A Fresh Look at Ecological Condition Indices for Southwest Florida's Urbanizing Tidal Streams

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Sarasota County Integrated Water Resource Management Initiative

Watershed scale

- *Water supply*
- *Flood control*
- *Natural resources*

Need for Performance

Measures

Marine

Mineral-Based

Consolidated (limerock, coquina) Substrate

Unconsolidated (mud, sand, shell) Substrate

Floral-Based

Algal Bed Seagrass Bed

Tidal Marsh Tidal Swamp

Faunal-Based

Coral Reef Mollusk/Worm Reef

Sponge Bed Octocoral Bed

Key Ecological Considerations

Salinity regime, tidal flushing, water transparency, wave energy, storms

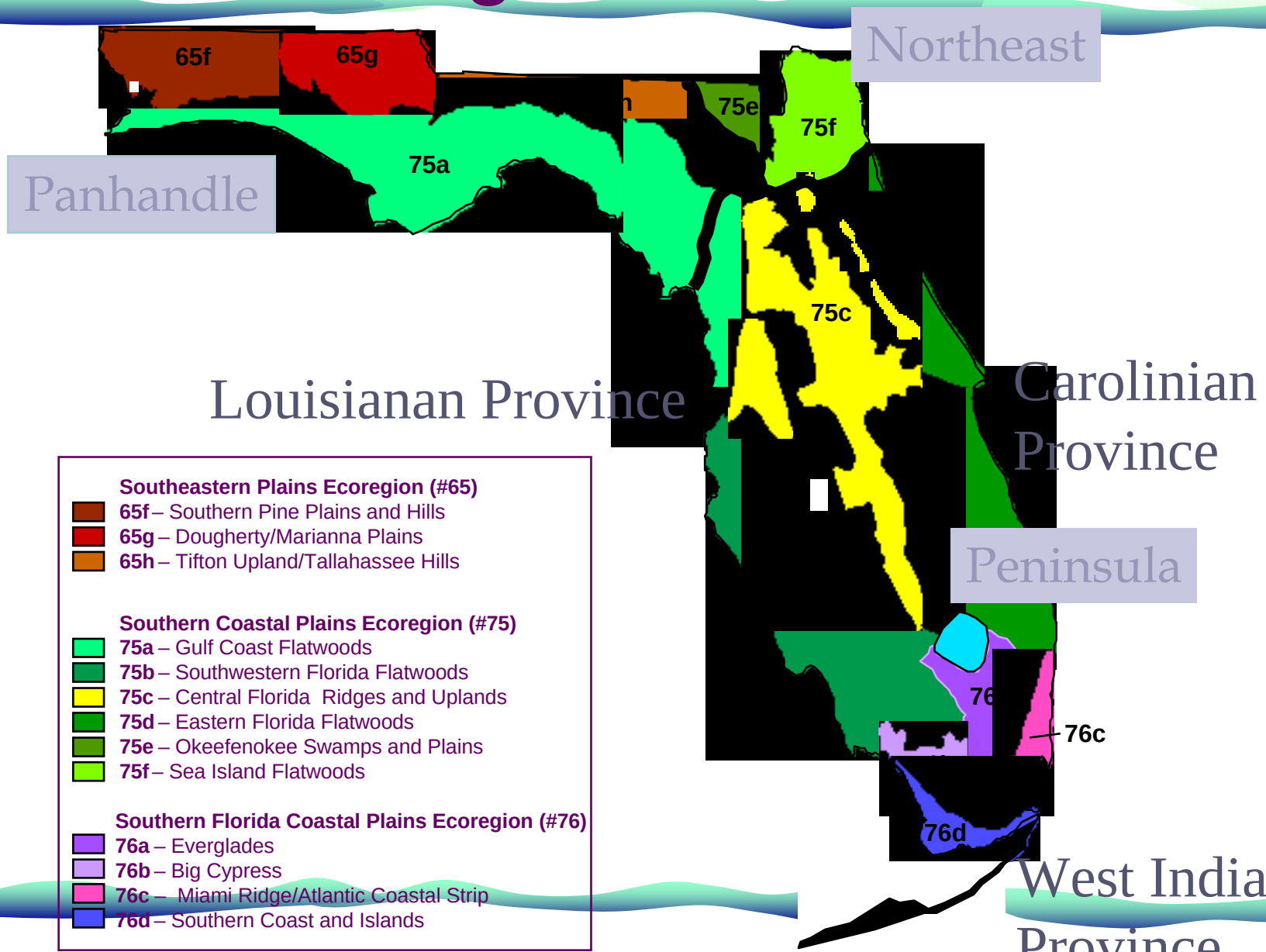
Biological index for county streams

- Small
- Tidally influenced
- Urbanizing

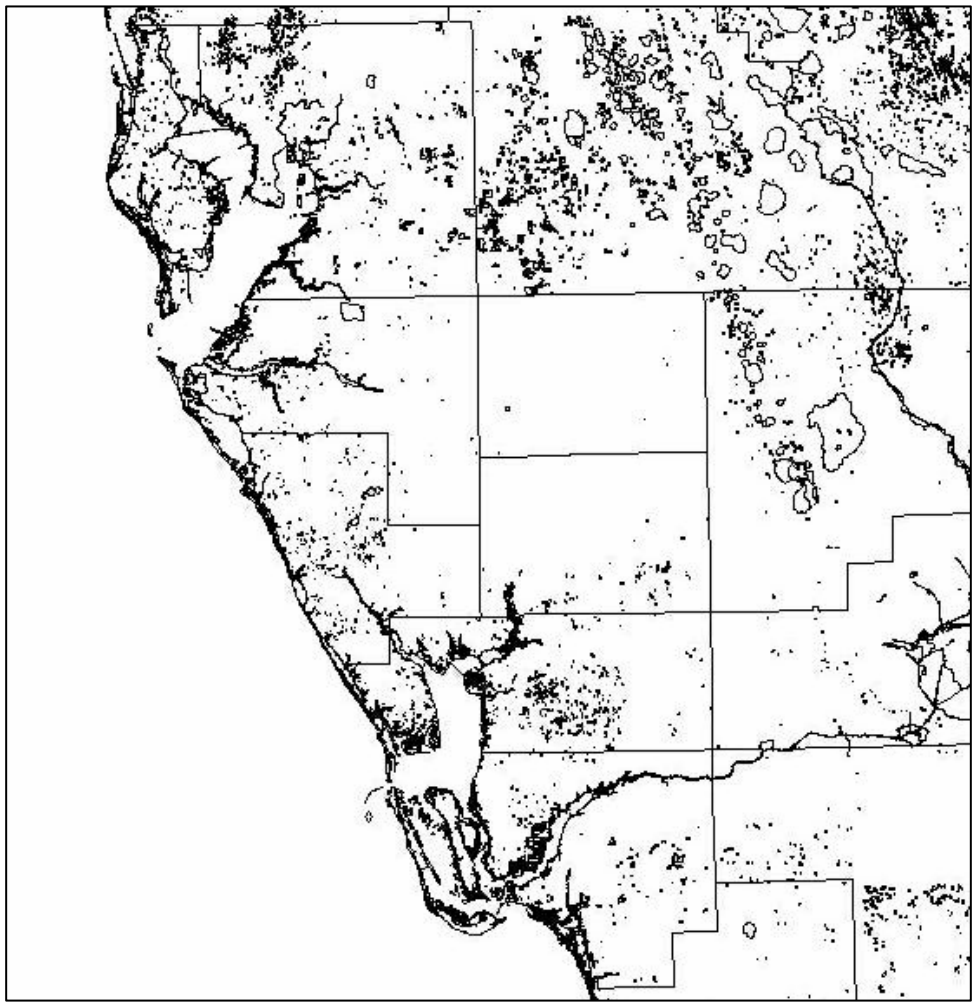
Essential Questions

- Geographic homogeneity?
- Watershed heterogeneity?
- Extremes in watershed condition?
- Differences in associated tidal streams?
- Candidate metrics?
- Behavior of prototypic index?

Eco-regions of Florida



Streams of Southwest Florida are Similar Because …



… The Coast of Southwest Florida is Fairly Homogeneous Respecting

Physiography	Gulf Coastal Lowlands	Cooke, 1939
Geography	Western Flatlands	Davis, 1943
Coastal Classification	West-Central Barrier Chain	Davis, 1997
Geology	Coastal Lowlands	Puri & Vernon, 1964
Exposed Aquifer	Surficial	Miller, 1990
Environmental Geology	Shelly Sand and Clay	Kautz *et al.,* 1998
Soils	Spodosols	Carlisle, 1981
Sediments	Holocene Quartz Sand	Hayes, 1975
Marine Geology	Peorian	Wilhelm & Ewing, 1972
Shoreline Type	Sandy Coast	Johnson & Barbour, 1990
Wave Climate	Low	Tanner, 1960
Tides	Mixed	Provost, 1973

