# Northern Estuaries

## Historic Conditions, Key Characteristics and Species, Ecological Needs

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# Outline

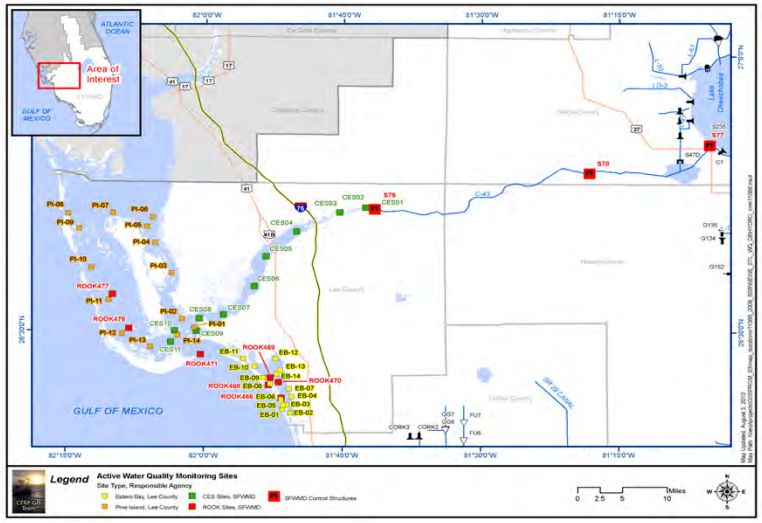
- ★ Historic conditions
- ★ The Altered System
- ★ Current Conditions – Problems
- ★ Proposed Solutions Under CERP
- ★ What CEPP can do to help
- ★ RECOVER monitoring
- ★ New Tools in the toolbox

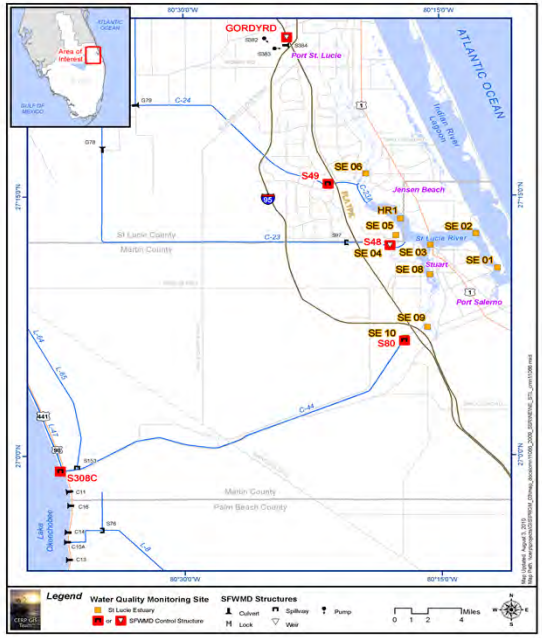
# Historical Conditions

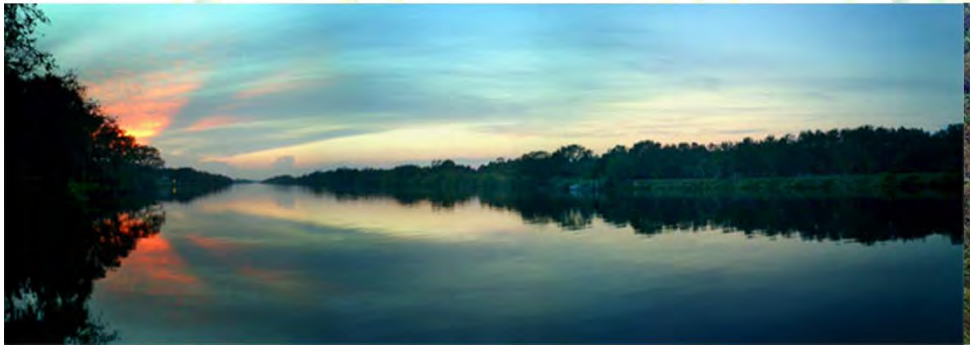
- ★ Watersheds in their pre-drainage condition were smaller and provided buffering of flows to the receiving water bodies
- ★ No permanent inlet to the St Lucie
- ★ No connections to Lake Okeechobee

