Water Quality and Plankton Communities of the Blackwater Satilla River

Mary E. Freund and C. Tate Holbrook

Department of Natural Sciences, College of Coastal Georgia, Brunswick, GA

Introduction

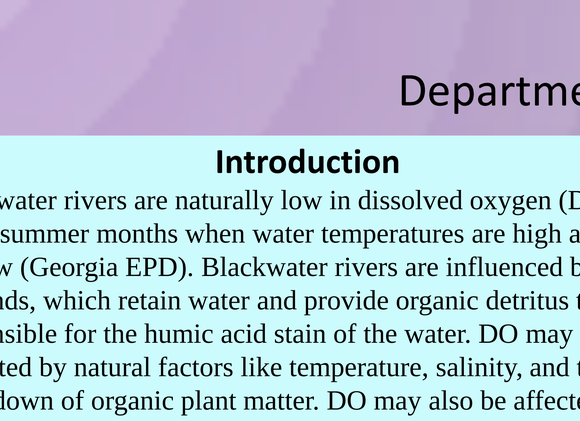
Blackwater rivers are naturally low in dissolved oxygen (DO) levels in the summer months when water temperatures are high and flows are low (Georgia EPD). Blackwater rivers are influenced by wetlands, which retain water and provide organic detritus that is responsible for the humic acid stain of the water. DO may be impacted by natural factors like temperature, salinity, and the breakdown of organic plant matter. DO may also be affected by human influences through point- and non-point source pollutants. Determining baseline water quality characteristics of a particular location, especially in blackwater systems, can begin to help us understand what factors are contributing to unhealthy DO levels.

Planktonic communities are the basis of aquatic food webs and essential in primary production. The metabolic activity of planktonic and microbial organisms can also affect the DO levels in the water column. As sediment bacteria break down organic detritus, oxygen is used. An influx of nutrients can promote algal growth in the water column. As phytoplankton begin to decompose, oxygen is used. Phytoplankton biomass and production can be regulated by bottom-up controls like light availability and nutrients. They can also be regulated by top-down controls like predation from zooplankton and filter feeders.

The Satilla River

The Satilla River drains Georgia's Coastal Plain and a watershed area of 9,140 km^2 (~3529 mi^2). The major land use in the Satilla Watershed is the timber industry. Two sites on the lower reaches of the Satilla River were chosen to study water physiochemical parameters and plankton diversity. **Woodbine (WB)** is in the middle of a DO-impaired segment. **Burnt Fort (BF)** is not DO-impaired (Georgia EPD).

Research question – How do WB and BF differ in water quality and plankton community composition?

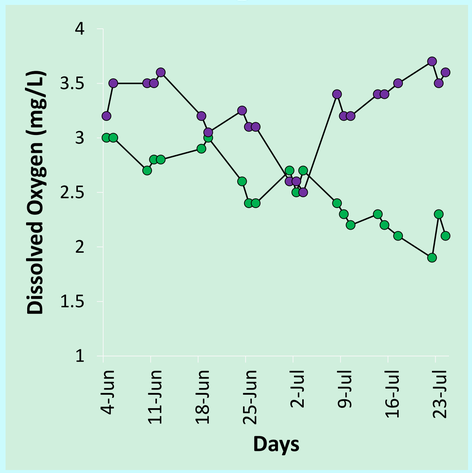


1 = Woodbine (WB) and 2 = Burnt Fort (BF). These two sites are separated by ~25 river miles. WB is closer the Atlantic Ocean and has both a salinity and a point-source influence. BF has no salinity influence and is nestled in pine stands.

