Florida Department of Environmental Protection

Investigation into the health of oysters (*Crassostrea virginica)* in natural and restored reefs across a latitudinal gradient in the Indian River Lagoon (IRL), Florida

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Background

Marine Estuarine Habitat Restoration Monitoring and Assessment (MEHRMA) 2016-17 Project

- Oyster reef restoration in the Indian River Lagoon
  -Restore ecosystem services
  - Structure and **function** as natural reef

- Monitoring and mapping of existing natural reefs and restoration projects

- Density, alive/dead, reef topography, settlement, growth, associated faunal communities

- **Functioning:** What makes a functioning reef?
  - "Healthy" oysters

- Growth, reproduction, adaptation/survival

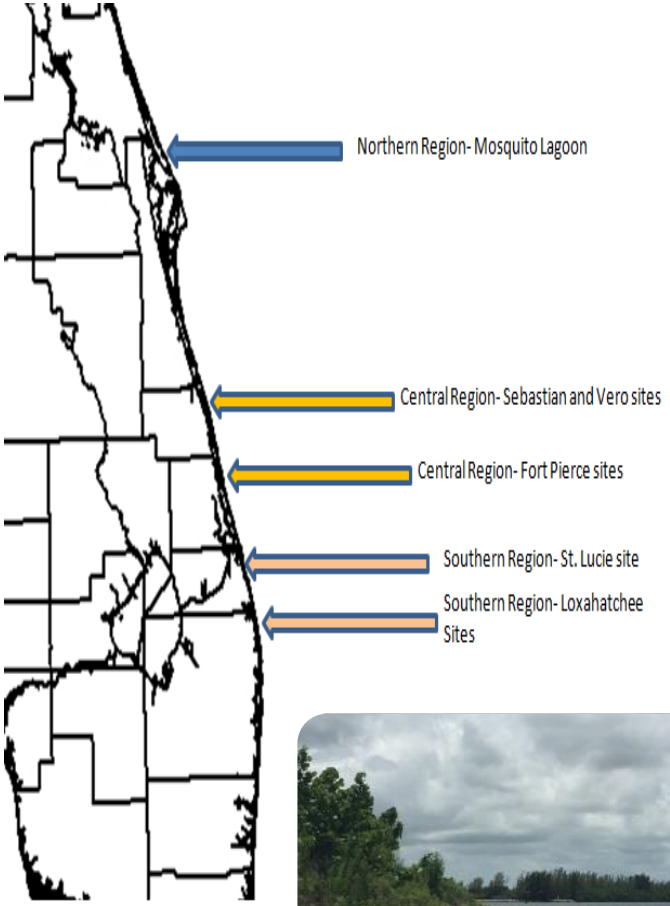
Goals & Objectives

- Examine the health of oysters in natural and restored reefs **throughout** the Indian River Lagoon

Vs.

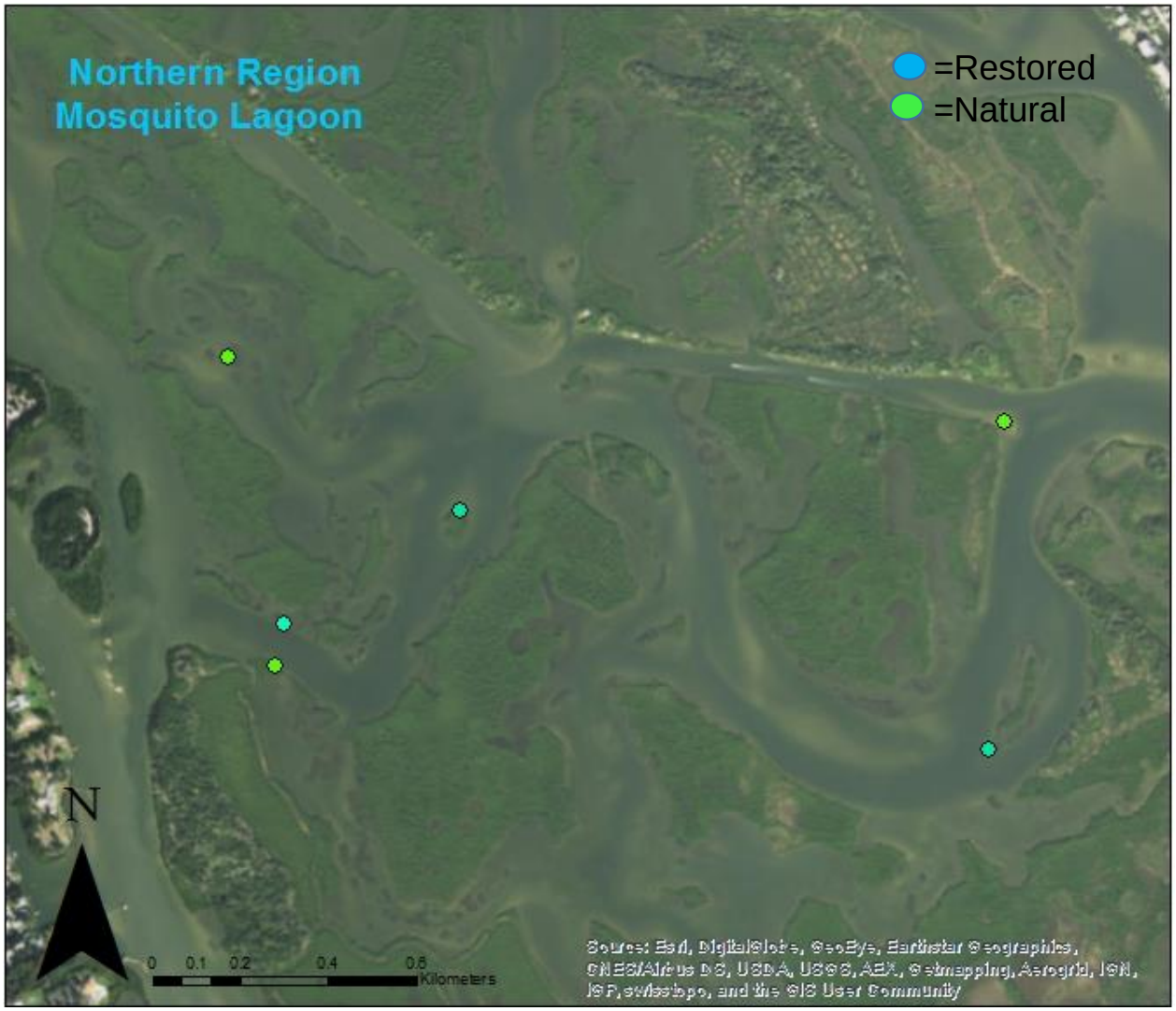
- Do we see difference between restored and natural reefs?
- Do we see regional/seasonal differences?
- Do we see difference between restored reefs of different ages?