# An Altered System

## The Caloosahatchee and St. Lucie Rivers, their watersheds and estuaries have been altered from the natural state





# Disruption of Natural Patterns

## Freshwater Inflow:

- Too much freshwater inflow during the wet season
- Too little during the dry season

## Salinity:

- Low salinity during wet season causes mortality of marine organisms
- Saltwater intrusion during the dry season causes mortality in the upper estuary

# Current Conditions

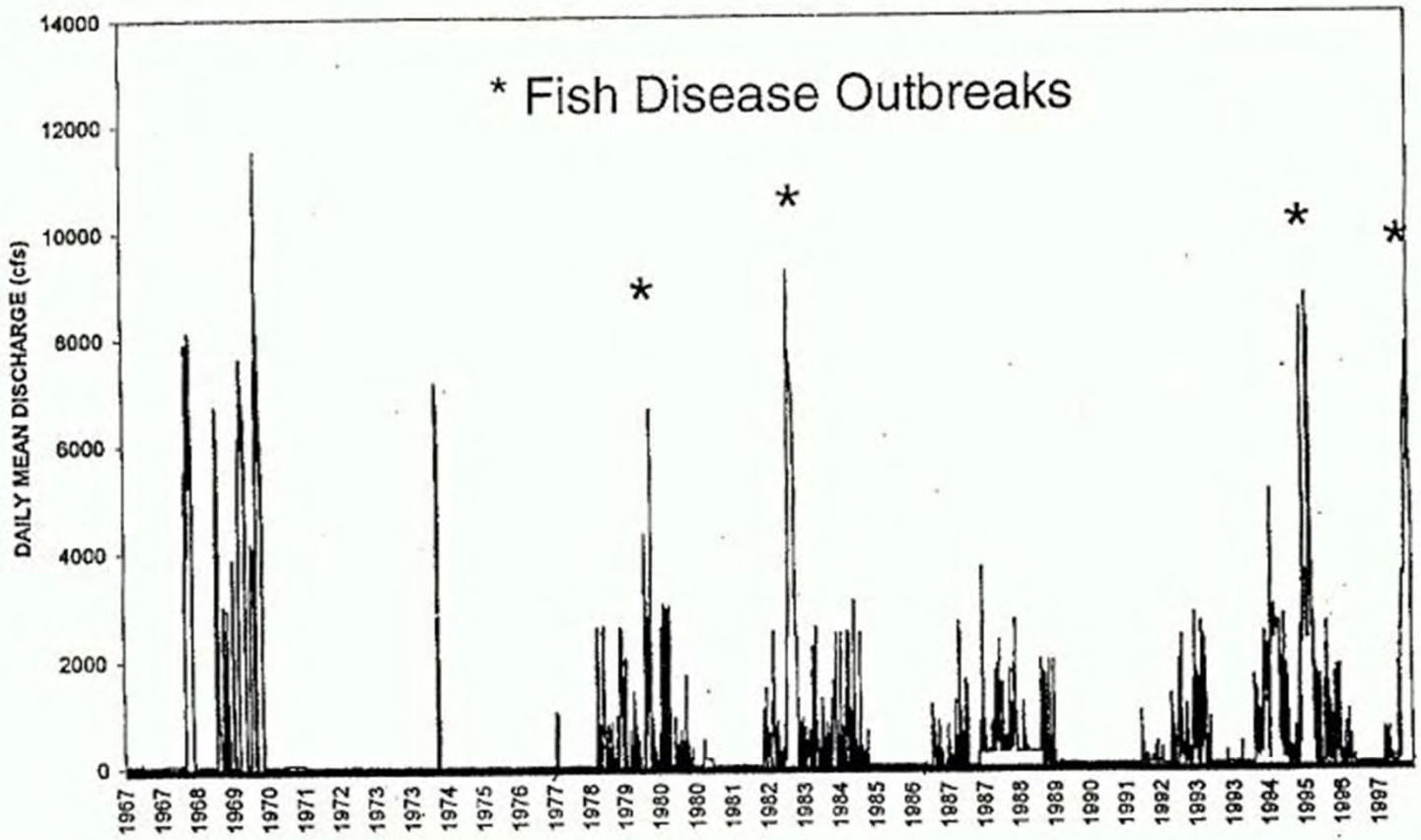
Too much flow

- ⋆ Low salinities for seagrass and oysters
- ⋆ Flushing of oyster larvae out of the estuary