Results: Water Quality

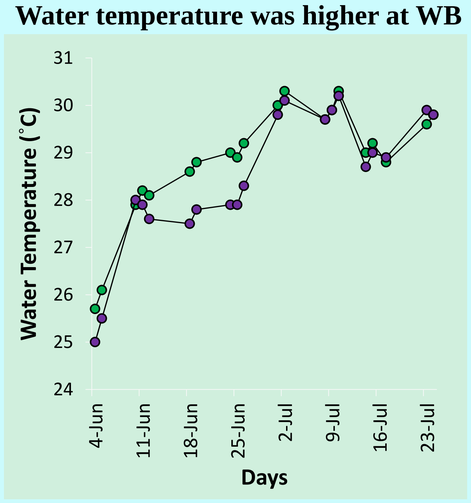
GREEN = Woodbine (WB) **PURPLE = Burnt Fort (BF)**

DO was higher at BF



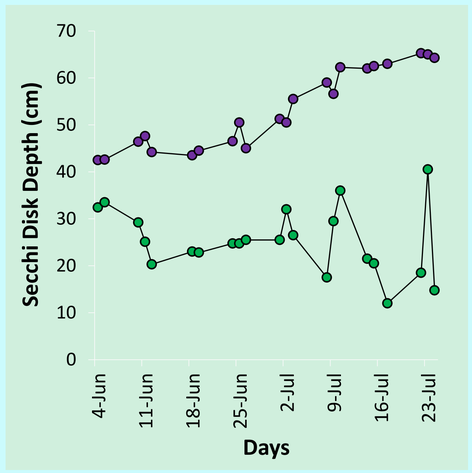
($\bar{x}$ = 3.3 mg/L > 2.5 mg/L; $p < 0.001$)

Water temperature was higher at WB



($\bar{x}$ = 28.86°C > 28.47°C; $p < 0.001$)

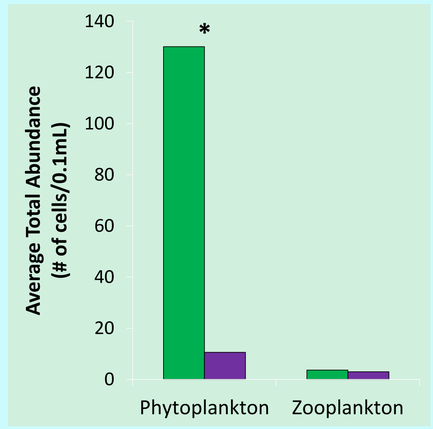
Secchi disk depth was greater (turbidity was lower) at BF



($\bar{x}$ = 53.2 cm > 25.27 cm; $p < 0.001$)