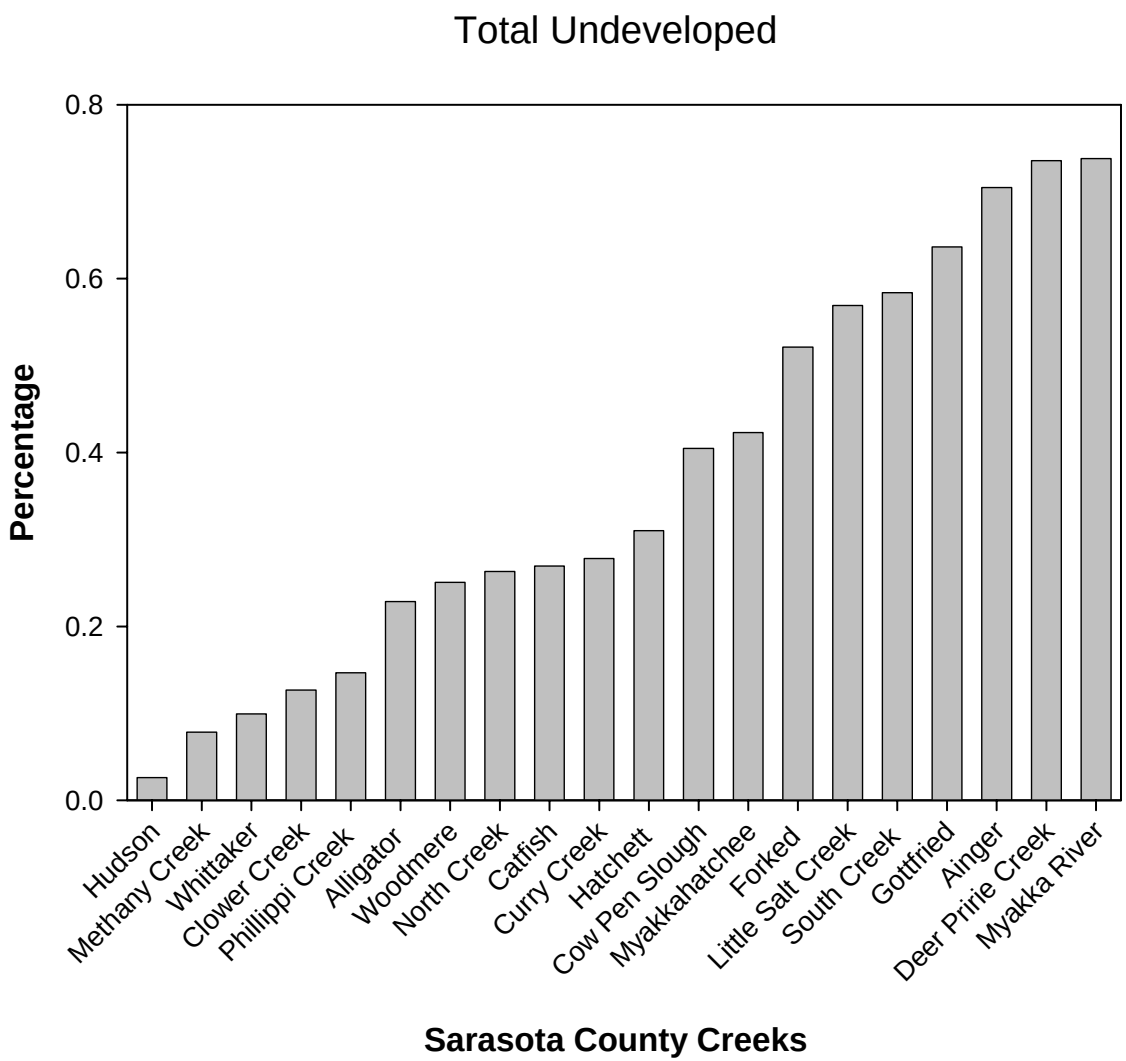
… And Also Respecting

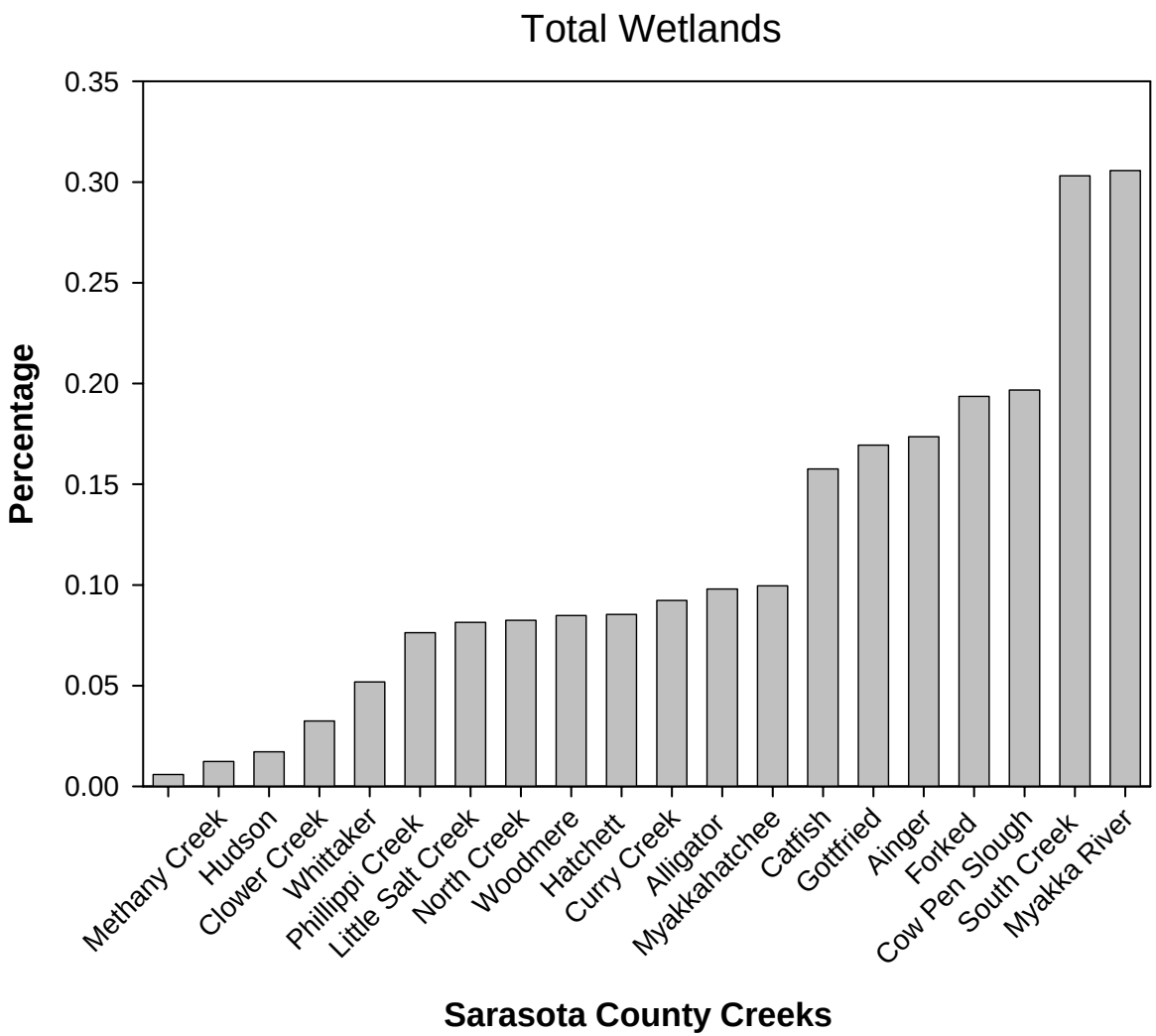
(Continued)

Tides	Microtidal	Nummedal *et al.,* 1977
Sea Level Rise	Eustatic-dominated	National Academy, 1987
Climate	Subhumid Mesothermal	Henry, 1998
Hurricane Risk	17.5 Percent	NOAA/NWC, 2002
Hydrology	SWCFGW Basin	Estevez *et al.,* 1991
River Type	Sand-Bottomed	Beck, 1965
River Type	Blackwater	Nordlie, 1990
Terrestrial Botany	Pine Flatwoods	Abrahamson & Hartnett, 1990
Marine Botany	Tropical	Earle, 1969
Marine Zoology	Transitional	Collard & D'Asaro, 1973
Ecoregion	Southwestern Florida Flatwoods	Barbour *et al.,* 1996

Tidal Stream Number

- 20 overall in Sarasota County
- (4 in Myakka River system)
- 16 coastal, tidal streams