Methods

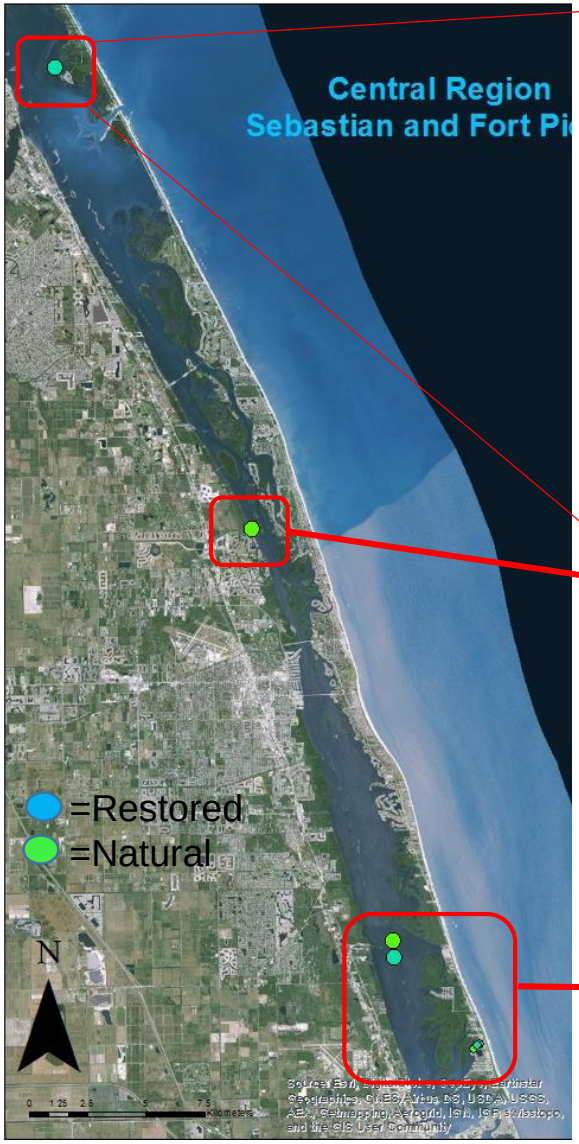


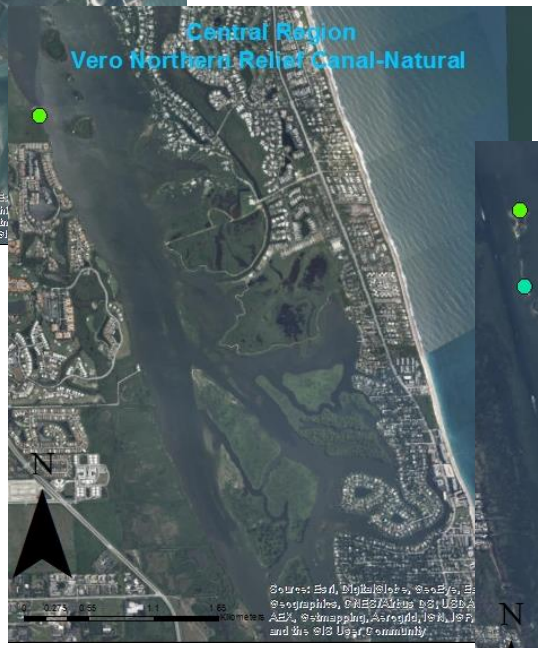
- Three Sampling efforts:
  Summer 2016, Fall 2016, and Winter/Spring 2017
- Three Regions: North (Mosquito Lagoon), Central (Sebastian-Fort Pierce), South (St. Lucie, Loxahatchee)
- Three Natural and three Restored reefs per region
- Thirty adult oysters per reef

