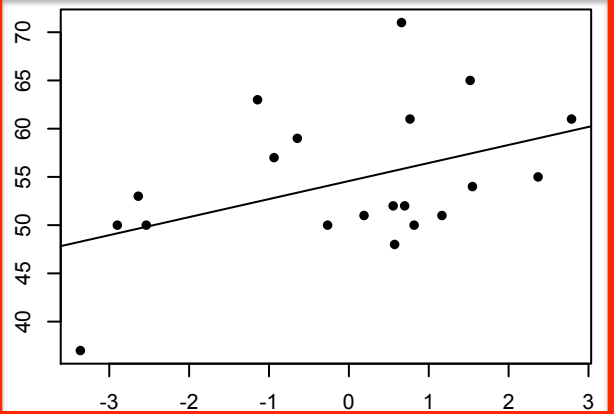
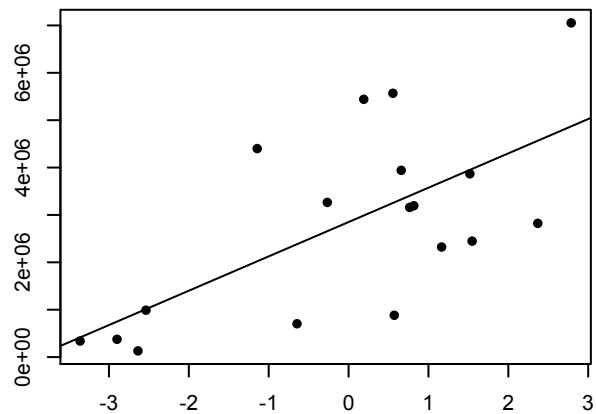
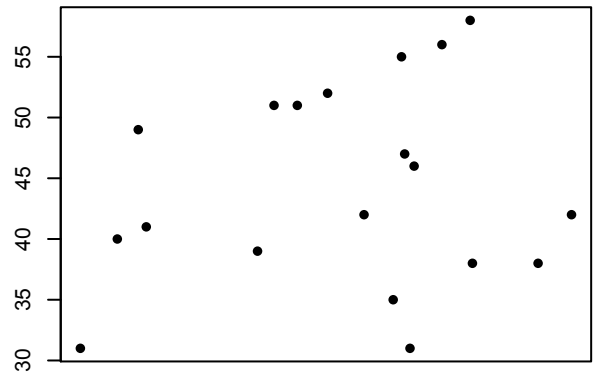
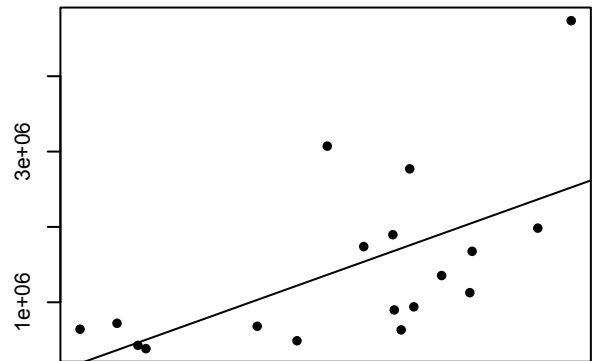
