CHARLOTTE COUNTY WATER QUALITY ASSESSMENT

PHASE I: DATA ANALYSIS AND RECOMMENDATIONS FOR LONG-TERM MONITORING

by
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HARBOR BRANCH
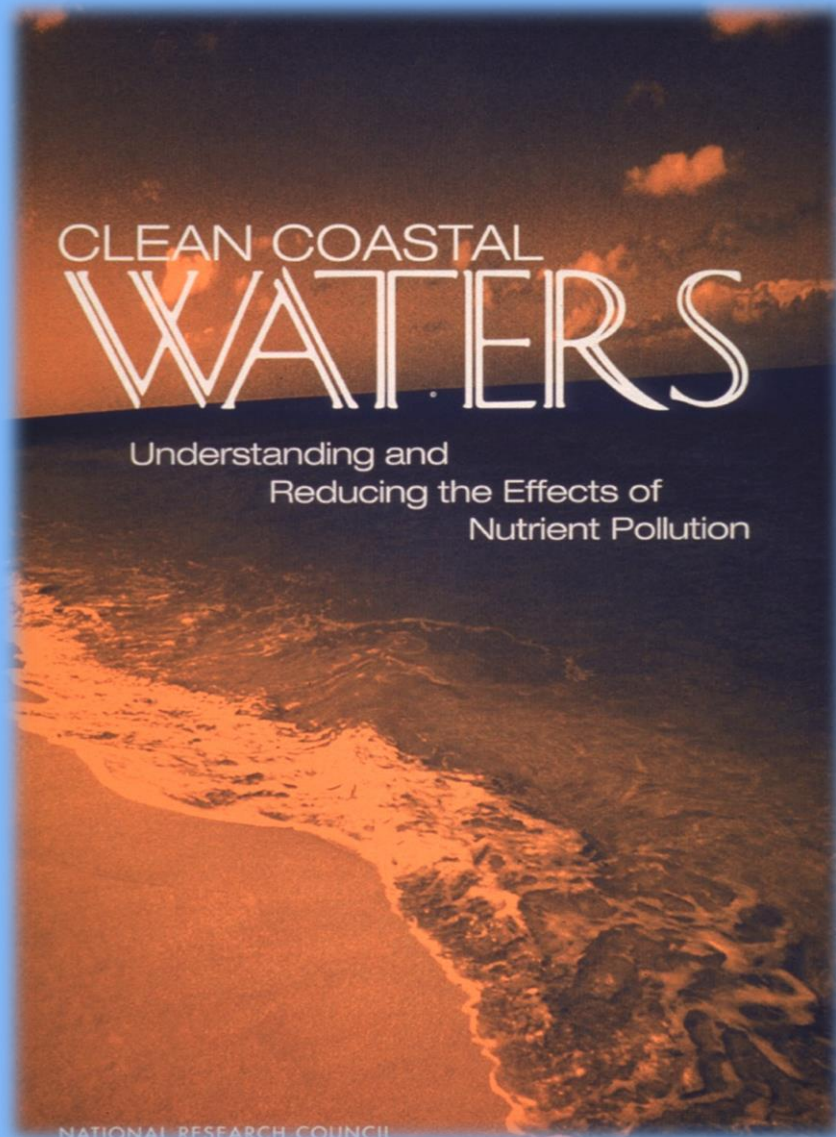FLORIDA ATLANTIC UNIVERSITY

Brian Lapointe, Ph.D.
Harbor Branch Oceanographic Institute-FAU
Harmful Algal Bloom Lab
-over 40 years of HAB research
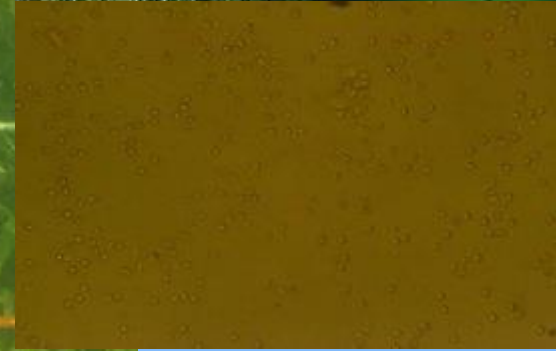
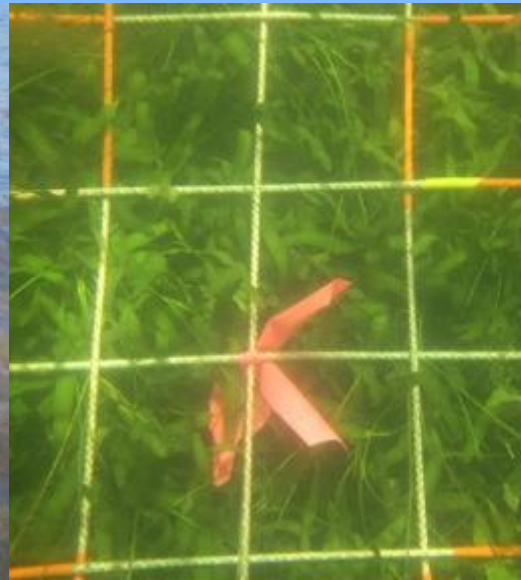# The Common Thread – Nutrient Pollution

"The fundamental driving force is the accumulation of nitrogen and phosphorus in fresh water on its way to the sea."

Clean Coastal Waters: Understanding and Reducing the Effects of Nutrient Pollution. (NRC 2000)

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 humans

Charlotte County
Commitment to "Blue Water"

CHARLOTTE HARBOR
National Estuary Program

Committing to Our Future

A Comprehensive Conservation and Management Plan
for the Greater Charlotte Harbor Watershed from
Venice to Bonita Springs to Winter Haven

Update 2013

Linda Soderquist

Water Resources

- Develop "Blue Water" strategy
  - Drinking water – Pursue interconnects
  - Wastewater
    - Develop next stage of Wastewater Master Plan
    - Educate citizens on benefits of having sewers in population dense areas
  - Reuse - Education and promotion of reuse water
  - Storm water - Proactive strategies for TMDL
- Review "Waters of the US" for impact

FDEP Water Quality Criteria

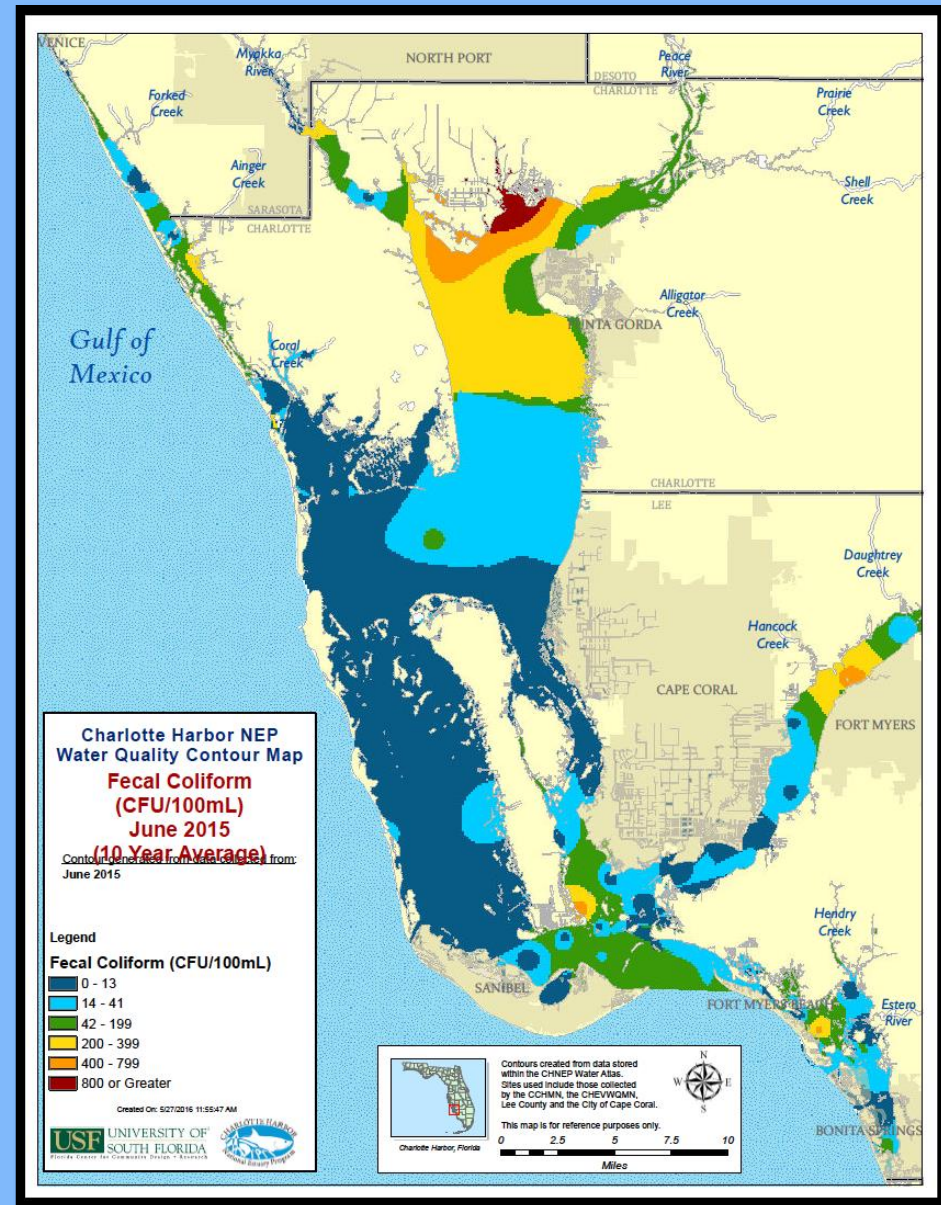| Analytes	Charlotte Harbor Proper	Tidal Peace River	Tidal Myakka River
Total phosphorus	0.19	0.31	0.50
Total nitrogen	0.67	1.02	1.08
Chlorophyll *a*	6.10	11.70	12.60

