

Achieving Ecological Restoration: Consideration of factors influencing the success or failure of restoration efforts

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Background

- **SW Florida one of the fastest growing areas in the country.**
- **Watershed development, water management practices to accommodate development.**
- **Interruption of sheet flow, water releases regulated through weirs.**
- **Watershed management typified by large freshwater releases during wet (rainy) summer months and little or no releases during dry winter months.**

Background

- **Historical records indicate that oysters were once significant features in the Caloosahatchee estuary, however, recent records show ecological impairment.**
- **Unknown questions: reproduction, potential sites for restoration, interaction between *Perkinsus marinus* and salinity, temperature, frequency, duration and quantity of freshwater releases...**
- **Understand the system!**

Healthy oyster reefs



Healthy oyster reefs





Healthy oyster reefs

NOT in the Caloosahatchee Estuary

Why aren't the oysters there?

- One cannot go by historical accounts when restoring oyster reefs. Need to know the limiting factors.
- Larval recruitment (Shell strings).
- Water quality (Salinity, DO, contaminants).
- Suitable substrate (Substrate firmness and quality).
- Diseases, predators (*Perkinsus marinus*, crustaceans, molluscs).
- Good growth, food (Juvenile growth).
- Water Flow / killing floods (Timing, Low salinity, larval flushing).

