Septic Tank Pollution In Florida’s Estuaries: An Emerging Water Quality Challenge

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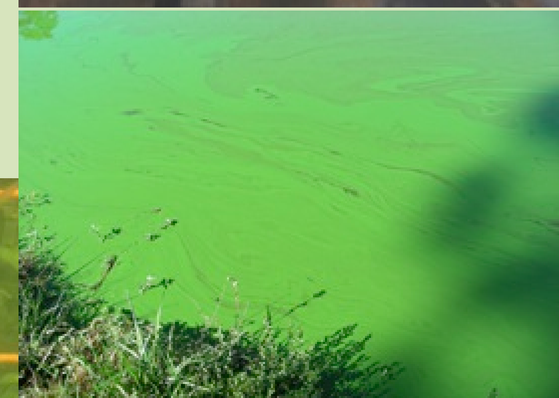
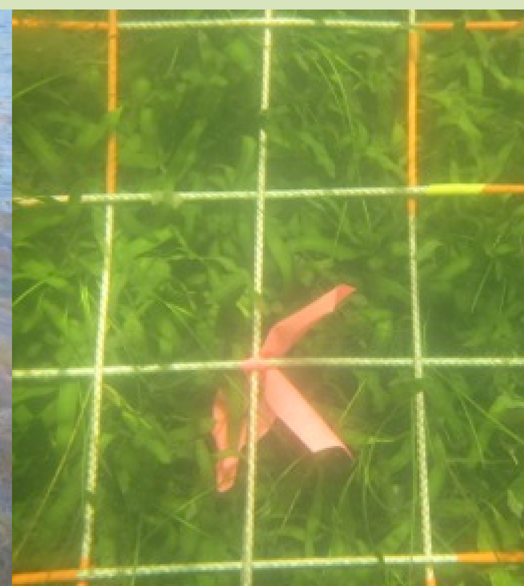
Critical Issues Facing Florida's Estuaries and Coastal Waters

- Nutrient, microbial and contaminant pollution
- Harmful algal blooms
- Loss of seagrass and coral reef habitat
- Decline of fisheries
- Emerging diseases and mortalities in wildlife (corals, manatees, dolphins, sea turtles, pelicans, fish, shellfish) and





Septic Tanks: An "Unseen" Source of Sewage Pollution in Florida's Waters

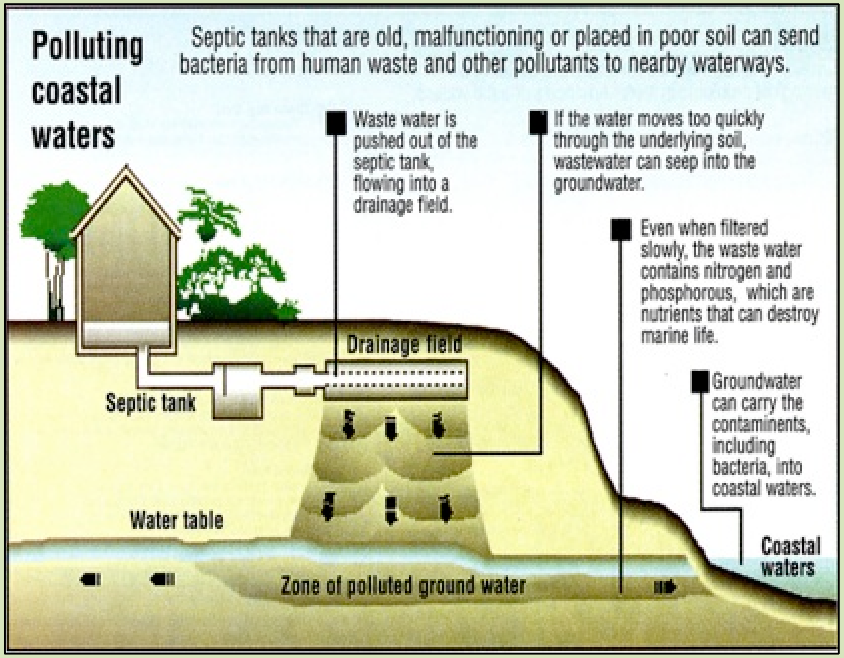
• Approximately one-third of households in Florida rely on septic tanks

• Soils in much of Florida are unsuitable for septic tanks (porous sands or karst limestone, low organic content, high water tables)

•Contaminants include nitrogen, phosphorus, OWCs (pharmaceuticals, hormones, etc.), bacteria, viruses

• Estimated N-load from septic systems in Florida is substantial:

Fertilizer: 1.4×10^{11} g-N/yr
Septic systems: $2.4 - 4.9 \times 10^{10}$ g-N/yr
Atmospheric inputs: $5.9 - 9.4 \times 10^{9}$ g-N/yr
Reclaimed water: $1.2 \times 10^{8} - 2.6 \times 10^{10}$ g-N/y
(Badruzzman et al. 2012)



Ecosystem Responses to Eutrophication in the Indian River Lagoon

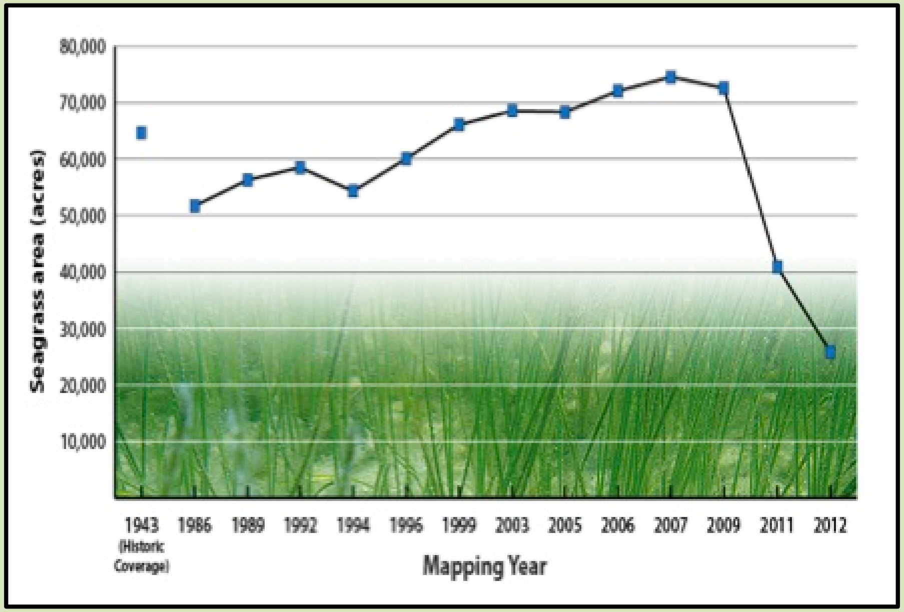
- Increasing seagrass epiphytes, macroalgae, and phytoplankton

