Appendix

Figure 1

It is difficult to examine the uncertainties surrounding the relationship between water residence time and lake P retention because empirical measures of these quantities do not exist for many lakes. One of the few comprehensive sources of these data is modelling studies which produce largely unverified estimates of water residence time and P retention (**???**). Such model output data may not be appropriate for statistical P retention modelling because P retention and water residence time values are not independently estimated. As an alternative, we performed a more qualitative analysis fitting separate smoothed functions to lakes of differing connectivity (see appendix source code for details). Specifically, we used the connectivity data provided in LAGOS-NE (P. A. Soranno and al 2017) and described in detail by (Fergus et al. 2017) where lakes are grouped based on whether they have upstream lake connections (DR_LakeStream), or upstream stream connections (DR_Stream), are headwater lakes, or are isolated lakes.

Figure 2

Our study lakes encompassed a range of land-use cover types and nutrient levels. Here, we examined whether a strong relationship of lake P retention with agricultural land use cover could be obscuring relationships with connectivity metrics. We used P retention data from the National Eutrophication Survey (**???**) and land cover data from the 1992 National Land Cover Database clipped to lake watersheds and available in the LAGOS-NE dataset (P. A. Soranno and al 2017).

Figure 3

Although our study considered many lakes spread across a broad spatial extent, we wanted to assess whether their basic characteristics were representative of lakes in general. We compared water quality (total phosphorus, chlorophyll concentration, and Secchi depth) of the lakes in our study with other US lakes as measured by the stratified random sampling design of the National Lakes Assessment (NLA) lake population (USEPA 2016). Our lakes are similar in most respects except that they are substantially larger and deeper than most NLA lakes.

References

Fergus, Carol Emi, Jean-François Lapierre, Samantha K. Oliver, Nicholas K. Skaff, Kendra S. Cheruvelil, Katherine Webster, Caren Scott, and Patricia Soranno. 2017. "The Freshwater Landscape: Lake, Wetland, and Stream Abundance and Connectivity at Macroscales." *Ecosphere* 8 (8): e01911. doi:10.1002/ecs2.1911.

Soranno, Patricia A, and et al. 2017. "LAGOS-NE: A Multi-Scaled Geospatial and Temporal Database of Lake Ecological Context and Water Quality for Thousands of US Lakes." *GigaScience* 6 (12): 1–22. doi:10.1093/gigascience/gix101.

USEPA. 2016. "National Aquatic Resource Surveys. National Lakes Assessment 2012." United States Environmental Protection Agency.