STUDY SITES

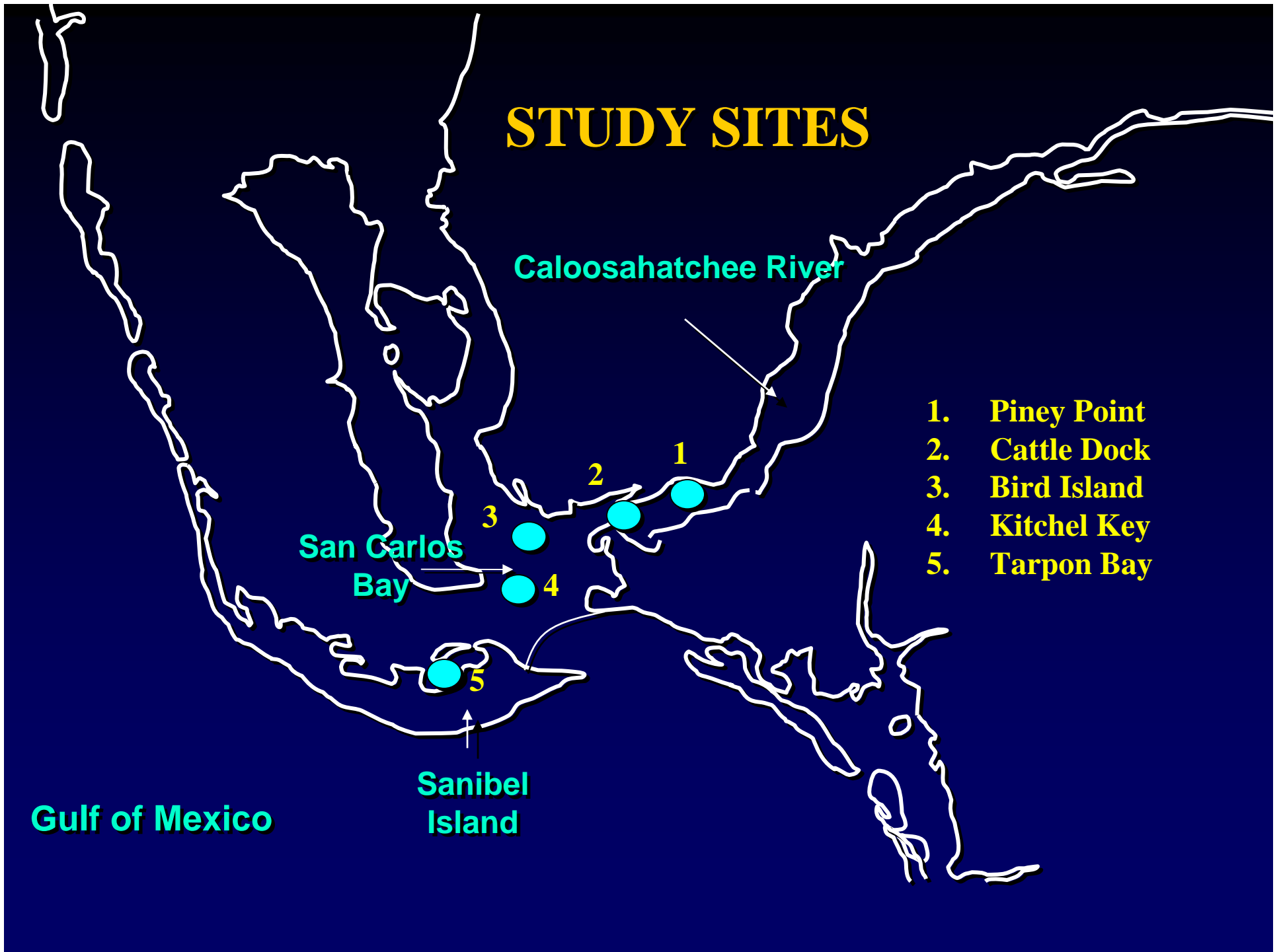
Caloosahatchee River

San Carlos Bay

Sanibel Island

Gulf of Mexico

1. Piney Point
2. Cattle Dock
3. Bird Island
4. Kitchel Key
5. Tarpon Bay

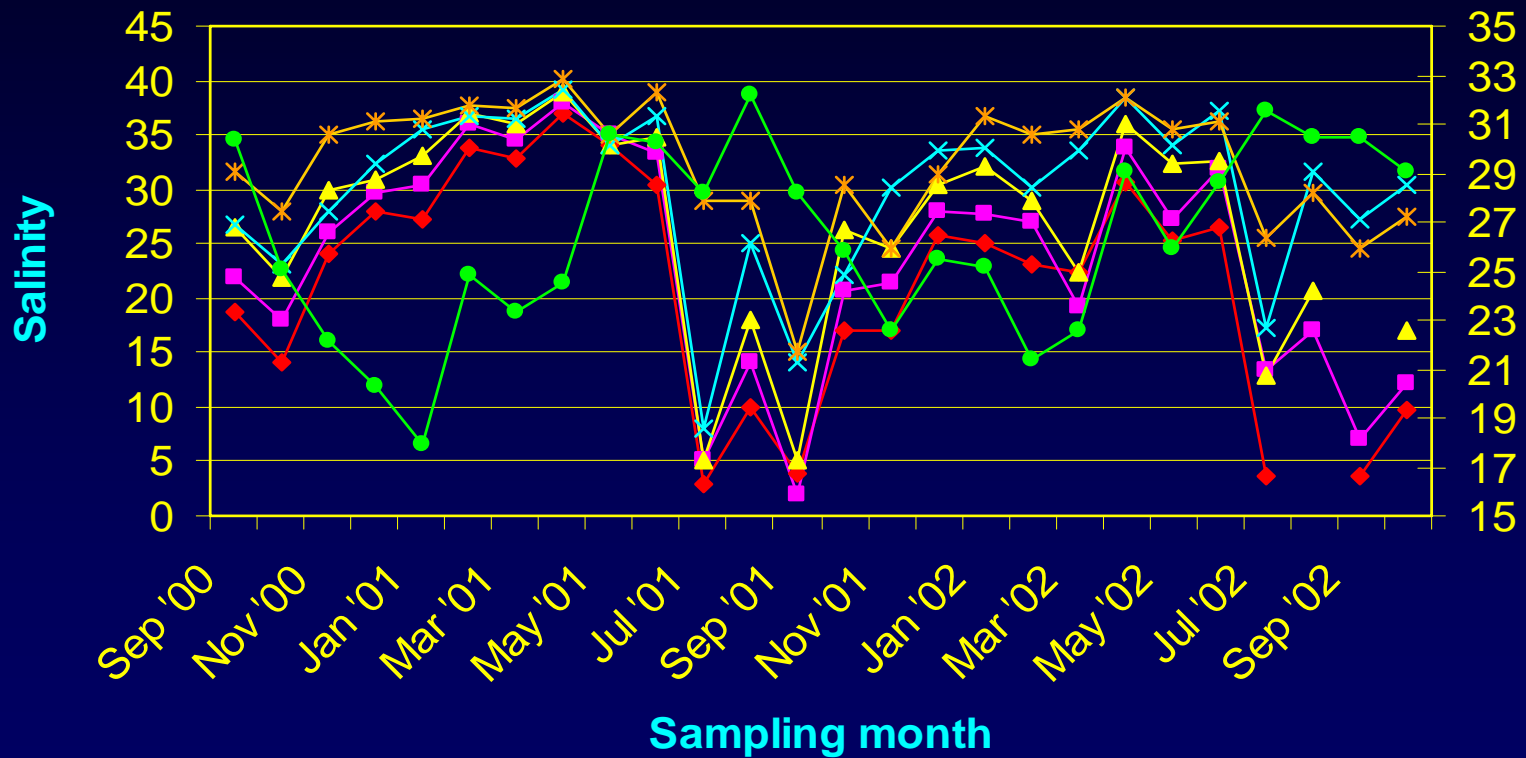


Oyster Responses

(e.g. Limiting Factors)