Partners

Charlotte Harbor Impairment Status

➢ Segments of Charlotte Harbor are listed on the EPA 303d list as impaired for:

- Nutrients
- Dissolved oxygen
- Chlorophyll *a*
- Bacteria in shellfish
- Mercury in fish tissue

Charlotte Harbor NEP Water Quality Contour Map
Fecal Coliform (CFU/100mL) June 2015 (10 Year Average)

Contour generated from data gathered from: June 2015

Legend
Fecal Coliform (CFU/100mL)
- 0 - 13
- 14 - 41
- 42 - 199
- 200 - 399
- 400 - 799
- 800 or Greater

Created On: 5/27/2016 11:55:47 AM

Contours created from data stored within the CHNEP Water Atlas. Sites used include those collected by the CCHMN, the CHEVWQMN, Lee County and the City of Cape Coral.

This map is for reference purposes only.

Charlotte Harbor, Florida

Lee County 2004-2007: Red Drift Algae

δ^{15}N values ranged +5.7 to +7.1 *per mille* in blooms along beaches in Lee County in 2004, wastewater implicated

Florida Red Tide: *Karenia brevis*
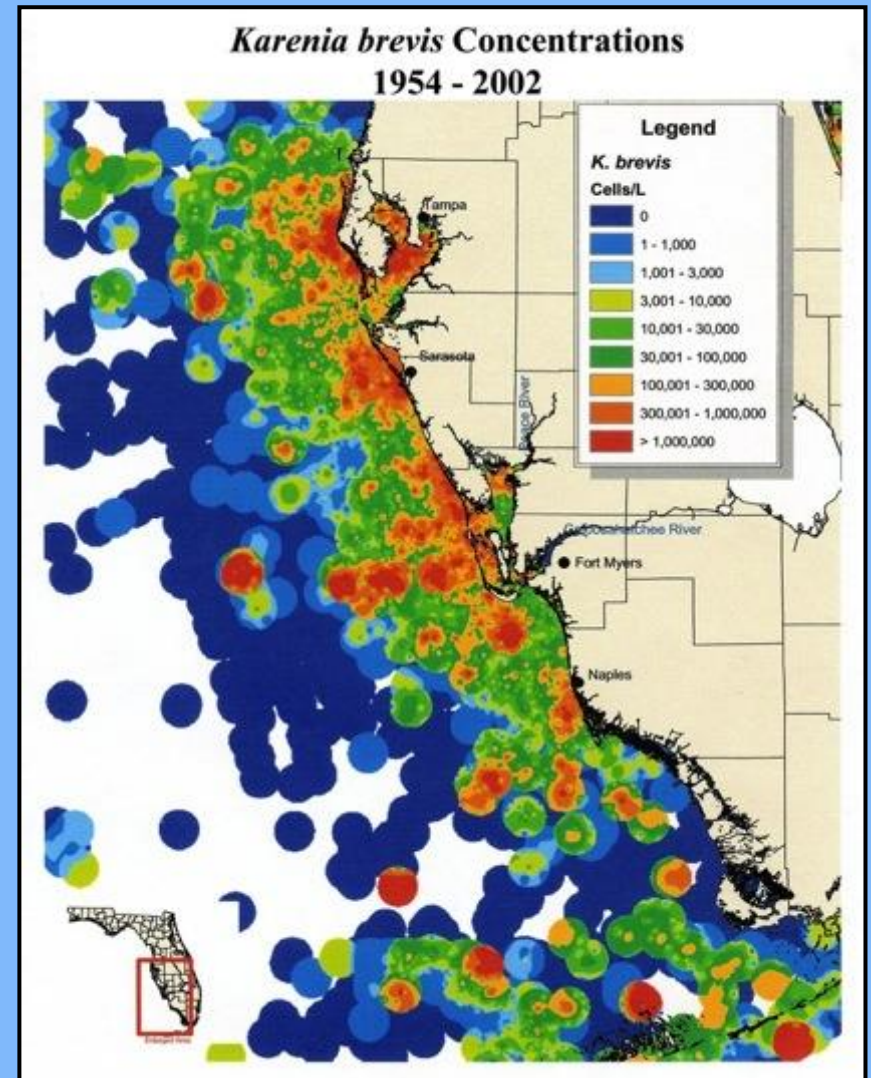
Brand & Compton 2007

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

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

Charlotte Harbor:
Dense Septic Tanks, Stormwater Runoff, and Fecal Pollution (2001)

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

Erin K. Lipp[1],*, Raymond Kurz[2],†, Robert Vincent[3], Cesar Rodriguez-Palacios[4],‡, Samuel R. Farrah[5], and Joan B. Rose[1]

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[2] Southwest Florida Water Management District, Surface Water Improvement Program, Tampa, Florida 33637

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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.

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

• About 1/3 of households use septic

• Soils unsuitable for septic systems
  -   porous sands, karst limestone
  -   low organic content, high water table

•Effluent contaminants:
   nitrogen, phosphorus, pharmaceuticals,
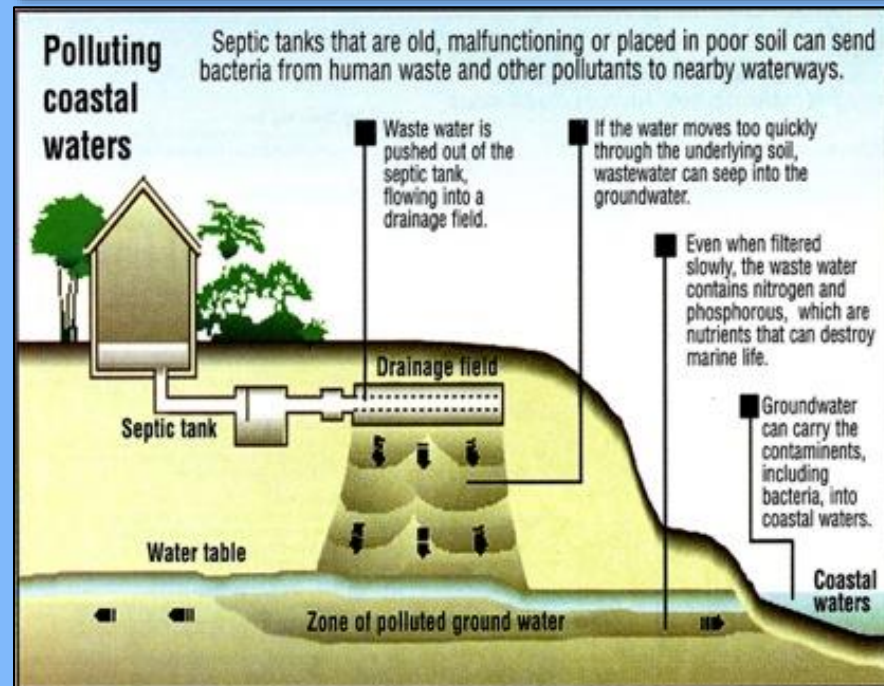   hormones, bacteria, viruses

• Substantial N-load from septic systems:

Fertilizer: 308,647,167 lb/yr
**Septic systems: 52,910,942–108,026,508 lb/yr**
Atmospheric inputs: 13,007,273-20,723,453 lb/yr
Reclaimed water: 264,554-573,201 lb/yr
(Badruzzman et al. 2012)

Polluting coastal waters

Septic tanks that are old, malfunctioning or placed in poor soil can send bacteria from human waste and other pollutants to nearby waterways.