- One per two miles of coast


Total Undeveloped
Percentage
0.0
0.2
0.4
0.6
0.8
Hudson
Methany Creek
Whittaker
Clower Creek
Phillippi Creek
Alligator
Woodmere
North Creek
Catfish
Curry Creek
Hatchett
Cow Pen Slough
Myakkahatchee
Forked
Little Salt Creek
South Creek
Gottfried
Ainger
Deer Pririe Creek
Myakka River
Sarasota County Creeks


Total Wetlands
Percentage
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Methany Creek
Hudson
Clower Creek
Whittaker
Phillippi Creek
Little Salt Creek
North Creek
Woodmere
Hatchett
Curry Creek
Alligator
Myakkahatchee
Catfish
Gottfried
Ainger
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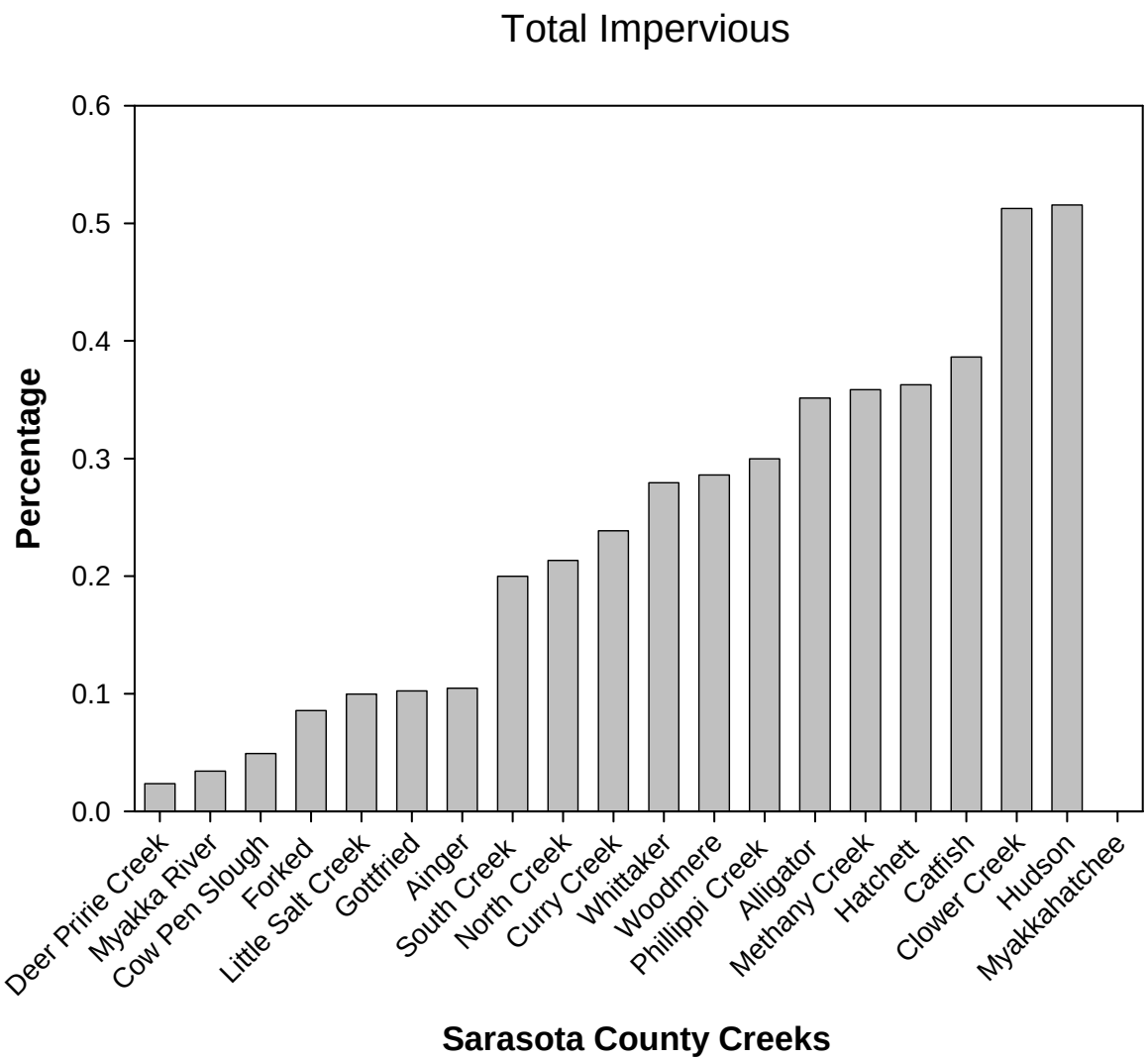
Cow Pen Slough
South Creek
Myakka River
Sarasota County Creeks