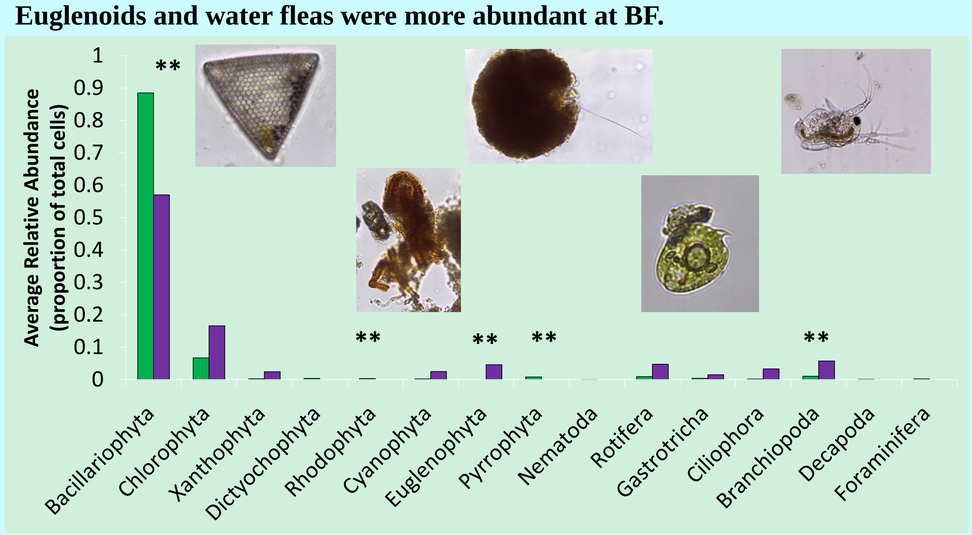
Results: Plankton Communities

WB had a greater abundance of phytoplankton but not zooplankton



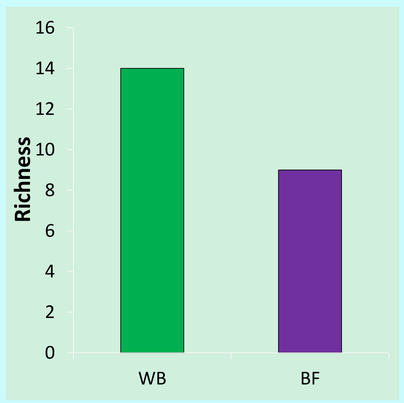
(phyto $\bar{x}$ = 130 cells > 11 cells; zoo $\bar{x}$ = 4 cells vs. 3 cells; * indicates $p < 0.001$)

Relative abundances of diatoms, red algae, and flame algae were higher at WB. Euglenoids and water fleas were more abundant at BF.

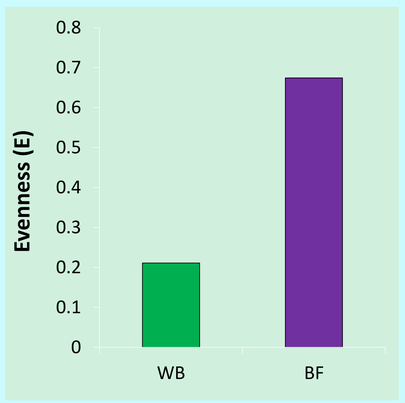


** indicates Bonferroni corrected $p < 0.003$

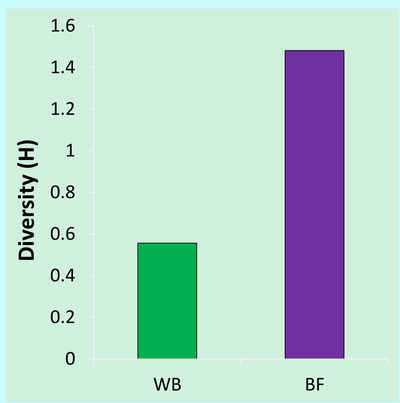
WB had a greater number of plankton taxa



Plankton taxa were more evenly distributed at BF



BF had a greater overall diversity of plankton



Methods

- 22 morning sampling events at WB and BF in June–July 2014
- 20 minute plankton tows
- Collected water quality and other physiochemical parameters
- Photographed, counted and identified (to higher taxa) plankton cells with microscope (0.1 mL random aliquot)
- Used paired *t*-tests to test for differences between WB and BF in physiochemical variables and abundance of plankton groups
- Compared plankton community composition using Shannon diversity index, richness, and evenness of higher taxa

Discussion

- Both sites fell below the minimum dissolved oxygen state standard of 4.0 mg/L. What should the state standard be for DO in blackwater rivers?
- WB and BF differed in DO, temperature, and turbidity. What is the impact of natural versus human factors on water quality?
- These measures are watershed-specific depending on land uses. Long-term monitoring is needed to better understand baseline characteristics.
- Total phytoplankton abundance differed between sites but zooplankton did not. Variation may be explained by current speed, productivity, and/or heterotrophy.
- Specific plankton taxa may be indicators that respond differently to water quality.

Acknowledgements

Communities of Coastal Georgia Foundation funded a portion of the project. Satilla Riverkeeper Executive Director Ashby Nix and the Board (especially Roger Lloyd and Clay Montague) have also been very supportive.

Satilla RIVERKEEPER®

COLLEGE of COASTAL GEORGIA
UNIVERSITY SYSTEM OF GEORGIA
Dreams in Action™

Georgia Adopt-A-Stream