Dissolved Oxygen Levels as a Factor in the Health of Freshwater Ecosystems

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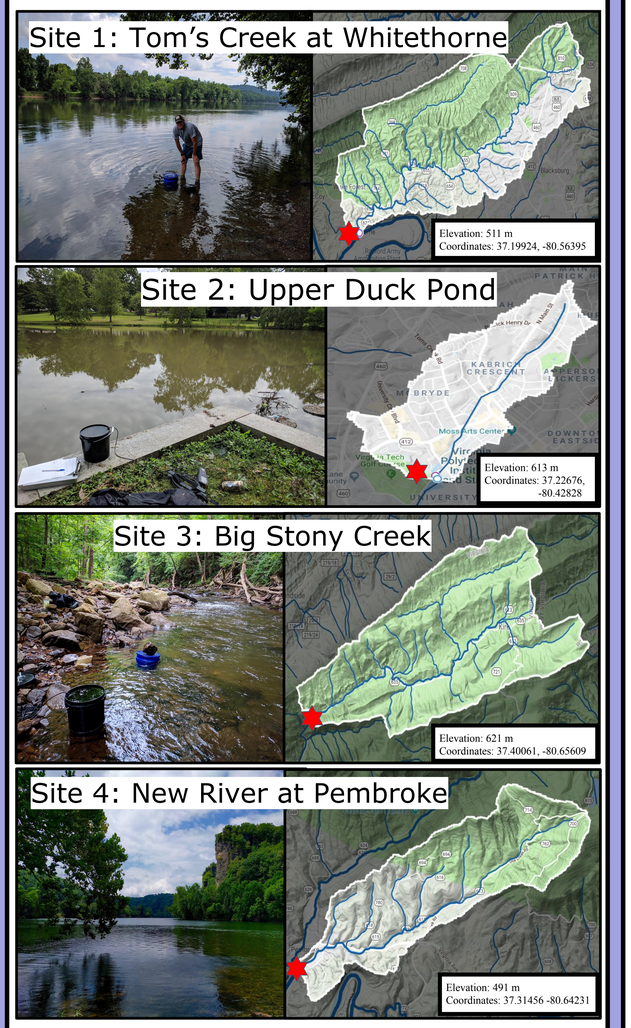
Introduction

- The health of freshwater ecosystems and suitability for aquatic species can be assessed through dissolved oxygen (DO) levels, DO consumption via respiration, as well as how DO fluctuates over time.
- The objective of this research was to test how characteristics such as land use, water temperature, and conductivity are related to DO and biological oxygen demand through short-term, on-site incubations of stream, pond, and river water.

Methods

- Watershed delineation and site information from www.wikimodeling.org
- Biological oxygen demand (respiration) measured at four sites using a new onsite "rapid assessment" method: miniDOT DO sensors logging at 1-min intervals in a dark bucket filled with site water for ~30 minutes
- We estimated site-specific respiration using a linear model to estimate respiration rates, where the slope of a linear model fit to DO data (m in $y = mx + b$) is the change in DO over time (mg O_2 L^{-1} min^{-1})

Sites



Results

- Our results show promising use of rapid assessment incubations for measuring respiration rates and ecosystem health.
- Greater land change (increasing % urban and developed) across watersheds was correlated with higher respiration rates and conductivity, while more forested sites had lower respiration and conductivity.
- The short-term rapid respiration assessment seems better suited to sites in more human-impacted watersheds (higher R^2 of linear model fits with increasing land change)

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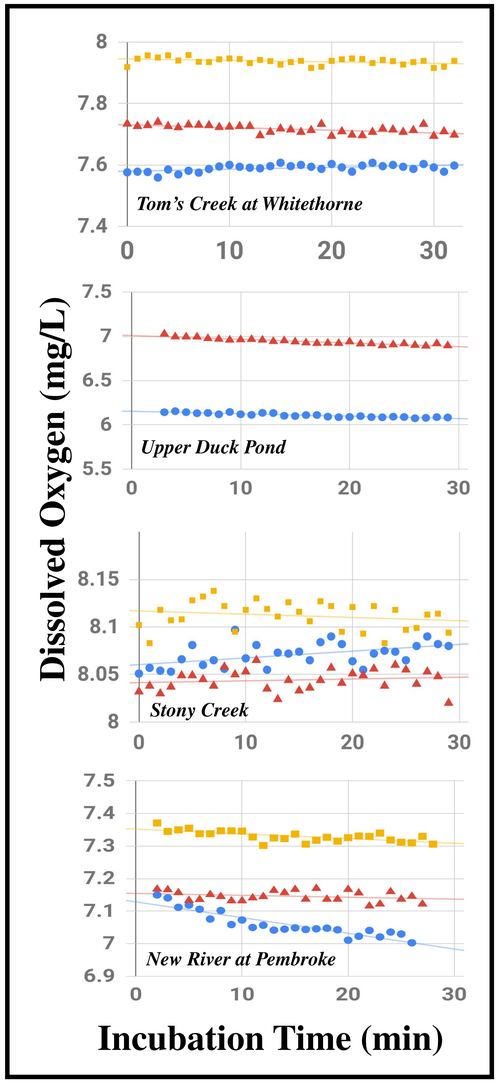
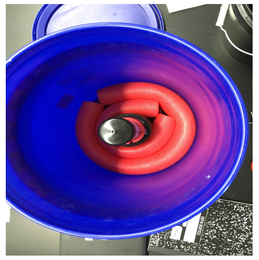


Classroom Learning Module

- Knowledge from this RET experience will be used to develop modules on freshwater biodiversity and water quality for high school students.
- After learning about dissolved oxygen (DO) and other water chemistry parameters, why water quality changes (including how photosynthesis and respiration change DO), and how water quality relates to invertebrate and fish species diversity and assessment, students will use www.wikimodeling.org to collect watershed data and make predictions about which freshwater habitats will have optimal conditions for species of interest.
- Students will design/construct probe-submerging incubators to measure respiration, collect samples at sites where they made predictions about water quality, and analyze/report results.



Site	Watershed Area (km²)	Temp. (°C)	Dissolved Oxygen (mg L^{-1})	Conductivity (µS cm^{-1})	Respiration Rate (mg O_2 L^{-1} min^{-1})	R^2	Land Cover % Forest	% AG	% Urban
Tom's Creek at Whitethorne	104	26.7	7.3	150	001: 6.3×10^{-4}	0.29	69	18	13
					002: -8.8×10^{-4}	0.41			
					003: -4.8×10^{-4}	0.17			
Upper Duck Pond	3	27.9	7.4	246	001: -2.7×10^{-3}	0.84	0.1	0.1	99.8
					002: -4.2×10^{-3}	0.89			
Big Stony Creek	93	22.5	7.6	55	001: 7.1×10^{-4}	0.25	97.4	1.4	1.2
					002: 1.9×10^{-4}	0.02			
					003: -3.4×10^{-4}	0.04			
New River at Pembroke	22	26.7	7.5	119	001: -4.8×10^{-3}	0.82	73.4	16.3	10.3
					002: -5.8×10^{-4}	0.08			
					003: -1.5×10^{-3}	0.47			