Too little flow

- ⋆ High salinities for tapegrass
- ⋆ Increased marine predators on oysters

# St. Lucie Canal Discharge and Flow



WARNING
HIGH BACTERIA AND BLUE GREEN ALGAE LEVEL WARNING. AVOID CONTACT WITH WATER IN THE ST. LUCIE RIVER
HEALTH
MARTIN CO. HEALTH DEPT. 221-4090

# Proposed Solutions for the Northern Estuaries

## Water Management

Reservoirs

Wetlands Rehydration

## Water Treatment

Stormwater Treatment Areas

## Habitat Alterations

Muck Removal

Will improve salinity patterns, water quality and habitat

To restore

Seagrass

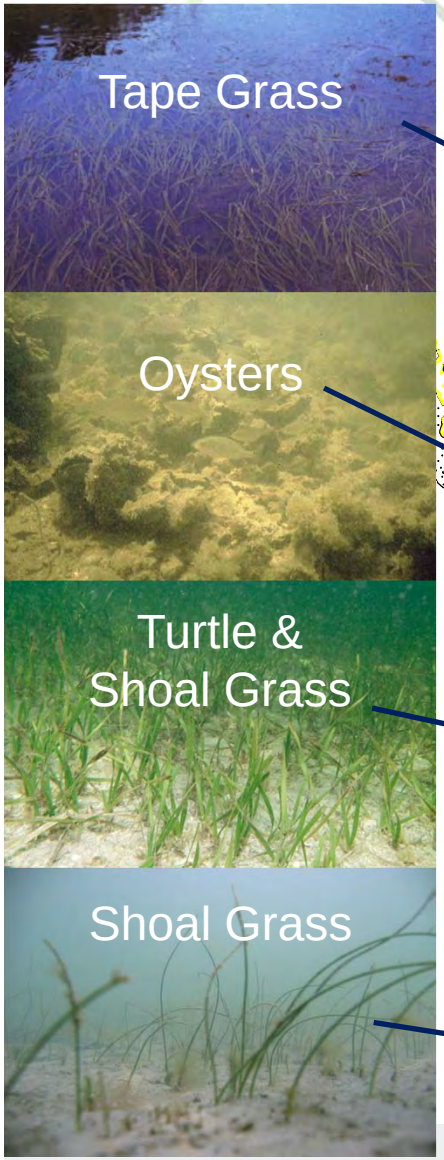
Benthos

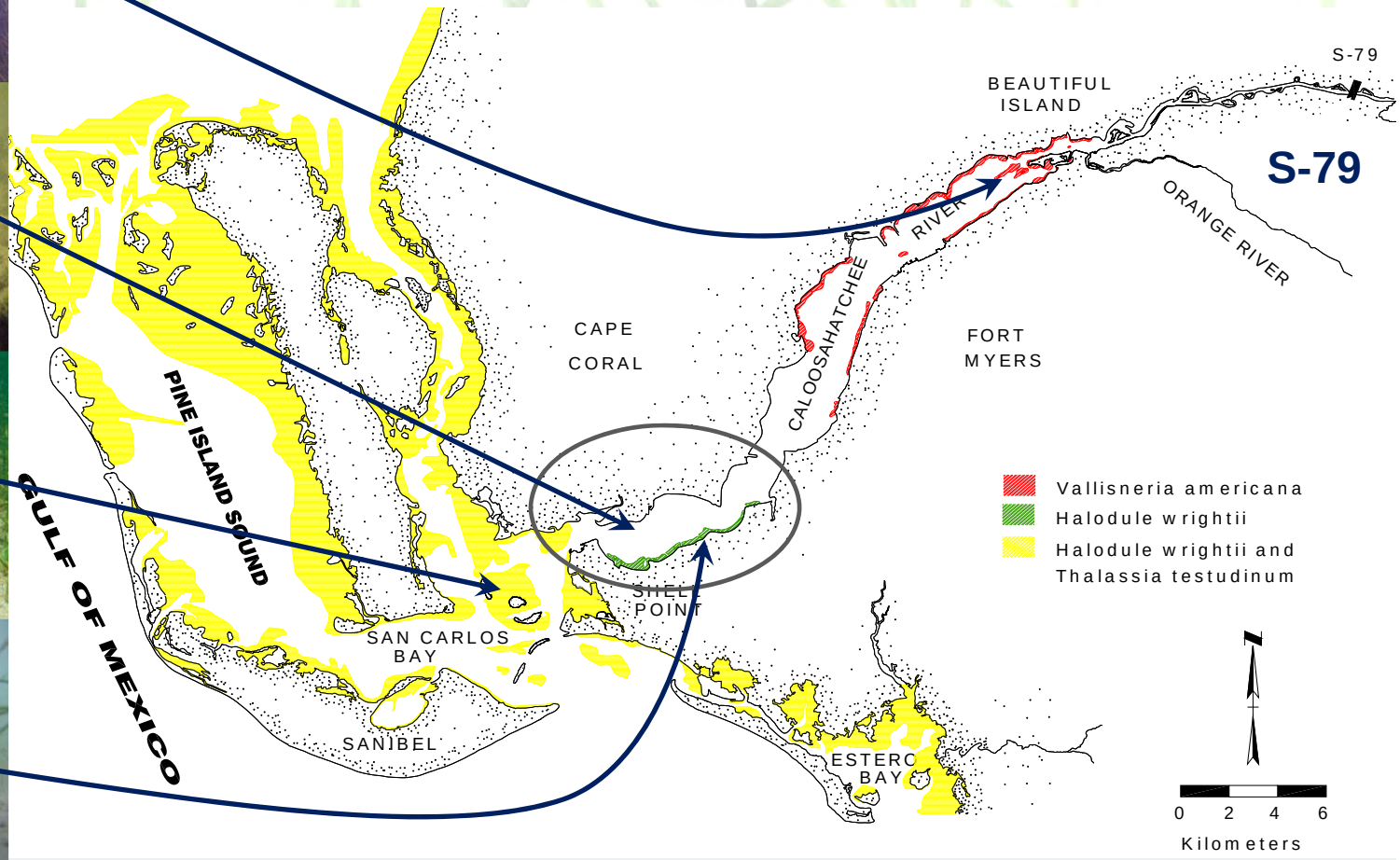
Oysters

# CEPP Objectives

- ★ Reduce high volume discharges from Lake Okeechobee to improve the quality of oyster and SAV habitat in the northern estuaries.
- ★ Along with the improvement afforded by the SIRL and C-43 reservoir and STA projects the quality of oyster and SAV habitat in the northern estuaries will improve.

# Flow Range at S-79




**SUBMERGED PLANTS**

| Tape Grass | | Shoal Grass | | Oysters | | Turtle & Shoal Grass | |
|---|---|---|---|---|---|---|---|
| <10 psu | **>450 cfs** | >6 psu | **<2800 cfs** | >3-5 psu | <4000 cfs | >20 psu | **<4500 cfs** |

# Key Findings From the first several years of RECOVER MAP Monitoring

# Key Indicators of Restoration Success

## Northern Estuaries

### *St. Lucie and Caloosahatchee*

Stressor Response

Water Quality, Quantity, Timing and Distribution of Flows

# Oysters

- Oysters in the Caloosahatchee River Estuary actively spawn when freshwater releases and watershed runoff are at their peak and larvae are flushed to downstream locations and settle.
- During the winter months, juvenile mortality increases due to predation as a result of elevated salinity.
- Low salinities in the St. Lucie Estuary during late summer 2008 resulted in widespread oyster mortality; however, with an increase in salinity by November, new recruits exhibited rapid growth.
- The recent drought indicated that oyster predation induced by sustained higher salinities may be a substantial stressor.