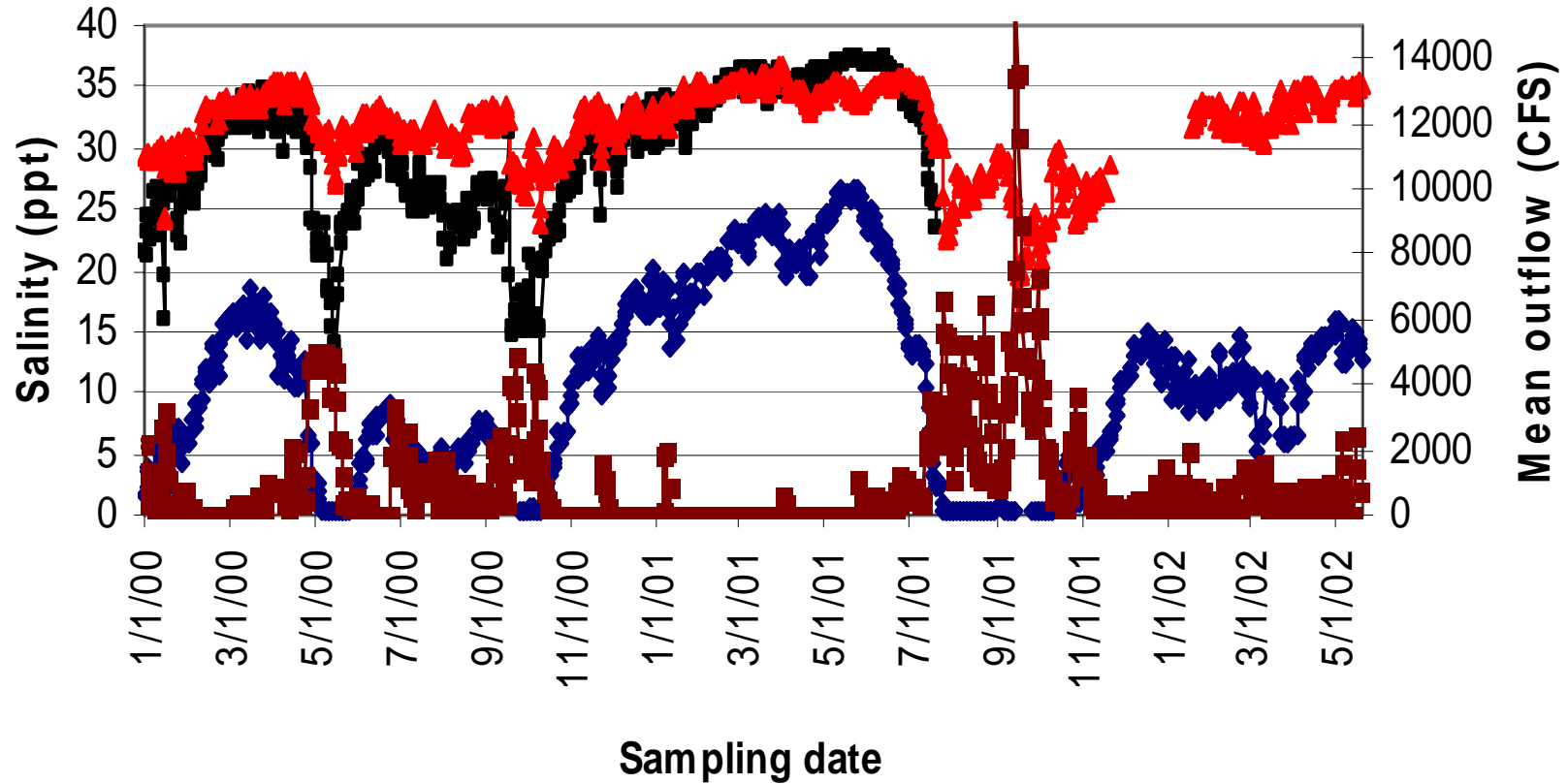
- Flows, salinities.
- Growth – juvenile growth, condition index.
- Survival – juvenile survival, adult distribution and density, disease.
- Reproduction – recruitment, gonadal condition.

Temperature - Salinity



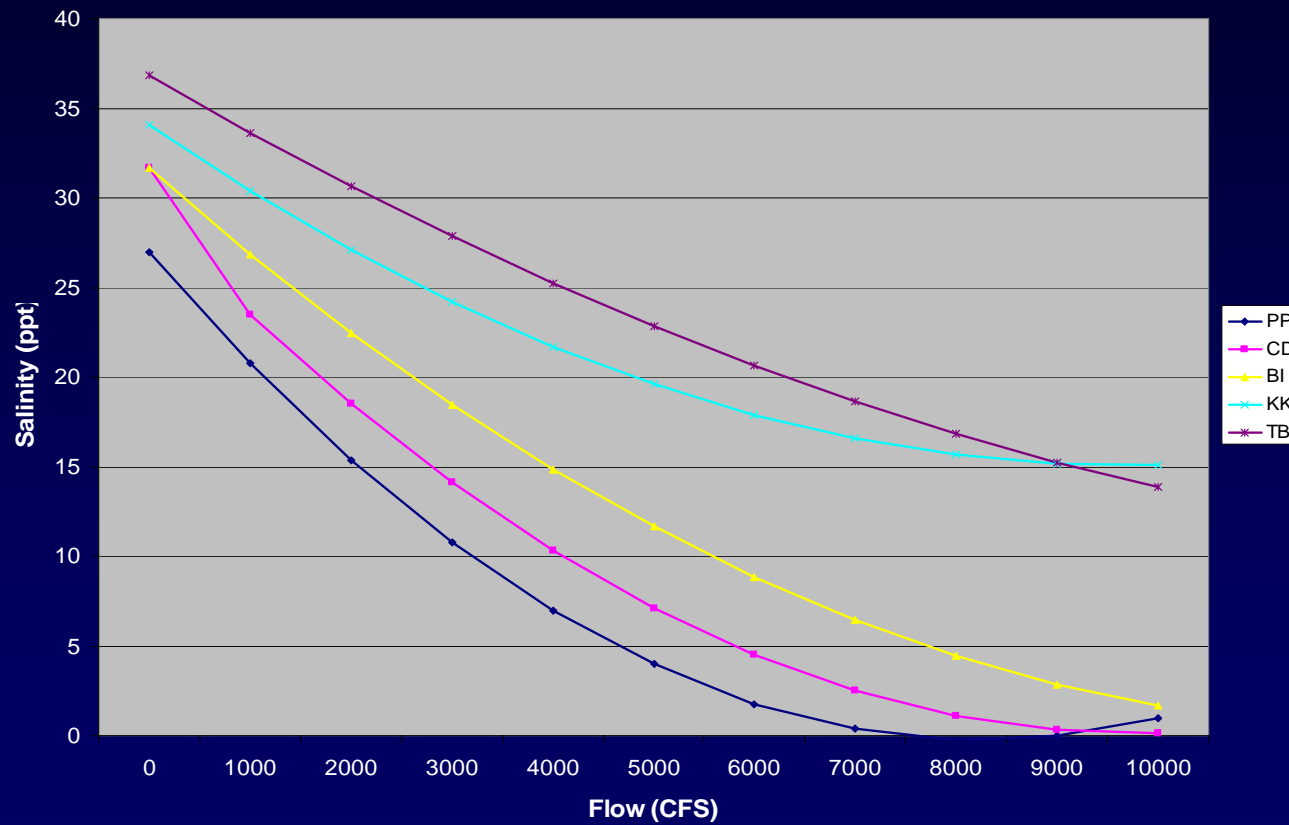
- ◆ Piney Point
- Cattle Dock
- ▲ Bird Island
- ✕ Kitchel Key
- * Tarpon Bay
- Temp

