



# **Does Lake and Stream Connectivity Control Phosphorus Retention in Lakes?**

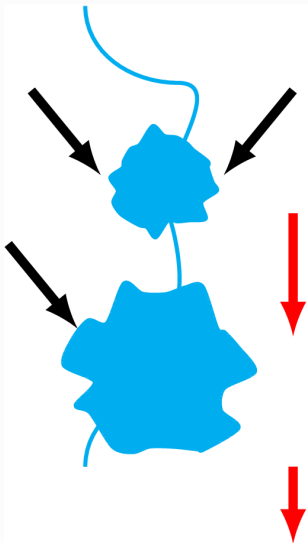
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Michigan State University

Assoc. Limnology and Oceanography, 2018 June

<http://doi.org/ckpf>

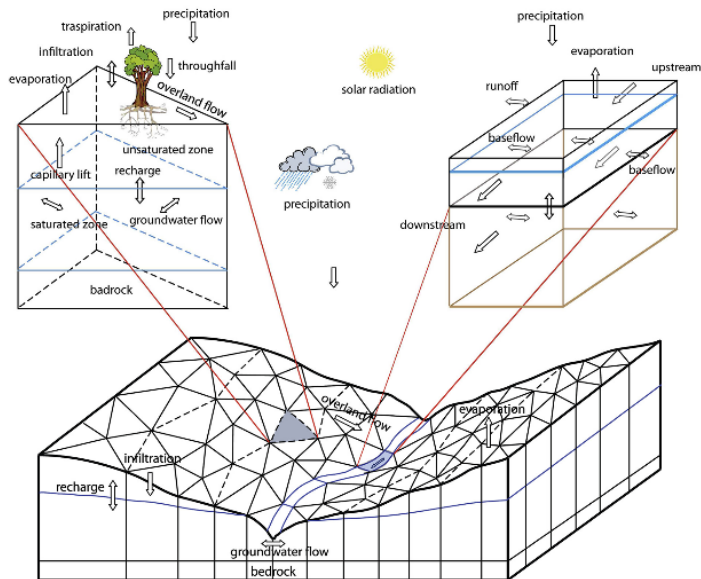
## LAKE PHOSPHORUS (P) RETENTION



P retention directly controls downstream transport [Alexander et al., 2002]

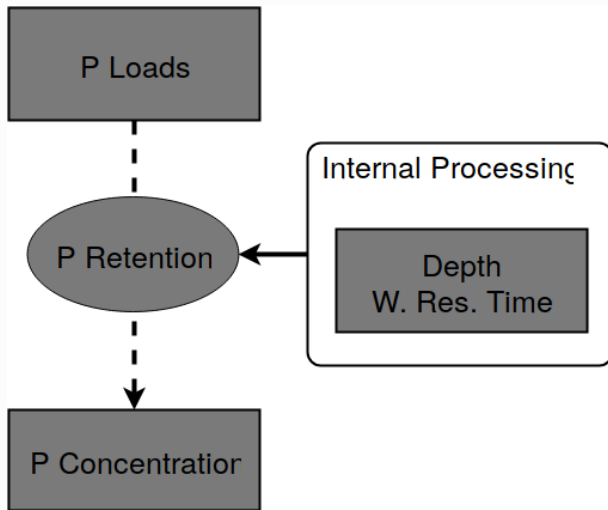
P retention indirectly controls sediment P accumulation [Søndergaard et al., 2013]