- “Super Bloom” followed multi-year drought in 2011

- Brown Tide in 2012

- Unprecedented seagrass die-off

- Wildlife, fish, shellfish mortality in IRL



IRL-Wide Study 2011-2012

20 IRL Sites + 4 Reference Sites

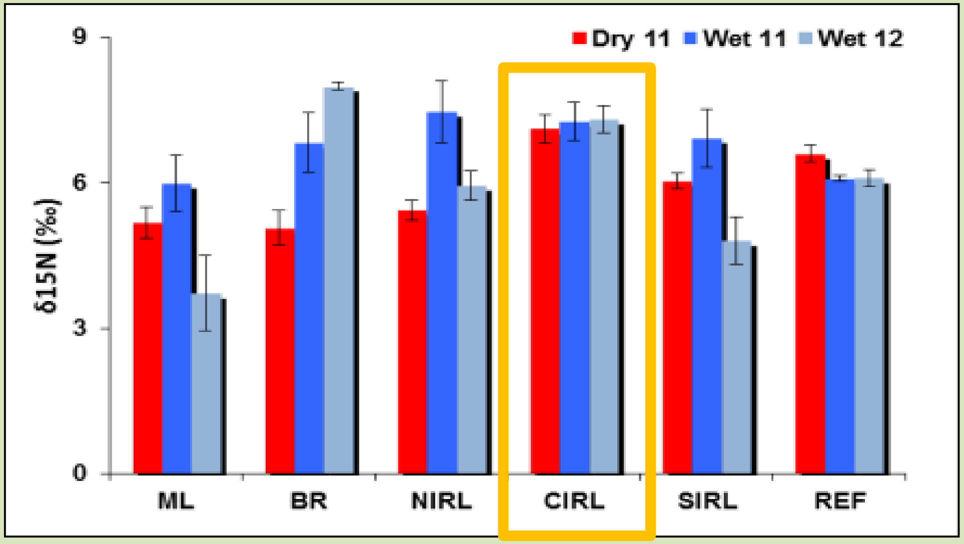
• Objectives: Use multiple lines of evidence (dissolved nutrients, C:N:P and δ^{15}N in macroalgae) to assess spatial/temporal patterns in nutrient pollution, N- vs. P-limitation of algal growth, and N sources fueling eutrophication in the IRL.

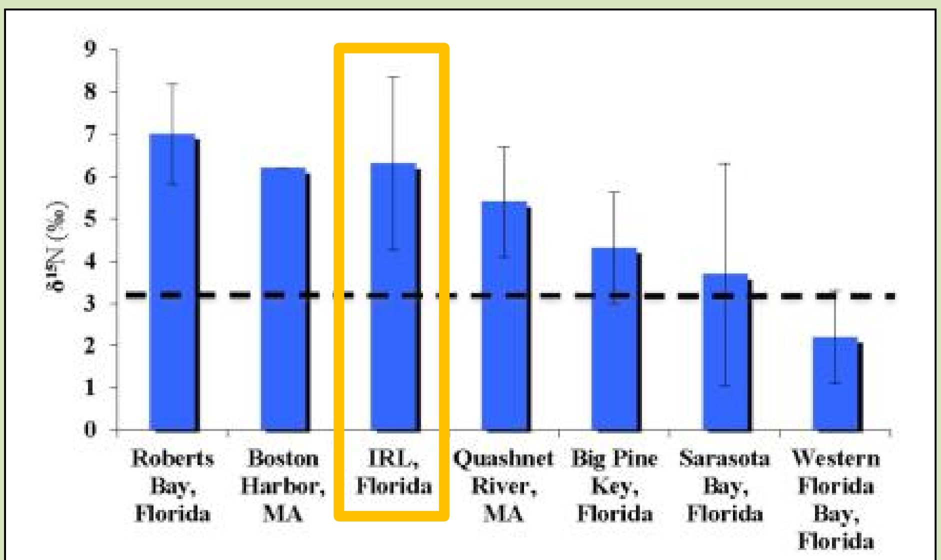
• Goal: Improve water quality in the IRL by providing high-quality, user-friendly data to resource managers and policy-makers.

Macroalgae as Bio-Observatories in the IRL

Gracilaria tikvahiae		*Caulerpa prolifera*	
Hypnea musciformis		*Hypnea spinella*	
Caulerpa mexicana		*Laurencia filiformis*	
Acetabularia schenck		*Acanthophora spicifera*	