Waste water is pushed out of the septic tank, flowing into a drainage field.

If the water moves too quickly through the underlying soil, wastewater can seep into the groundwater.

Even when filtered slowly, the waste water contains nitrogen and phosphorous, which are nutrients that can destroy marine life.

Groundwater can carry the contaminents, including bacteria, into coastal waters.

Septic tank

Drainage field

Water table

Zone of polluted ground water

Coastal waters

Charlotte County PHASE I: Design of a Long-Term Water Quality Sampling Program

1. **Datamine and Synthesize Historical Data**
2. **Reconnaissance Field Trips, QA/QC sampling across study area**
3. **Identify Long-Term Monitoring Stations and Outline Sampling Design**
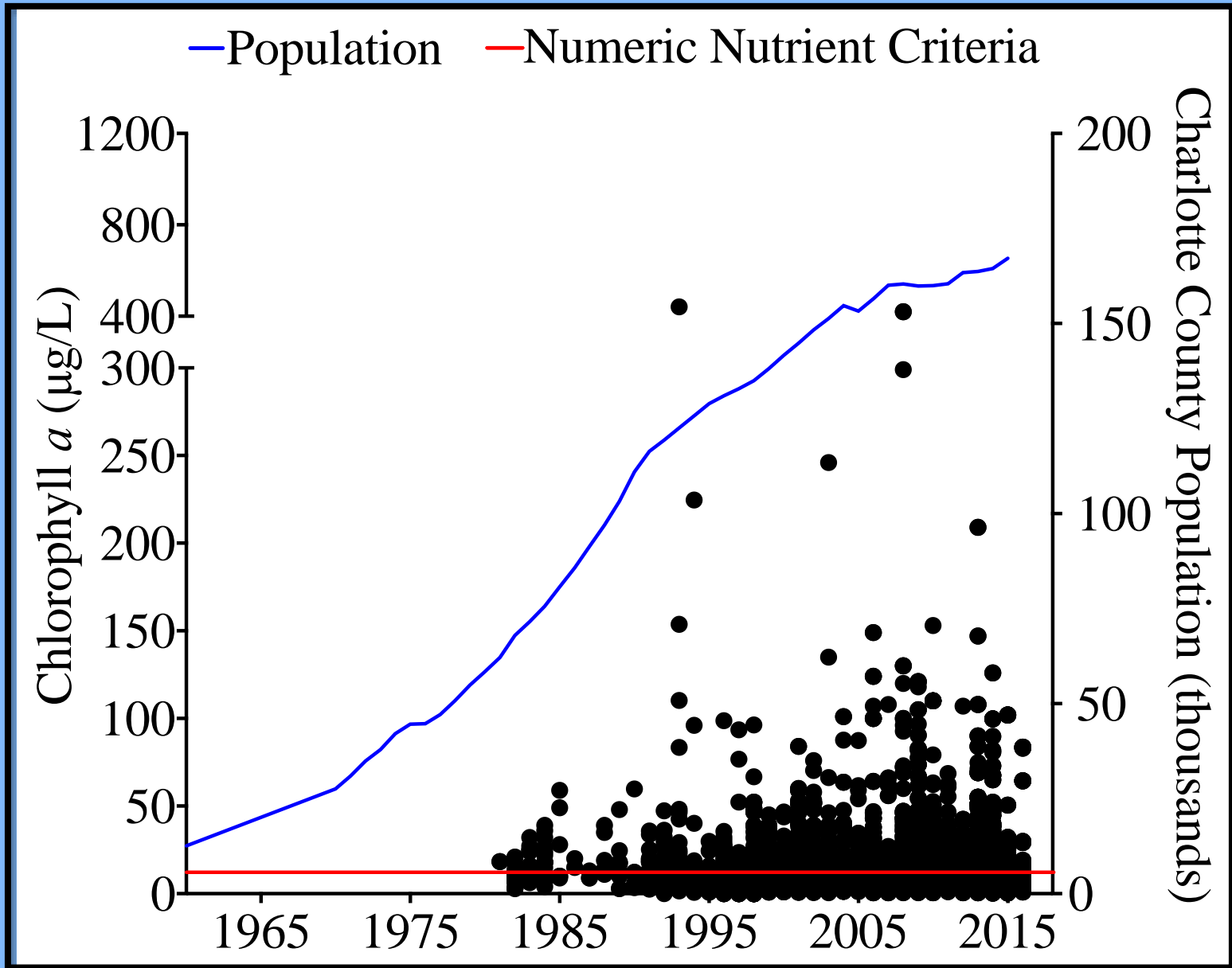4. **Identify Laboratories & Volunteer Networks to Collect & Analyze Samples**