# PREDICTING FLUX IS COMPLEX

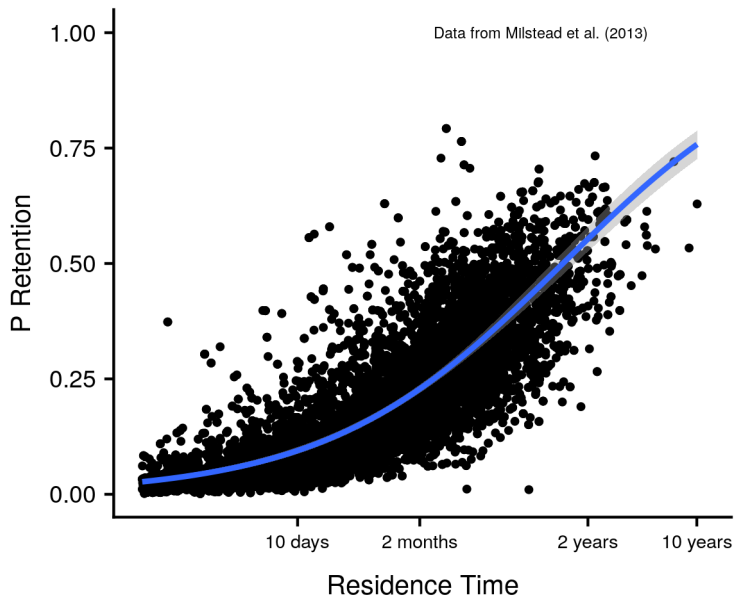


[Bhatt et al., 2014]

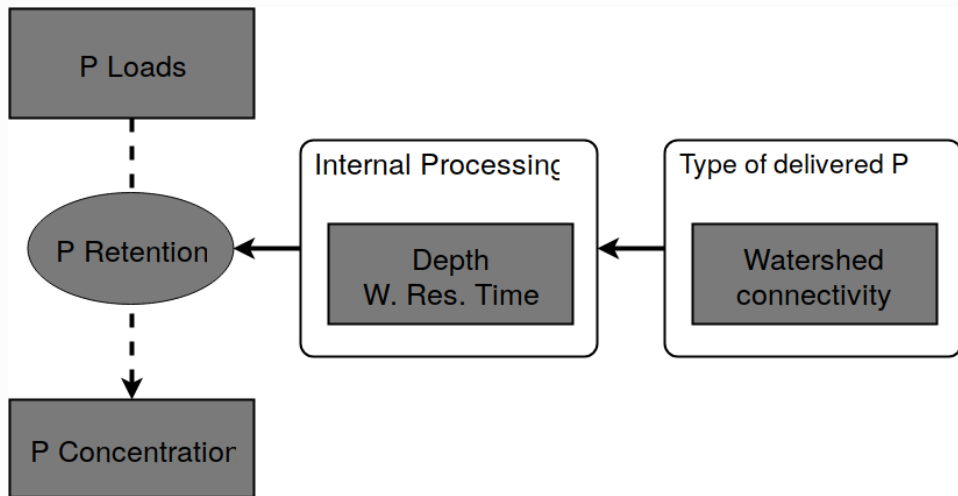
## P RETENTION CONCEPTUAL MODEL



## P RETENTION VERSUS WATER RESIDENCE TIME



## EXTENDING P RETENTION MODELS

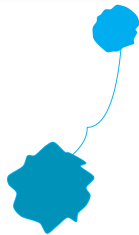


## MULTIPLE WAYS TO DEFINE CONNECTIVITY

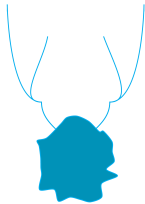
Low Connectivity

High Connectivity

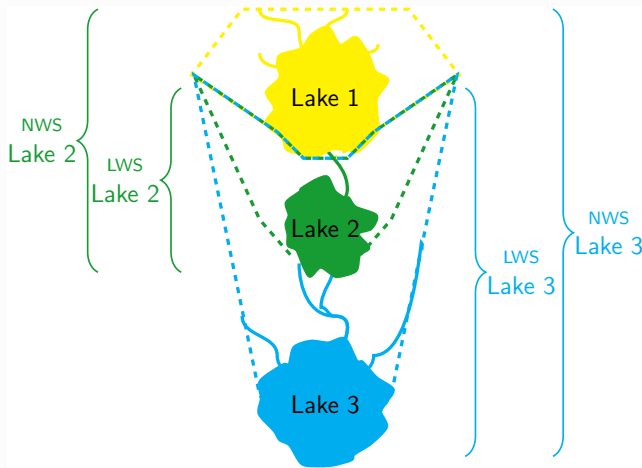
**Closest Lake Distance:** Network distance to the closest upstream lake.



**Average Link Length:** Sum of the total length of stream reaches between junctions divided by the total number of reaches.