Stable N Isotopes in Macroalgae Identify Sewage N Source



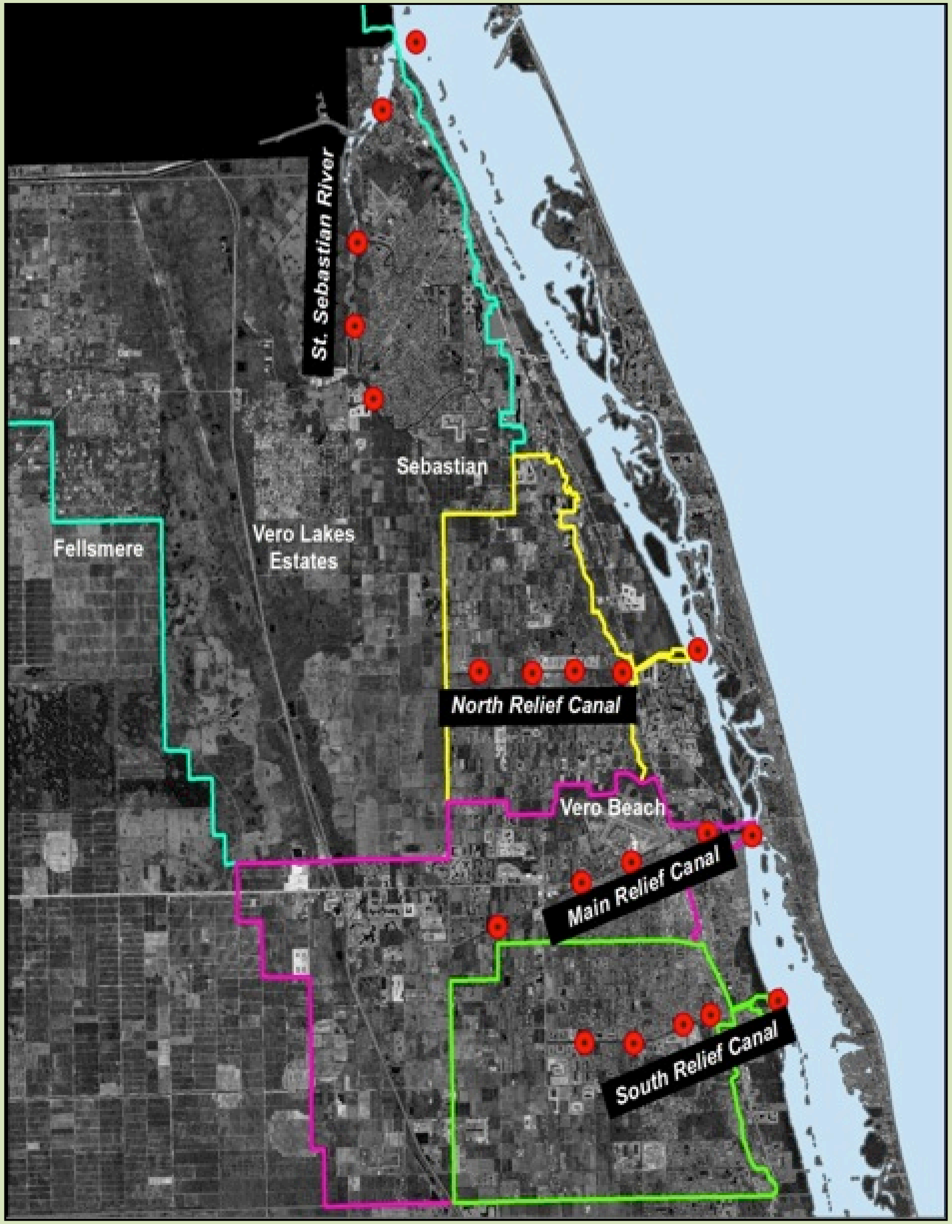


Source	δ^{15}N Level
OSTDS effluent	+3 to +5
Treated wastewater	+5 to +28
Upwelling	+2
Nitrogen fixation	0
Atmospheric N	-3 to +2
Fertilizers	-2 to +2
Everglades peat	0 to +2

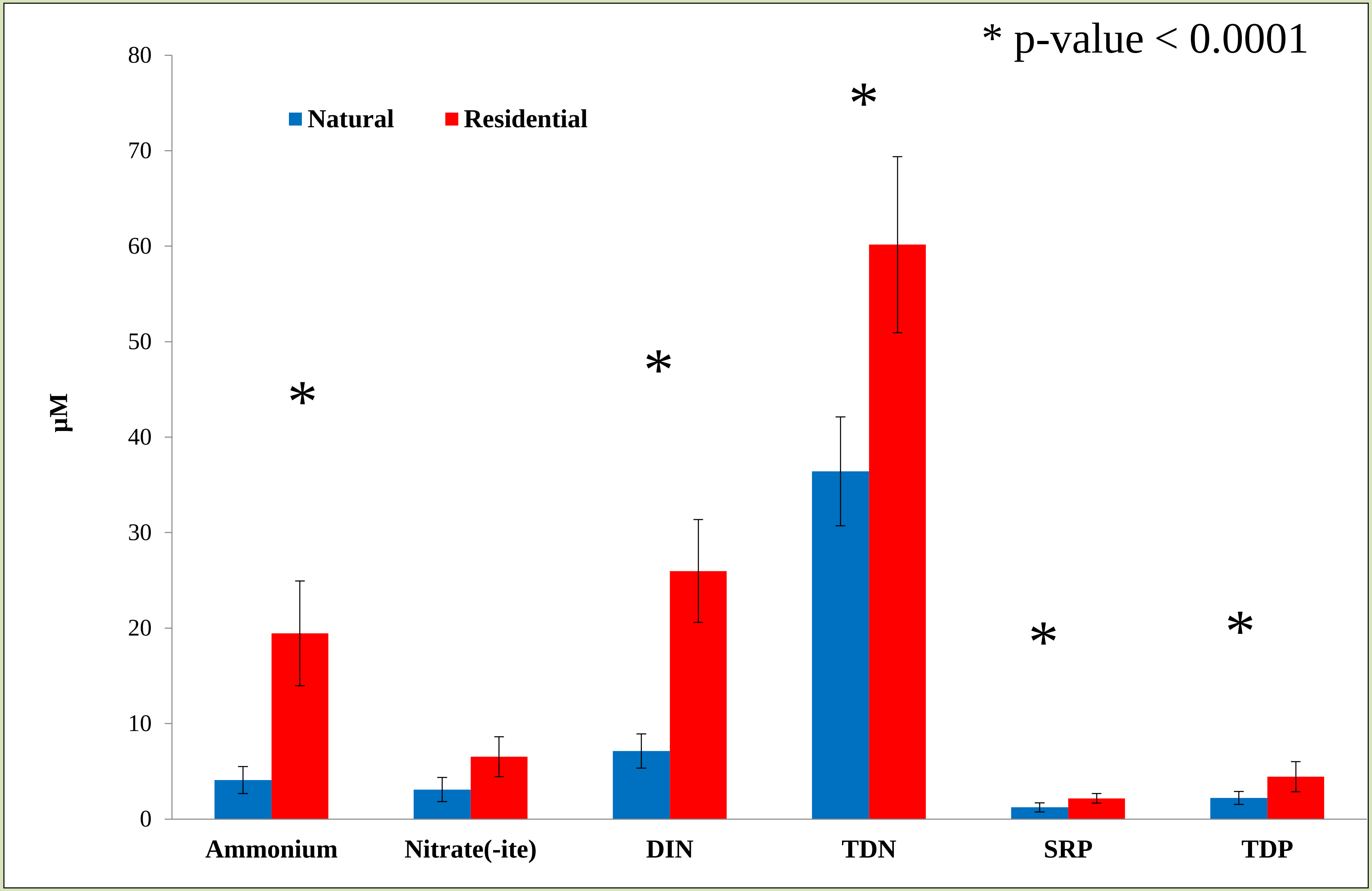
- δ^{15}N in IRL averaged + 6.3 o/oo
- δ^{15}N in IRL comparable to other areas with known sewage contamination