# Submerged Aquatic Vegetation

- In the upper Caloosahatchee River Estuary, high salinity conditions adversely impacted the historically-present freshwater tape grass (*Valisneria americana*).
- Adding freshwater to the estuaries during the dry season is necessary to increase recruitment and survival of tape grass in the Caloosahatchee Estuary.
- The St. Lucie Estuary was impacted by hurricanes and associated freshwater discharges in 2004 and 2005 that caused declines in coverage and density of seagrasses.

# Benthic Fauna

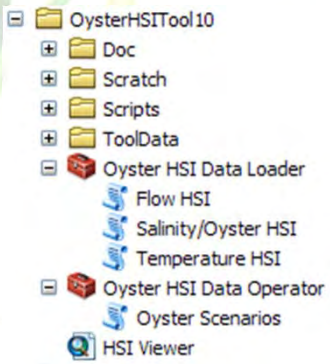
- In the St. Lucie Estuary, benthic invertebrates are used to tease out effects of natural climactic events from those related to human impacts.
- Sedentary and long lived, benthic invertebrates have a strong relationship between the seasonal freshwater inflow and species richness and individual abundance.
- High freshwater pulses through the St. Lucie estuary from tropical storms resulted in a decline in abundance and diversity of benthic invertebrates with a lag in recovery of about a year.

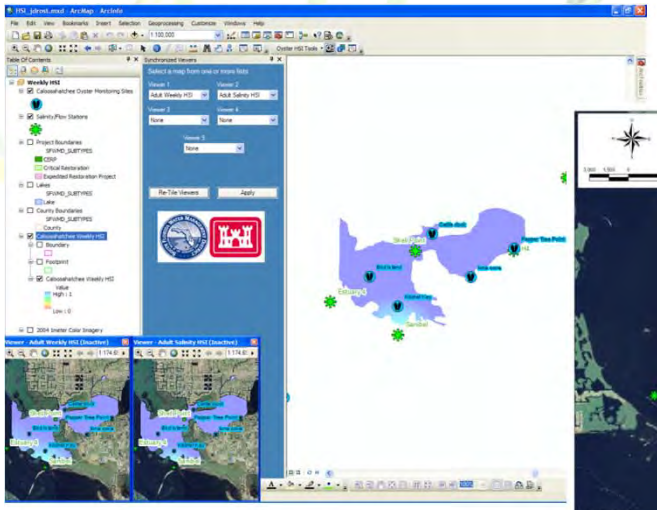
# New and Developing Tools

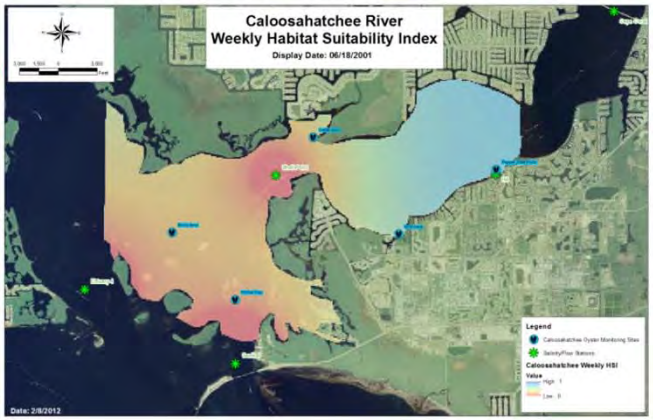
# Geographic Information System (GIS) Technology

## Oyster Habitat Suitability Index (HSI)

- ★ Utilize specific data gathered at collection stations of an estuary
  - Salinity, Flow, and Water Temperature
- ★ Load collected data into a centralized database
- ★ Process data to create HSI values of the oyster species per week
- ★ View HSI values of oyster species over time
- ★ Provide user with the ability to manipulate data for planning purposes



