Does Connectivity Control Lake Phosphorus Retention?

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Introduction

- Water residence time is viewed as a major factor controlling lake P retention.
- However, there is large variation in that relationship with some evidence that this variation may be partly explained by lake connectivity.

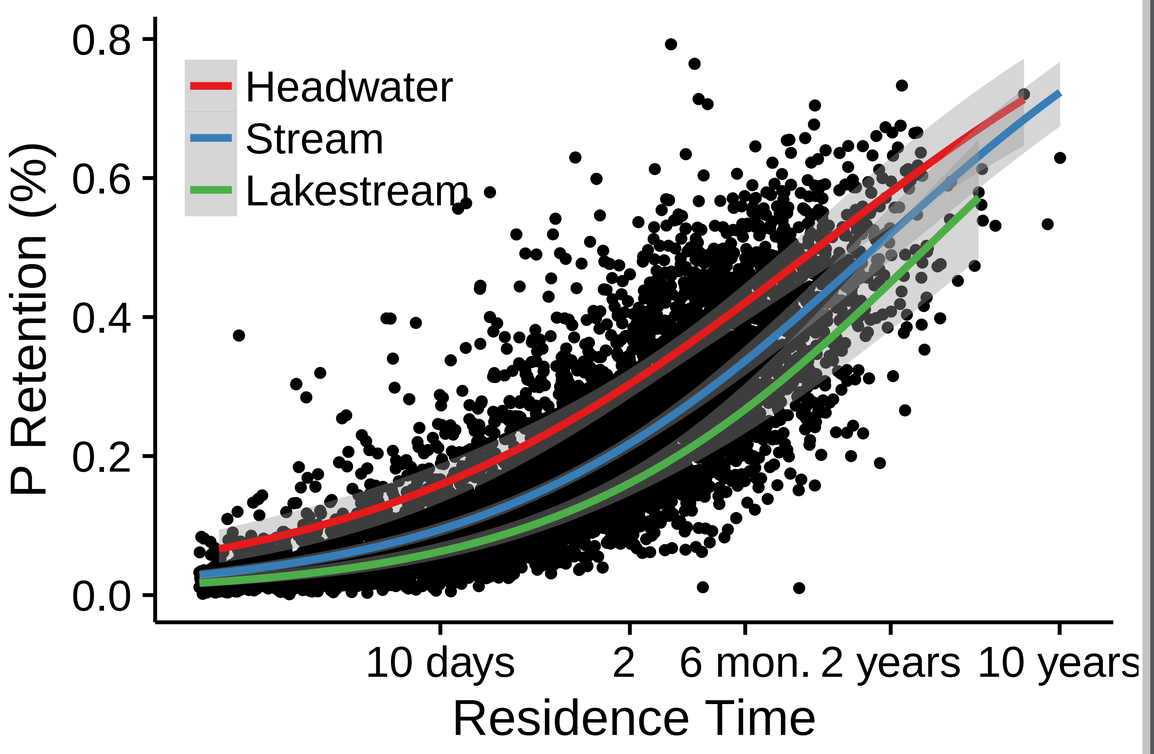
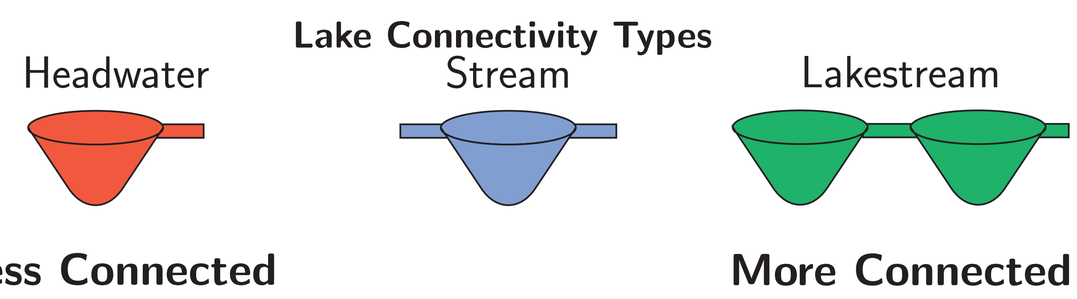


Figure 1: Lake P Retention as a function of residence time and lake connectivity. Re-analysis of data from [2] with data from [3].



Research Questions

1. **Do connected lakes retain less P than less connected lakes (given equal residence times)?**
2. **Does lake connectivity influence the relative control of internal and hydrological processes on P retention?**

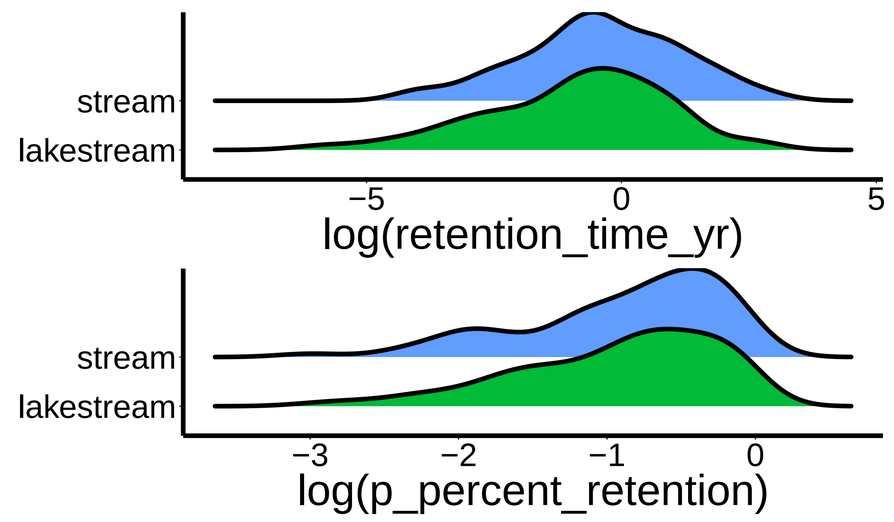
Figure 2: Expected relationship between lake connectivity, residence time, and P retention.

Methods

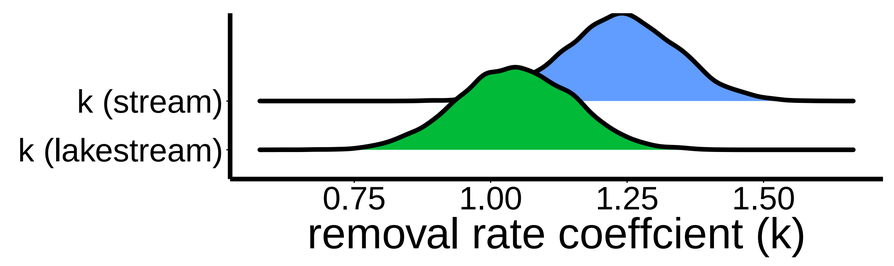
- Data on P loading, P export, and residence time from approximately 250 lakes included in the National Eutrophication Survey (1972 - 1975)[4].
- Model P retention as a function of residence time using 2 parameter (k, x) Vollenweider models [1].
- k (removal rate coefficient) and x (hydrologic flux coefficient) can be interpreted as representing interal 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: The relative control of internal processes over P retention appears to be greater in less connected lakes (without upstream lakes) because estimates of the removal rate coefficient (k) were higher.**



Future Work

- Calculate additional lake connectivity measures 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 connectivity properties** as well as other potential explanatory factors such as landuse and climate.

References

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

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