Water Flow vs. Salinity



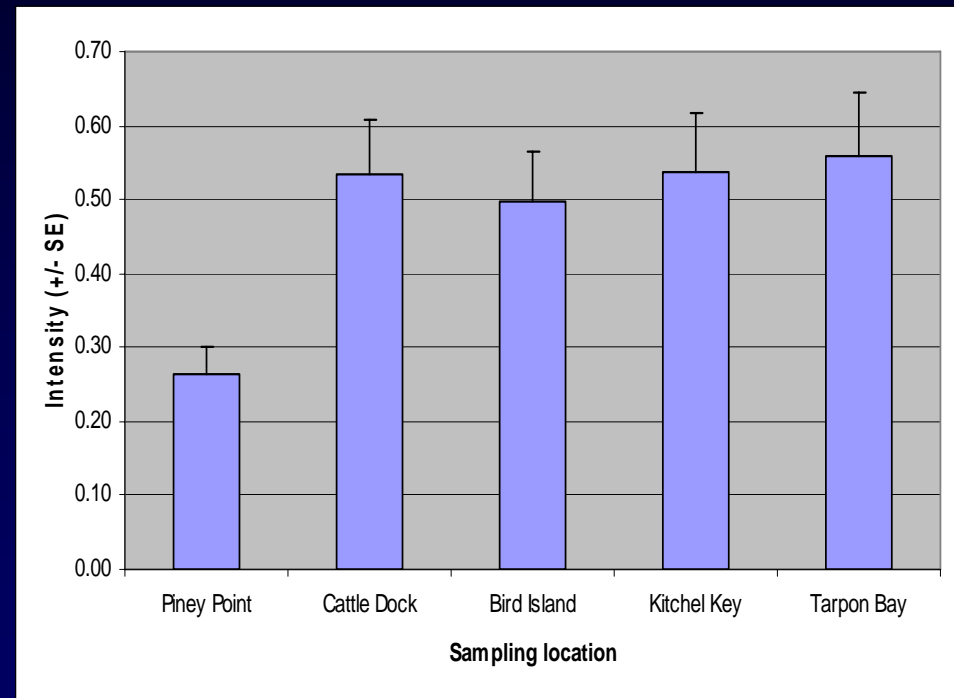
—◆— Ft. Myers —■— Shell Point —▲— Sanibel —■— S79 flow