Indian River County Septic Study: 2013-2014

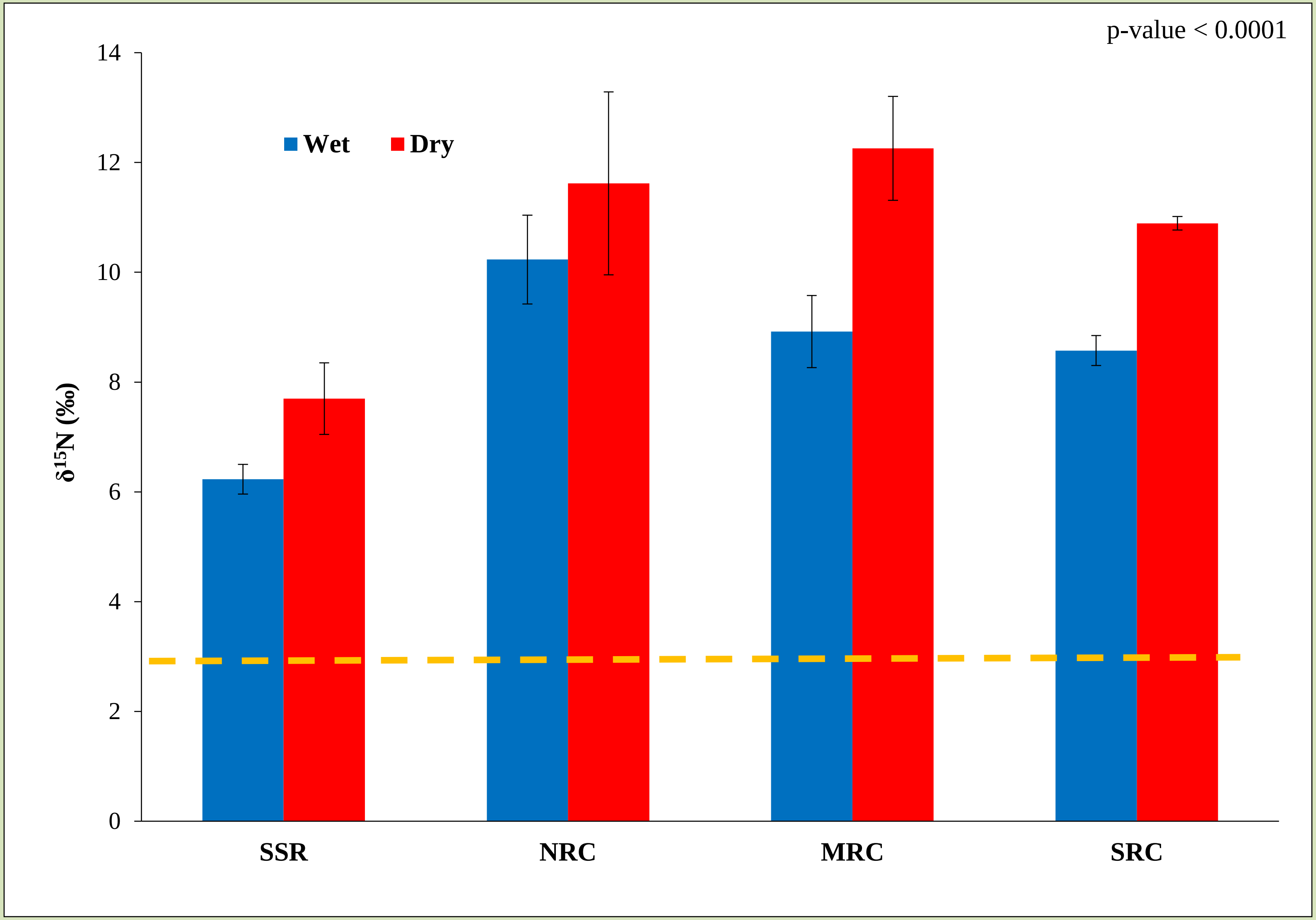
- October 2013 (wet season)
- March 2014 (dry season)
- Surface water
- Groundwater
- Reference Sites



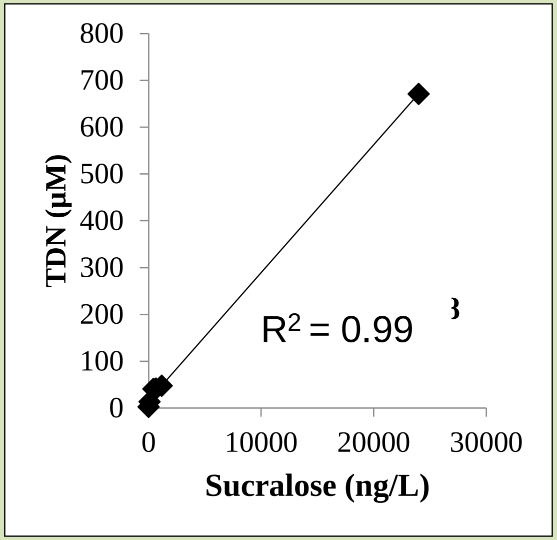
Dissolved N and P Levels in Natural Vs. Residential Areas