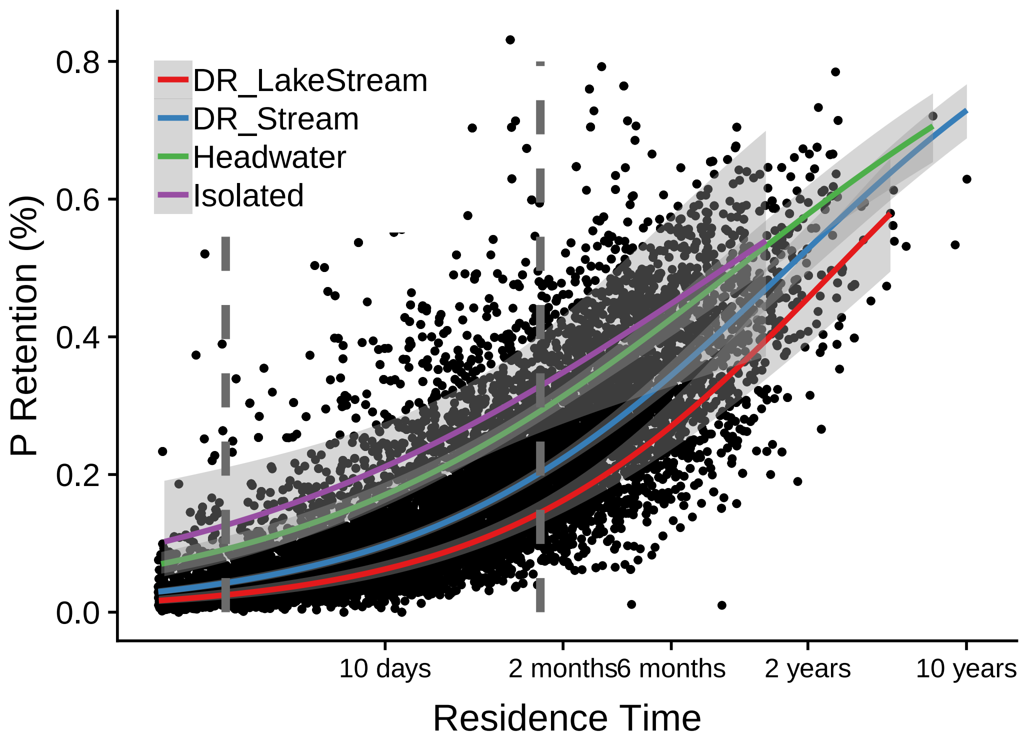

Figure 1: Relationship between residence time and phosphorus retention for inland lakes with surface area greater than 4 ha in Northeastern USA (New England). Vertical dashed lines denote lakes with intermediate residence times (within the interquartile range). Best fit lines are colored based on whether they have upstream lake connections (DR_LakeStream), or upstream stream connections (DR_Stream), are headwater lakes, or are isolated lakes. Data from Milstead et al. (2013).

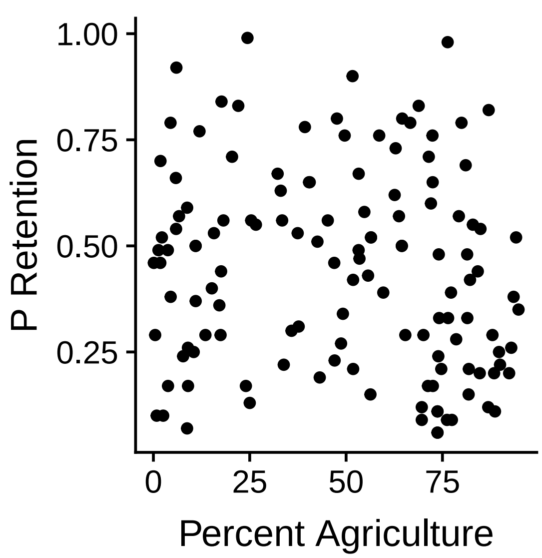

Figure 2: P retention versus percent agriculture in lake watersheds.

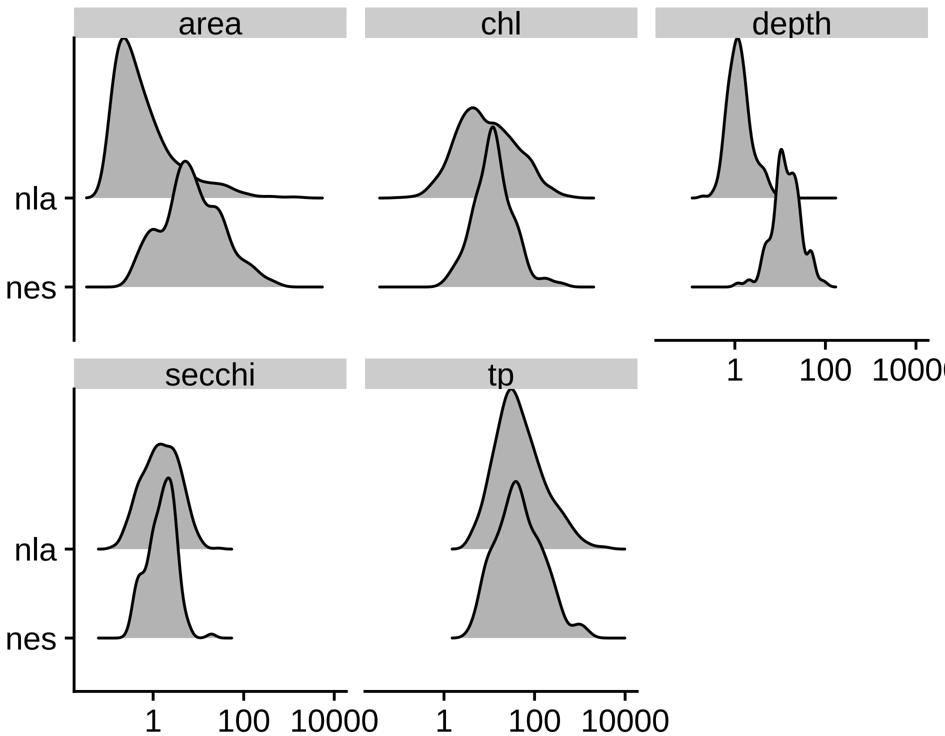

Figure 3: Comparison of selected lake characteristics among the stratified random sampling design of the National Lakes Assessment (nla) and the haphazard sampling of the National Eutrophication Survey (nes) lakes analyzed in the present study.