Flow vs. Salinity



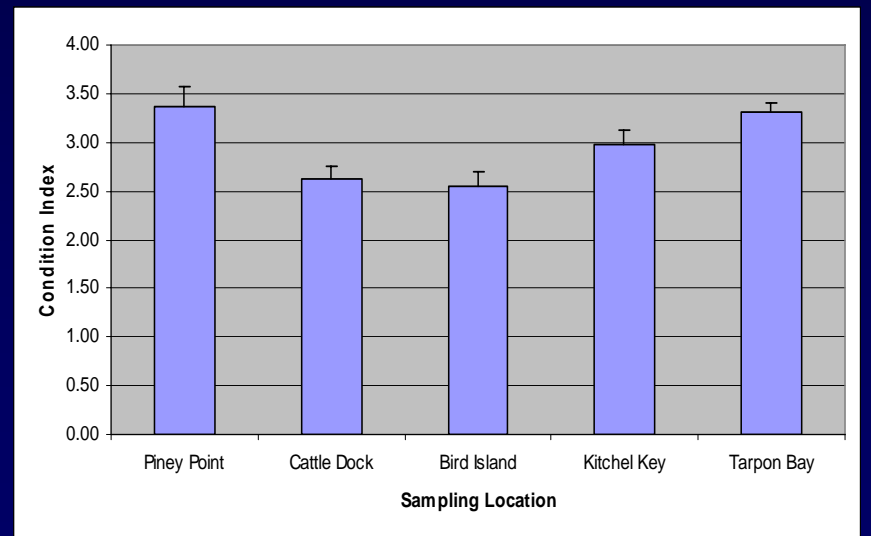
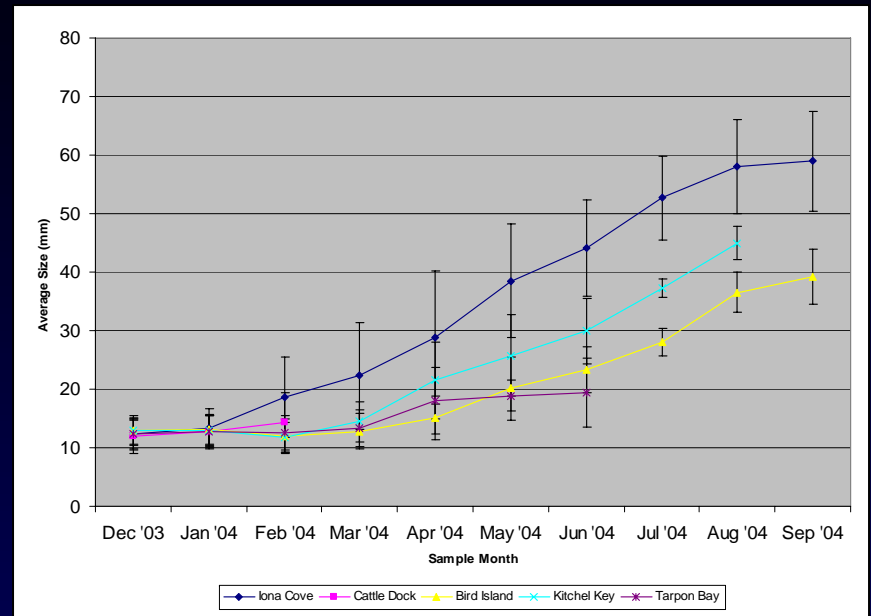
Survival: Disease

Juvenile survival
and disease analyses
yield results related
to short-term
survival



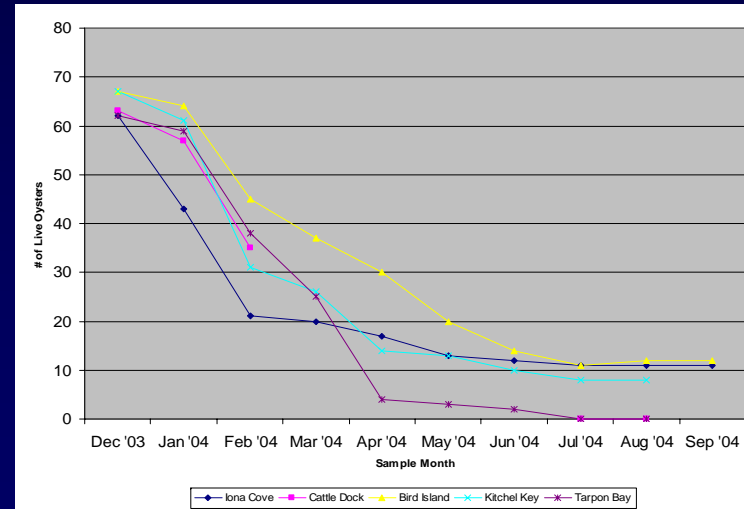
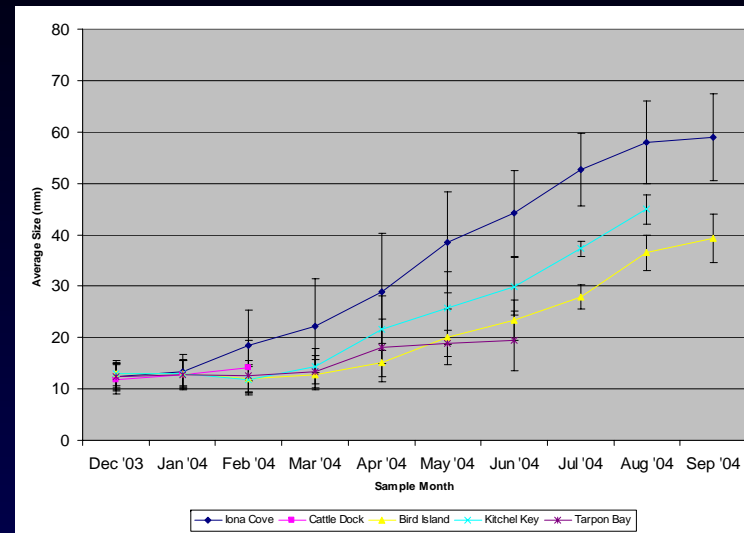
Growth & CI

Quantify the ability of an area to support oyster growth (i.e., suitable water quality, food availability). CI quantifies the overall health.