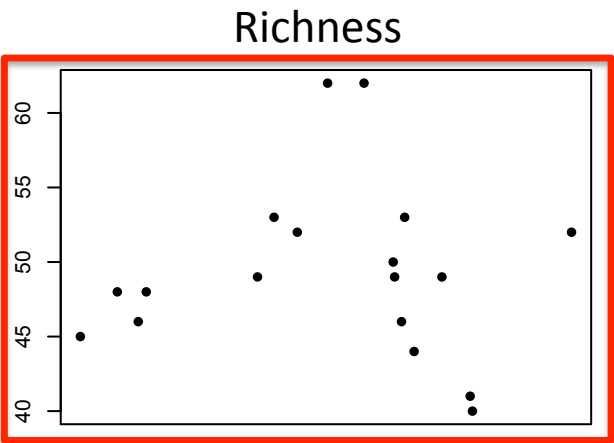
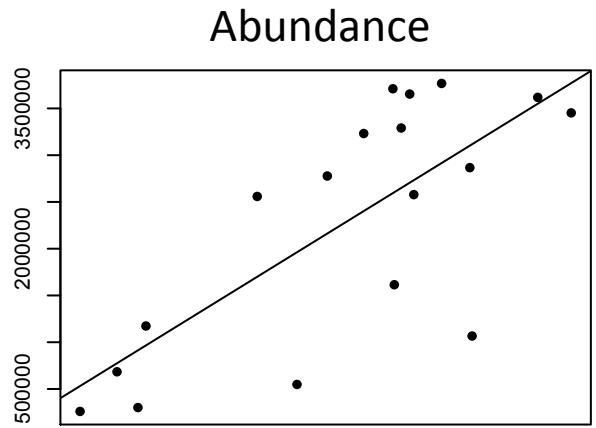
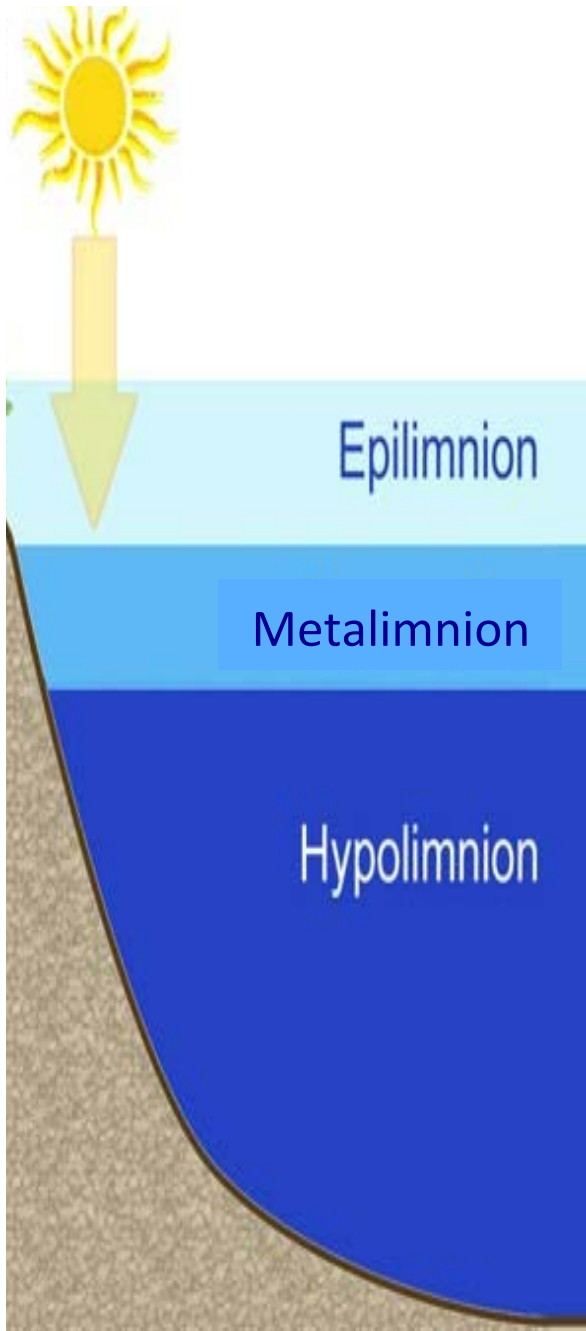
Question 1. How do bacterial communities respond to eutrophication?