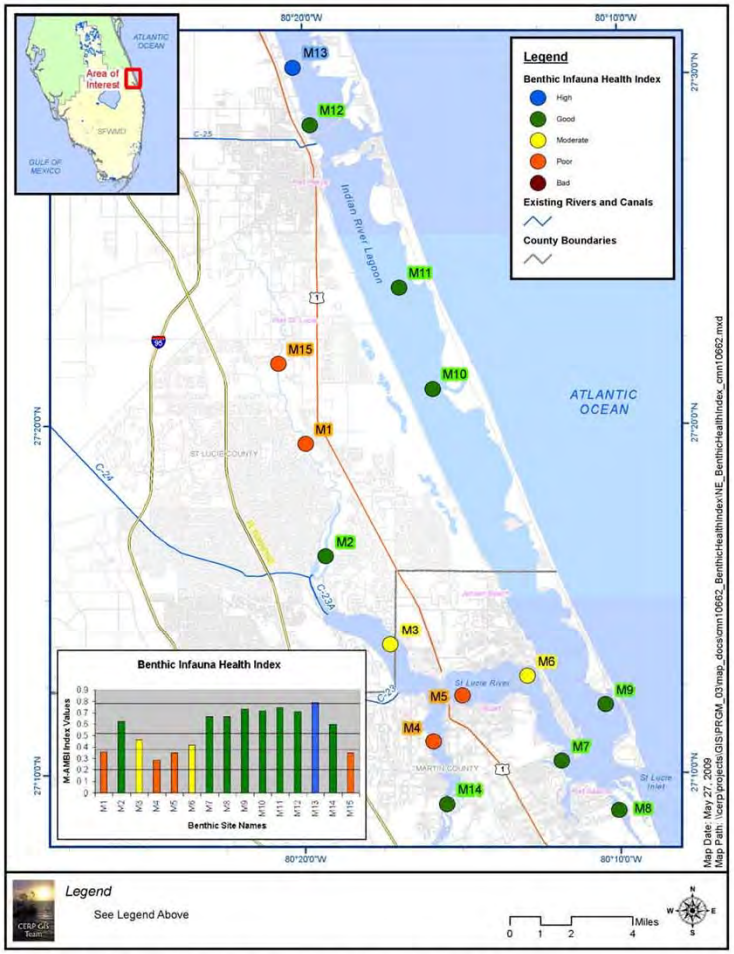


# Marine Biotic Index

- AZTI's Marine Biotic Index (AMBI) and Multivariate-AMBI (M-AMBI) use benthic invertebrates to assess the ecological integrity of estuaries.
- Florida species assigned to ecological groups and added to AMBI's species list in 2010.
- St. Lucie reference conditions established and AMBI and M-AMBI determined to be adequate tools to assess the benthic ecological status of subtropical lagoons and estuaries.
- Scientists, managers, and stakeholders easily understand this type of index, due to its intuitive nature.
- Reduce or summarize environmental conditions or quality to a number, which will form the basis for management decisions regarding environmental conditions.