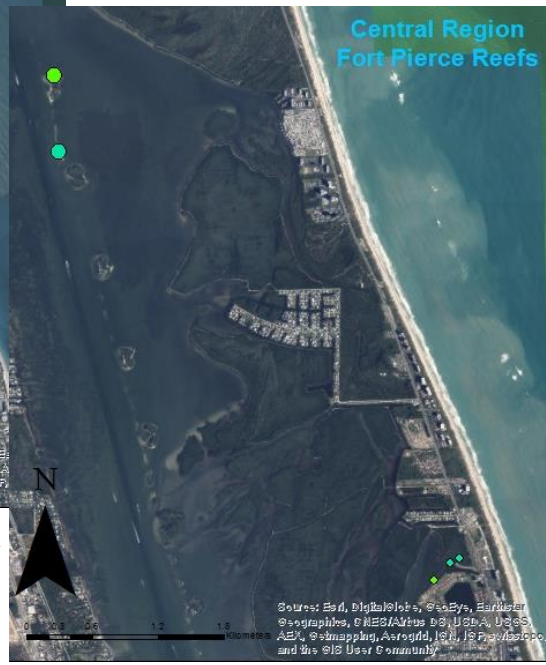
Northern Reefs



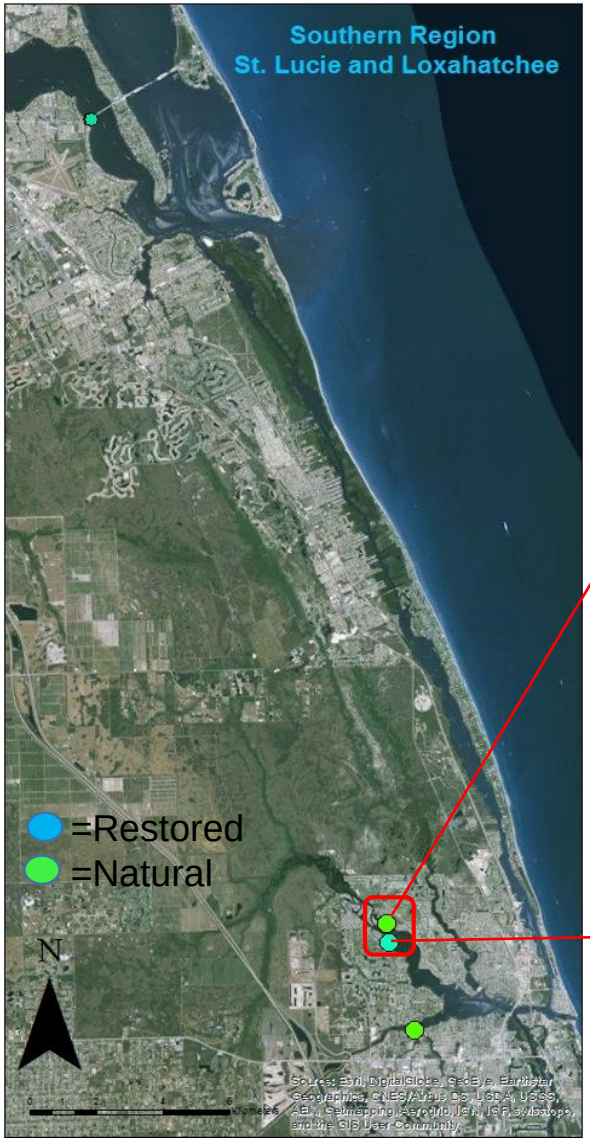
Central Reefs







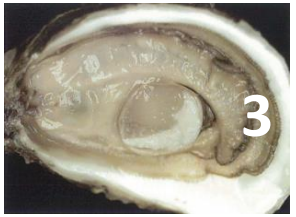
Southern Reefs

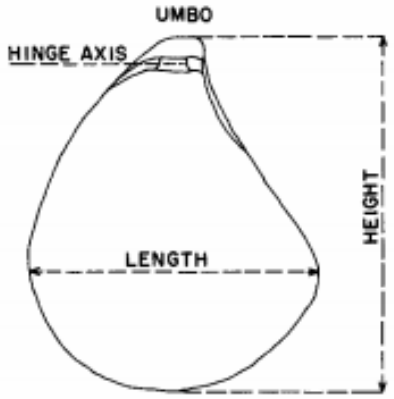


Methods

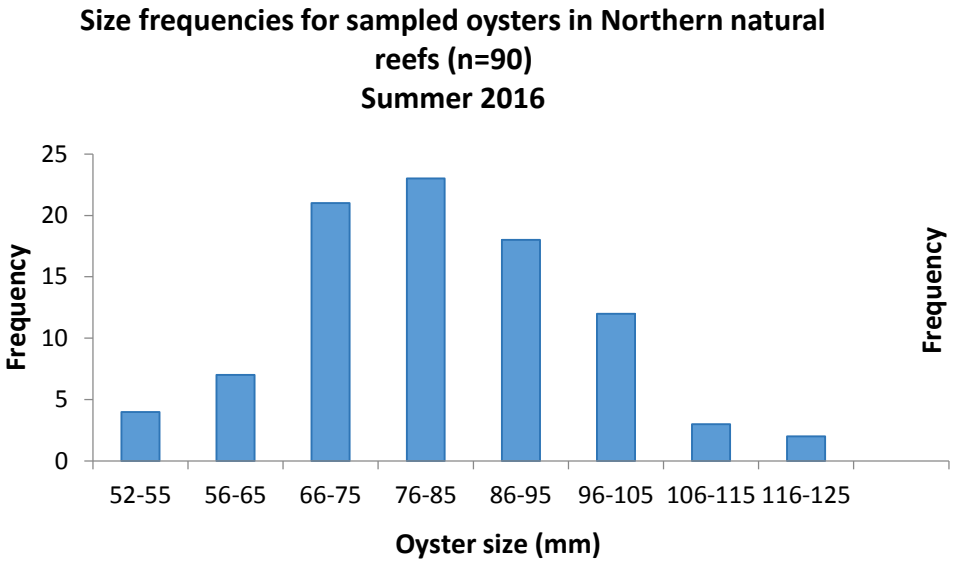
- Size measurements (length, height, width, shell weight, meat weight)
- Physiological condition (Ranking based on Howard et al. 2004)
- Health of digestive system
- Sex determination
- Presence of abnormalities, predators, pests/parasites (mud blisters, pea crabs, boring sponge, *Nematopsis spp.*, *Tylocephalum spp.*, *Bucephalus spp.*, trematodes)
- Prevalence and intensity of *Perkinsus marinus*
- Presence of Bonamia

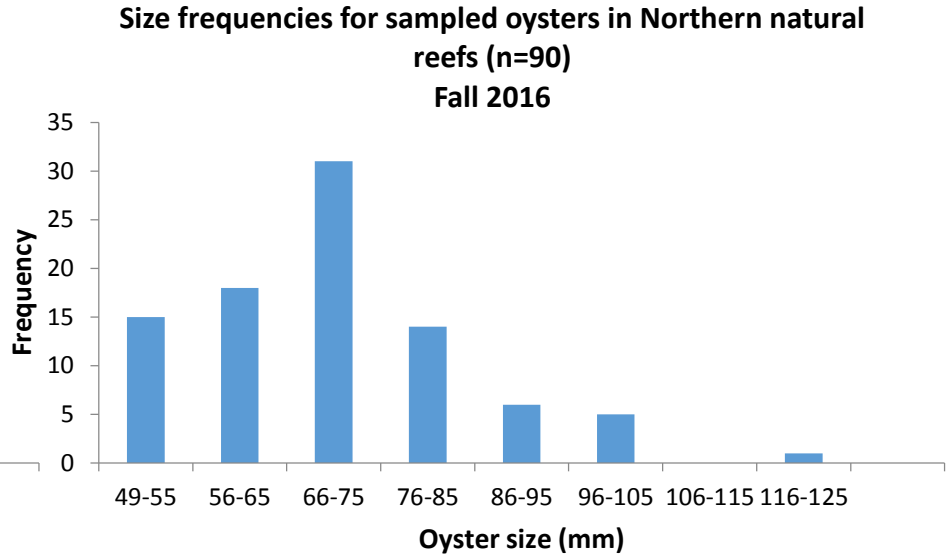
Howard et al. 2004)

