Beach Management Practices and Characteristics at 316 Beaches in Florida

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Introduction

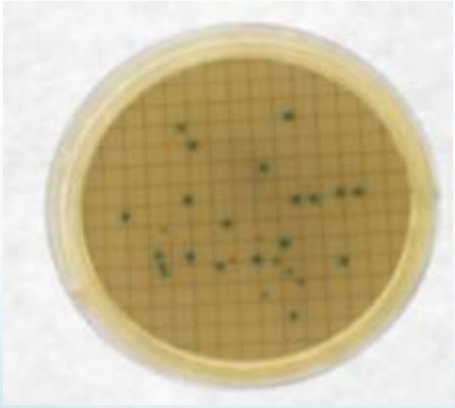
- Healthy beaches and good water quality lead to the prevention of disease
  - attract beach visitors
  - sustain local tourism/outdoor-recreation-based economies
- Water quality may be related to beach management and beach characteristics

Objectives

- To evaluate associations between beach water quality and management policies in an effort to assess approaches that minimize exceedances of fecal indicator bacteria (FIB)

How FIB is Measured

- Enterococci (recommended for salt/brackish water) or E.coli
- 100mL of sampled water filtered through membrane; analyzed for CFUs per 100 mL

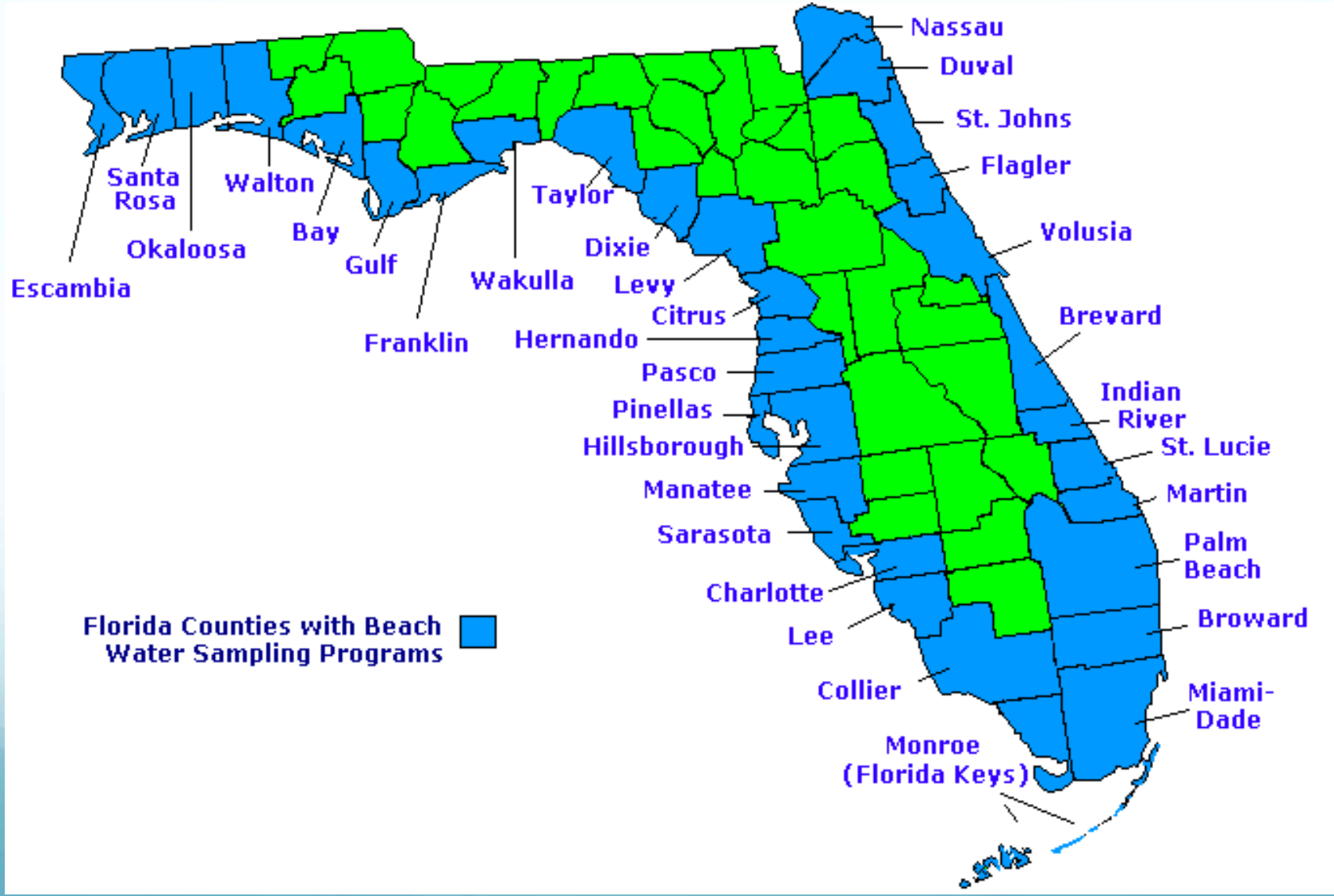


Blue-green areas = colony-forming units (CFU)