Charlotte Harbor
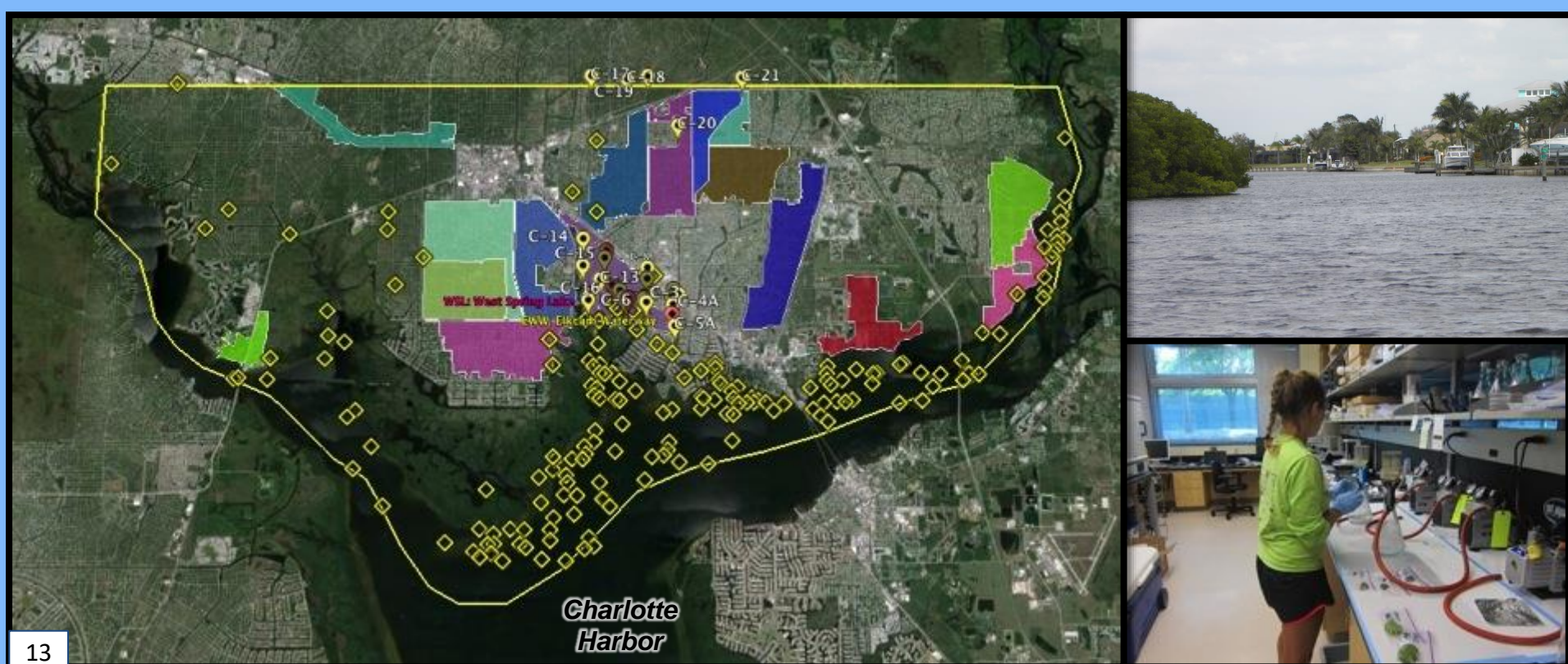
Charlotte County

- Long-term historical data obtained from public records

- Data include canals and estuaries within Charlotte County

- Values above line exceed NNC

- Nitrogen peaks evident in El Niño years

- Reveals a history of impairment
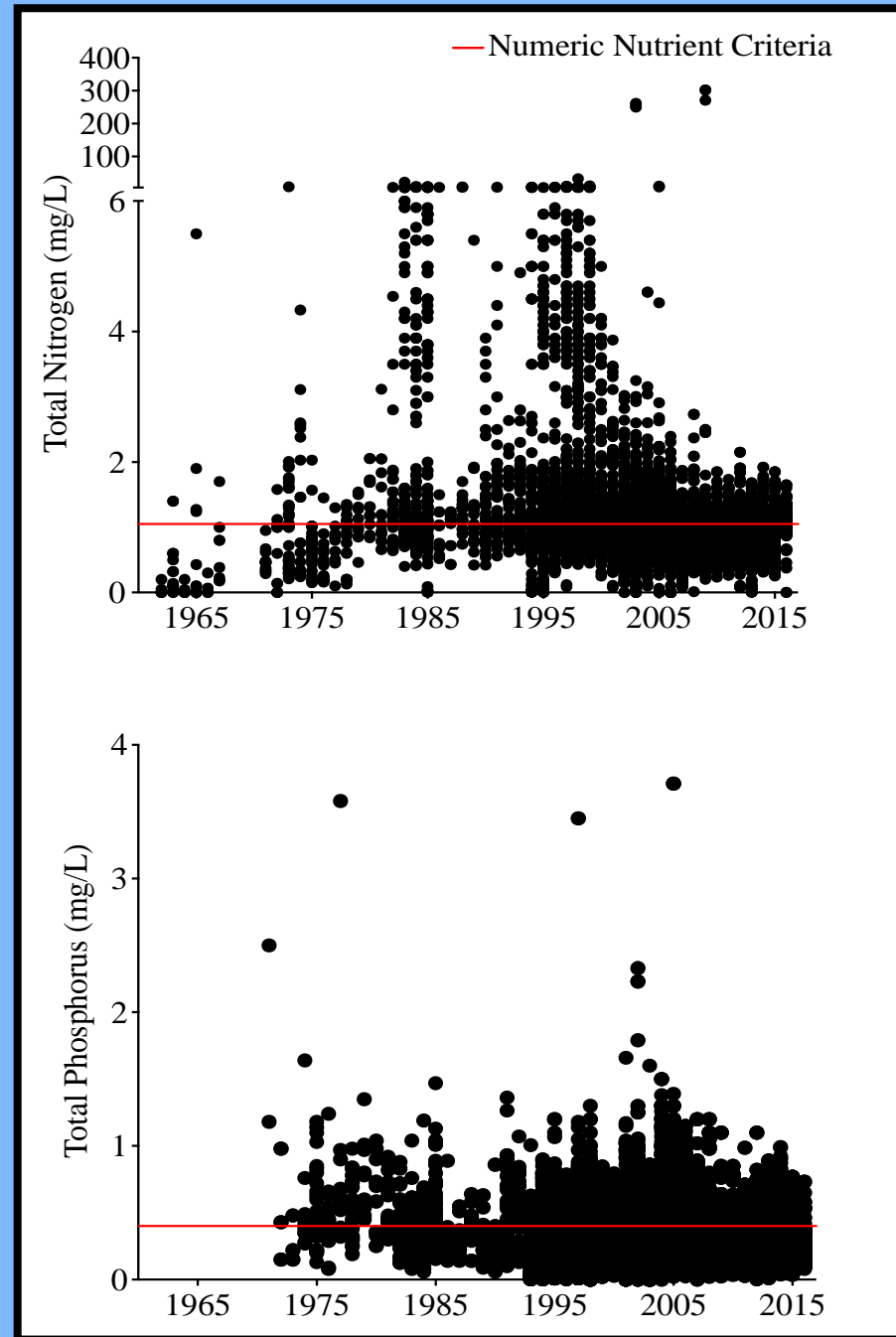
Charlotte County

East and West Spring Lake Wastewater Pilot Program Area: Surface Water

- Sampled independent of tidal stage

- Total nitrogen values were similar to NNC

- Some nitrogen and phosphorus values exceed NNC

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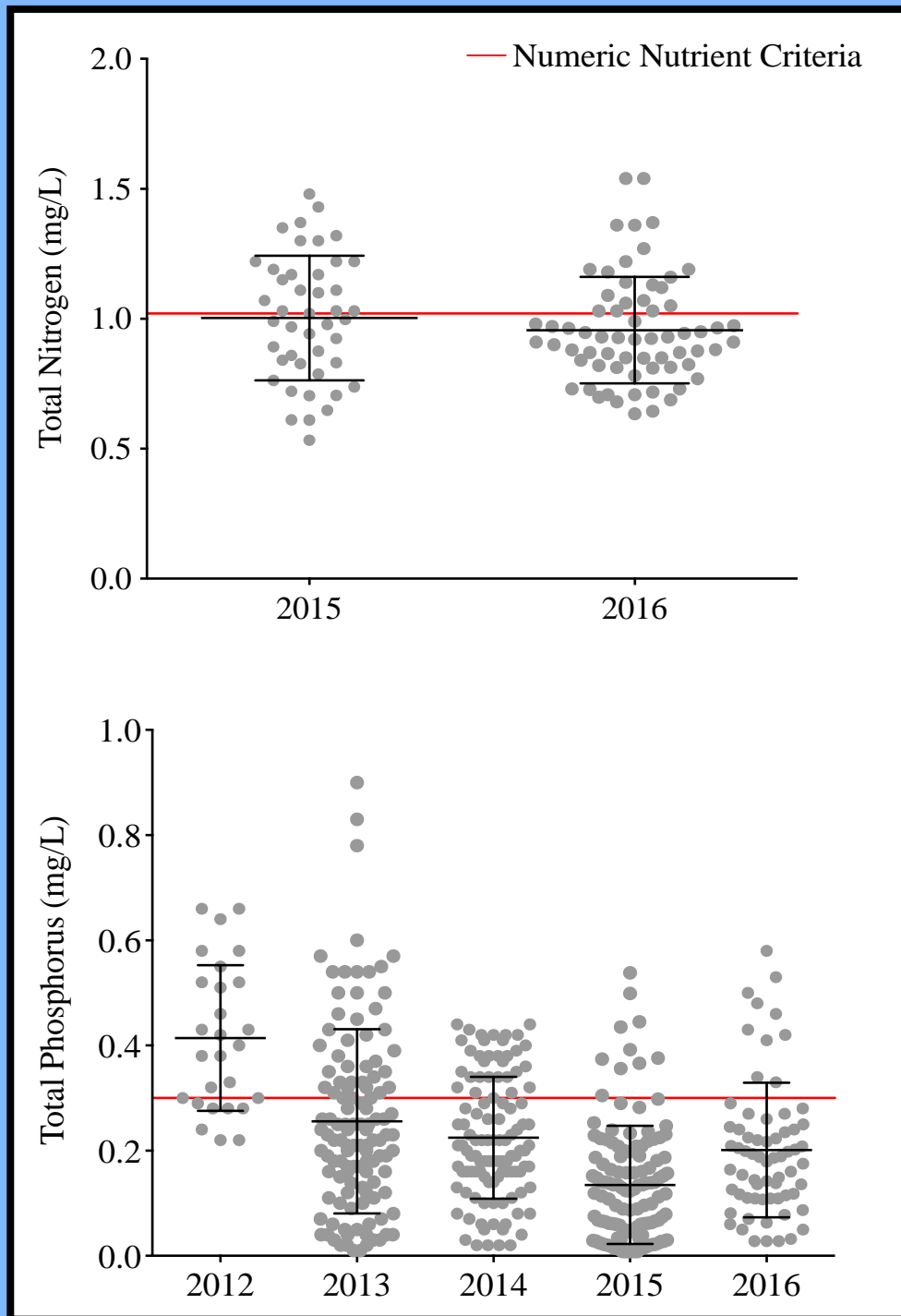
East and West Spring Lake Wastewater Pilot Program Area: Surface Water