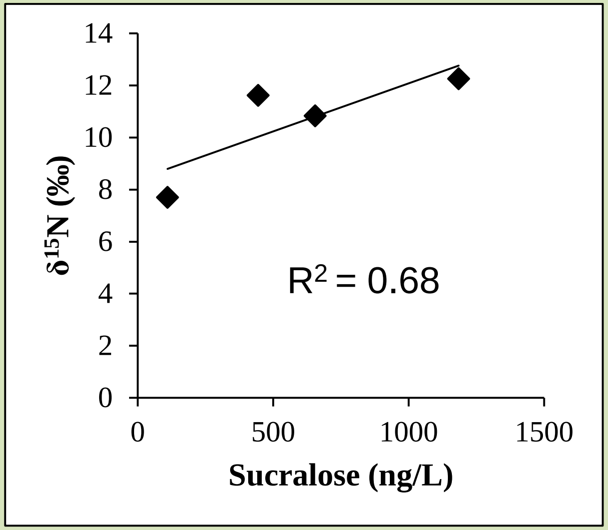


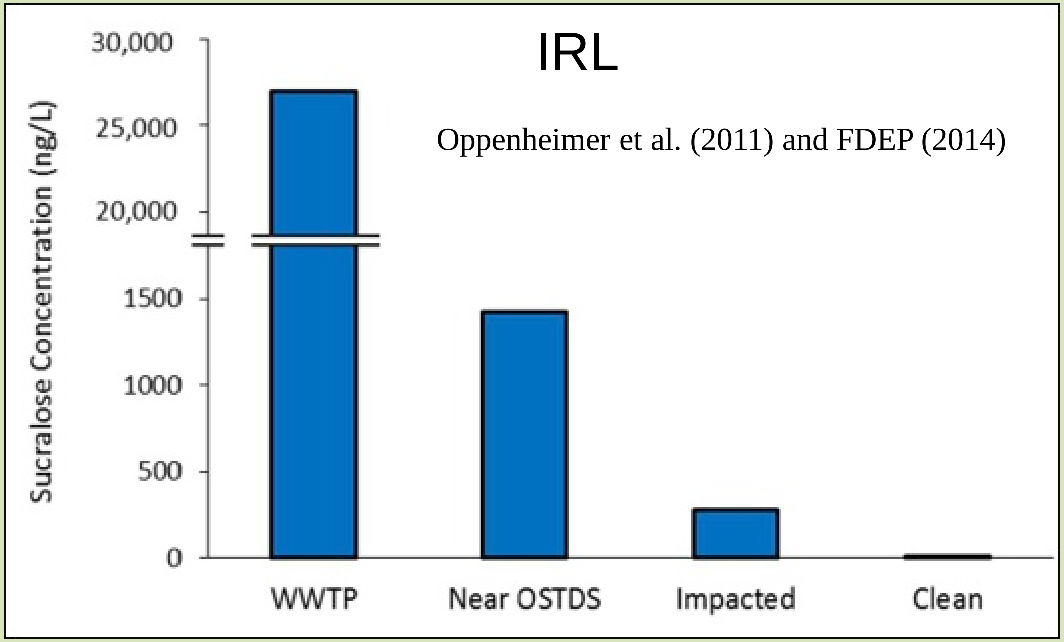
Macrophyte δ^{15}N



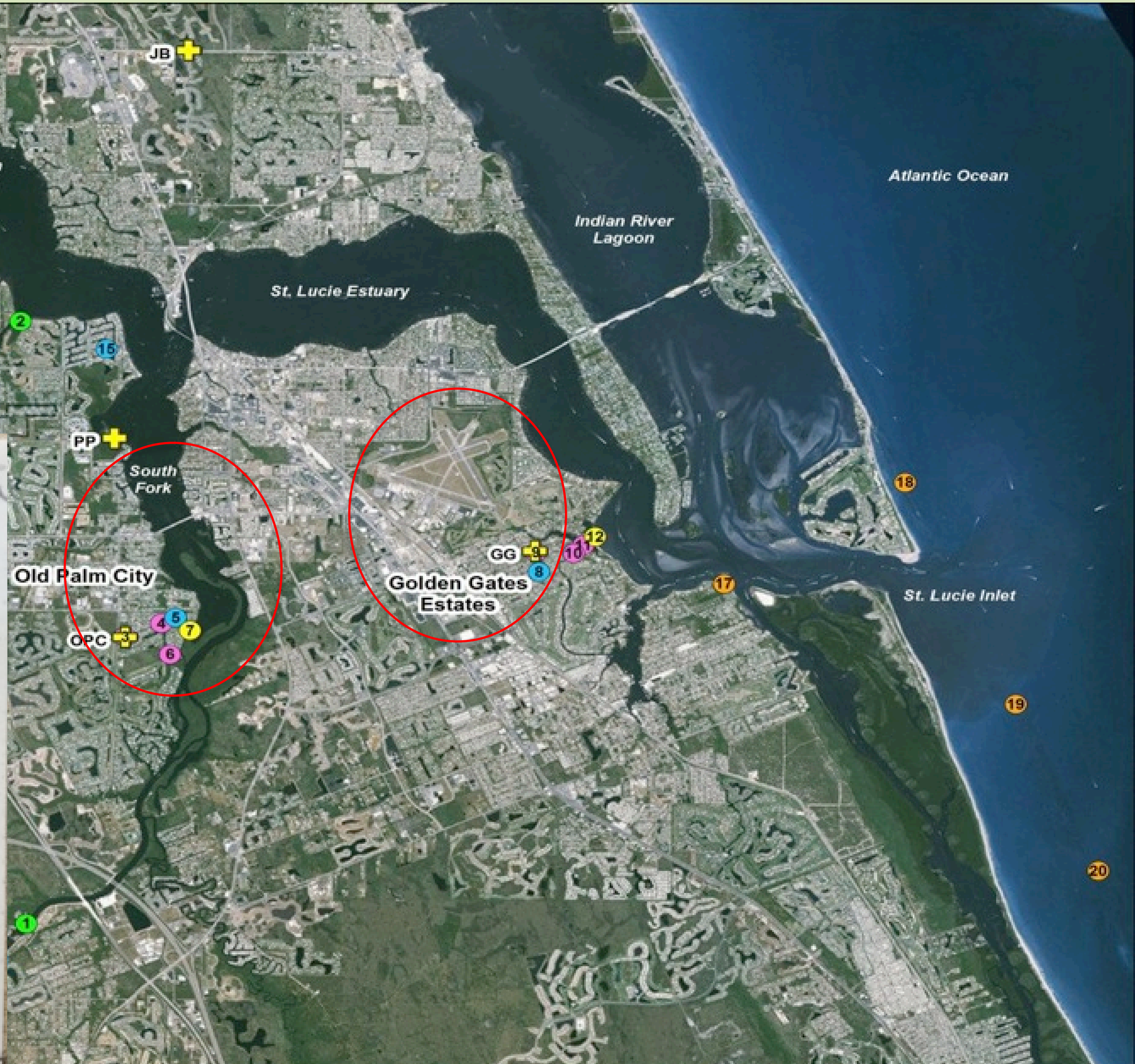
A Human Tracer: Sucralose

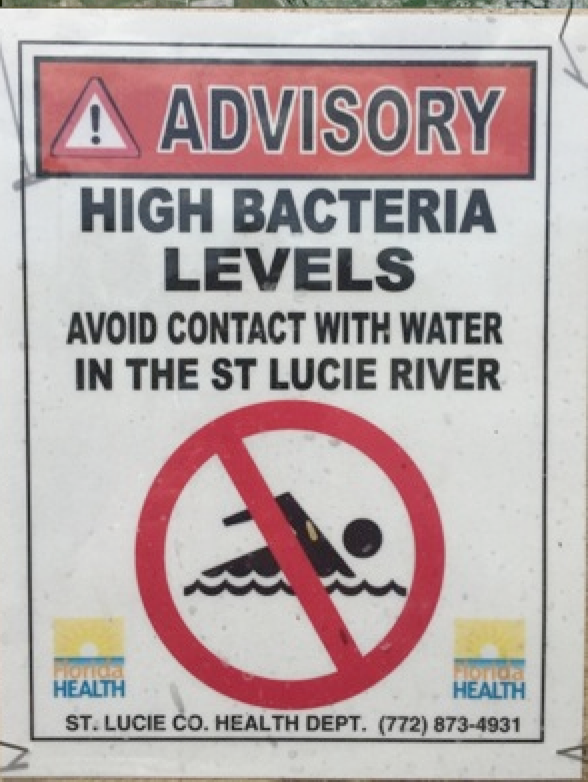






Septic Tank Pollution in the St. Lucie Estuary





Martin and St. Lucie Counties Beaches Closed
State of Emergency!

Charlotte Harbor: Dense Septic Tanks, Stormwater Runoff, and Fecal Pollution

The Effects of Seasonal Variability and Weather on Microbial Fecal Pollution and Enteric Pathogens in a Subtropical Estuary

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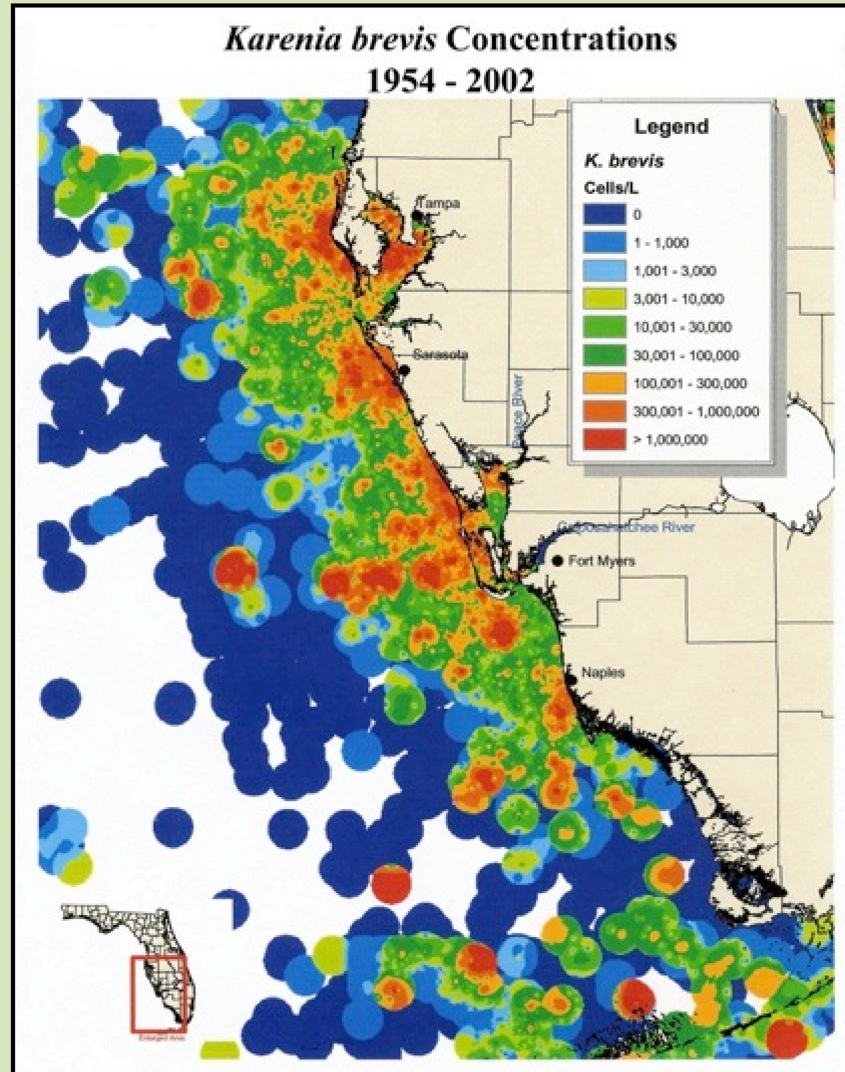
ABSTRACT: The Charlotte Harbor estuary in southwest Florida was sampled monthly for one year at twelve stations, in the lower reaches of the Myakka and Peace Rivers. The objectives of the study were to address the distribution and seasonal changes in microbial indicators and human pathogen levels in Charlotte Harbor shellfish and recreational waters, and to determine those factors that may be important in the transport and survival of pathogens. Monthly water samples and quarterly sediment samples were analyzed for fecal coliform bacteria, enterococci, *Clostridium perfringens*, and coliphage. Quarterly samples also were analyzed for the enteric human pathogens, *Cryptosporidium* spp., *Giardia* spp., and enteroviruses. Fecal indicator organisms were generally concentrated in areas of low salinity and high densities of septic systems; however, pollution became widespread during wet weather in the late fall and winter of 1997–1998, coincident with a strong El Niño event. Between December 1997 and February 1998, enteroviruses were detected at 75% of the sampling stations; none were detected in other months. Enteric protozoa were detected infrequently and were not related to seasonal influences. Fecal indicators and enteroviruses were each significantly associated with rainfall, streamflow, and temperature. Regression models suggest that temperature and rainfall can predict the occurrence of enteroviruses in 93.7% of the cases. Based on findings in this watershed, factors such as variability in precipitation, streamflow, and temperature show promise in modeling and forecasting periods of poor coastal water quality.