Total Impervious
Percentage
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Deer Pririe Creek
Myakka River
Cow Pen Slough
Forked
Little Salt Creek
Gottfried
Ainger
South Creek
North Creek
Curry Creek
Whittaker
Woodmere
Phillippi Creek
Alligator
Methany Creek
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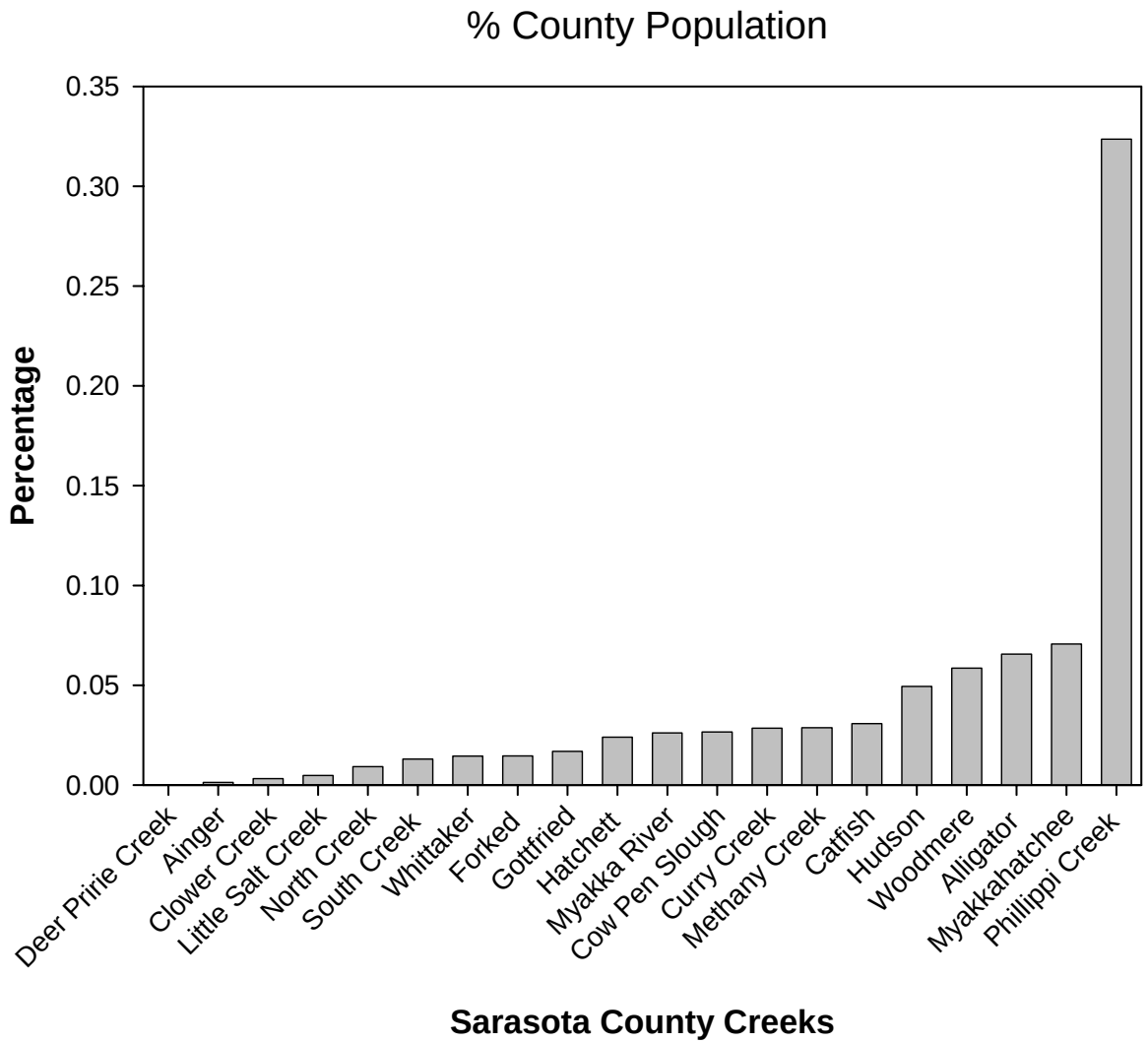