- Ammonia values above threshold for macroalgae blooms

- Fecal coliforms present 2012-2016

- Suggests pollution via septic tank effluent

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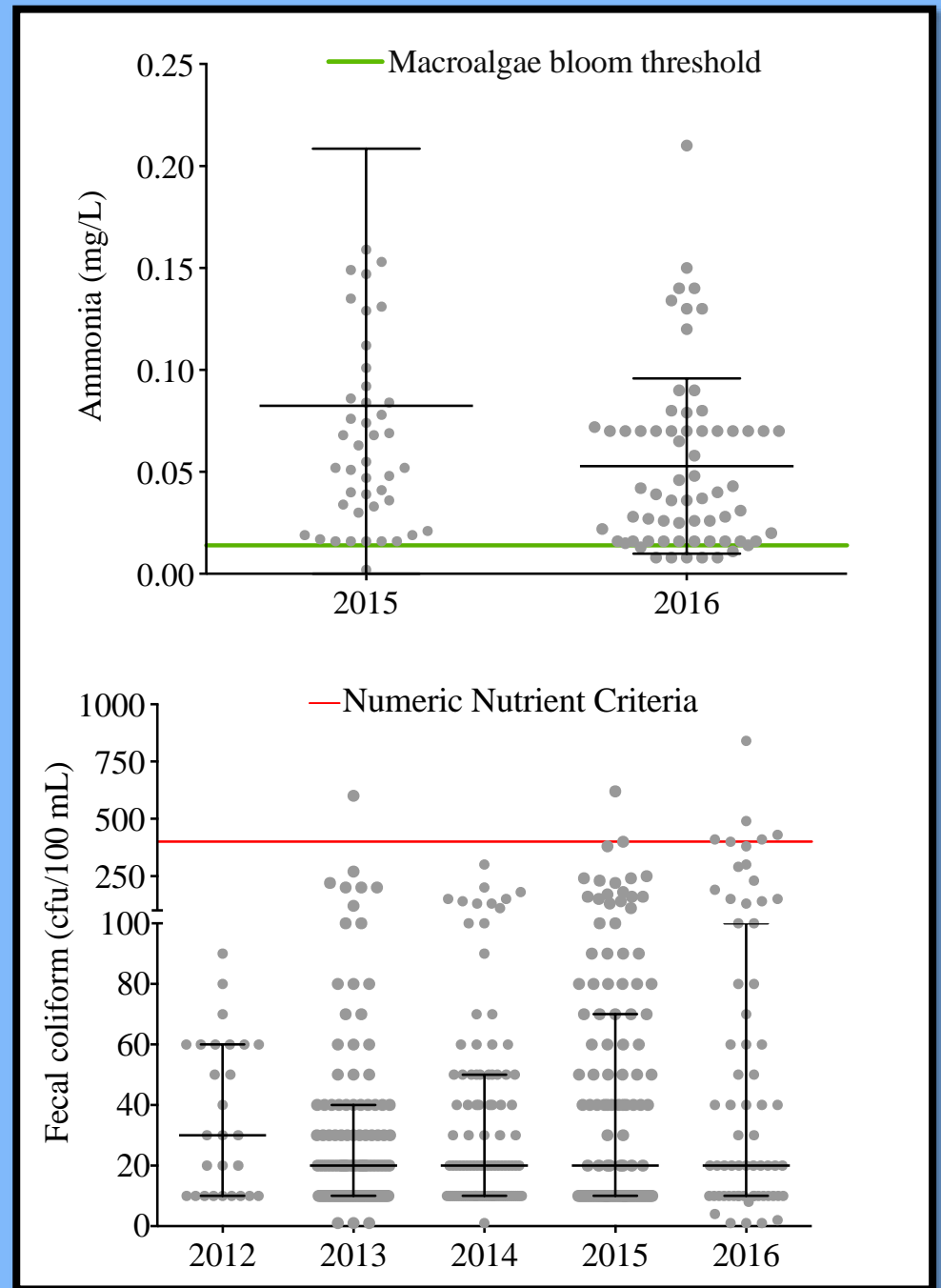
East and West Spring Lake Wastewater Pilot Program Area: Groundwater