Standards

- Enterococci
  - Geometric mean 35 CFU/100mL
  - Single sample 104 CFU/100mL (71 CFU/100mL since January 2016
- Fecal coliform (discontinued)
  - Geometric mean 200 CFU/100mL
  - Single sample 400 CFU/100mL

Florida Healthy Beaches Program – Participating Counties



Methods

Analysis

- Beach oceanographic/geographic environmental factors and geomorphology (Feng et al)
- Beach management practices and associations with FIB data - analyzed through survey sent to beach managers at 316 beaches
  - Part I - county sampling and analysis policies
  - Part II - beach management policies at the individual beaches
- Visualize everything in GIS

Beach Management

- Surveys were sent to beach managers
  - Questions on:
    - numbers of animals and people
    - wastewater treatment facilities, stormwater, sewer outfalls, septic tanks
    - beach use
    - beach grooming
    - storms and beach renourishment
    - trash cans
  - Yes/no questions,

    open-ended, multiple choice

Beach Classifications

Types of Beaches

High Energy

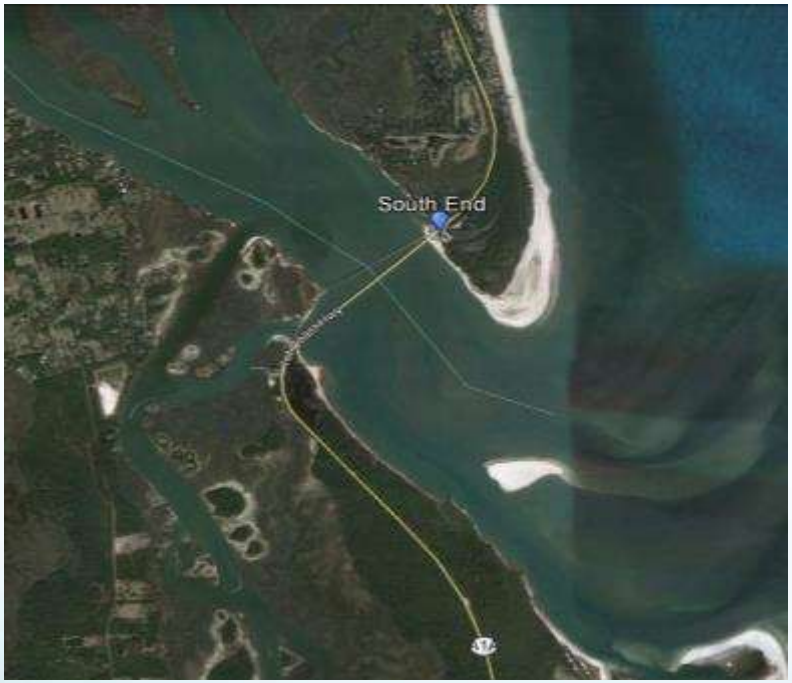
Open-coast beach (1)

Low Energy

Bay beach (2)

Types of Beaches

Inlet-channel situated beaches (3)