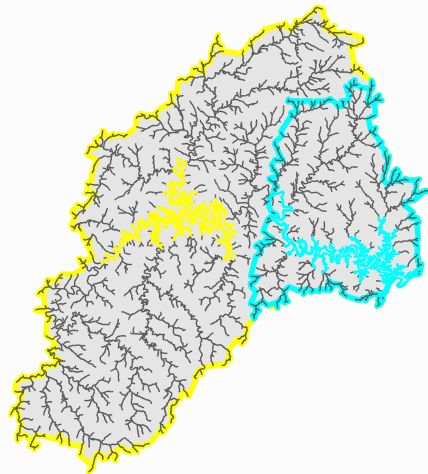
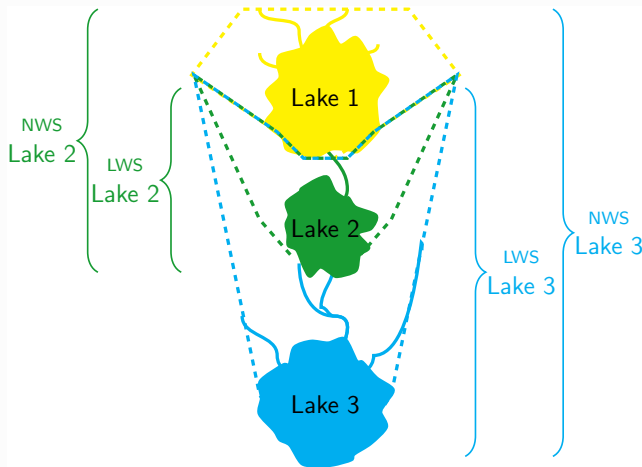