% County Population
Percentage
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Deer Pririe Creek
Ainger
Clower Creek
Little Salt Creek
North Creek
South Creek
Whittaker
Forked
Gottfried
Hatchett
Myakka River
Cow Pen Slough
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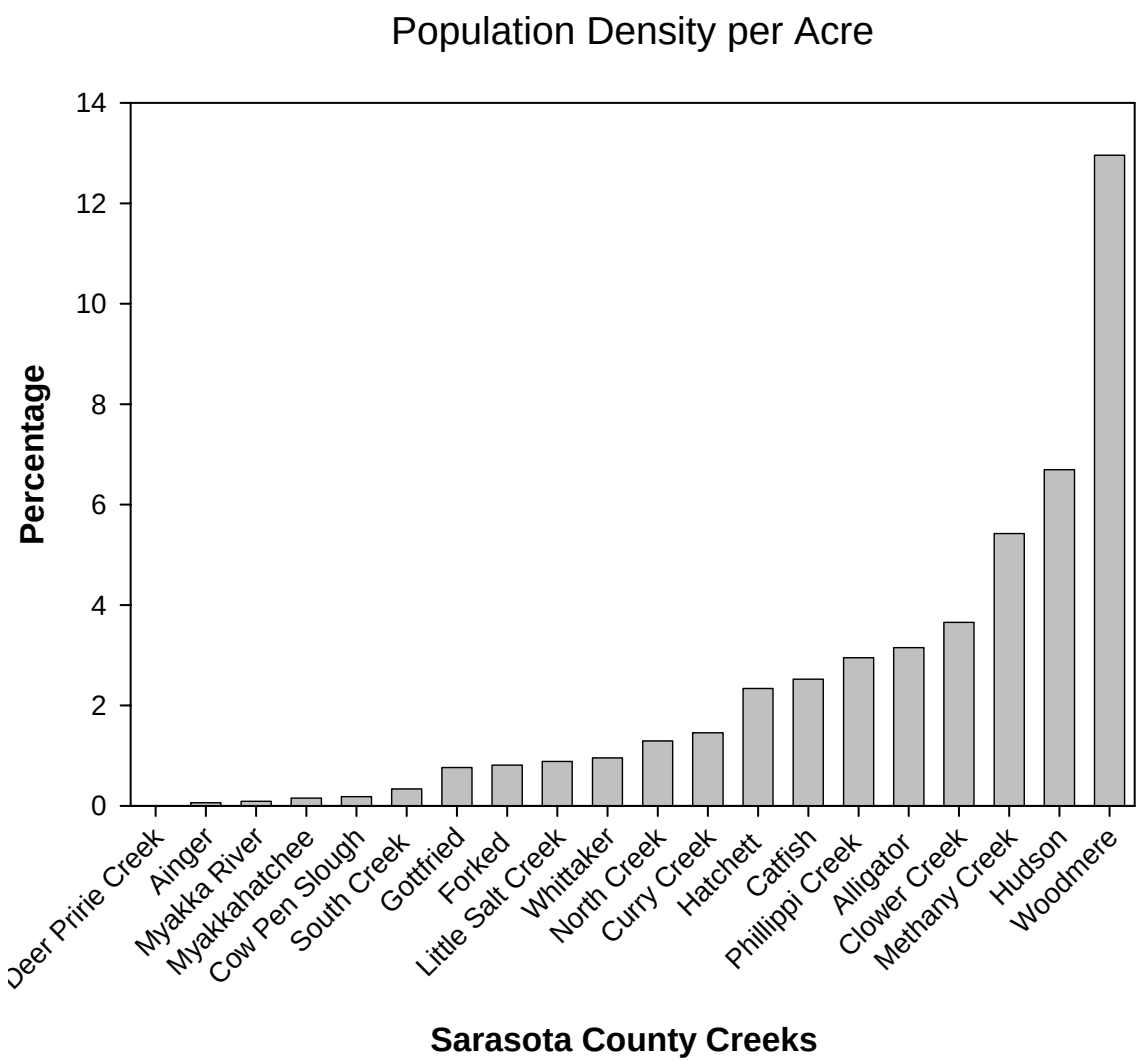
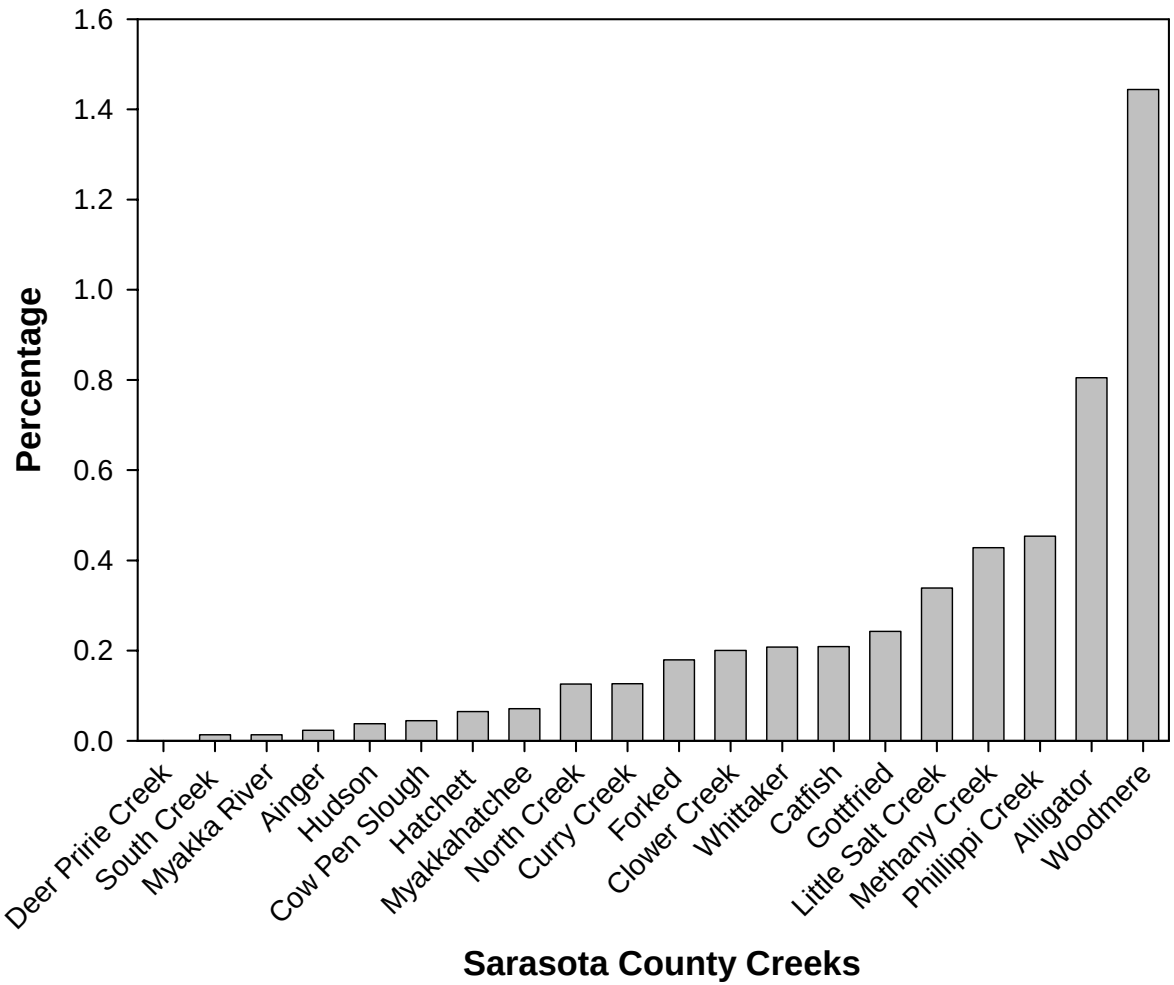

