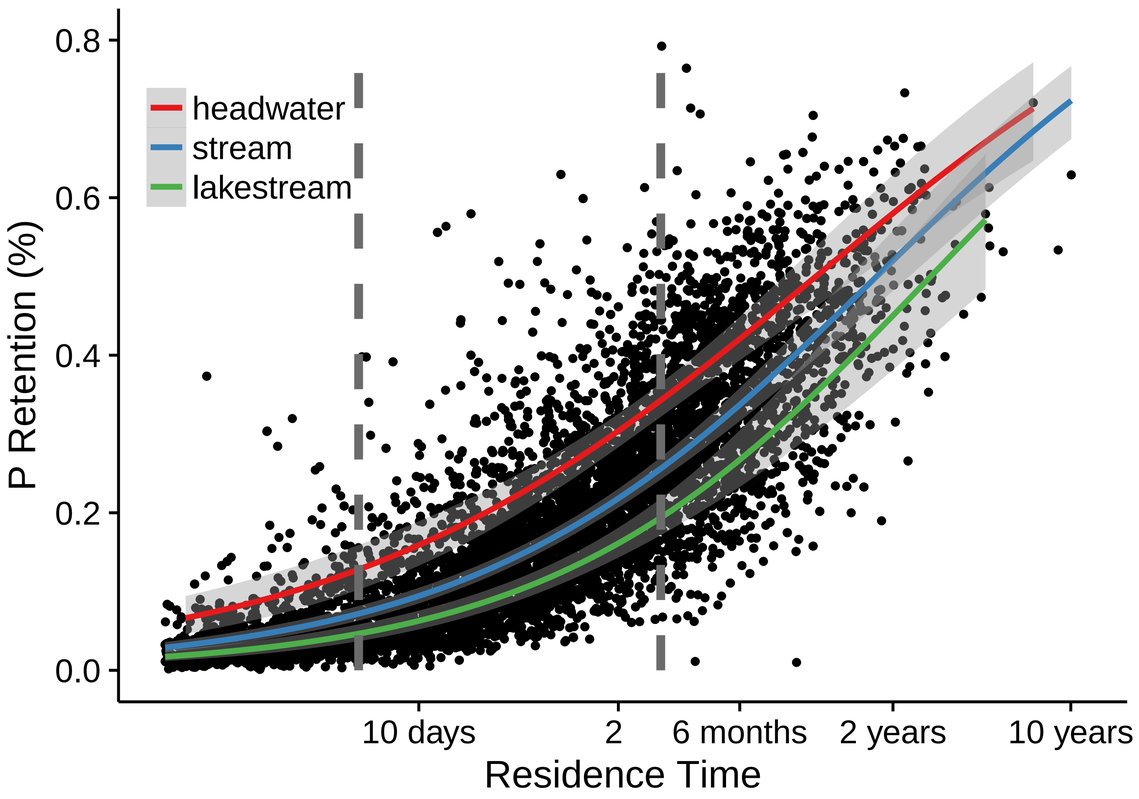
Does Connectivity Control Lake Phosphorus Retention?

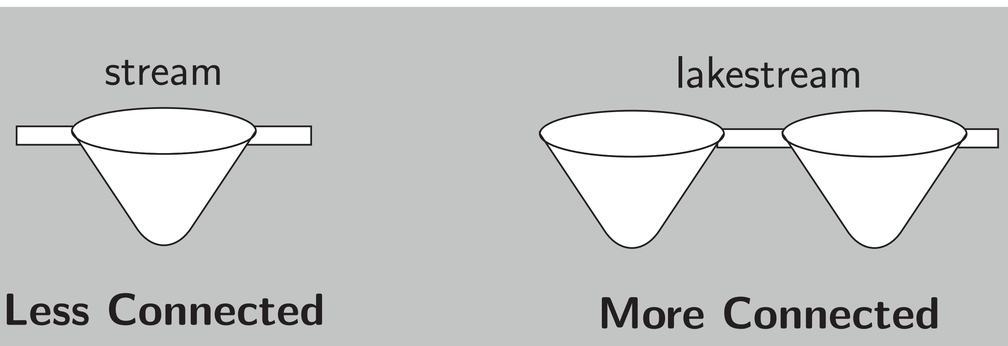
Joseph Stachelek, Pat Soranno
Department of Fisheries and Wildlife, Michigan State University, MI, USA