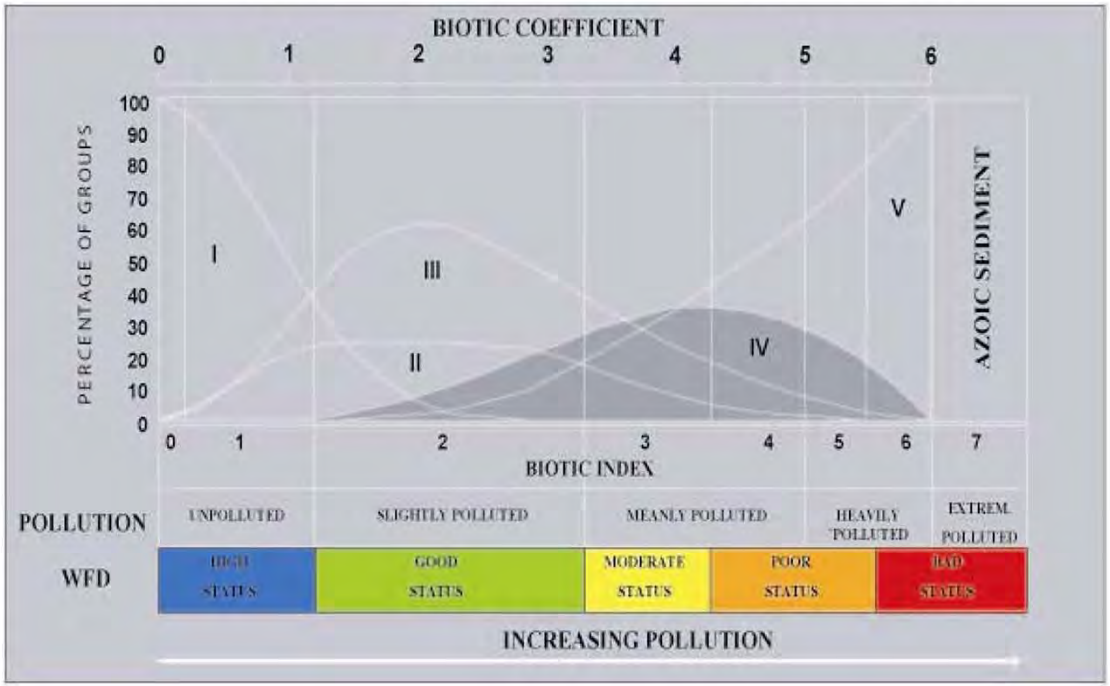
# Marine Biotic Index

Average M-AMBI scores for benthic macroinvertebrates in St. Lucie Estuary and Southern Indian River Lagoon




**Key** M-AMBI – ecological quality score based using AZTI's Marine Biotic Index

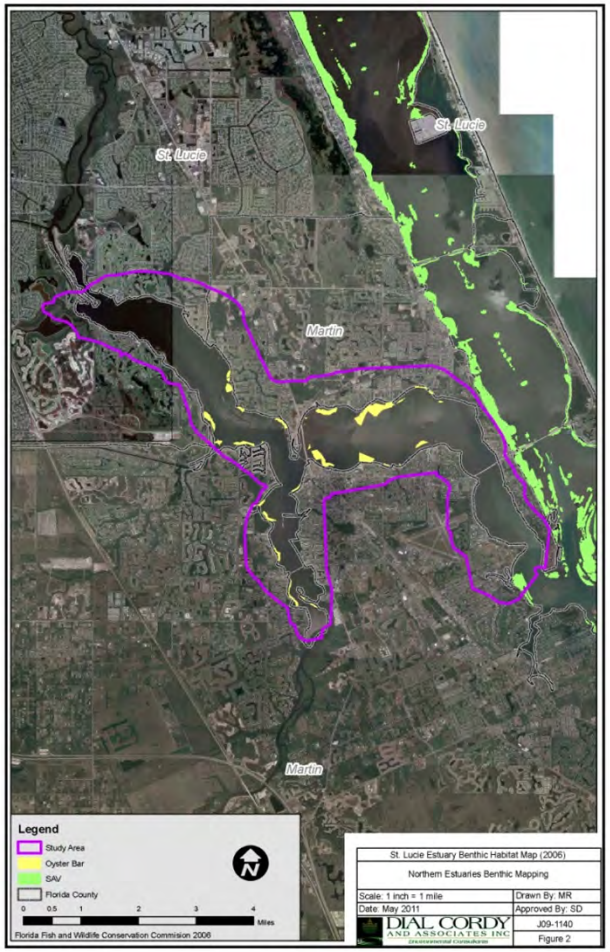
Ordination of benthic species into five ecological groups according to their sensitivity to an increasing pollution gradient (Bjora et al. 2000)




Borja, A., J. Franco and V. Perez. 2000. A marine biotic index to establish the ecological quality of soft-bottom benthos within European estuarine and coastal environments. Marine Pollution Bulletin 10(12):1100-1114.