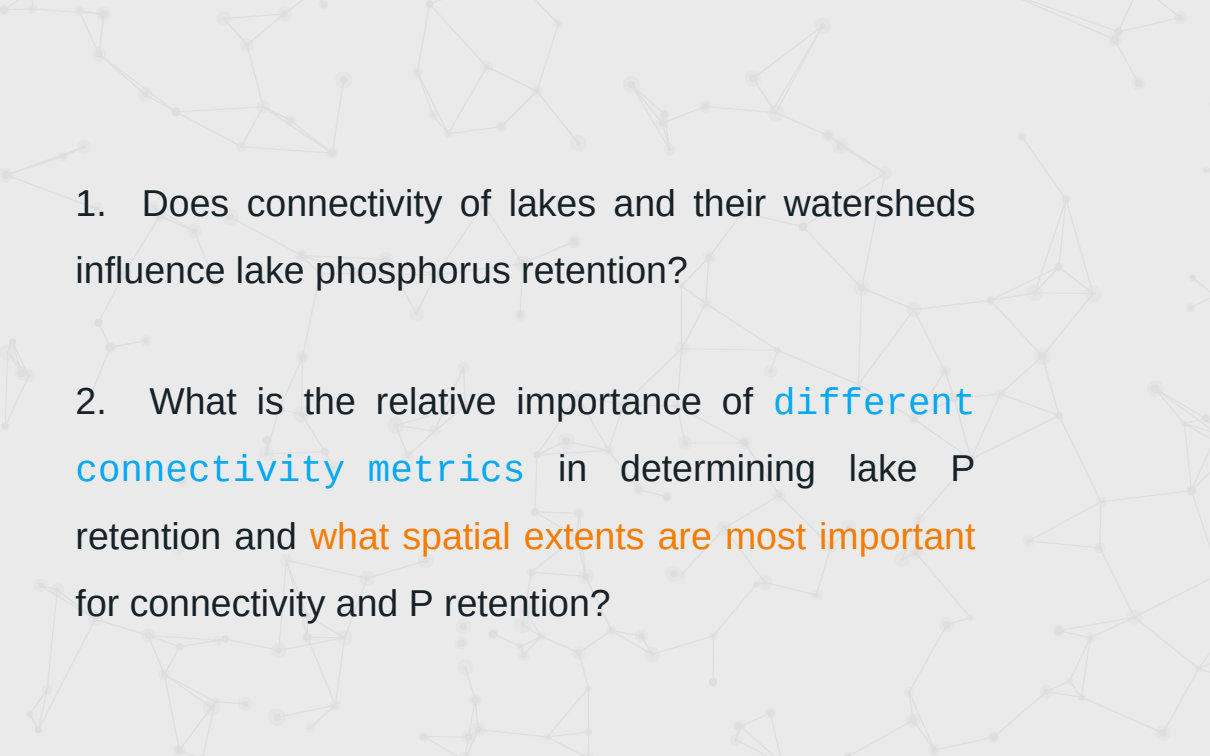
# WATERSHED CONNECTIONS





# WATERSHED CONNECTIONS

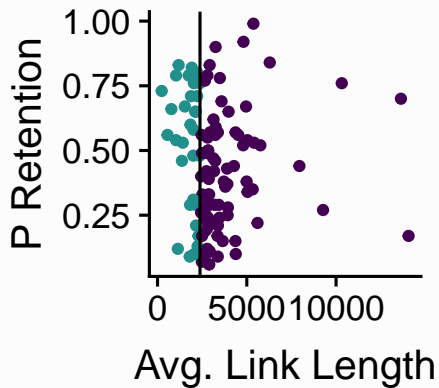
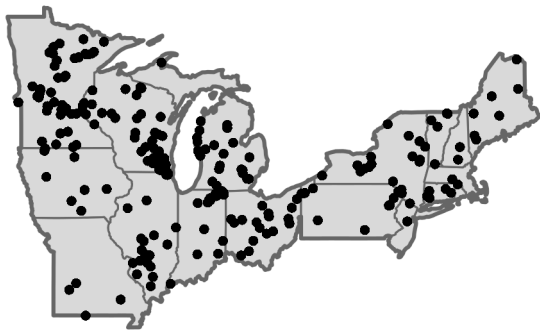


A faint, light gray background pattern consisting of a network of interconnected nodes and lines, resembling a molecular structure or a complex web, covering the entire slide.

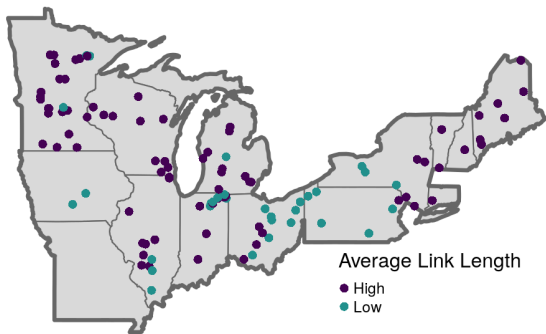
1. Does connectivity of lakes and their watersheds influence lake phosphorus retention?

2. What is the relative importance of **different connectivity metrics** in determining lake P retention and **what spatial extents are most important** for connectivity and P retention?

