Developing GAMs to Identify Algal Biomass Controls in Mid-Atlantic Streams

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Abstract. Benthic algae populations serve as critical primary producers in freshwater lotic ecosystems, but excess biomass leads to harmful eutrophic conditions. Nutrients are often identified as key drivers of eutrophication, but many other abiotic and biotic factors affect algal biomass accrual. For instance, despite their demonstrated role as primary consumers, aquatic insects (macroinvertebrates) have rarely been included in large-scale analyses of algal biomass controls. The 1997-1998 EPA EMAP Mid-Atlantic streams dataset was used to develop generalized additive models (GAMs), with the goal of identifying major controls on algal biomass. Three different backward selection methods were used to choose top GAMs, including generalized cross-validation (GCV) scores, Bayesian Information Criteria (BIC), and p-values. Models were evaluated using k-fold cross-validated fitted values, which were compared to chlorophyll *a* observations via linear regression and correlation. The top GCV and p-value models included similar covariates and both performed well in terms of deviance explained (73.2% and 68.5%), correlation of observed and fitted values (Pearson's r >0.40), and model calibration as evidenced by linear regression parameters. All models were unique but contained four overlapping covariates: collector-filter taxa richness, total macroinvertebrate density, mid-channel tree canopy, and watershed percent commercial/ industrial/ transportation. The addition of macroinvertebrate data to this analysis provided new insights about the relationships between chlorophyll *a* and stream biota. For instance, collector-filter and shredder taxa were positively related to chlorophyll *a*. Scraper taxa (common algal grazers) were only included in one of the models, with a positive but insignificant chlorophyll *a* relationship. These results require further experiments and field observations to fully understand the mechanisms involved.