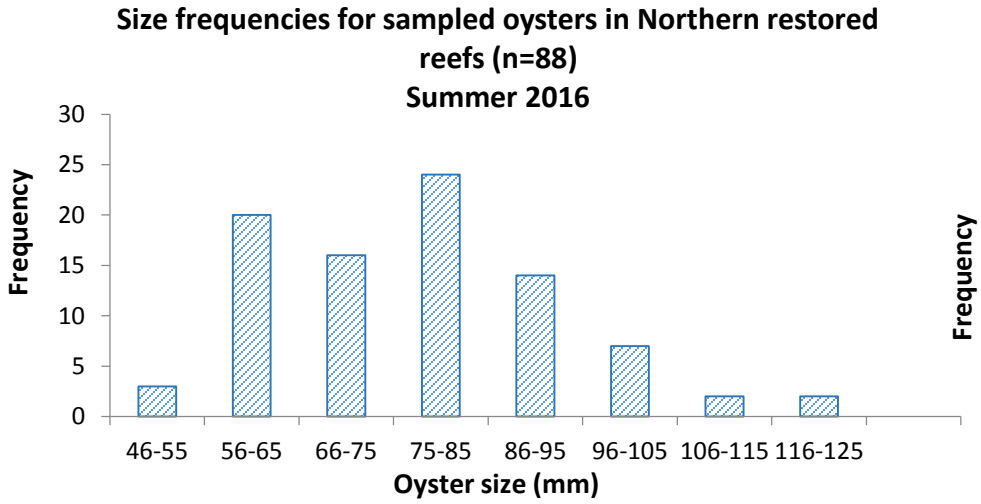


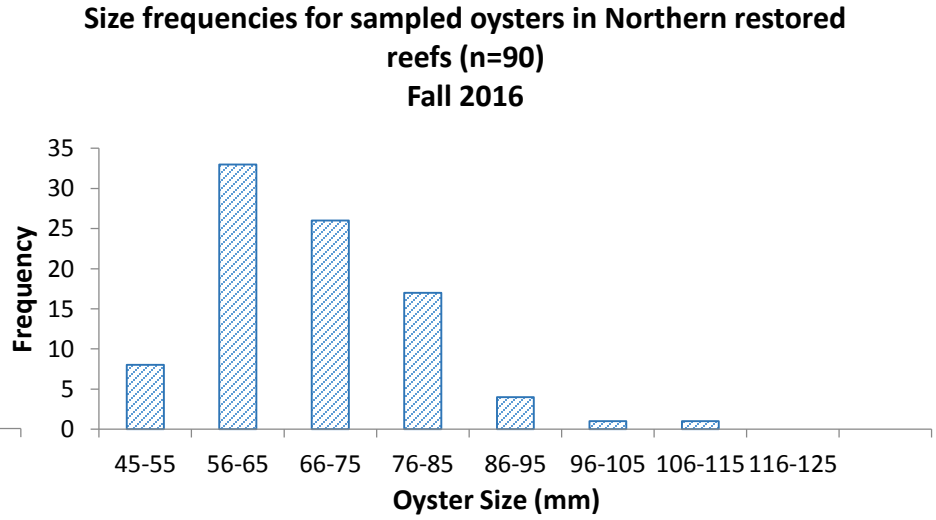


Size frequencies: North

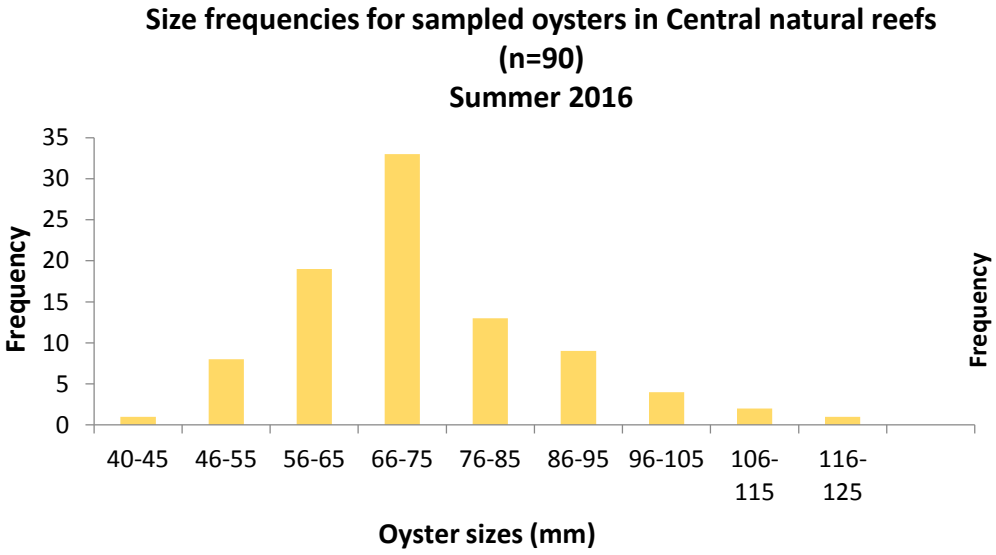


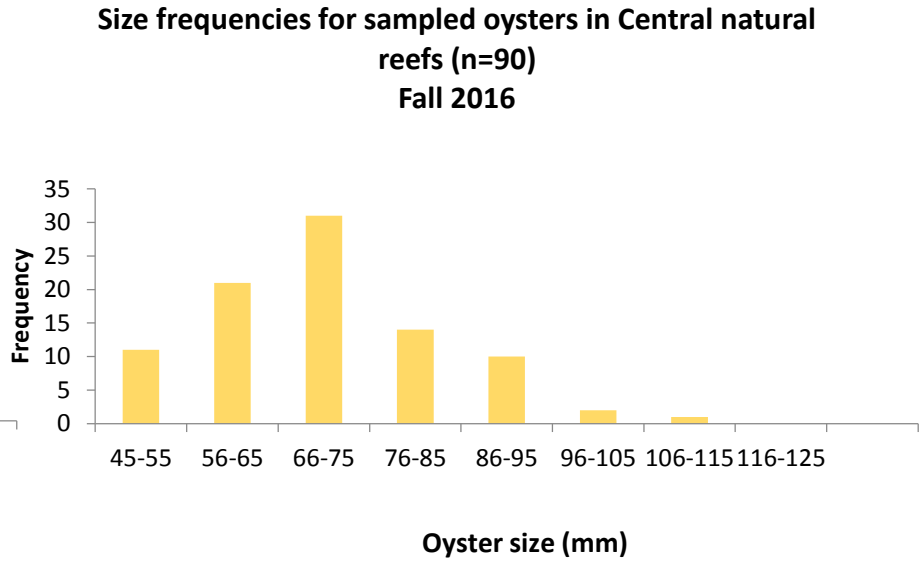


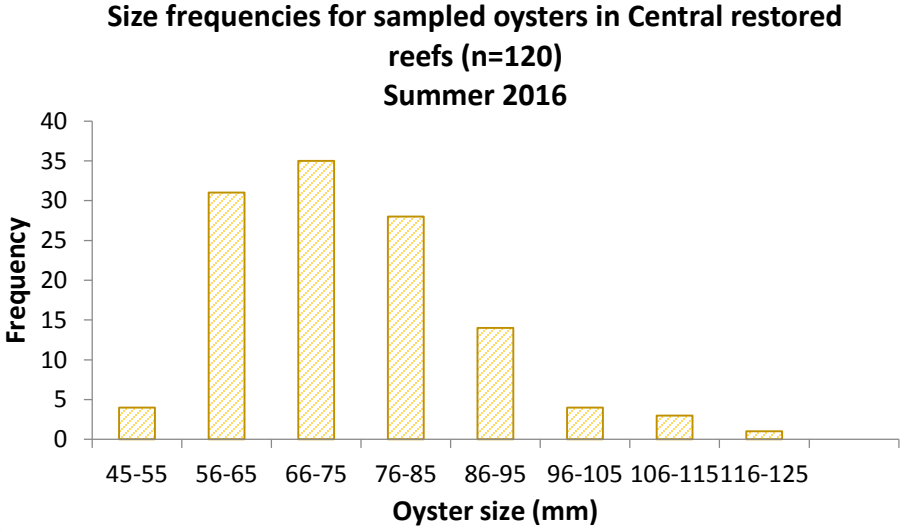


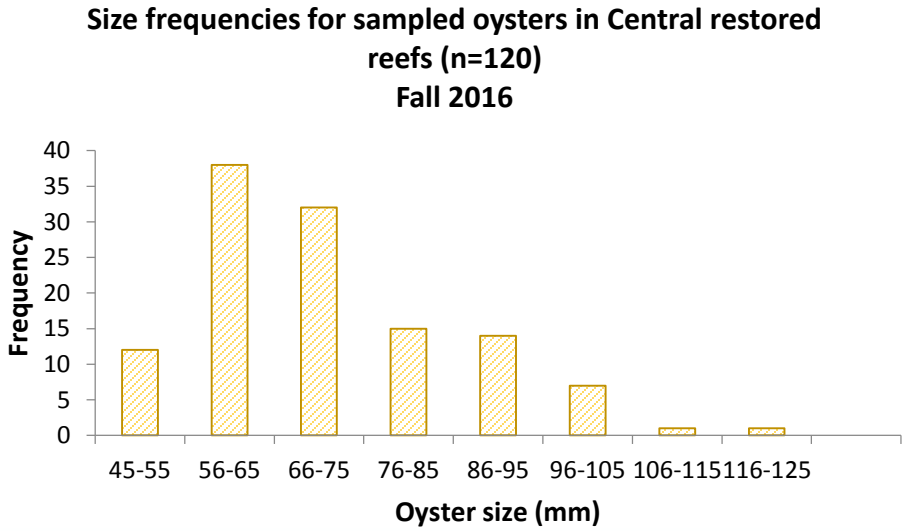


Size frequencies: Central