# Benthic Mapping

2006

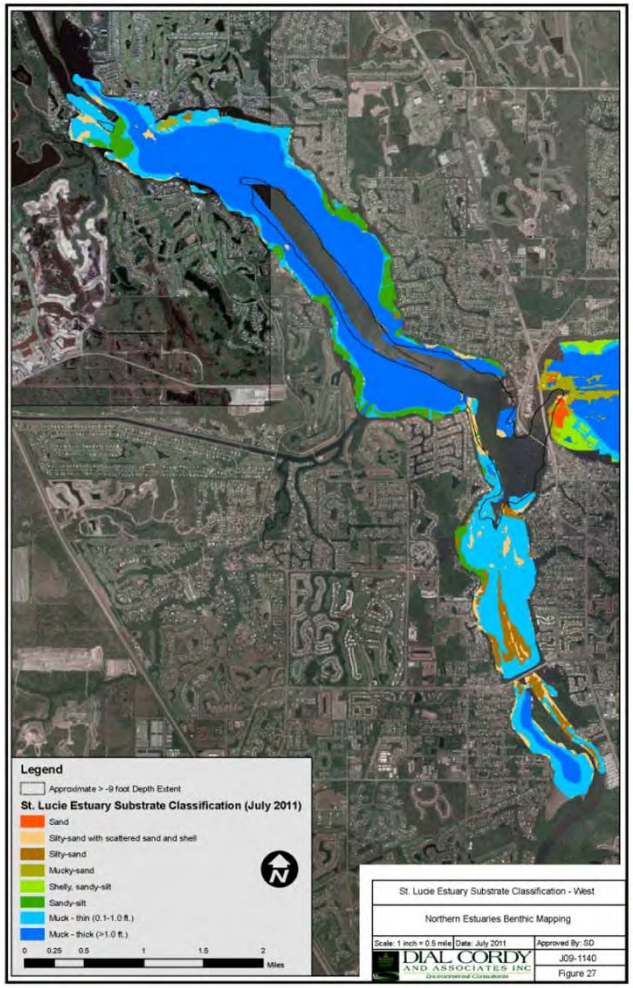


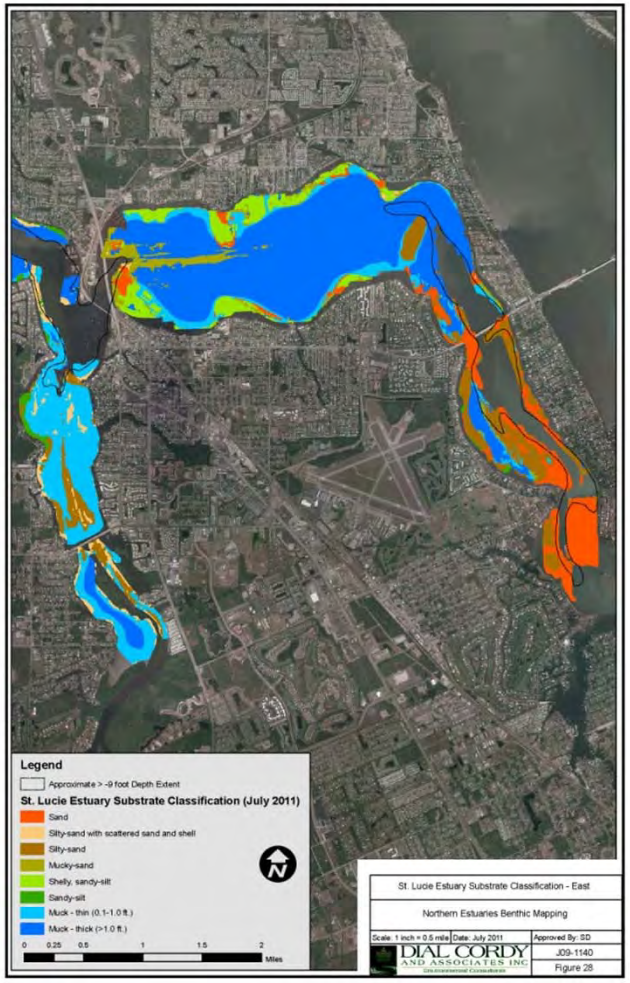

2011

2011

St. Lucie – Oyster and SAV mapping

# Benthic Mapping




St. Lucie – Substrate mapping

# Acknowledgements

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- ★ Aswani Volety - Oysters
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- ★ Melanie Parker - Oysters
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- ★ Peter Gottfried – SAV
- ★ Becky Robbins - SAV

# Questions?