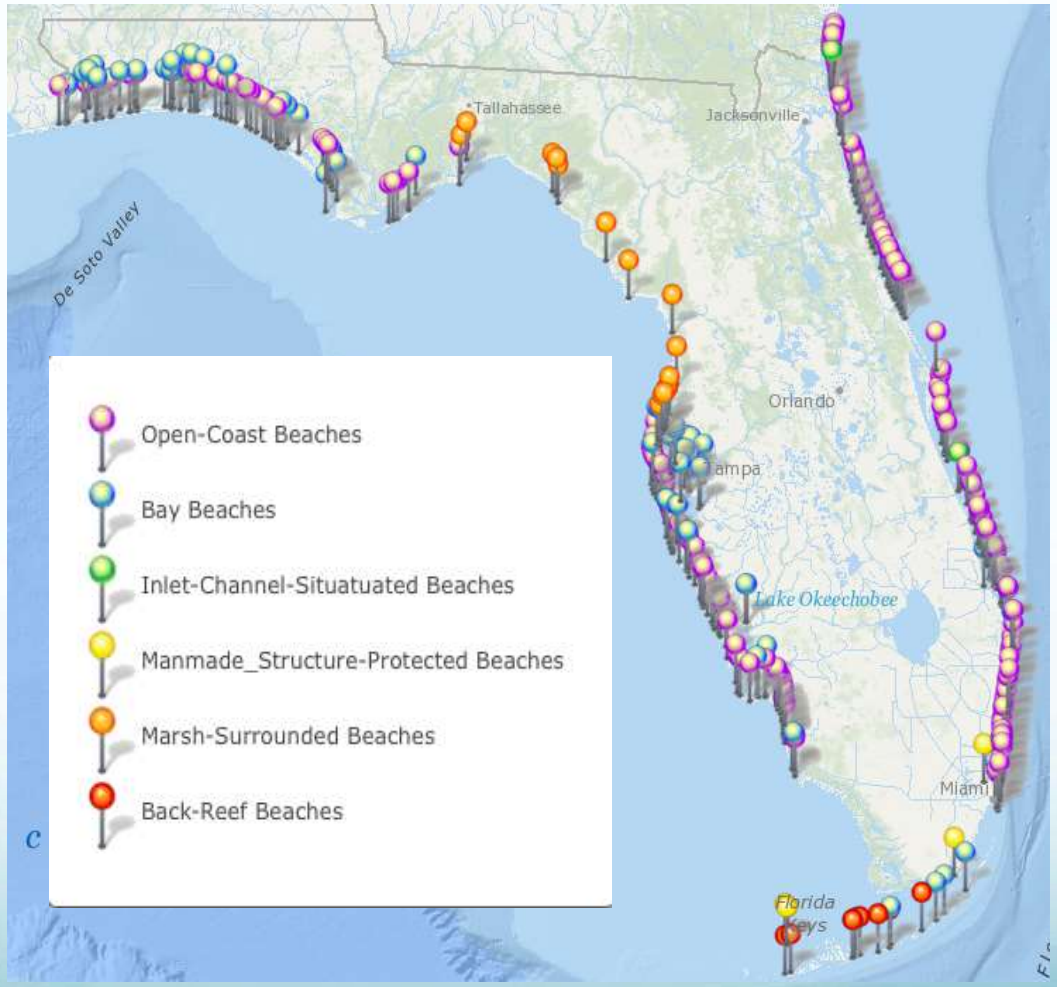


Manmade-structure-protected beaches (4)

Types of Beaches

Marsh-Surrounded beaches (5) Back-Reef beaches (6)