Population Density per Acre
Percentage
0
2
4
6
8
10
12
14
Deer Pririe Creek
Ainger
Myakka River
Myakkahatchee
Cow Pen Slough
South Creek
Gottfried
Forked
Little Salt Creek
Whittaker
North Creek
Curry Creek
Hatchett
Catfish
Phillippi Creek
Alligator
Clower Creek
Methany Creek
Hudson
Woodmere
Sarasota County Creeks

Septic Density per Acre



Watershed Condition…

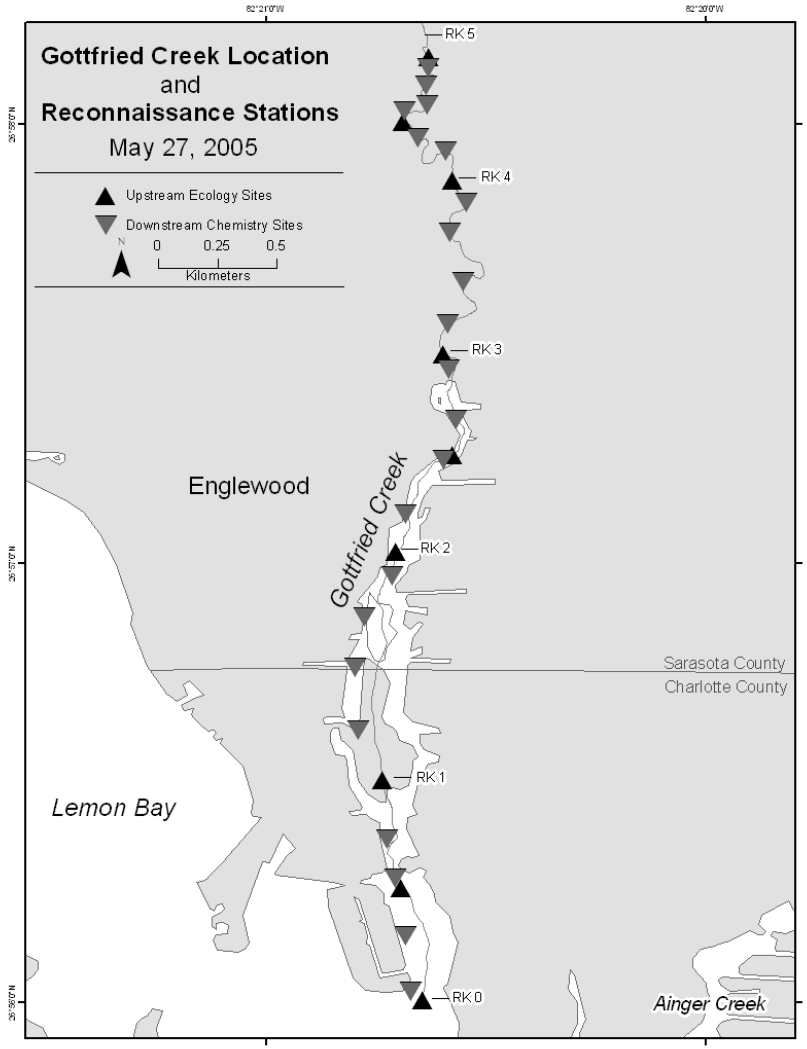
- **Varies substantially**

  Whitaker, Hudson, Woodmere

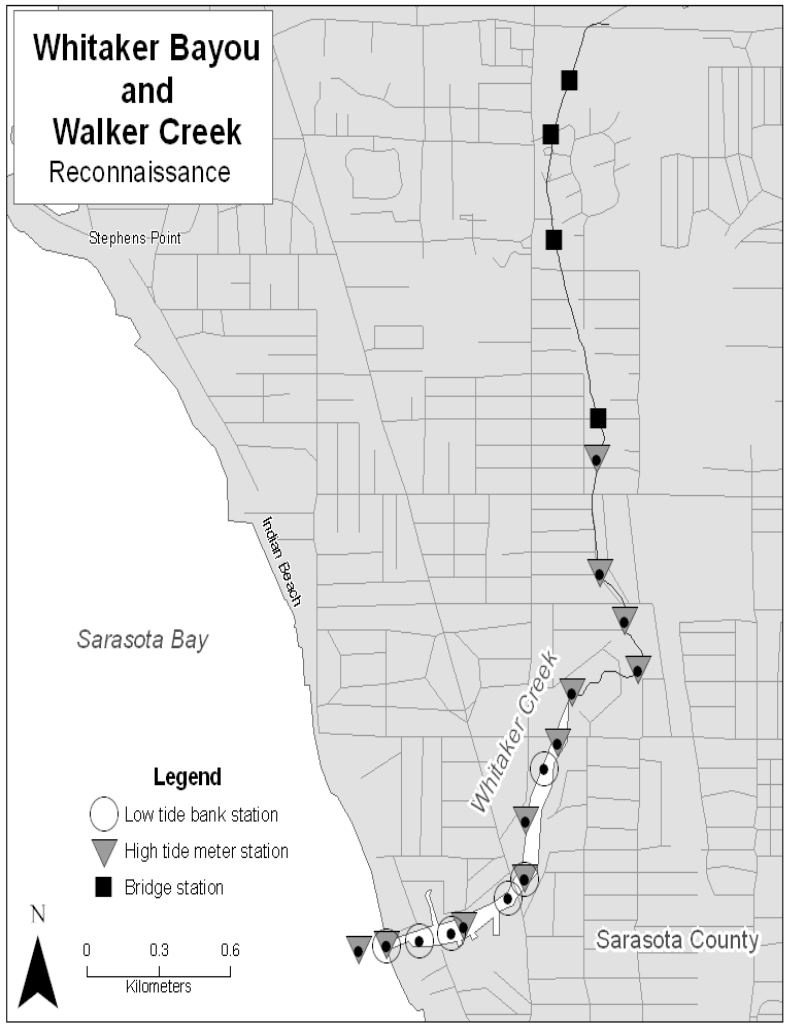
  versus

  South, Gottfried, Ainger

Location of Gottfried Creek and Ecological and Chemistry Sampling Sites



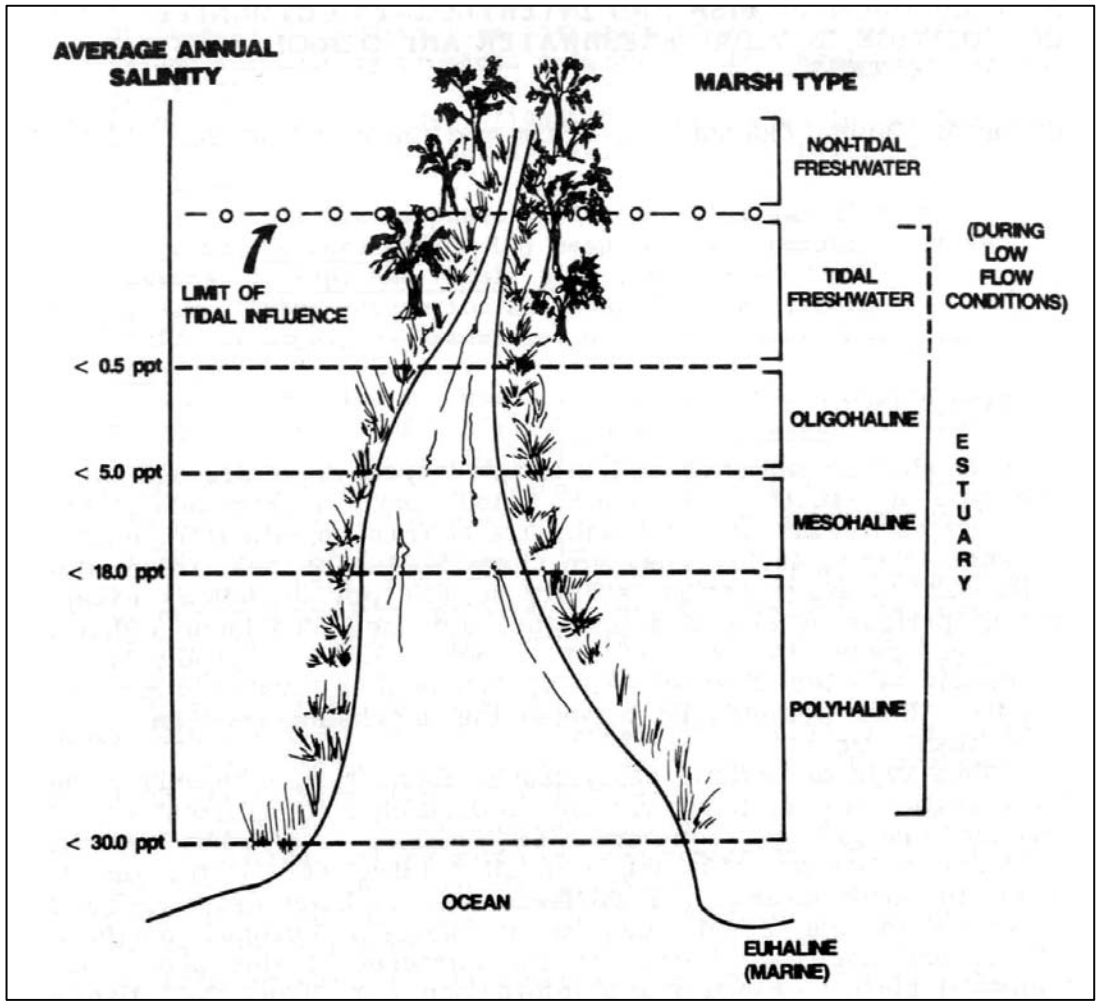
Location of Whitaker Bayou and Walker Creek, and Ecological and Chemistry Sampling Sites



	Gottfried	Whitaker
Percent DO< 4mg/l	*36*	*86*
No. Bottom Types	*21*	*17*
% Natural Bottom Types	*76*	*47*
Problem Sediments	*No*	*Yes*
Hardened Shorelines	*Present*	*Dominant*

	Gottfried	Whitaker
Wetland Species No.	*6*	*3*
Wetland Cover	*Extensive*	*Sparse*
Seagrass Species	*2*	*0*

	Gottfried	Whitaker
Oyster Cover	*Moderate*	
Sparse		
No. Mollusk Species	*20*	*9*
Oligohaline Indicators	*2*	*0*
Intertidal Index Candidates	*3*	*0*
Total Species Richness	*45*	*24*



Source: From Odum et al., (1984).

Next Steps

- Develop prototype tidal stream index based on FDEP river habitat and marine benthic habitat assessment protocols
- Apply to all sixteen tidal streams
- Evaluate index performance

FDEP Coordination Efforts

- December 2005 meeting- Sarasota
- January, February 2006 exchange of scopes and reports
- March 2006 meeting- Tallahassee
- April 2006 conference call

Human Disturbance Factor Analysis (Florida system)

- Landscape level
  - Landscape Development Intensity Index
- Habitat alteration
  - Habitat assessment data
- Hydrologic modification
  - Hydrologic scoring process
- Chemical Pollution
  - Ammonia, etc.