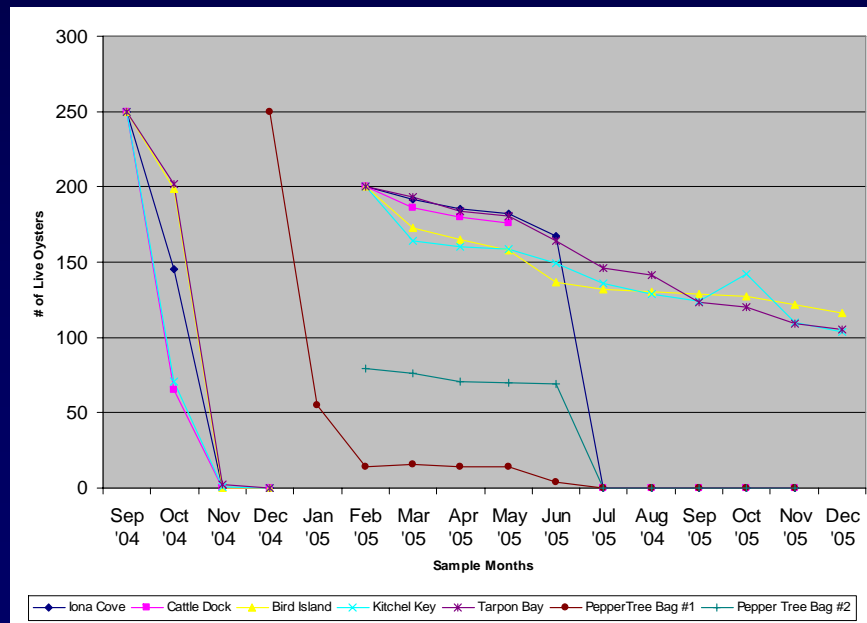
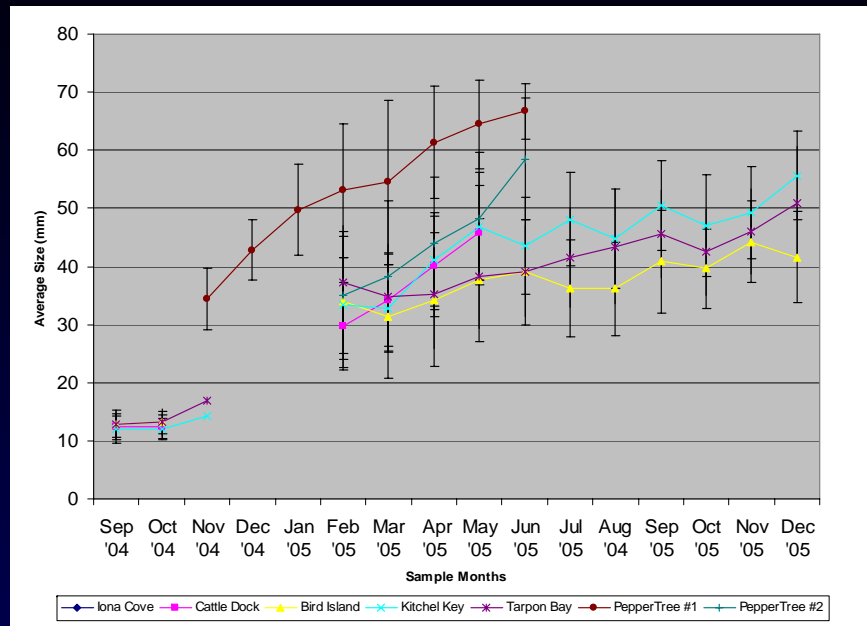
Survival - Growth

Juvenile survival and growth analyses yield results related to short-term survival and long term potential to support oyster reefs