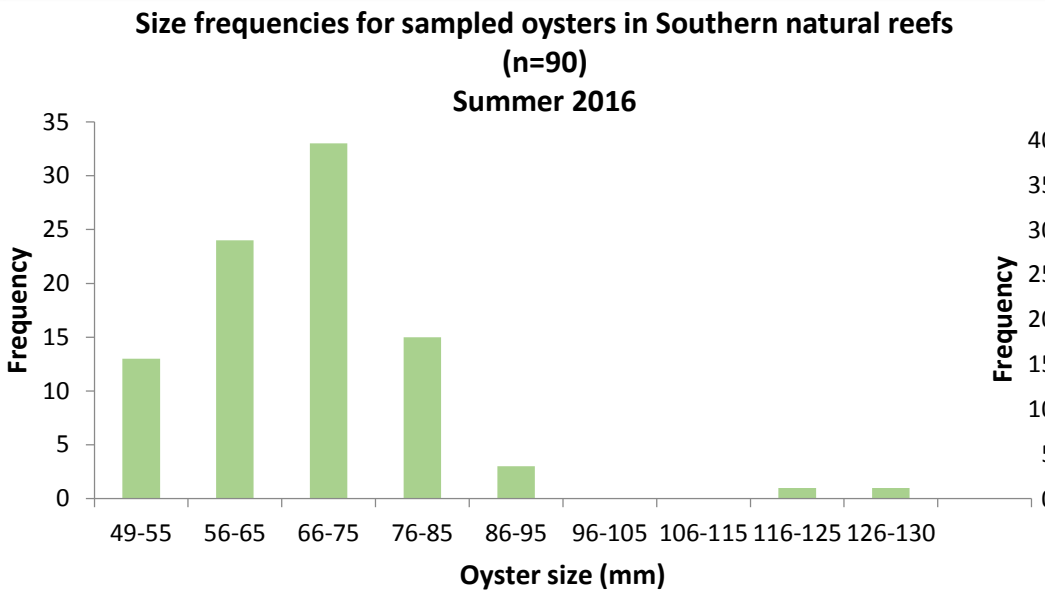


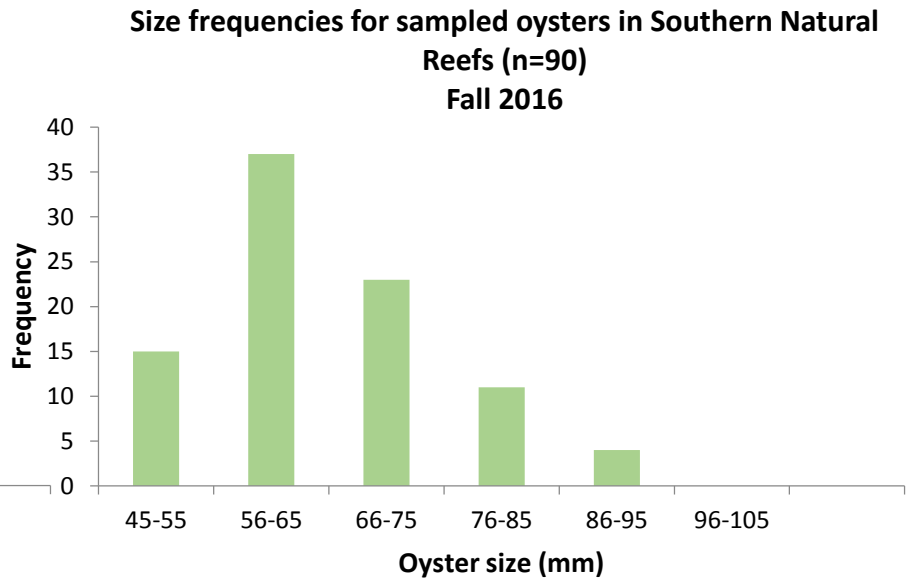


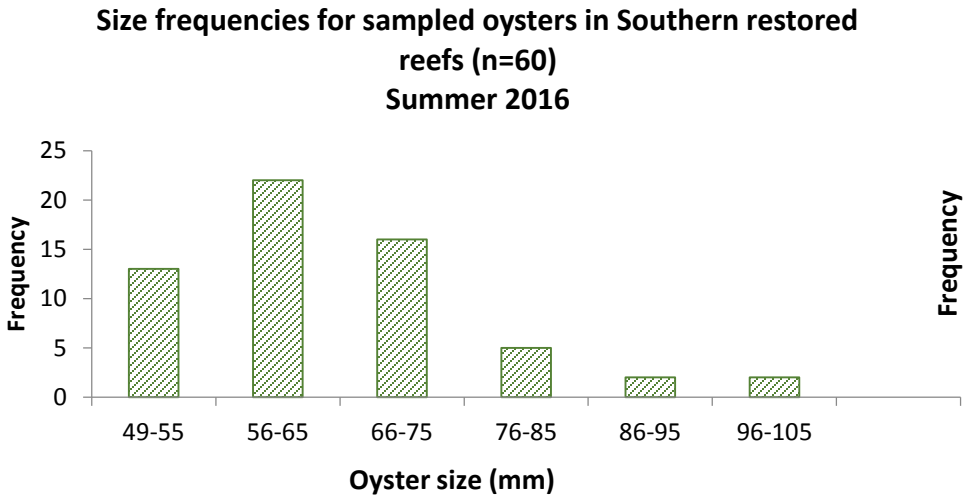


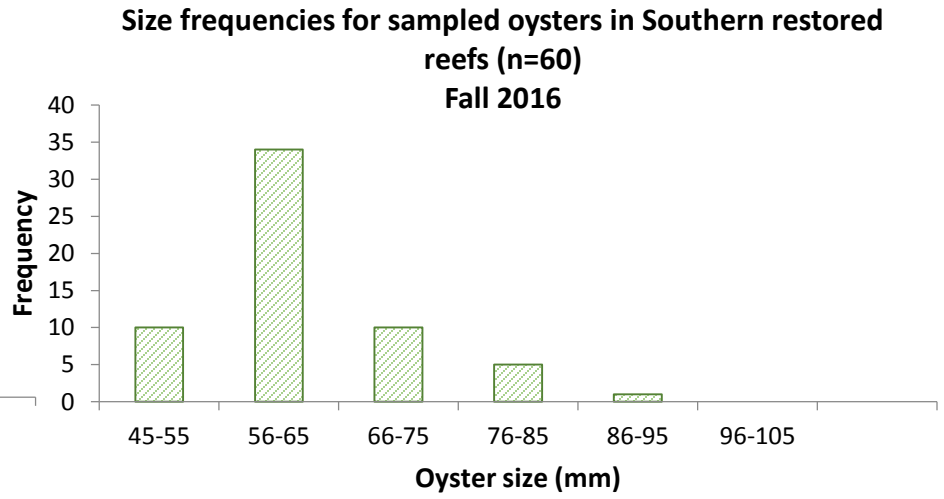


Size frequencies: South



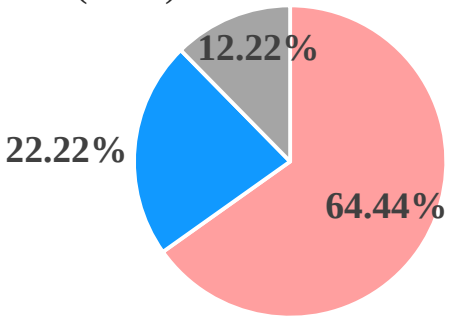




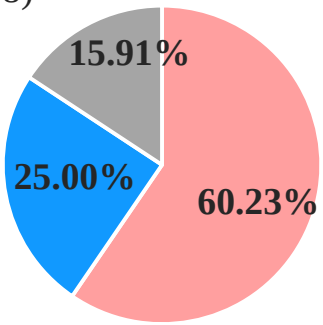


Results: Sex Ratios