- TN and TP above NNC

- Higher levels than surface waters suggests septic contamination

- Some phosphorus values exceed raw effluent

- Very high phosphorus may reflect interactions between wastewater & natural deposits
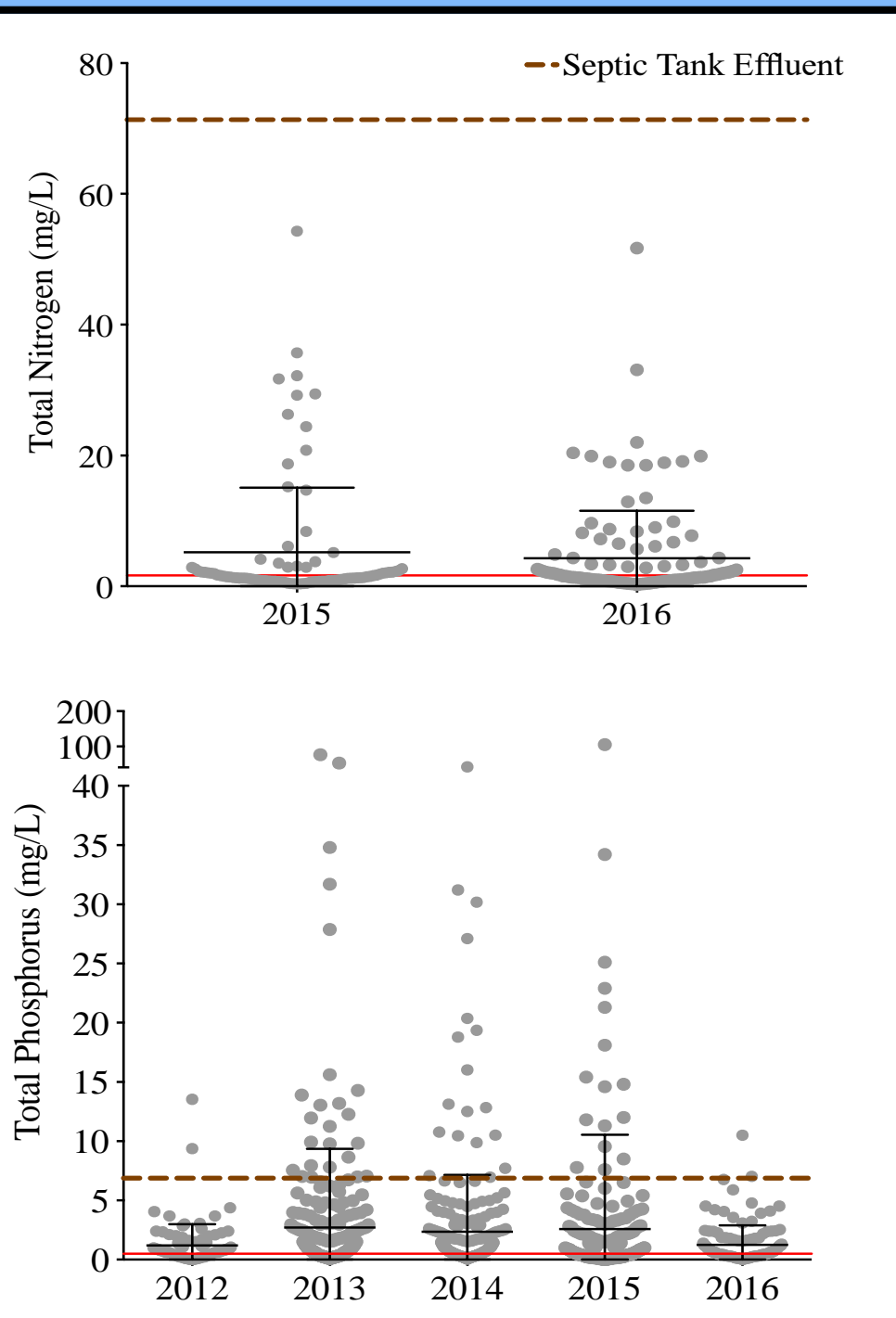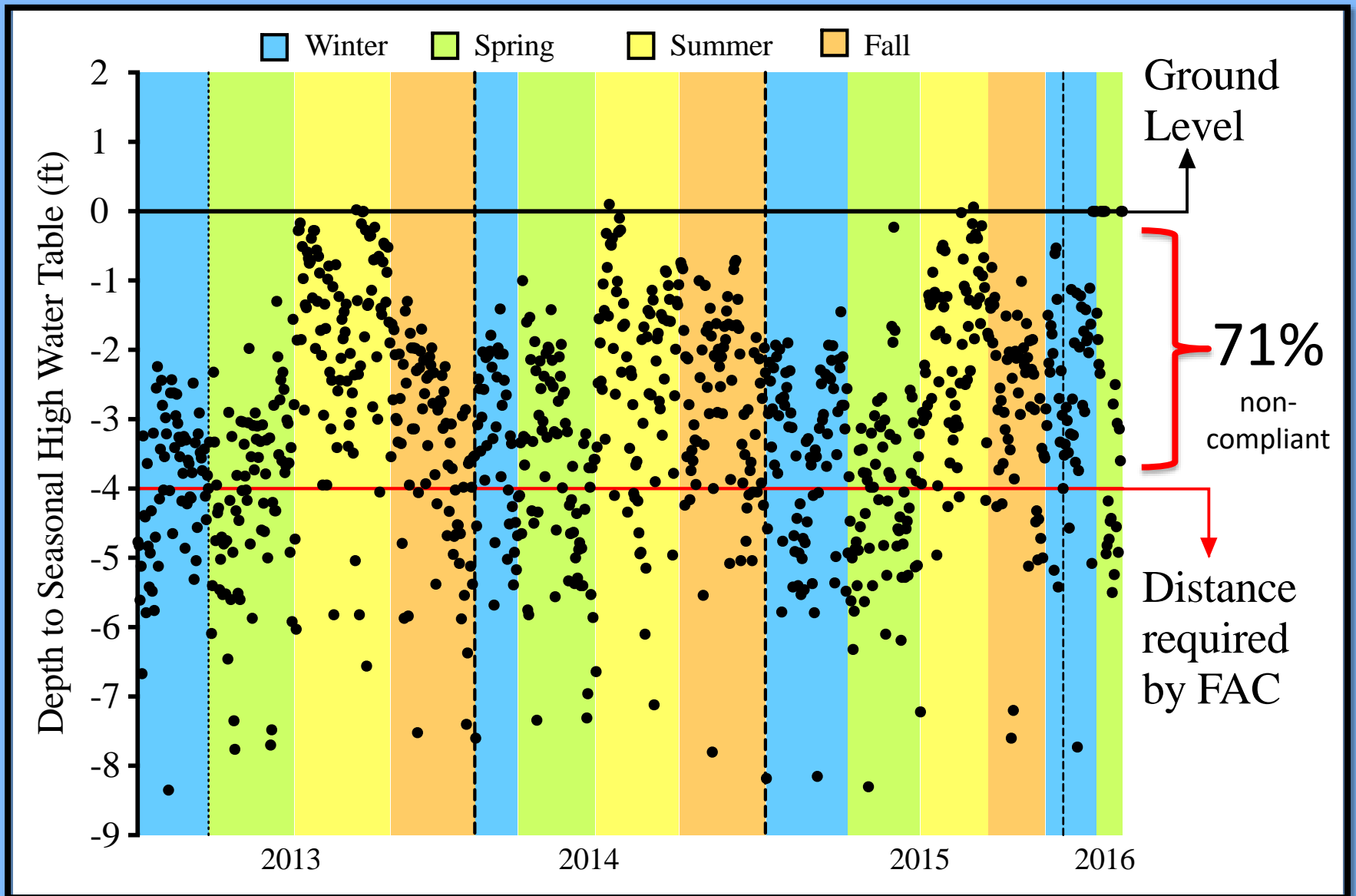
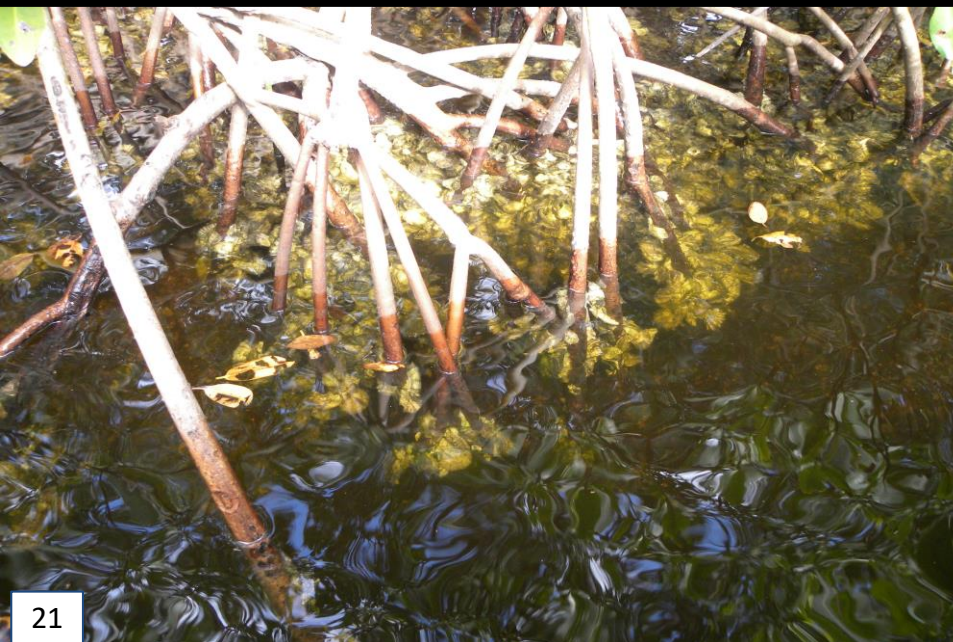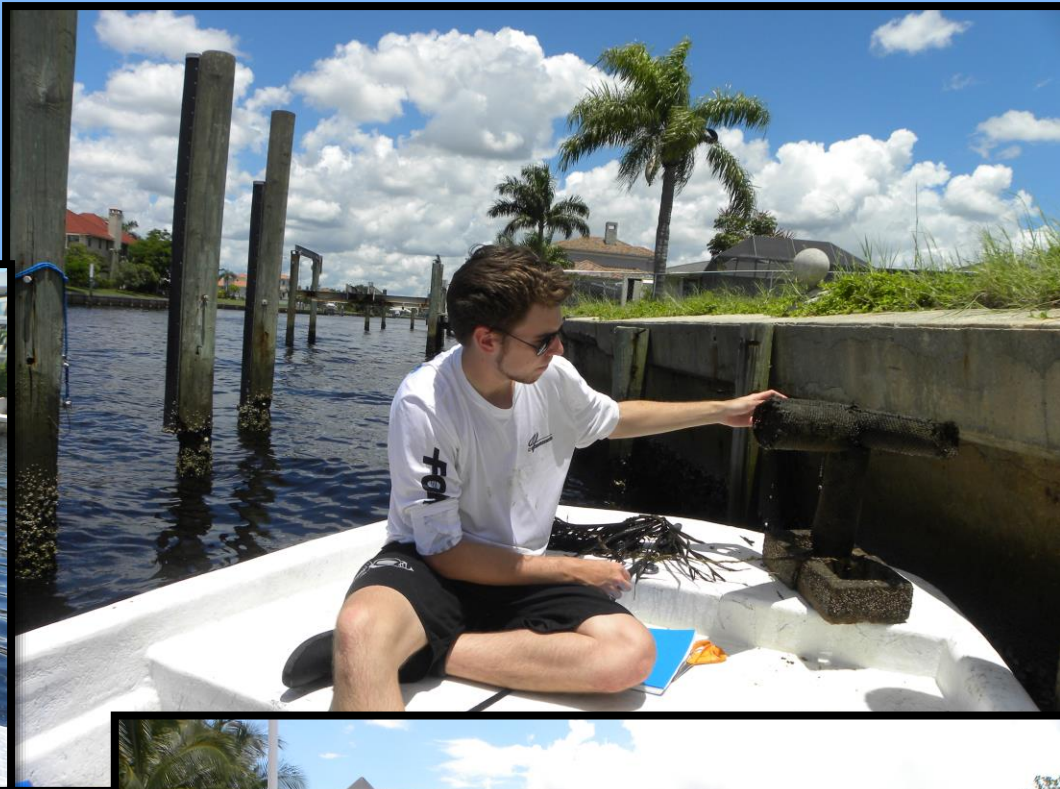# East and West Spring Lake Wastewater Pilot Program Area: Groundwater

