Fate and Transport of Various Nonpoint Pollutants in North Florida Watersheds: Current Research and Future Directions

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1. Introduction

The watersheds and ecosystems in northern Florida are increasingly being impacted by sediment, nutrient, and pathogen loadings emanating from upstream agricultural watersheds and rapidly urbanizing areas. These watersheds feed into the Gulf of Mexico, thus adding to existing concerns regarding water quality in the Gulf. Our current research aims to identify pollutant sources definitively, and to determine pollutant fate and transport and the resulting impacts on coastal water quality.

2. Key Concerns

Three watersheds are included (Fig. 1):

- Apalachicola River watershed (FL portion). The Apalachicola River is listed as impaired for a variety of pollutants including sediment and bacteria (FDEP, 2005). Increasing abstractions upstream have also led to water quantity and availability concerns.
- Juniper Creek watershed. Juniper Creek is listed as impaired for coliform bacteria with levels often exceeding the 400 cfu/100ml fecal coliform criteria. Bacterial contamination in this watershed is as a result of livestock production accounting for over 98% percent of the loads (Wieckowicz et al., 2008).
- The Suwannee River watershed. The Suwannee River is listed as impaired, for dissolved oxygen (Upper Suwannee) and nutrients (Lower Suwannee), as well as sediment and pesticides (USGS, 2004).

Table 1: Summary of impairments and concerns for the study watersheds

Watershed	Impairment/Concern
Apalachicola	Water Quantity Sediment/Dredging Pathogens Development
Juniper/Ocklochonee	Fecal Coliform Nutrients
Suwannee	Nutrients (nitrates) Dissolved Oxygen Total Phosphorus (Upper Suwanee)

Sources: EPA, 2009. http://cfpub.epa.gov/surf/state.cfm?statepostal=FL; Local Environmental Groups (Apalachicola)



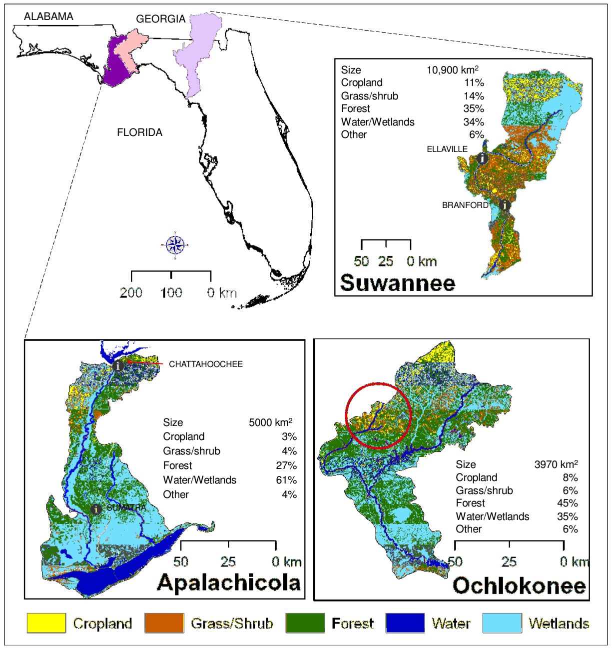

Figure 1: Study sites location and land use

3. Approaches

Preliminary studies in the Apalachicola watershed involve analyses of historical water quality and quantity data and trends. For Juniper Creek watershed initial studies involve soil column experiments in the laboratory, with laboratory fecal coliform transport data being analyzed using the CXTFIT model (Toride et al., 1995; Gongsheng et al., 2007). In the Suwannee watershed, initial analyses include flood (Northrop, 2004) and drought (Flynn, 2003) frequency analyses.

References

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4. Preliminary Results

Apalachicola

Table 2: Water quality statistics for the Apalachicola watershed

Component	Statistic	Apalachicola River	New River	Apalachicola Bay
Fecal Coliform, #/100 ml	Maximum	2800	5300	540
	Minimum	1	1	0
	Mean	64	102	13
	SD	247	496	35
Phosphorus, mg/l	Maximum	2600	1300	--
	Minimum	0.007	0.006	--
	Mean	38.8	11.6	--
	SD	206.5	120.7	--
Nitrogen, mg/l	Maximum	0.57	0.039	--
	Minimum	0.015	0.004	--
	Mean	0.31	0.01	--
	SD	0.07	0.01	--

Source: EPA STORET data 1999-2006.; FDEP (2005)

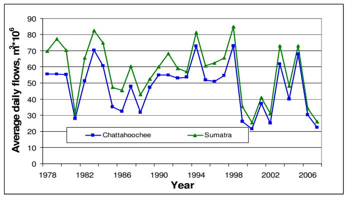

Figure 2: Average daily flows in the Apalachicola River at onset near Chattahoochee and downstream near Sumatra

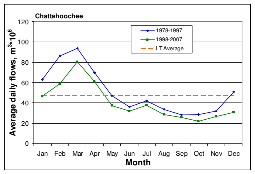

Figure 3: Historical (1978-1997) and recent (1998-2007) flows in the Apalchicola River at onset near Chattahoochee

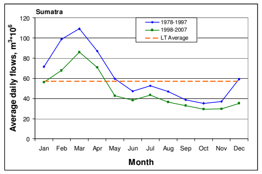

Figure 4: Historical (1978-1997) and recent (1998-2007) flows in the Apalachicola River downstream near Sumatra

Juniper

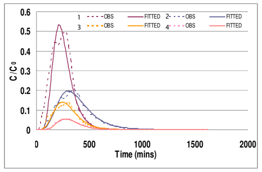

Figure 5: Bacteria (*E. coli* k12) breakthrough curves: observed and simulated values for samples 1 (0.001M); 2 (0.005M); 3 (0.01M); and 4 (0.1M)

Suwannee

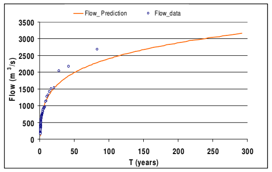

Figure 6: Maximum flow prediction for Suwannee River at Ellaville fitted to GEV distribution

Table 3: Parameter values as determined from transport modeling of *E. coli* k12 as obtained for different ionic strengths

Sample	Ionic Strength (M)	D (cm^2/min)	V cm/min	R	μ	β	ω
1	0.001	12	6.04	1.88	$1.00*10^{-07}$	0.994	$1.00*10^{-07}$
2	0.005	11.96	6.04	3.27	0.456	0.01	34.21
3	0.01	12	6.04	2.73	1.17	0.0001	35
4	0.1	12	6.04	3.52	2.51	0.655	13.5

D = Dispersion coefficient; V = Velocity, cm/min; R = Retardation factor; μ= First order decay coefficient; β, ω = Dimensionless partitioning and mass transfer coefficients

5. Impacts and Directions

This work will provide information that will aid watershed planners, state and federal agencies, and agricultural producers in system management and timing of operations, while also providing the data and tools necessary for further water quality research in the area.