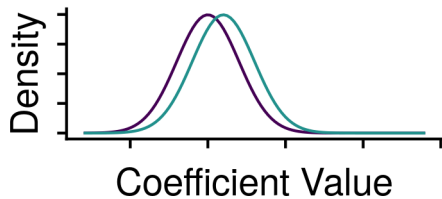
## METHODS - CONNECTIVITY PARTITIONS



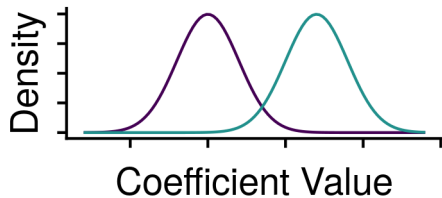
## METHODS - P RETENTION MODELLING



### No Connectivity Effect

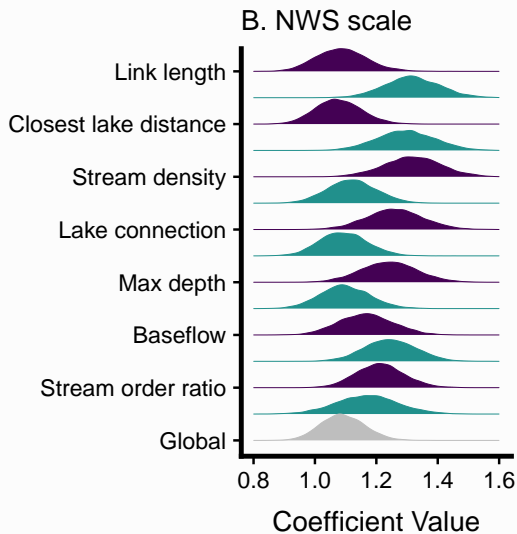
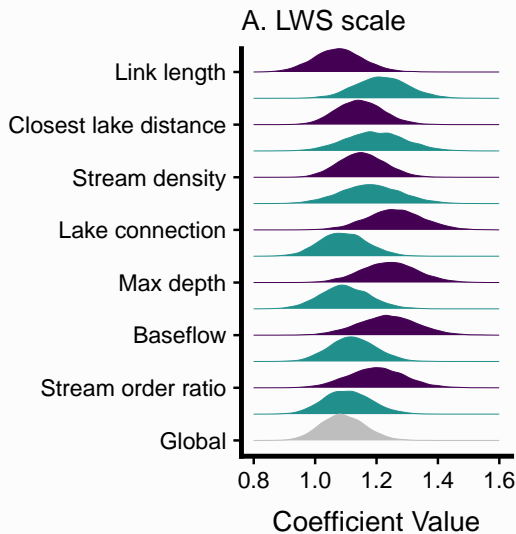


### Connectivity Effect



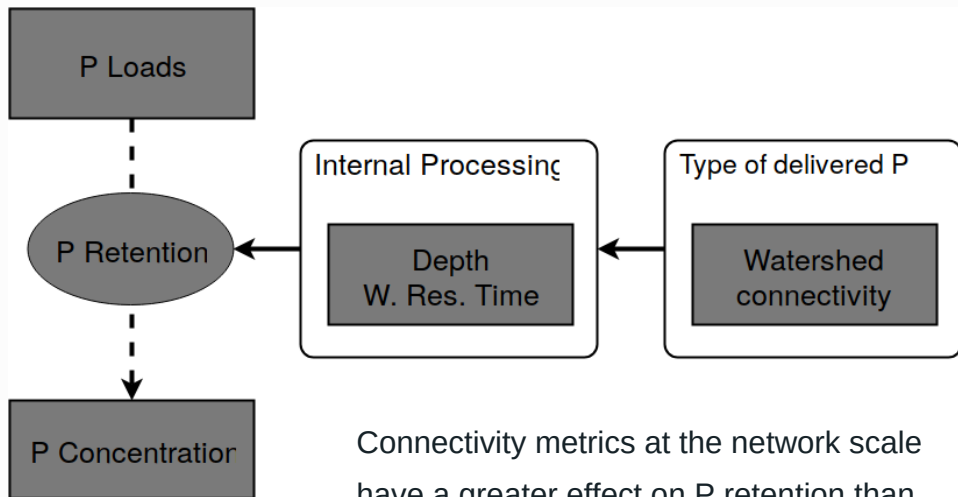


## P RETENTION (PROCESSING) COEFFICIENT DISTRIBUTIONS



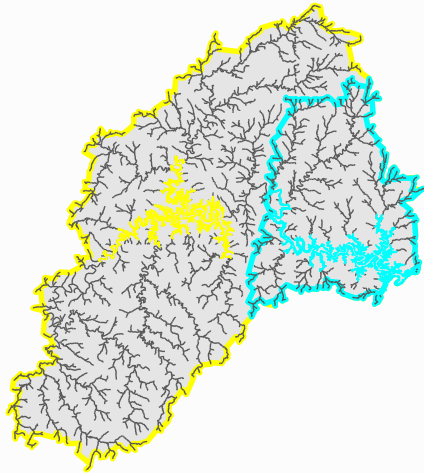


## CONCLUSION



Connectivity metrics at the network scale have a greater effect on P retention than metrics at finer scales.

## IMPLICATIONS









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Søndergaard, M., Bjerring, R., and Jeppesen, E. (2013).

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*Hydrobiologia*, 710(1):95–107.



Stachelek, J. and Soranno, P. ("In prep").

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