Summary of the Landscape Development Intensity* Coefficients

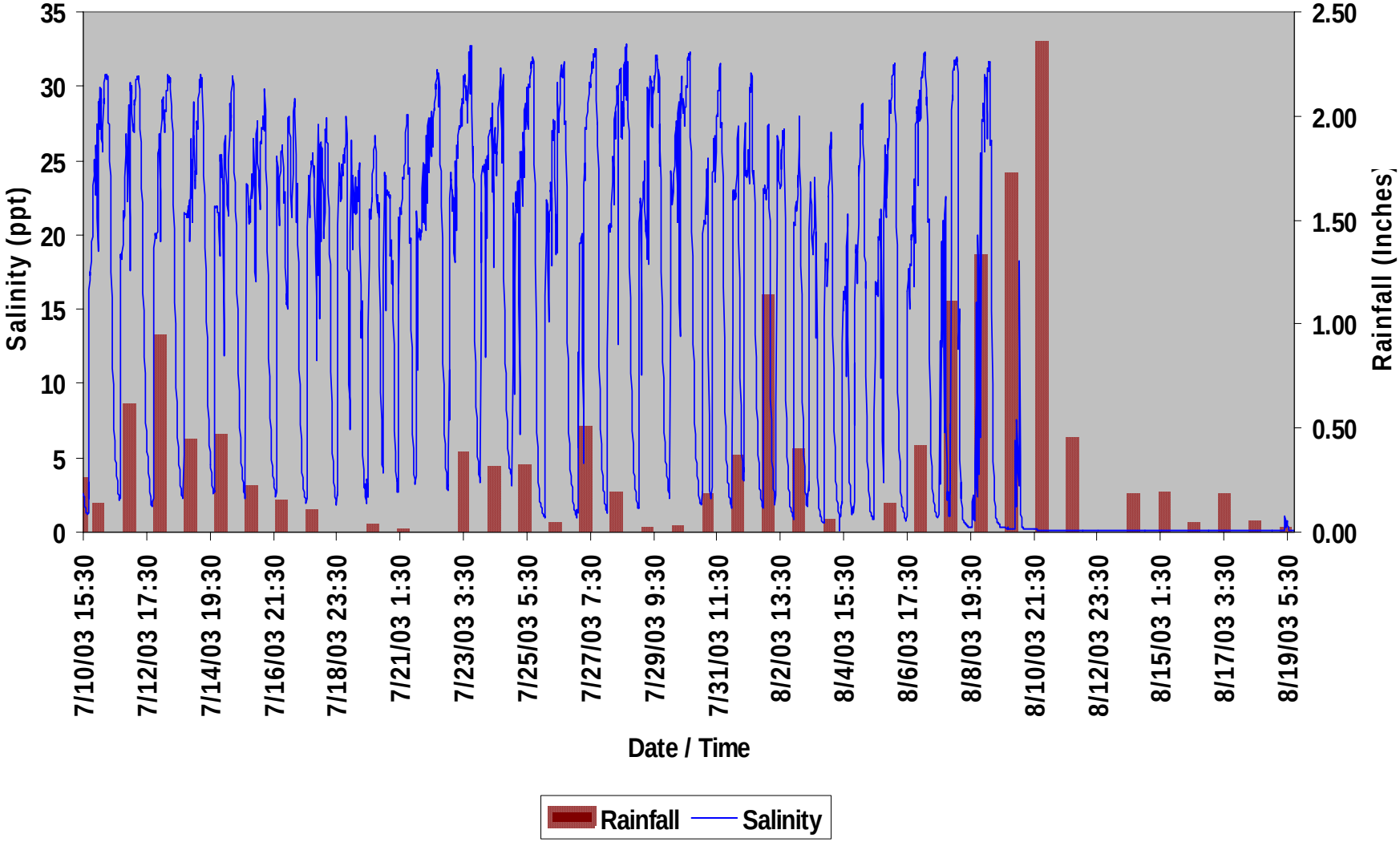
Category	Coefficient
Natural System	1
Pine Plantation	1.6
Pasture	3.4
Row Crops	4.5
Residential (low)	6.8
Residential (high)	7.6
Commercial	8.0
Industrial	8.3
Commercial (high)	9.2
Business District	10.0

*Developed by Mark Brown, University of Florida, based on non-renewable Energy inputs, Odom's "Embodied Energy" concept.

Human Disturbance Factors: Quantifying NPS Pollution

- Landscape level
  - Landscape Development Intensity Index
- Habitat alteration
  - Habitat assessment data
- Hydrologic modification
  - Hydrologic scoring process
- Chemical Pollution
  - Ammonia, etc.

Salinity at Curry Creek / U.S. 41 compared to rainfall in the Myakka River basin 7/10/2003 – 8/18/2003



Desirable Metric Qualities

- Ecologically Justified
- Discriminating
- Represent Integrity
- Precise
- Sufficient range of values

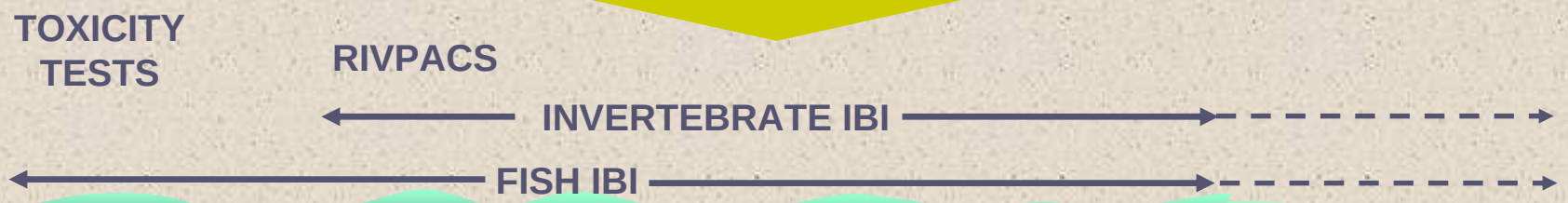
Metric Selection Criteria

- Meaningful measure of ecological structure or function
- Strong and consistent correlation with human disturbance
- Statistically robust, low measurement error
- Represent multiple categories of biological organization
- Cost-effective to measure
- Not redundant with other metrics
  - Exception: “response signature” metrics

Attribute Groups

INDIVIDUAL CONDITION	TAXONOMIC COMPOSITION	COMMUNITY STRUCTURE	LIFE HISTORY ATTRIBUTES	SYSTEM PROCESSES
DISEASE	IDENTITY	TAXA RICHNESS	FEEDING GROUPS	TROPHIC DYNAMICS
ANOMALIES	TOLERANCE	RELATIVE ABUNDANCE	HABIT	PRODUCTIVITY
CONTAMINANT LEVELS	RARE OR ENDANGERED KEY TAXA	DOMINANCE	VOLTINISM	MATERIAL: CYCLES
DEATH				PREDATION
METABOLIC RATE				RECRUITMENT

INTEGRATED BIOASSESSMENT



Floral Metrics

- INTERTIDAL ZONATION
- FILAMENTOUS ALGAE EXTENT
- FILAMENTOUS ALGAE COVER
- FLESHY ALGAE EXTENT
- FLESHY ALGAE COVER
- INTERTIDAL SAV SPECIES NUMBER
- INTERTIDAL SAV EXTENT
- INTERTIDAL SAV COVER
- SUBTIDAL SAV SPECIES NUMBER
- SUBTIDAL SAV EXTENT
- SUBTIDAL SAV COVER

Faunal Metrics I

- INTERTIDAL BIOTURBATION EXTENT
- INTERTIDAL BIOTURBATION COVER
- SUBTIDAL BIOTURBATION EXTENT
- SUBTIDAL BIOTURBATION COVER
- INTERTIDAL BARNACLE EXTENT
- SUBTIDAL BARNACLE EXTENT
- RAZOR CLAM EXTENT
- NUMBER OF RAZOR CLAM COHORTS

Faunal Metrics II

- INTERTIDAL OTHER CLAM EXTENT
- SUBTIDAL OTHER CLAM EXTENT
- INTERTIDAL PERIWINKLE EXTENT
- INTERTIDAL NERITE EXTENT
- BARE BOTTOM PUSHNET CRUSTACEAN ABUNDANCE
- VEGETATED BOTTOM PUSHNET CRUSTACEAN ABUNDANCE
- WOOD BORER SEVERITY
- FISH PATHOLOGY

Sarasota County Comprehensive Oyster Monitoring Plan, March 2006