Lee County 2004-2007: Red Drift Algae

δ^{15}N values ranged +5.7 to +7.1 ‰ in blooms along beaches in Lee County in 2004, sewage implicated

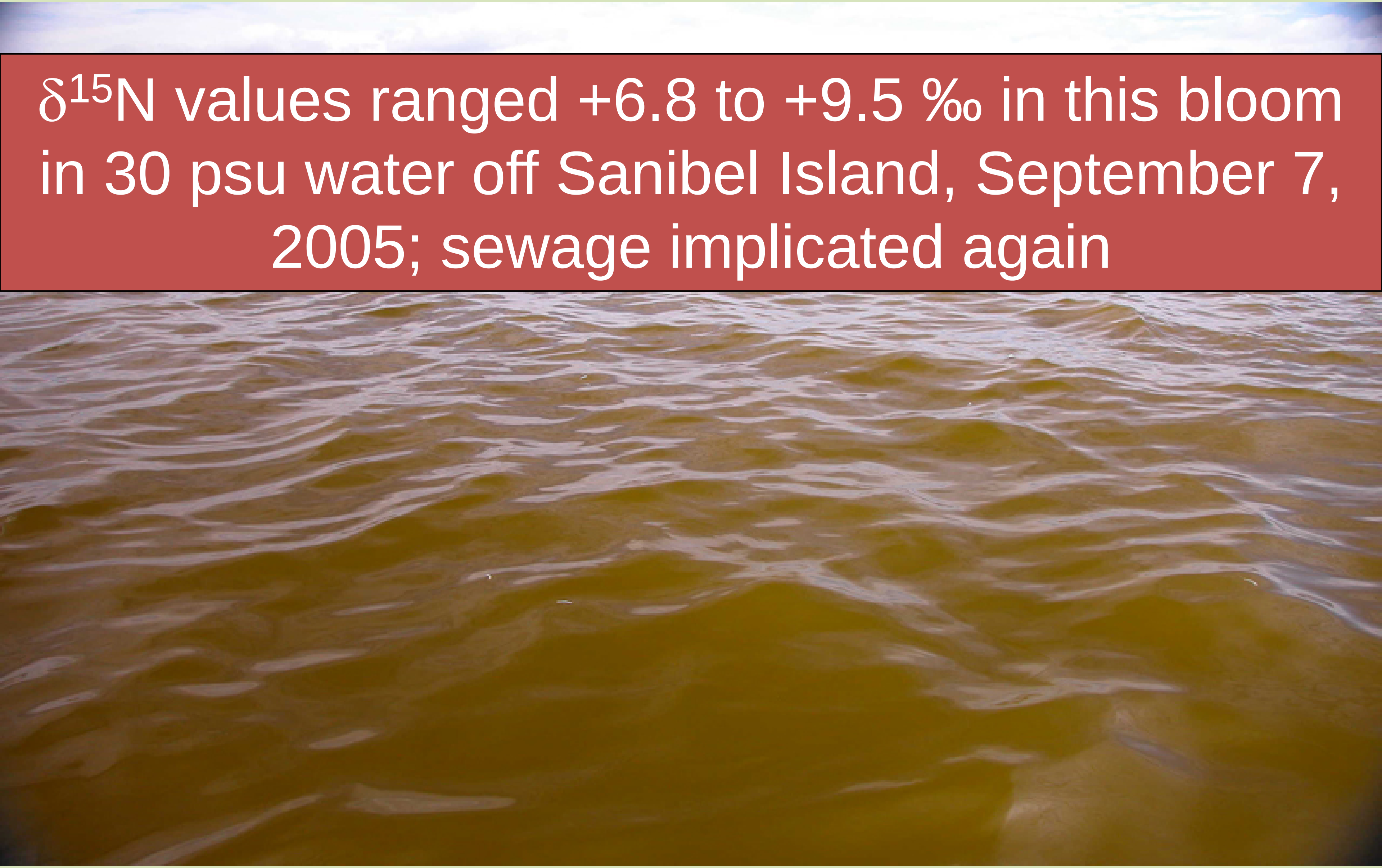
Florida Red Tide: *Karenia brevis*



Brand & Compton 2007

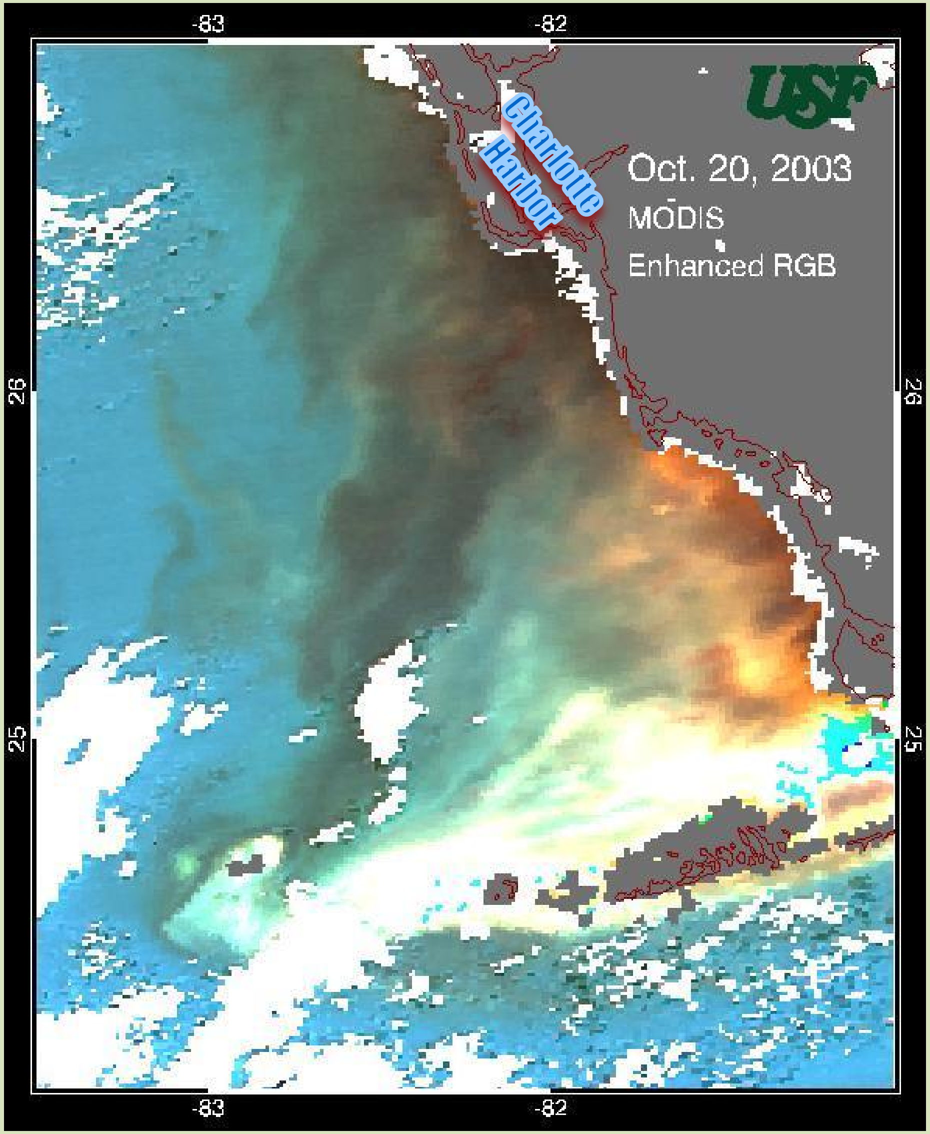
Lee County 2005: Red Tides (*Karenia brevis*)

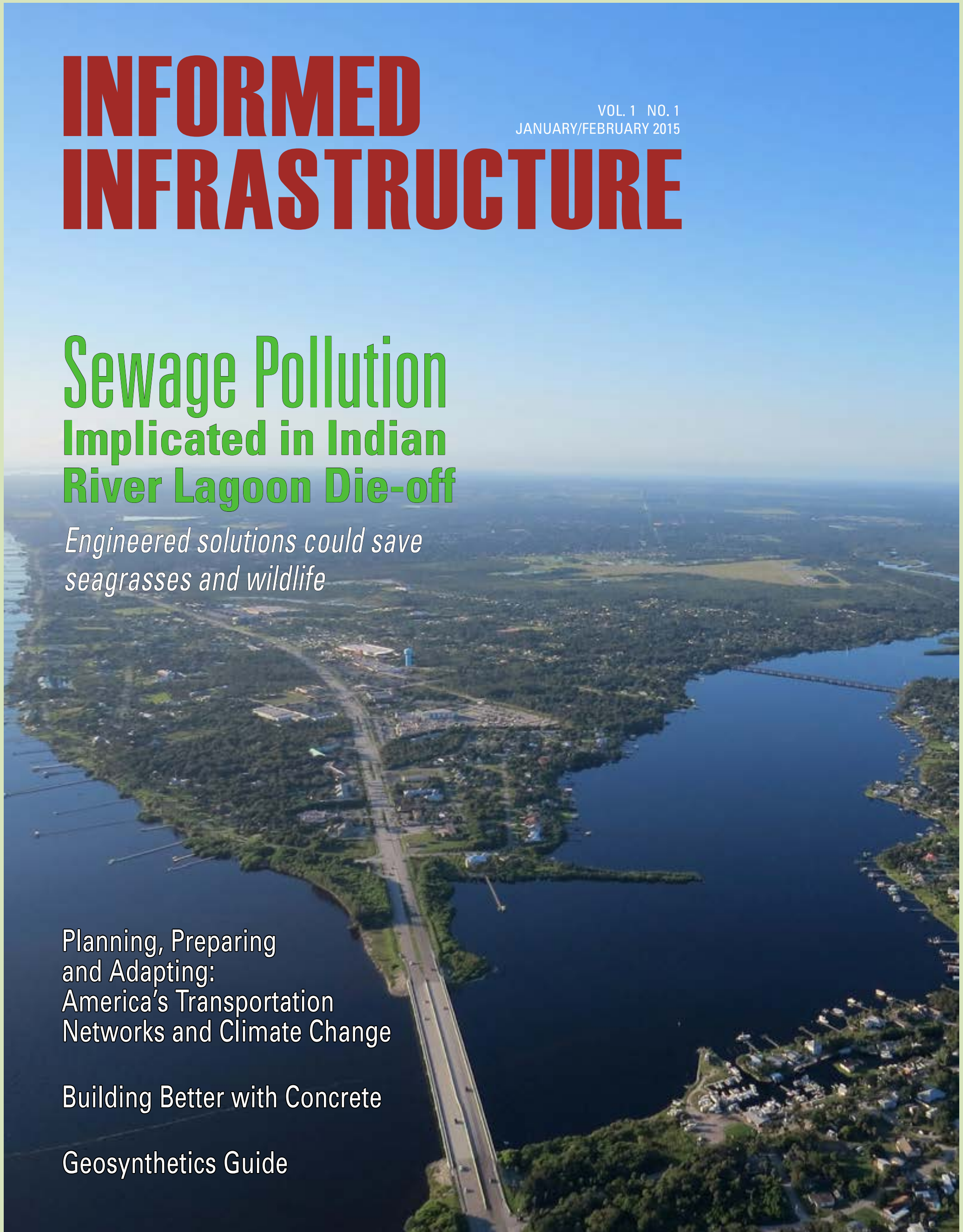
$\delta^{15}N$ values ranged +6.8 to +9.5 ‰ in this bloom in 30 psu water off Sanibel Island, September 7, 2005; sewage implicated again



“Black Water Events”

CDOM from coastal runoff





Moving Forward

- Septic tanks do not protect Florida's extensive aquatic resources
- This is an inadequate infrastructure problem on watersheds of many sensitive waterbodies
- Need pro-active planning process to prevent problem from worsening
- Septic tank reductions as part of BMAPs for "nitrogen credits"


Questions?