- Ammonia higher than surface waters

- Ammonia levels above macroalgae bloom threshold

- Fecal values similar to surface waters
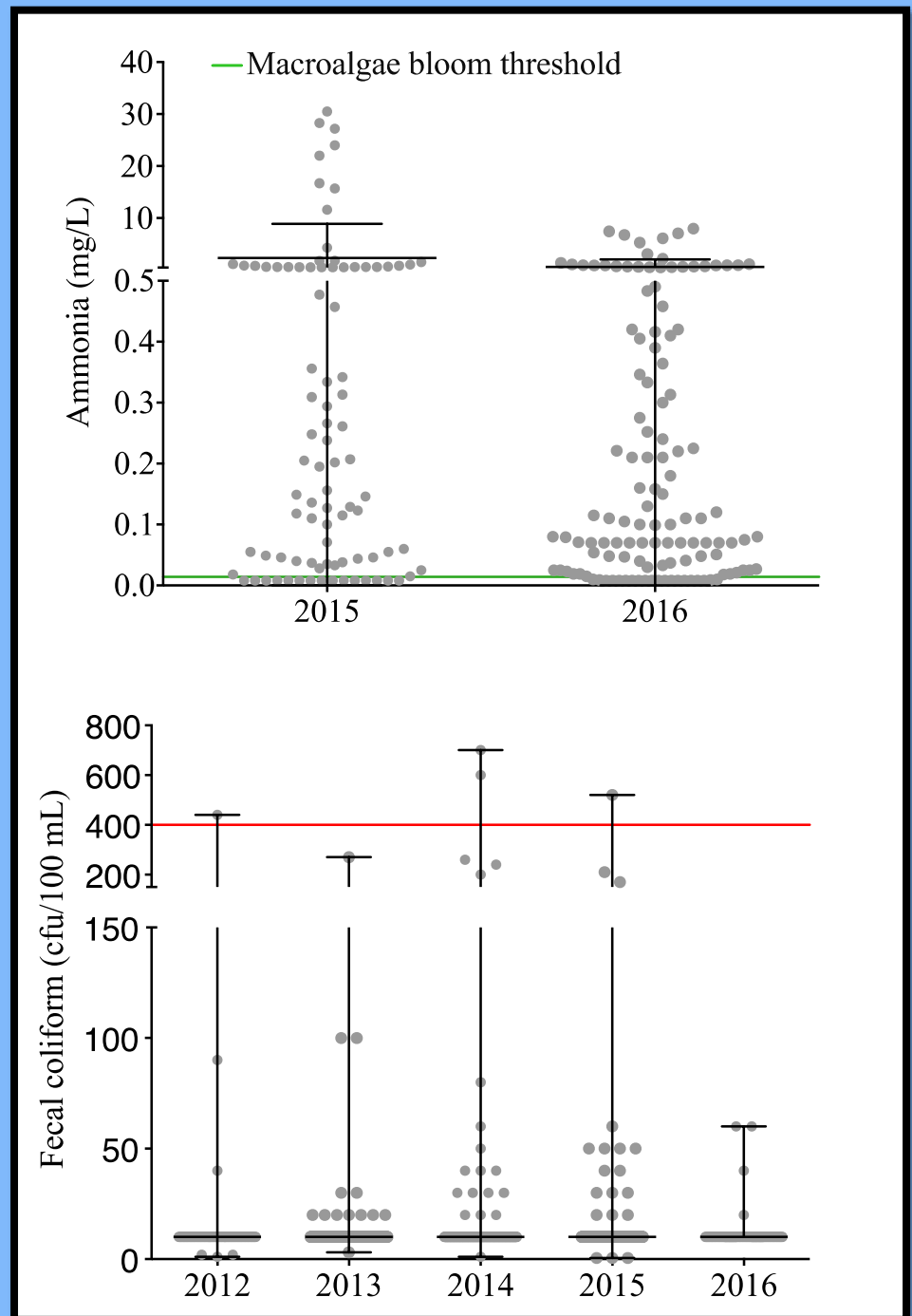
East and West Spring Lake Wastewater Pilot Program Area: Distance of Septic Drainfield to Seasonal High Water Table
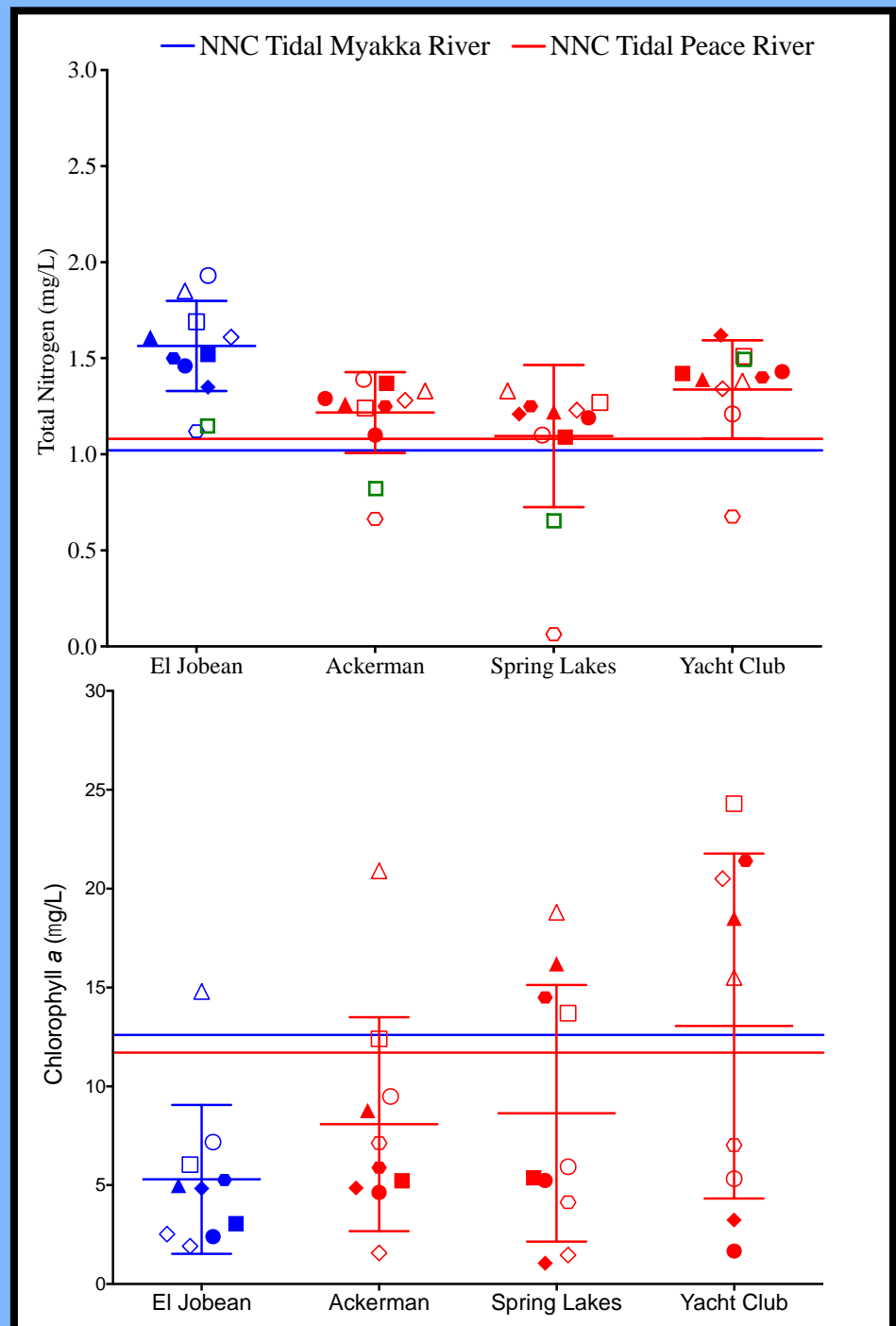
Reconnaissance Sampling

Reconnaissance Sampling Nutrient Concentrations

- Highest TN at El Jobean, decreases to east

- TN at all sites ≥ NNC

- TN at all sites > the previous data (East and West Spring Lake Wastewater Pilot Program)

- Chl *a* at Yacht Club > NNC

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Bacteria in Surface Water

- Bacteria present at all sites

- Similar spatial trend for fecal & *Enterococcus*

- *Enterococcus* exceeded criteria at 3 of 4 sites

- Highest at El Jobean, decreased west to east

- El Jobean & Ackerman
   = "poor water quality"
 per DOH (>71 cfu/100mL)

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Stable Nitrogen Isotopes & C:N Ratio