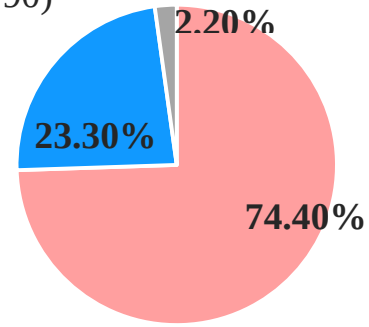
North - Natural (n=90)



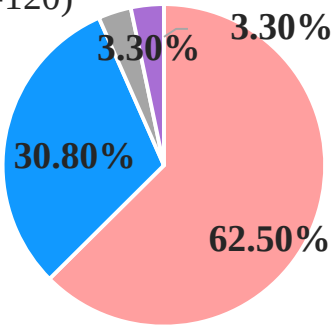
North-Restored (n=88)



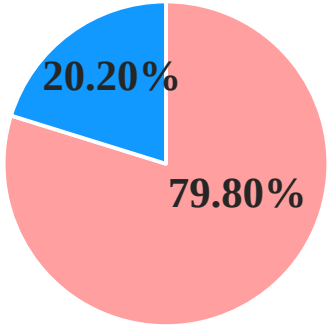
Central Natural (n=90)



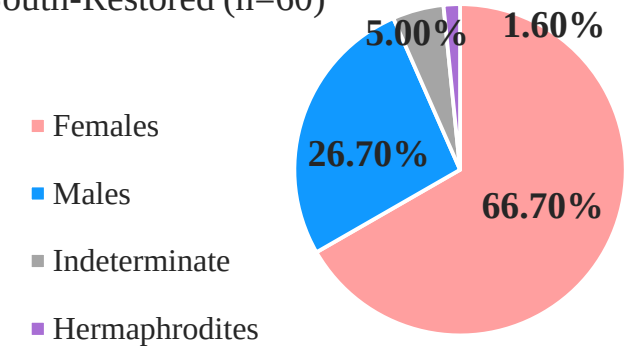
Central-Restored (n=120)



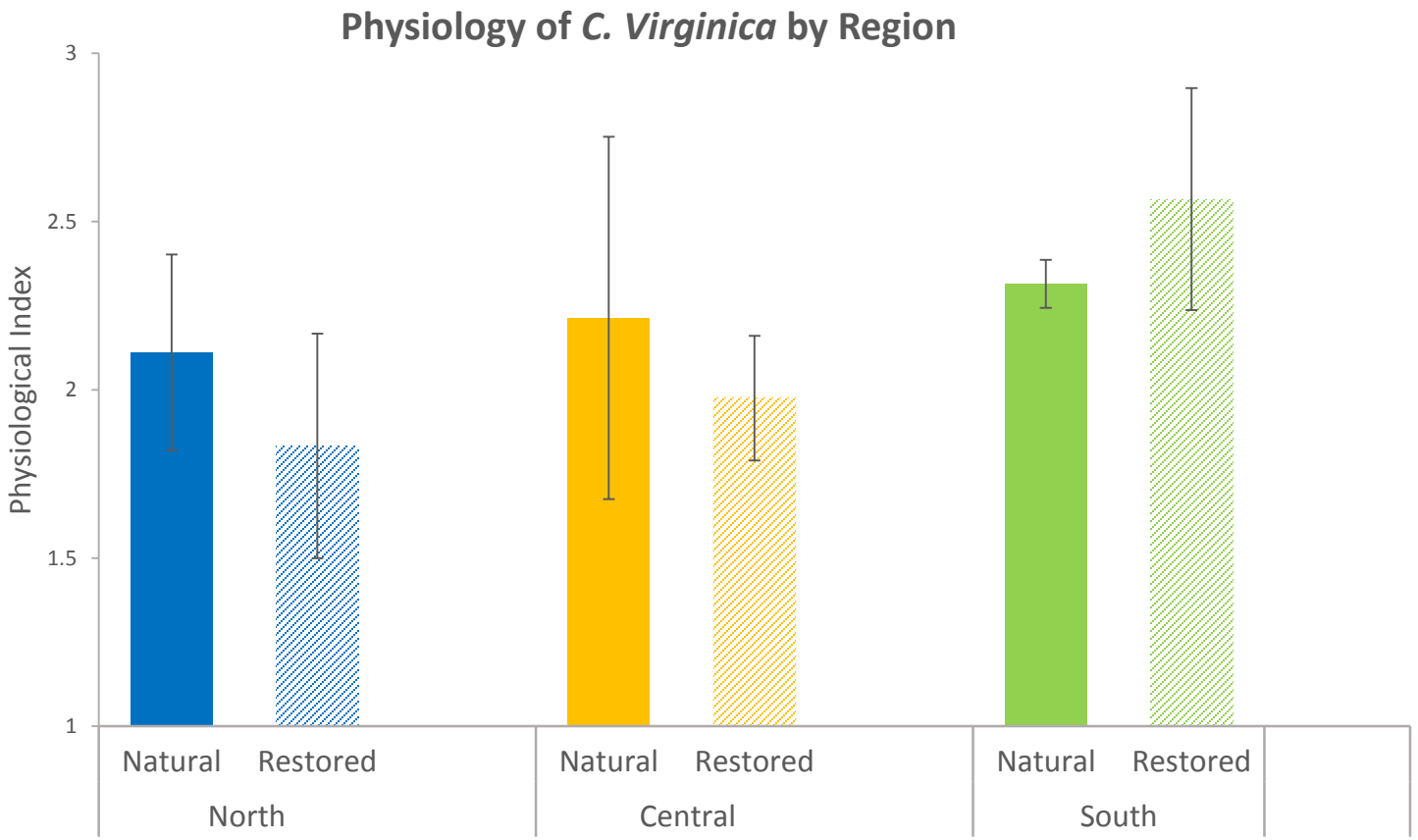
South-Natural (n=89)



