

Measurement of Water Residence Time, Flowpath, and Sediment Oxygen Demand in Seasonally Inundated Floodplain Swamps of the Georgia Coastal Plain

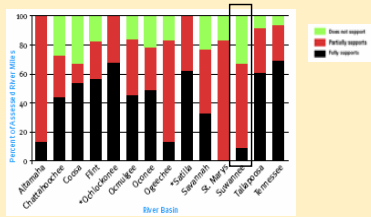
M. Jason Todd¹, George Vellidis², R. Richard Lowrance³, Catherine M. Pringle¹, David D. Bosch³, Joseph M. Sheridan³, and Andrew Mehring¹

¹Institute of Ecology, University of Georgia, Athens, GA; ²Biological and Agricultural Engineering, University of Georgia, Tifton, GA;

³USDA-ARS, Southeast Watershed Research Lab, Tifton, GA

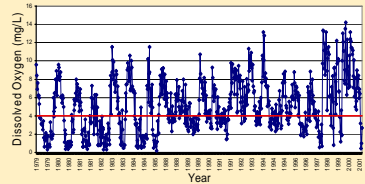
Background

- Coastal Plain streams have dissolved oxygen (DO) levels below set standards
- State minimum set at 4.0 mg L⁻¹
- DO has been called the "most important of all chemical methods available for the investigation of the aquatic environment" (Joyce et al. 1985)



- 90% of waters not fully supporting designated use in Suwannee Basin
- 91% of impaired waters listed for DO violations

Little River Watershed DO



- Over 30 year period DO levels often fall below the designated limit during spring, summer and fall
- 334 km² research center. Weirs established 1967.
- Land use is primarily agricultural
- Largely intact riparian vegetation with swamp hardwood communities.

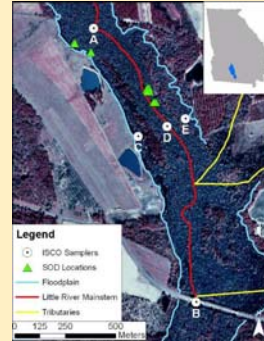
Funding

- USDA-CSREES Integrated Research, Education, and Extension Competitive Grants Program
- Hatch & State funds allocated to the GA Agricultural Experiment Stations
- USDA-ARS CRIS project funds

Objectives and Study Area

Instream swamps are a common landscape feature on the Coastal Plain and DO leaving these areas is typically low. What role do these swamps have on DO dynamics?

- How long does it take water to travel through a representative swamp?
- What role does sediment oxygen demand (SOD) play?

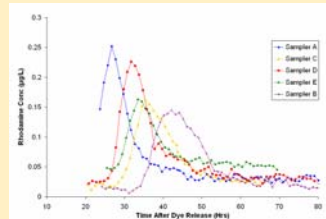


Residence Time and Flowpath

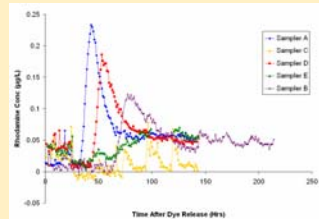


Use of rhodamine WT dye and multiple discrete samplers to characterize wetland hydrology

Dye Trace 1



Dye Trace 2



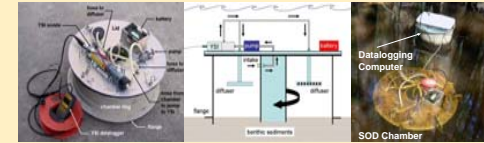
Residence Time Conclusions

	Dist (m)	Date	Avg. Daily Flow (m ³ s ⁻¹)	Travel Time (hrs)
Dye Trace 1				
Inj. Point to A	6500	1/24/06 – 1/30/06	2.63 – 4.14	26
Sampler A to D	600			5
Sampler D to B	950			10.5
Total Reach	1550			15.5
Dye Trace 2				
Inj. Point to A	6500	3/29/06 – 4/7/06	0.32 – 1.01	43
Sampler A to D	600			11
Sampler D to B	950			16
Total Reach	1550			27

- Travel time nearly twice as long during low flow period
- Less floodplain contact and more dispersion during low flow period
- Extended travel times allows prolonged sediment contact and could lead to lowered DO concentrations

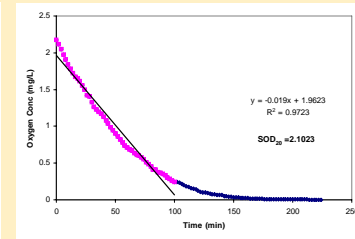
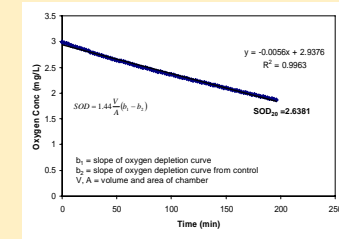
Sediment Oxygen Demand (SOD)

- SOD is the sum of all oxygen consumed by biological and chemical processes in sediment.
- May be the most important sink in the Suwannee River Basin
- Very few data for Coastal Plain blackwater streams and instream swamps.
- Despite importance, often estimated when developing TMDLs and other models



SOD Chamber Setup. Three experimental and one control chamber deployed for three hour interval

SOD Chamber Data



SOD Conclusions

- Reported SOD rates for Southeastern US rivers range between 0.33 – 0.77 g O₂ m⁻²day⁻¹ (Truax et al., 1995).
- All measures in this study are higher than reported range and up to 48 times higher (rates between 0.9 – 15.8 g O₂ m⁻² day⁻¹).
- Previous study in similar watersheds had rates between 0.6 – 1.4 g O₂ m⁻²day⁻¹ in the agricultural catchment and 0.9 – 2.5 g O₂ m⁻²day⁻¹ in the forested catchment (Crompton, 2005).
- More than 1/2 of measures in this study are above the highest value recorded during the previous study.
- SOD may play even greater role than previously thought in the LREW.
- Instream swamps may be areas of intense Sediment Oxygen Demand.

For More Information, please contact:
Jason Todd jatodd@uga.edu
229-386-3959