Survival - Growth

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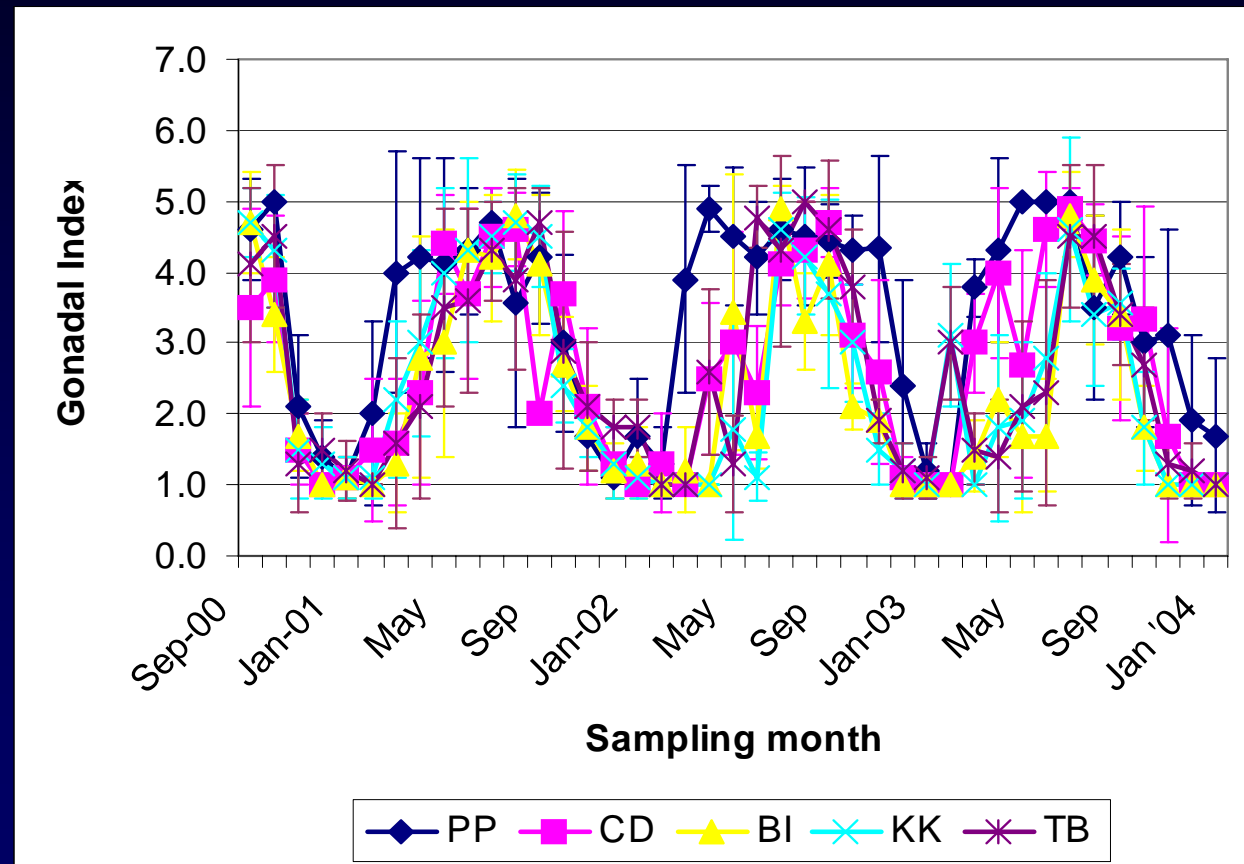


Reproduction

- Effects of water quality and substrate on long-term viability of reef
- Gonadal index: reproductive stage and qualitative estimate of fecundity
- Recruitment: estimates for next year class
- Management implications: timing of freshwater inflows