Introduction

- There is some evidence that P retention in lakes and streams is affected by network connectivity:



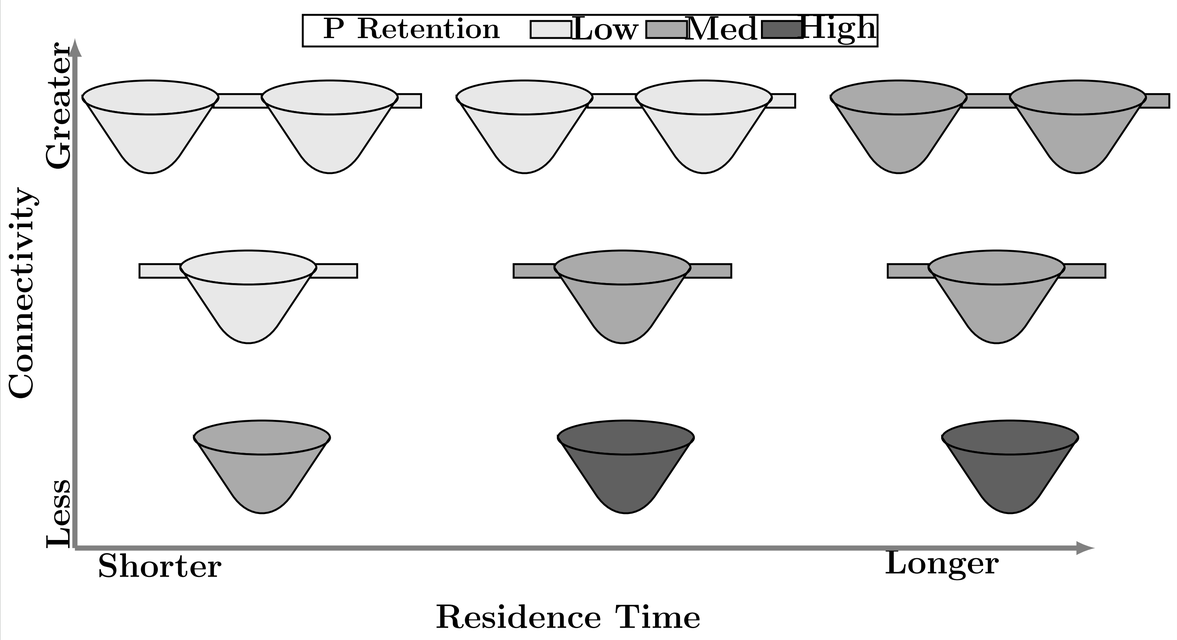
Re−analysis of data from [3] with data from [4]



Less Connected **More Connected**

Research Questions

1. **Do connected lakes retain less P than less connected lakes (given equal residence times)?**
2. **Are there differences in the relative influence of biological and hydrological control on P retention in lakes of differing connectivity?**