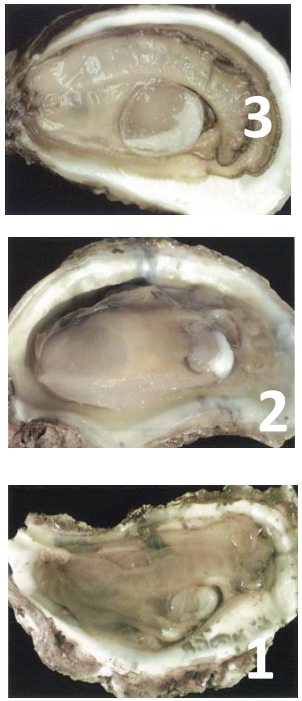
South-Restored (n=60)



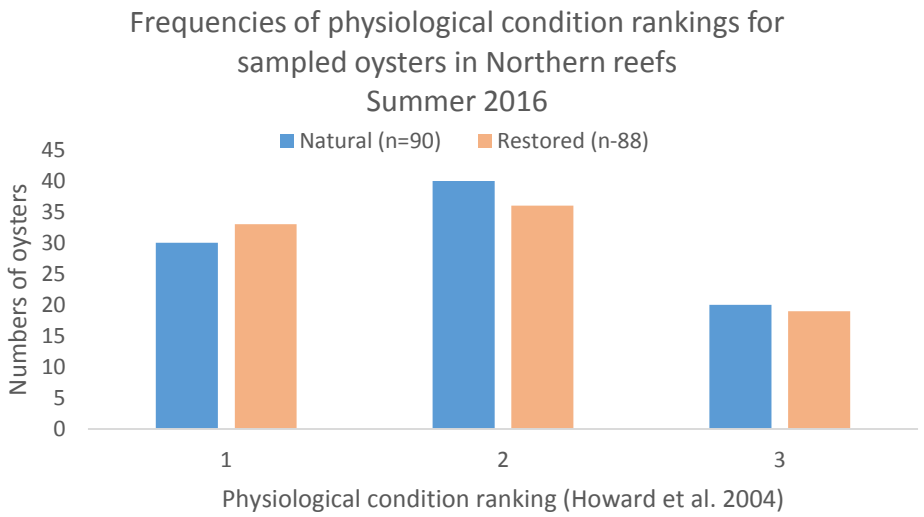
Physiological Condition

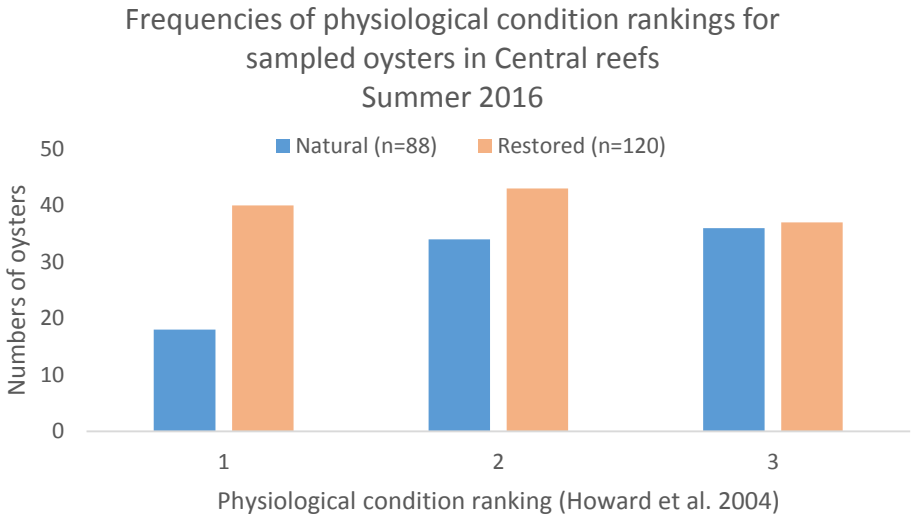


Howard et al. 2004)