- Macroalgae & oysters effective bioindicators of wastewater

- Reveals a strong septic signal in surface waters

- Low C:N ratio in macroalgae indicate high nitrogen levels
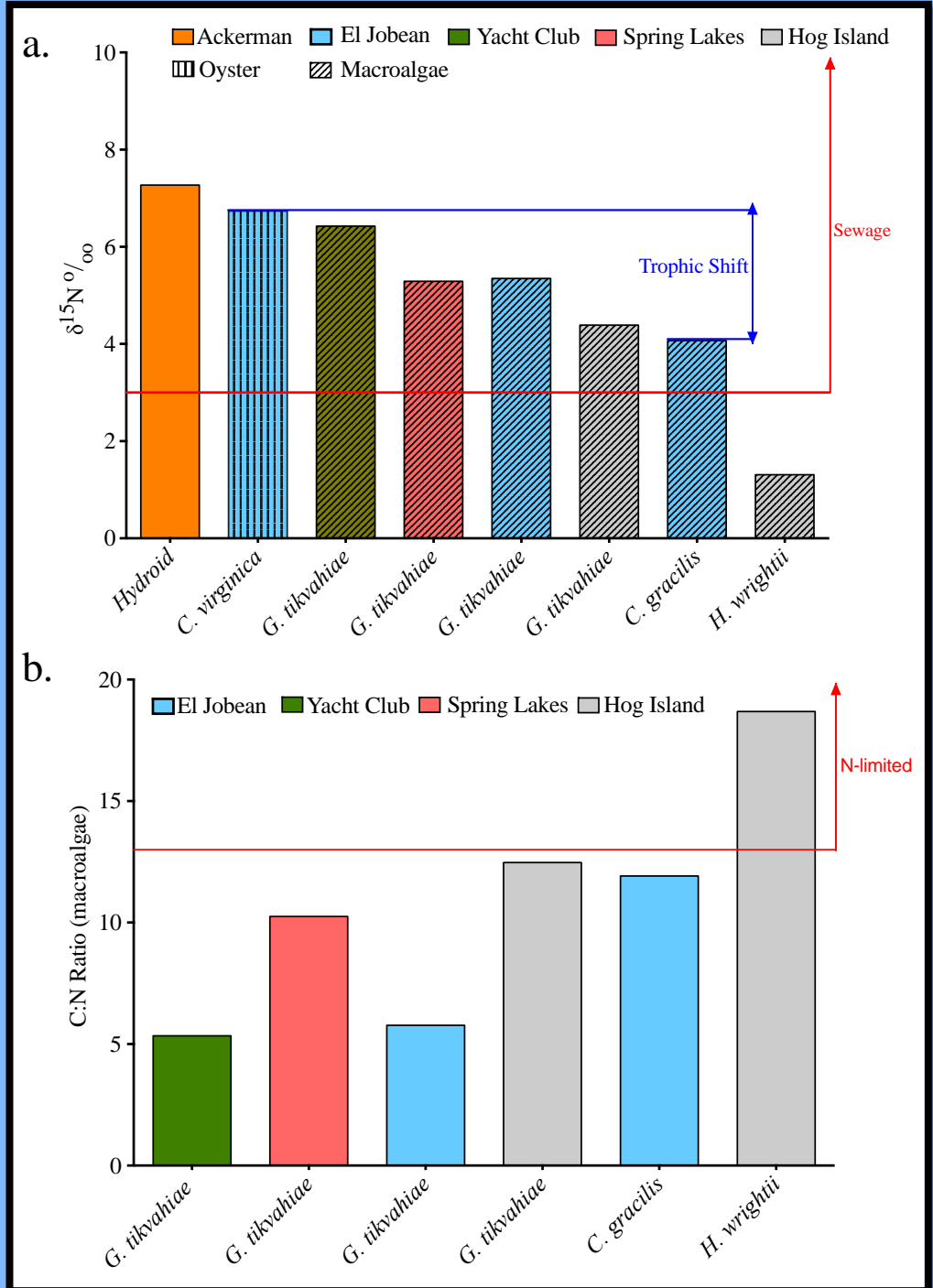
Human Tracer: Sucralose

- Not naturally occurring

- Higher levels in groundwaters

- Present in surface waters

- Indicative of septic contamination

- Similar pollution issues in Martin County
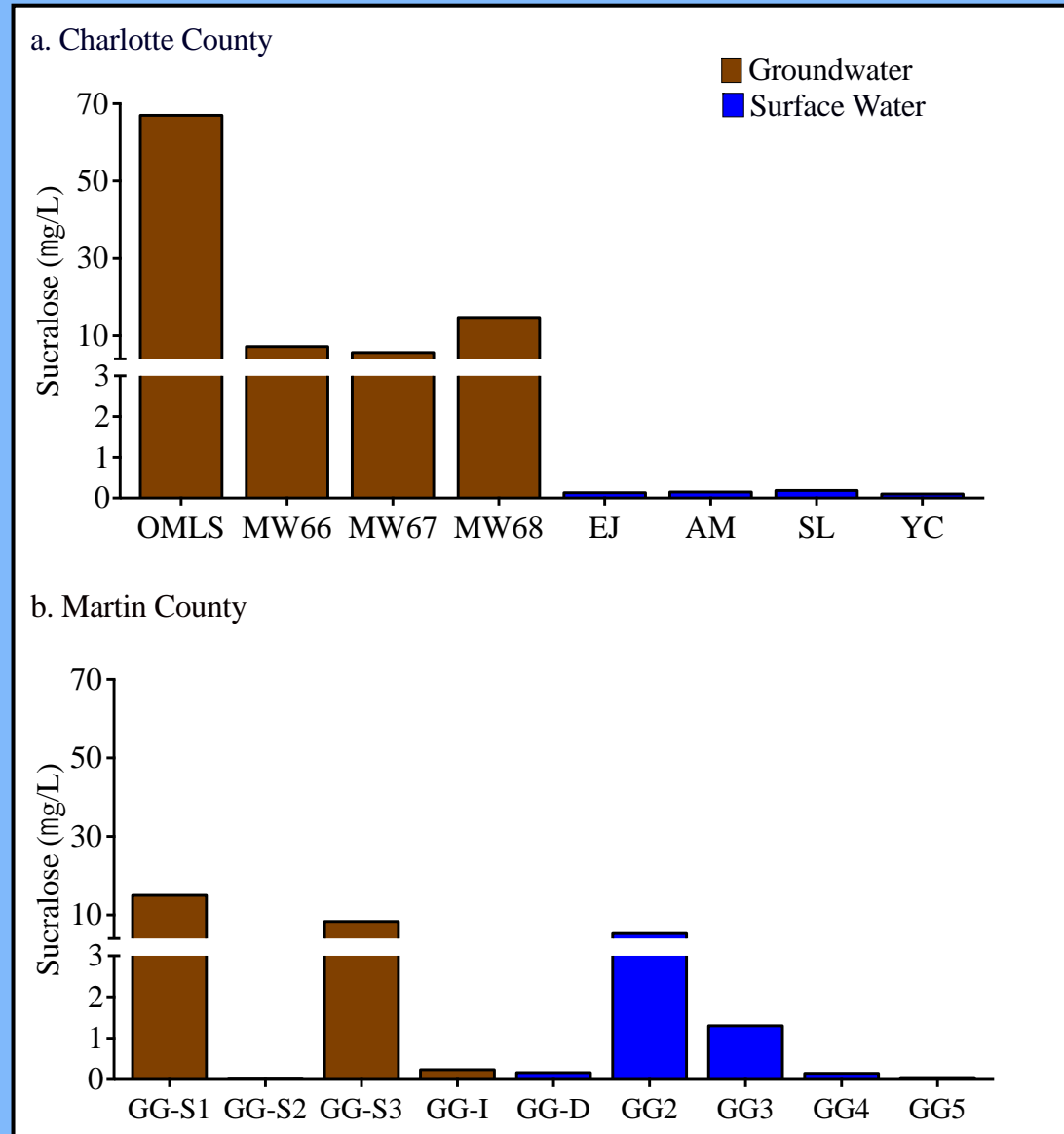
Martin and St. Lucie Counties Beaches Closed

Conclusions

- NNC exceedance at reconnaissance sites
  - TN ≥ NNC at all 4 sites
  - TP > NNC at El Jobean
  - Chl a > NCC at Yacht Club

- Strong septic signal in surface waters and groundwaters
  - Stable nitrogen isotopes
  - C:N ratio
  - Sucralose

- 71% of the Spring Lakes area does not meet state standards for distance from ground surface to water table

- These data support previous studies that septic systems are a significant source of pollution to Charlotte Harbor

Recommendations

GROUNDWATER

- Strategically placed monitoring wells and piezometers to study groundwater mounding

- Monthly sampling schedule

- Wet and dry season sampling for aqueous isotopes and sucralose

- Geospatial study of drainfield distance to groundwater, including soil characteristics

SURFACE WATER

- Continue and expand spatial coverage of canal discharges to other sub-watersheds

- Sample at ebbing tides

- Expand stable nitrogen isotope monitoring using algae, oysters, and fish

- Model water quality using heat maps to discover critical areas contributing septic pollution

Acknowledgments

- Charlotte County Board of County Commissioners
- Charlotte County Utilities Department
- Charlotte County Public Works Departments
- Captain Betty Staugler with Florida Sea Grant & Florida Sea Grant volunteers, Born Stornes and Dianne Quilty
- Captain Marcus Shore with Sea Tow
- Lisa Beever and Judy Ott with CHNEP
- Dennis Hanisak with HBOI-FAU Marine Botany Laboratory

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Questions?