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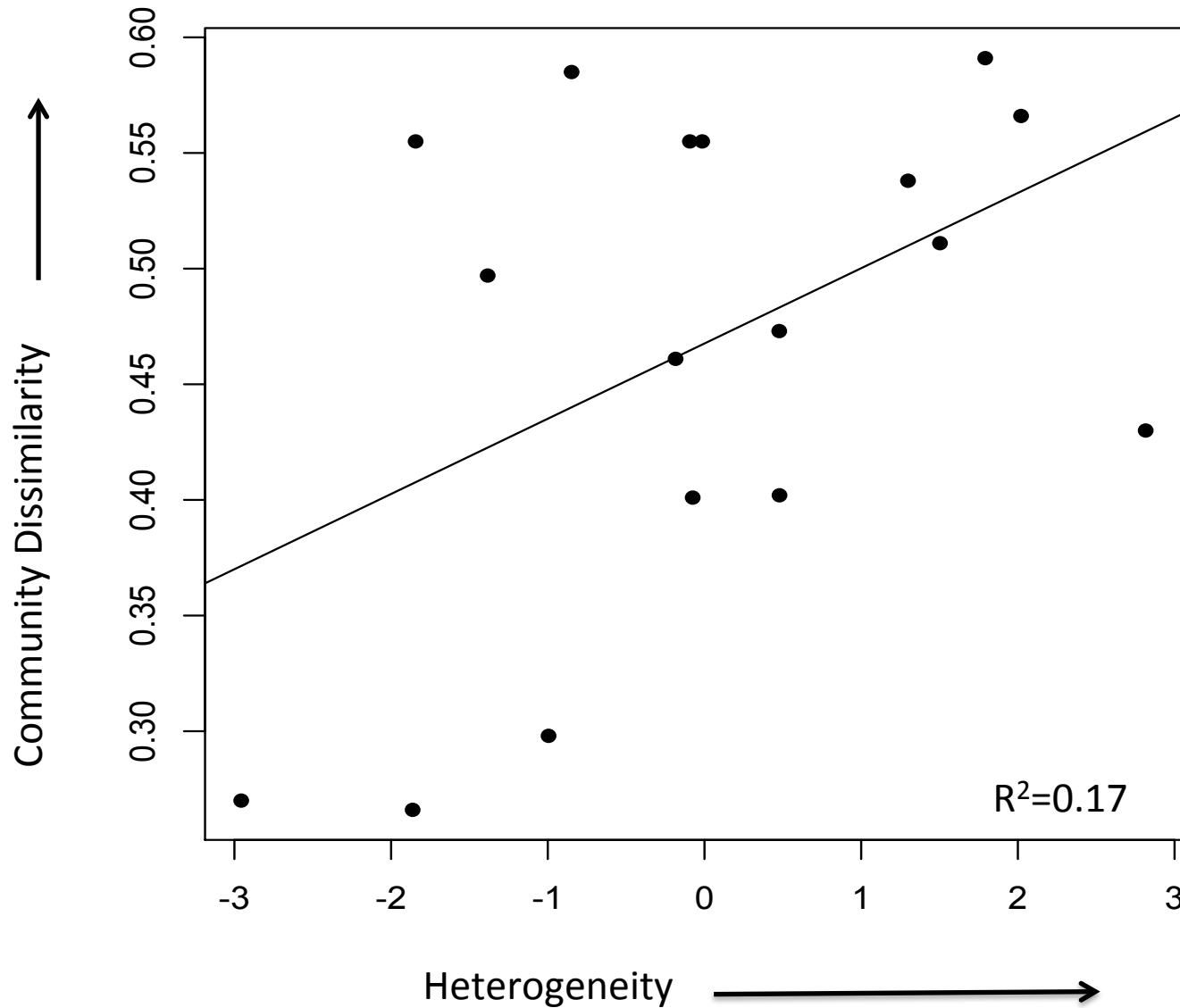
Question 2. Does heterogeneity in the water column affect how associated bacterial communities respond to eutrophication?