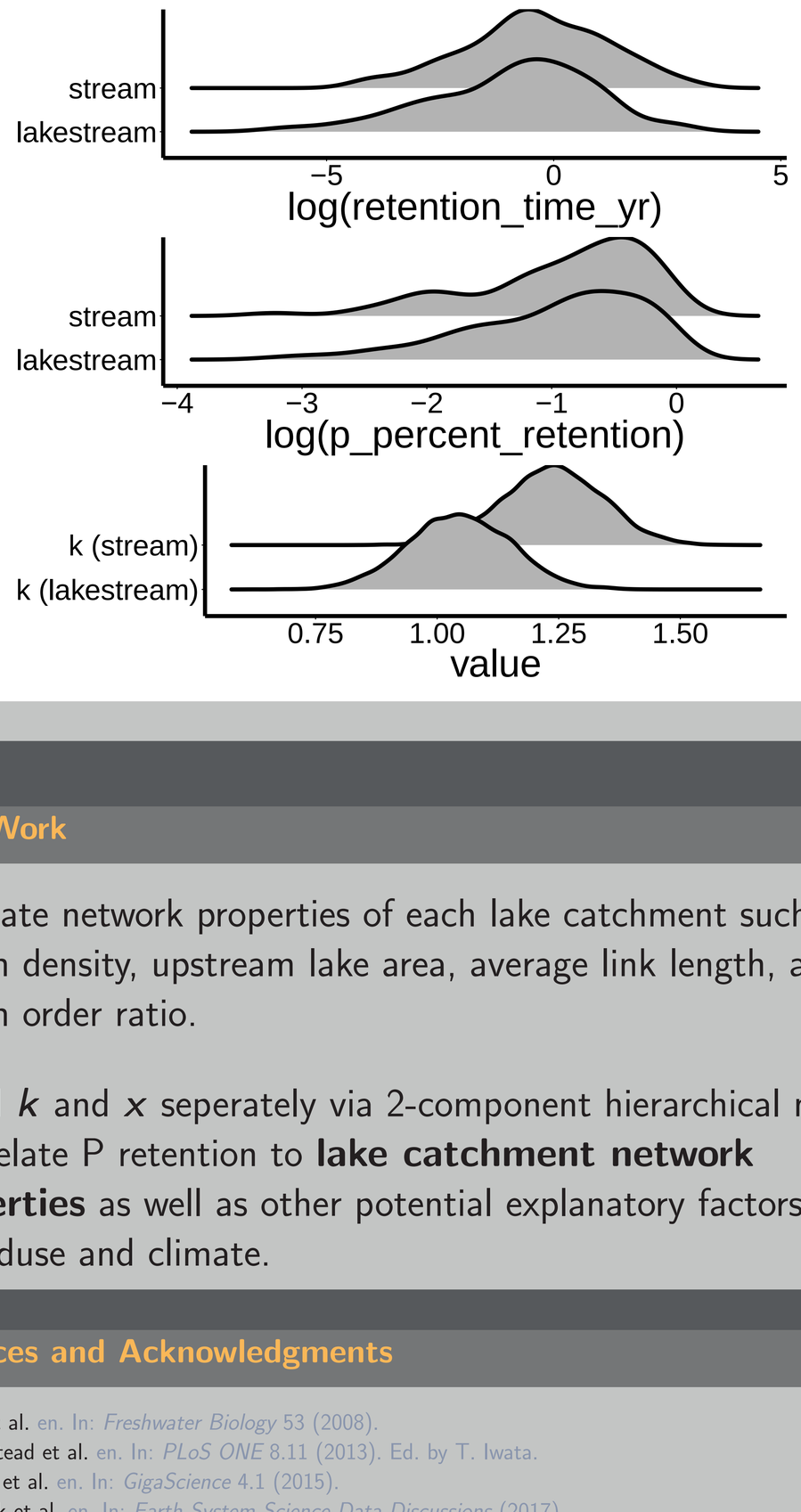
Methods

- Data on P loading, P export, and residence time from approximately 250 lakes included in the National Eutrophication Survey (1972 - 1975)[4].
- Model P retention as a function of residence time using 2 parameter (k, x) Vollenweider models [1].
- k (removal rate coefficient) and x can be interpreted as representing biological and hydrological controls on P retention respectively.

Results

1. **No, lakes with and without upstream lakes had similar distributions of residence time and P retention.**
2. **Yes, estimates of k were higher in (less connected) lakes without upstream lakes.**

This suggests that P inputs are controlled by biological processes to a greater extent in lakes without upstream lakes.



Future Work

- Calculate network properties of each lake catchment such as stream density, upstream lake area, average link length, and stream order ratio.
- Model k and x seperately via 2-component hierarchical models that relate P retention to **lake catchment network properties** as well as other potential explanatory factors such as landuse and climate.

References and Acknowledgments

[1] M. Brett et al. en. In: *Freshwater Biology* 53 (2008).
[2] W. B. Milstead et al. en. In: *PLoS ONE* 8.11 (2013). Ed. by T. Iwata.
[3] P. Soranno et al. en. In: *GigaScience* 4.1 (2015).
[4] J. Stachelek et al. en. In: *Earth System Science Data Discussions* (2017).

Viginia Tech - NSF #1517823

stachel2@msu.edu