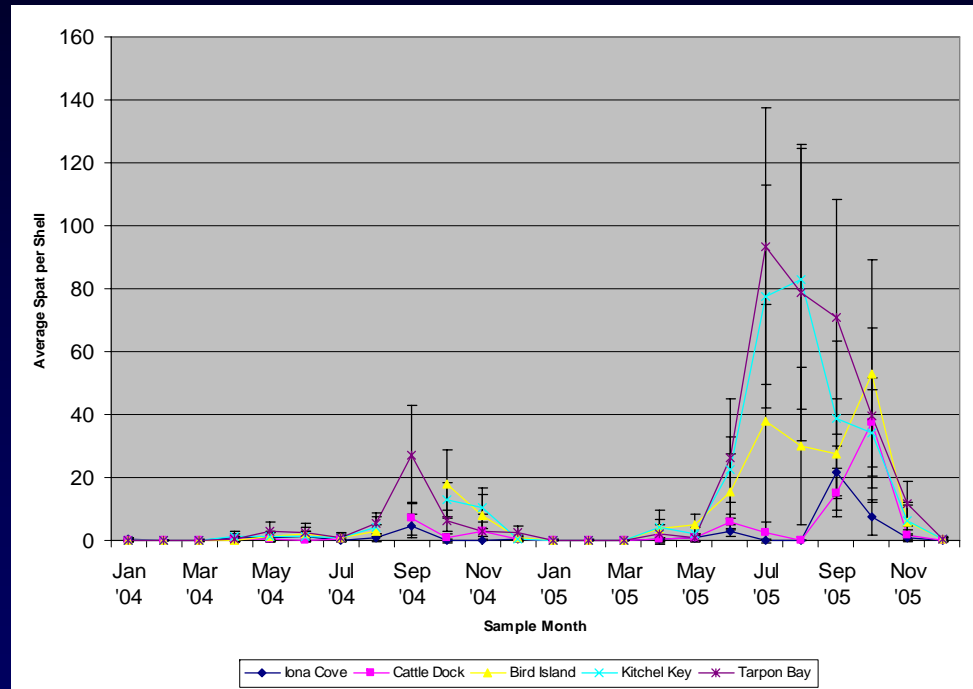
Reproduction: Gonadal Index

- Implications for freshwater releases - timing

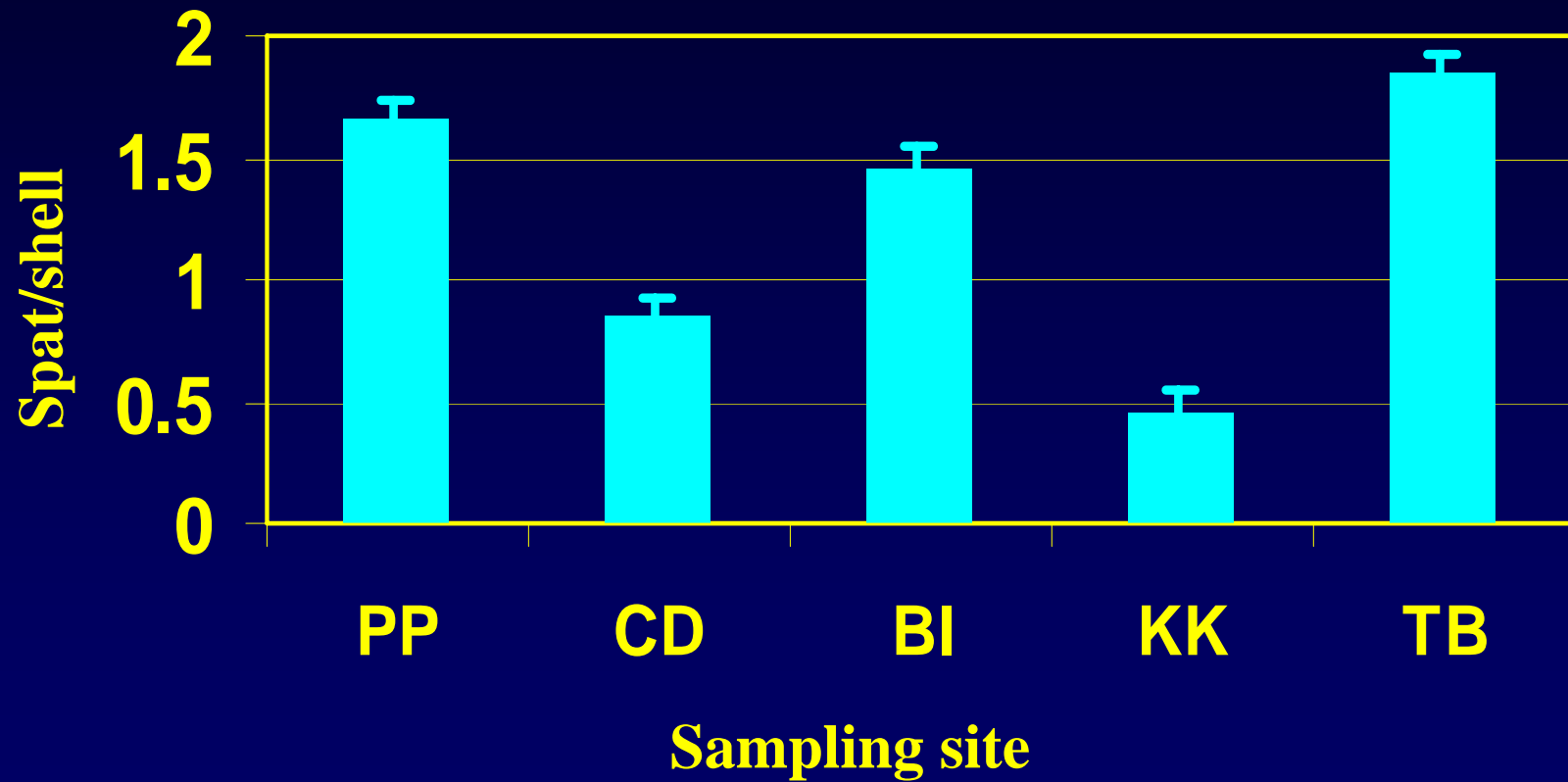


Reproduction: Recruitment

- Oysters reproduce between May – October.
- During high flows oyster spat are flushed downstream.



Spat Recruitment



Spat Recruitment



Reef Restoration

Select areas that have:

- **Suitable substrate (at least create hard substrate)**
- **Low disease intensity**
- **Good spat recruitment**
- **Good growth rate**
- **Low # of killing floods (suitable salinity)**
- **Low predation**
- **Support high diversity / biomass of organisms**









Needs substrate!





Despite a an year with heavy rainfall, and high amounts of freshwater discharges (and unfavorable salinities), oyster spat that recruited towards the end of the spawning season survived and grew on constructed reefs

Summary

- **Freshwater releases from Lake Okeechobee decrease salinities at the samples sites by 3-6 ppt.**
- **Juvenile oysters at upstream locations with intermediate salinities showed higher growth, with the exception of Cattle Dock, a location that receives output from Cape Coral (water quality?)**
- **Oysters in the Caloosahatchee Estuary spawn continuously between April – October. Limit freshwater flows during this time.**

Summary

- **High levels of freshwater flows during summer (spawning) months may flush out oyster larvae or reduce salinities to unfavorable levels.**
- **Low salinities (< 10 ppt) during year 2 at upstream locations resulted in poor spat recruitment compared to downstream locations that experienced intermediate salinities.**
- **Flows between 500 – 3000 CFS from Lake Okeechobee will result in optimum salinities at sampling locations (15 – 25 ppt).**

Summary

- **Decide on what is being restored / targeted and examine the water quality requirements.**
- **We identified water quality targets and specific sites that should sustain, enhance and restore oyster reefs in the Caloosahatchee estuary.**
- **Working with resource managers about the timing, quantity and duration of flows. Results are currently being used in setting minimum flows and levels.**
- **Pilot reefs are being built at targeted upstream locations.**

Acknowledgements

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