Modeling Lake Trophic State: A Data Mining Approach

Carl Boettiger[*,a], First Coauthor[b]

[a] *Center for Stock Assessment Research, 110 Shaffer Rd, Santa Cruz, CA 95050, USA*

[b] *Full address of First Coauthor*

Abstract

Write the abstract of the paper here

Introduction

Cyanobacteria are an important taxonomic group associated with harmful algal blooms in lakes. Understanding the drivers of cyanobacteria presence has important implications for lake management and for the protection of human and ecosystem health. Chlorophyll a concentration, a measure of the biological productivity of a lake, is one such driver and is largely, although not exclusively, determined by nutrient inputs. As nutrient inputs increase, productivity increases and lakes transition from low trophic state (e.g. oligotrophic) to higher trophic states (e.g. hypereutrophic). These broad trophic state classifications are associated with ecosystem health and ecosystem services/disservices (e.g. recreation, aesthetics, fisheries, and harmful algal blooms). Thus, models of trophic state might be used to predict things like cyanobacteria.

We have three goals for this preliminary research:

1. Build and assess models of lake trophic state
2. Assess ability to predict trophic state in lakes without available *in situ* water quality data
3. Explore association between cyanobacteria and trophic in order to expand models.

Data and Modeling Methods

Data We utilize four primary sources of data for this study. These are outlined below and in Table 1.

1. National Lakes Assessment (NLA) 2007: The NLA data were collected during the summer of 2007 and the final data were released in 2009. With consistent methods and metrics collected at 1056 location s across the conterminous United States (Map 1), the NLA provides a unique opportunity to examine broad scale patterns in lake productivity. The NLA collected data on biophysical measures of lake wat er quality and habitat. For this analysis we primarily examined the water quality measurements from the NLA (USEPA 2009).
2. National Land Cover Dataset (NLCD) 2006: The NLCD is a nationally collected land use land cover dataset. We collected total land use land cover and total percent impervious surface within a 3 kilo meter buffer surrounding the lake to examine larger landscape-level effects (Homer et al. 2004, Xian et al. 2009).
3. Modeled lake morphometry: Various measures of lake morphometry (i.e. depth, volume, fetch, etc.) are important in understanding lake productivity, yet many of these data are difficult to obtain for large numbers of lakes over broad regions. To add this information we modeled lake morphometry (Hollister and Milstead 2010, **???**, Hollister et al. 2011, Hollister 2013).
4. Estimated Cyanobacteria Biovolumes: Cyanobacteria biovolumes is a truer measure of Cyanobacteria dominance than abundance as there is great variability in the size within and between species. To a ccount for this, Beaulieu *et al.* (2013) used literature values to estimate biovolumes for the taxa in the NLA. They shared this data and we have summed that information on a per- lake basis.

*Corresponding author
Email address: cboettig(at)gmail.com (Carl Boettiger)

References

Beaulieu, M., F. Pick, and I. Gregory-Eaves. 2013. Nutrients and water temperature are significant predictors of cyanobacterial biomass in a 1147 lakes data set. Limnol. Oceanogr 58:1736–1746.

Hollister, J. 2013. lakemorpho: Lake morphometry in r.

Hollister, J. W., and W. B. Milstead. In Preparation. National lake morphometry dataset v1.0.

Hollister, J. W., W. B. Milstead, and M. A. Urrutia. 2011. Predicting maximum lake depth from surrounding topography. PLoS ONE 6:e25764.

Hollister, J., and W. B. Milstead. 2010. Using gIS to estimate lake volume from limited data. Lake and Reservoir Management 26:194–199.

Homer, C., C. Huang, L. Yang, B. Wylie, and M. Coan. 2004. Development of a 2001 national land-cover database for the united states. Photogrammetric Engineering & Remote Sensing 70:829–840.

USEPA. 2009. National lakes assessment: a collaborative survey of the nation's lakes. ePA 841-r-09-001. Office of Water; Office of Research; Development, US Environmental Protection Agency Washington, DC.

Xian, G., C. Homer, and J. Fry. 2009. Updating the 2001 national land cover database land cover classification to 2006 by using landsat imagery change detection methods. Remote Sensing of Environment 113:1133–1147.