Slow Bivalves at Work: the role of filter feeders in the restoration of the Indian River Lagoon

Dr. Susan Laramore, FAU HBOI
Emily Dark, FDEP
Dr. Jessica Lunt SMS
Anne Birch TNC

Jeff Beal, FWC MESS
Dr. Melanie Parker FWRI
Dr. Todd Osborne UF
Dr. Jose Nunez UF
Leroy Creswell UF
Dr. Melanie Parker FWRI
Dr. Jose Nunez UF
Leroy Creswell UF
Pure Shellfishness

Average annual catch 1995–2004 (t*1000)
The IRL Shellfish Cultchure
Indian River Lagoon

- 156-mile estuary
- 3 distinct waterbodies
- 5 inlets
- Temperate/subtropical
- Site-specific micro-climates
Hysteresis-HABs

Pyrodinium bahamense

Takayama tasmanica

Aureoumbra lagunensis

Other?

Banana River; 8/28/13; photo by D. Scheidt

IRL across from Turkey Creek; 9/20/13; photo by T. Miller

Mouth Banana Creek; 9/6/13; photo by T. Miller

IRL east shore by 528 Cswy; 9/6/13; photo by T. Miller
Southern IRL
created vs. natural reefs

- Created reefs similar for shell height/live cover in 1 year
- Invertebrate biomass/species assemblages/abundances unique
- Snapping shrimp sound production as proxy for invert populations; similar except when salinity declines

Parker and Geiger 2012
Oyster Reefs of Sebastian/St. Lucie/Loxahatchee Rivers and Lake Worth Lagoon

• Significant differences among estuaries for shell height (live, relic), live cover, reef size/density
• Significant dynamic changes within estuaries over time (volume)

Sebastian Reef 470

Gambordella et al. 2007

Net gain 2006-2011
Net loss 2006-2011
Oyster Health at the organismal scale?
Goals and Objectives

• Conduct the first lagoon-wide oyster (organismal) health survey
• Compare natural and restored reefs over latitude (three regions)
• Compare natural and restored reefs over seasons
  Summer; Fall; Winter/Spring (2016-17)

• Intertidal reefs only
• Collected 26-30 adult (>=48mm) oysters
Hypotheses

• Ho: null hypothesis of no difference between natural vs. restored reefs
• Ho: null hypothesis of no difference among regions (latitude)
• Ho: null hypothesis of no difference among seasons
Methods

- Morphometrics (length, height, shell weight, meat weight)
- Physiological condition (Howard et al. 2004)
- Health of digestive system (Mackin scale)
- Sex determination
- Prevalence and intensity of *Perkinsus marinus* (Dermo)
- Presence of *Bonamia* sp.
• Randomly chosen
• 3 natural
• 3 restored (8–10yrs)
• Paired
• 3 natural
• 4 restored (1.5-4yrs)
• Paired
• 3 natural
• 2 restored (7-8yrs)
Size Frequency

All sites/seasons shell height mm

north  central  south

Kruskal Wallis; Mann Whitney U Tests
PERMANOVA Results

• Entire dataset: most factors and interactions significant* (latitude)
• Analyzed by Latitude

  o Season       North*, Central*, South*
  o Reef Type    North*, Central*, South*

  o Season x Reef Type   Central*
    ▪ Pairwise interactions among restored reefs by season *
      and between natural and restored reefs*
ANOSIM Results

• Analyzed by Latitude
  
  o Season       North*, Central*, South*
  
  o Reef Type    N.S.

  o Season x Reef Type  Central*
Principle Coordinates Analysis-Central

2 principle axes:
- Season 63%/52%
- Reef Type 67%/50%
- SeasonxReef 2.5-50%
Physiological Condition

Dry Meat Wt (g) by Physio Cond

Shell Height mm by Physio cond

Kruskal Wallis; Mann Whitney U Tests

(Howard et al. 2004)
Seasonal Sex Ratios in C. virginica in the IRL

- **Summer:**
  - North-N: Hermaphrodite
  - North-R: Indeterminate
  - Central-N: Males
  - Central-R: Females
  - South-N: Hermaphrodite
  - South-R: Indeterminate

- **Fall:**
  - North-N: Hermaphrodite
  - North-R: Indeterminate
  - Central-N: Males
  - Central-R: Females
  - South-N: Hermaphrodite
  - South-R: Indeterminate

- **Spring:**
  - North-N: Hermaphrodite
  - North-R: Indeterminate
  - Central-N: Males
  - Central-R: Females
  - South-N: Hermaphrodite
  - South-R: Indeterminate

Legend:
- Hermaphrodite
- Indeterminate
- Males
- Females
Seasonal Digestive Tubule Atrophy in *C. Virginica* in the IRL

![Bar chart showing seasonal digestive tubule atrophy in different regions of *C. Virginica* in the IRL. The chart compares the average digestive tubule atrophy during summer, fall, and spring seasons for regions North-N, North-R, Central-N, Central-R, South-N, and South-R.](chart.png)
Dermo (*Perkinsus* sp.) Prevalence
Dermo (*Perkinsus* sp.) Intensity

**Light/Moderate**
*Bonamia* sp. (Haplosporiid)
Study Summary

- Latitude (region) important
- Season important
- Natural and restored reefs similar except in Central region
- Morphometrics ≠ physiological condition
- Disease/parasites/pests/sex less important
- Confounding factors
  - Reef age
  - Restoration/creation technique
Reef Temperature

Salinity, recruitment, other hydrologic effects....
Restoring a macrophyte-based system

Booth and Heck 2009
• Develop a filter feeder management plan
• Functional reefs as defined by Performance Measures
• HSI models for site selection
• Relationship with seagrass goals
• Segmented approach
IRL Hard Clam Harvest Landings 1960-2000

Arnold et al. 2002
IRL Hard Clam Restoration

- Survey extant population
- Collect resilient brood stock
- Assess physiology/genetics
- Culture and outplant
- Fate track
Cocoa

Oysters ~15 gallons/day

Clams ~4 gallons/day

Hopeful Monsters

Canaveral National Seashore

Oysters ~ 18 gallons/day

Mytella ~33 gallons/day

Jacksonville

Ischadium ~6 - 19 gallons/day

Mytella ~12 - 31 gallons/day

Perna ~16 - 20 gallons/day

St Lucie River

Oysters ~9 - 15 gallons/day

Ischadium ~9 - 15 gallons/day

Lucinids?

Questions

?!