| | Variable | n | k | R2 | AIC | AICc | $\Delta AICc$ |
|--------------------------|----------------|----|---|------|-------|-------|---------------|
| ABUNDANCE | | | | | | | |
| Average abundance | Eutrophication | 21 | 3 | 0.46 | 610.8 | 612.2 | 9.1 |
| | Heterogeneity | 21 | 3 | 0.66 | 601.7 | 603.1 | 0 |
| | Both | 21 | 3 | 0.61 | 604.4 | 605.8 | 2.7 |
| RICHNESS | | | | | | | |
| Pooled richness | Eutrophication | 17 | 3 | 0.30 | 127.5 | 129.3 | 2.9 |
| | Heterogeneity | 17 | 3 | 0.41 | 124.6 | 126.4 | 0 |
| | Both | 17 | 3 | 0.38 | 125.5 | 127.3 | 0.9 |



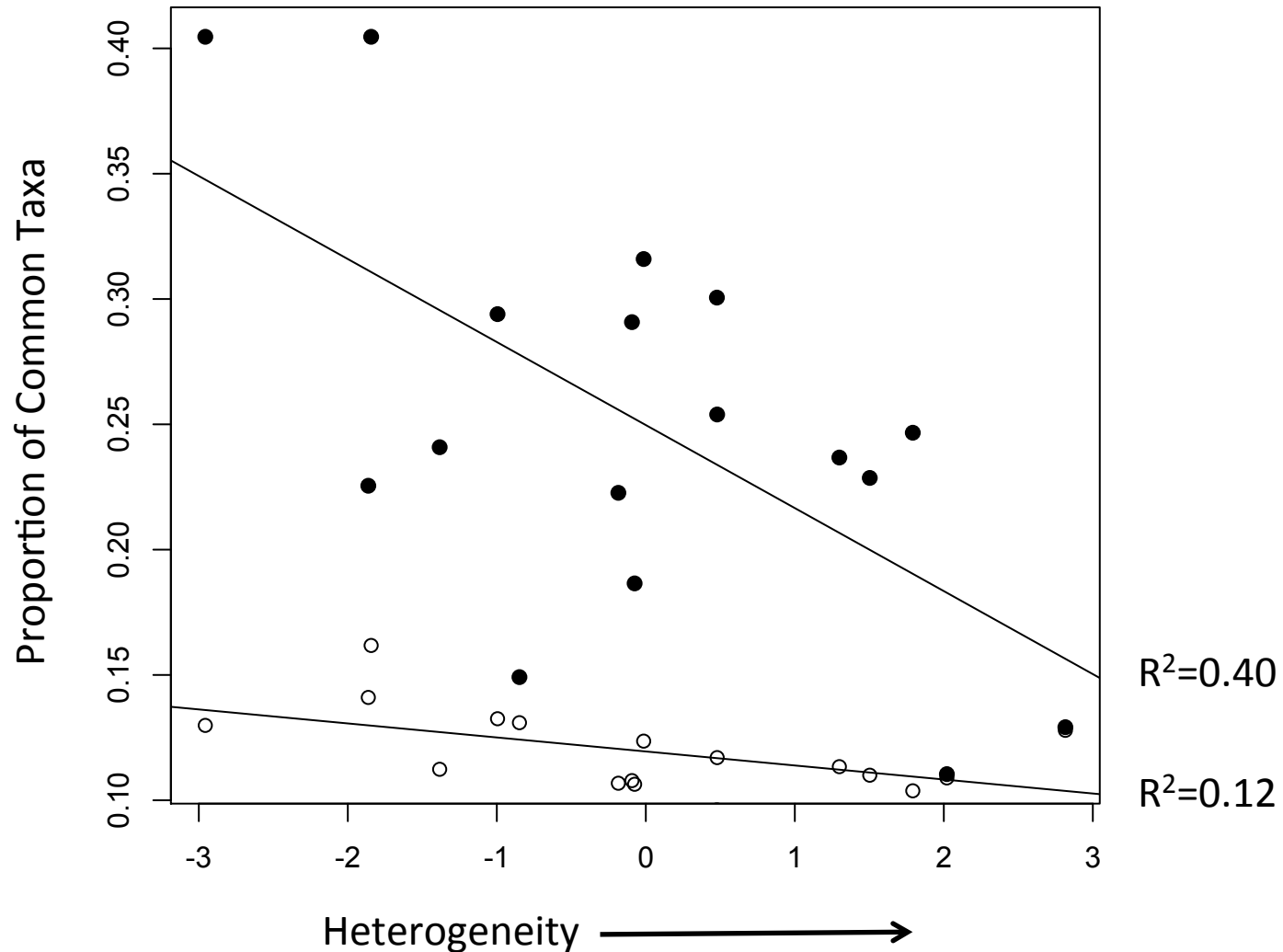
Eutrophication \longrightarrow

Communities become increasingly distinct among habitats in water column of eutrophic lakes



Question 3. Which taxa are responding to increase in eutrophication?

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Conclusions

- Bacteria respond differently to lake eutrophication than other taxa
- Heterogeneity allows for diverse assemblage of bacteria to coexist, while retaining a core community
- Diversity promotes resilience of ecosystem function
- Restoration potential of ecosystem processes is higher because of retention of core functional groups?

Management tools?

- Use of functional genes as leading indicators of eutrophication (MacGregor et al. 2001)



Photo: Kendra Boymer



Photo: WFFF, Colchester, VT

Acknowledgements

- **Funding:** Royalty Research Fund, Keeler Professorship
- **Collaborators:** King County Small Lakes Program and Sally Abella
- **Field and lab Assistance:** Anna Coogan, Rachel Lange, Kendra Boymer, Michael Dyen, Helen Bekris