Beach Classification



Results

Geomorphology

High-energy beach

+

Steep profile beach

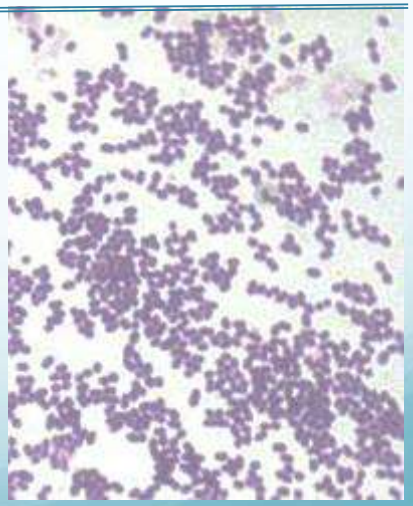
=

Low-energy beach

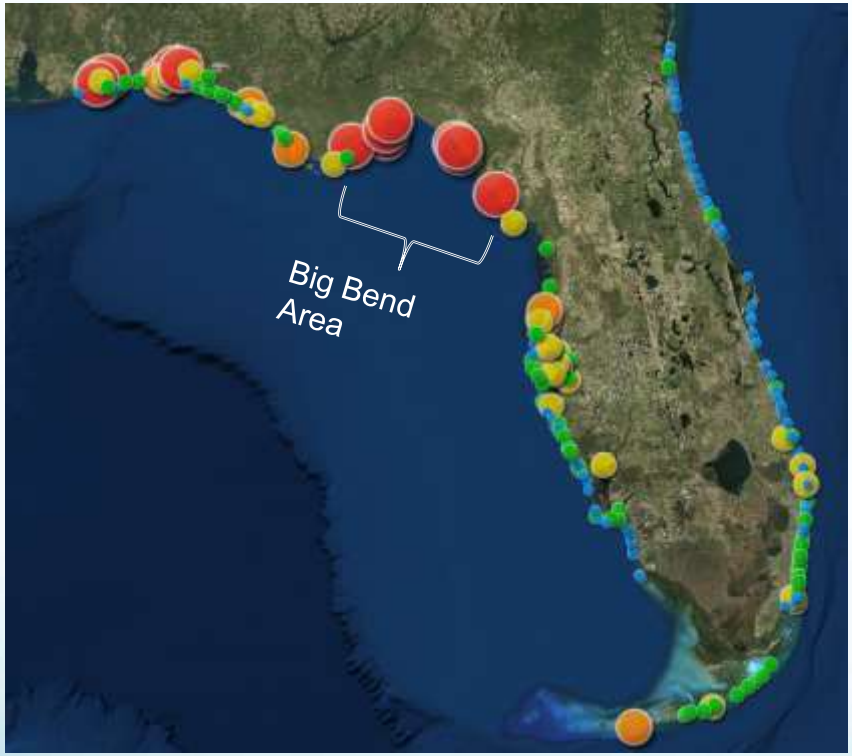
+

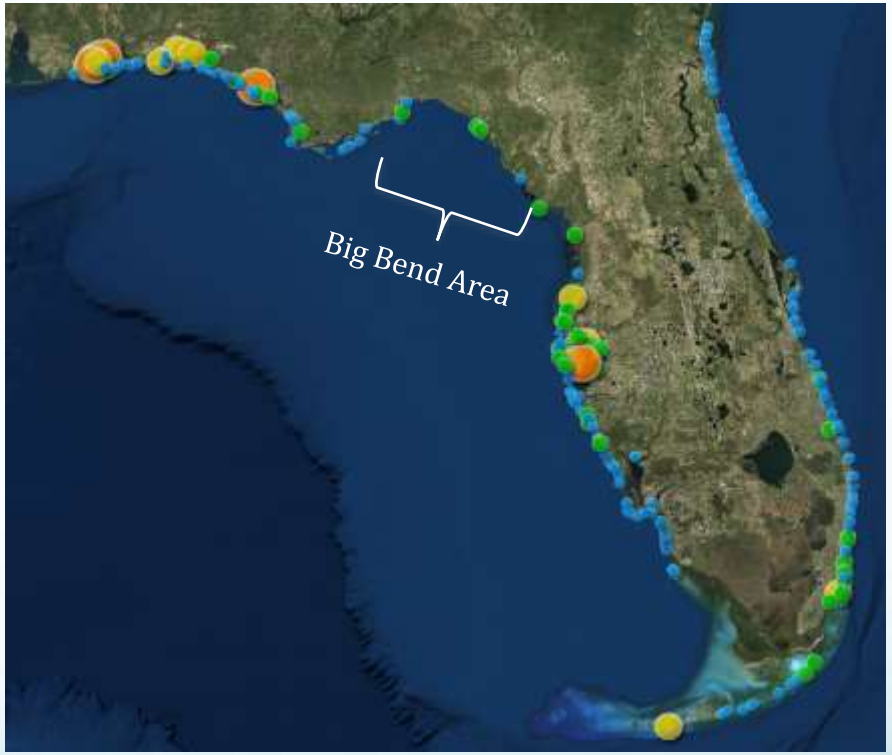
Flat, low profile beach

=



GIS - Percent Exceedance for Enterococci and Fecal Coliform





Percent Exceedance for Enterococci and Fecal Coliform

>16 to 31

>11 to 16

to 11

2 to 6

0 to 2

Statistical Analysis

Beach Classification

Beach Type	ENTEROCOCCI			FECAL COLIFORM		
	Mean % Exceed.	Standard Dev	Statistical Significance*	Mean % Exceed.	Standard Dev	Statistical Significance*
Open coast (n=211)	1.65	1.72	A	0.64	1.03	A
Bay (n=72)	6.87	5.33	B	3.84	4.04	B, C, E
Inlet-channel-situated (n=3)	3.54	1.60	A, B	1.43	1.43	A, B, D
Manmade-structure-protected (n=5)	6.46	5.52	B	6.09	3.64	C, E
Marsh-surrounded (n=17)	14.5	10.5	C	2.94	1.60	D, E
Back-reef (n=8)	3.50	2.02	A,B	1.08	0.90	A, D

*Beach types sharing the same letter are statistically not different.

Low Enterococci at Open-Coast Beaches

Open Coast Enterococci Statistics

	yes	no	p-value
Address Dogs	**1.7 (n=119)**	**2.1 (n=13)**	0.3
Bird Policies	**0.9 (n=41)**	**1.7 no (n=138)**	<0.1
Marinas	**1.8 (n=64)**	**1.5 (n=91)**	0.4
Manage Storm Water	1.4 **(n=101)**	1.4 **(n=39)**	0.1

Conclusion

- Beach geomorphology and environment have an overwhelming effect
- Beach management policies influence FIB levels
- Not all beach policies were associated with improvements in water quality
- Beach management varies greatly throughout the state, related to funding
- Future work on human use including dogs, birds, beach use and amenities, beach access, and local beach environment