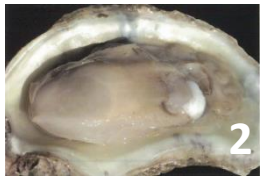


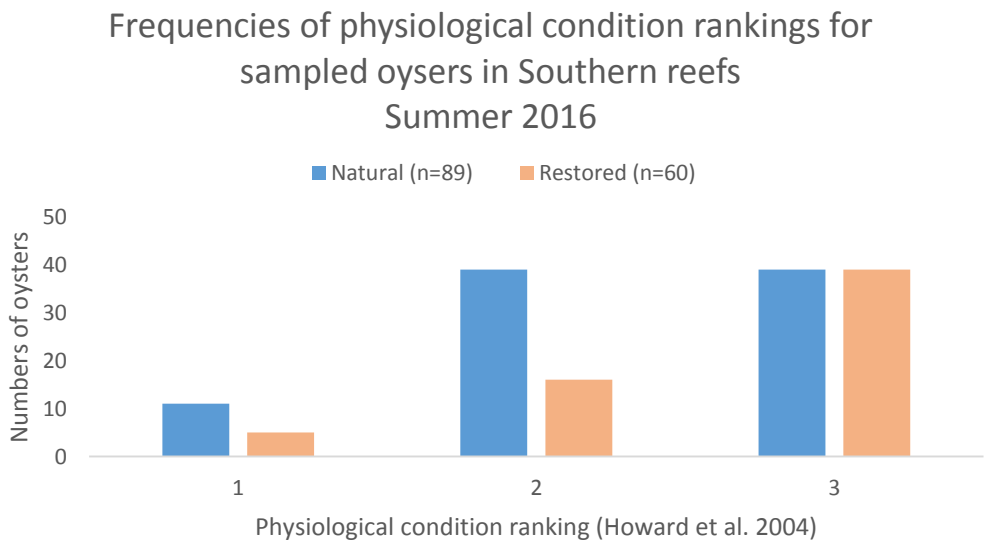
Physiological Condition



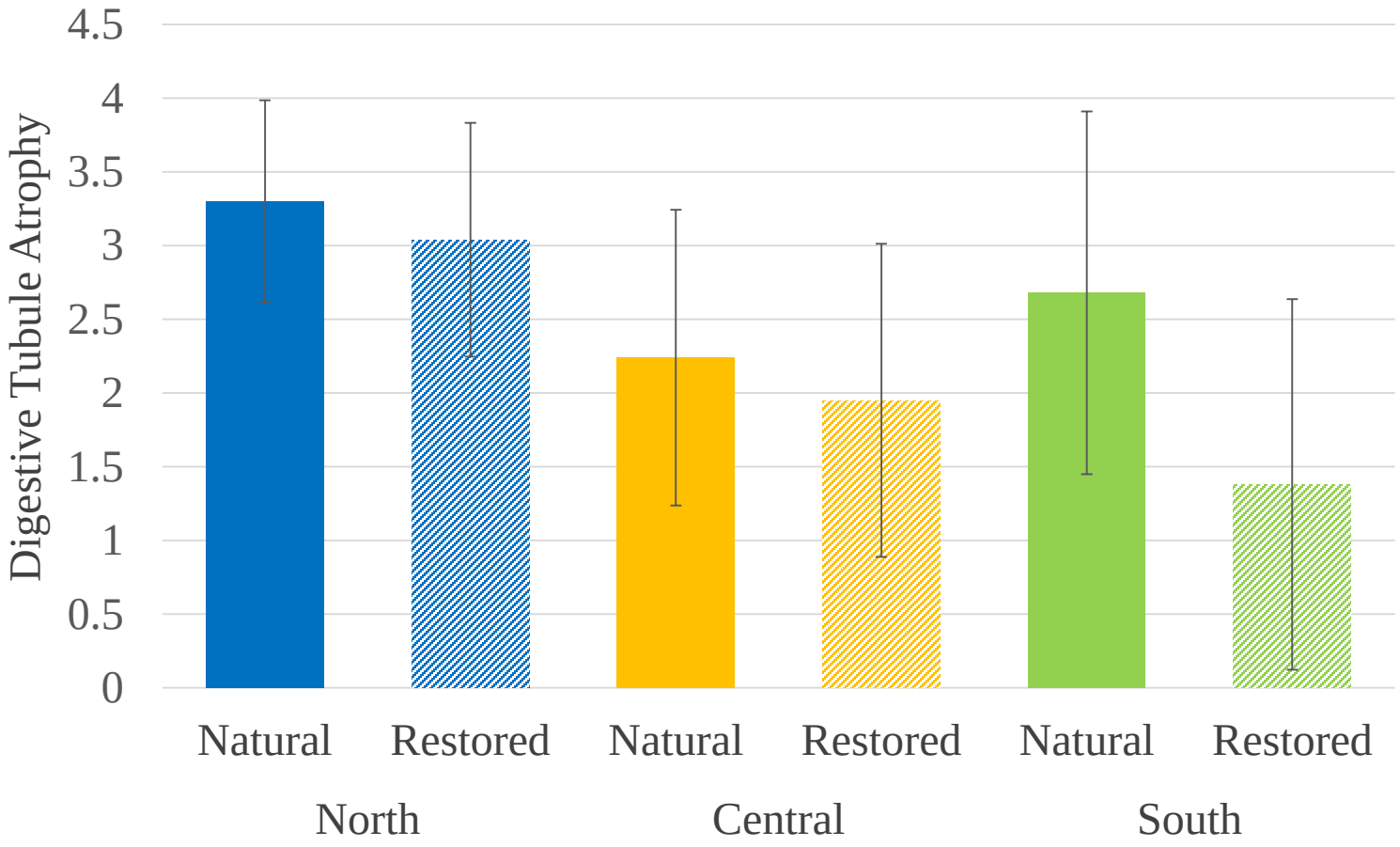


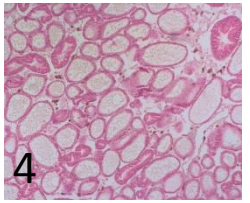
Howard et al. 2004)

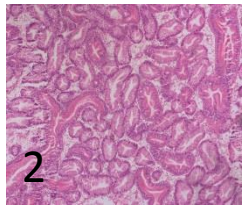


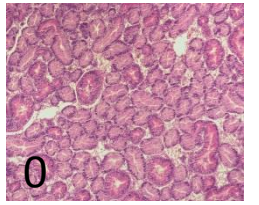


Digestive Tubule Atrophy







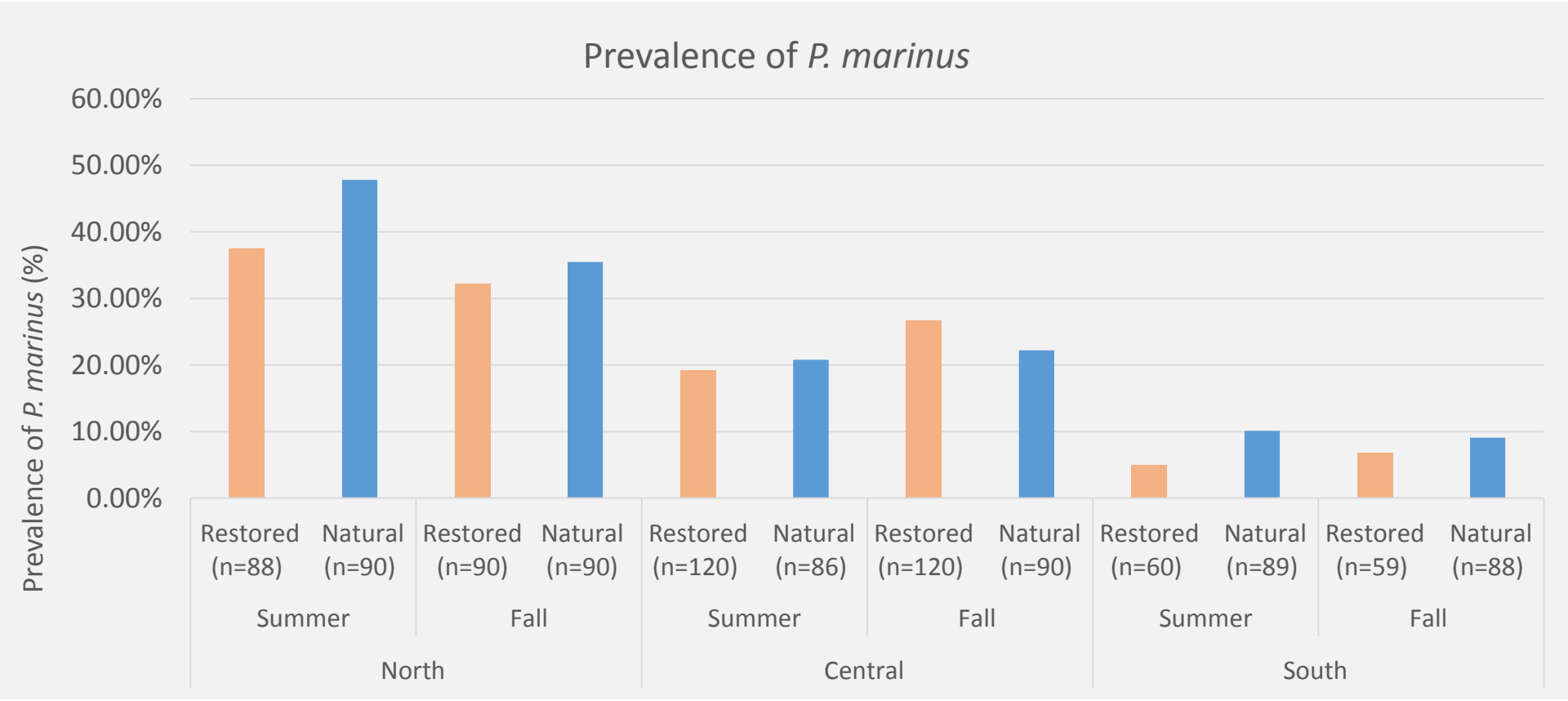


Pests/Parasites

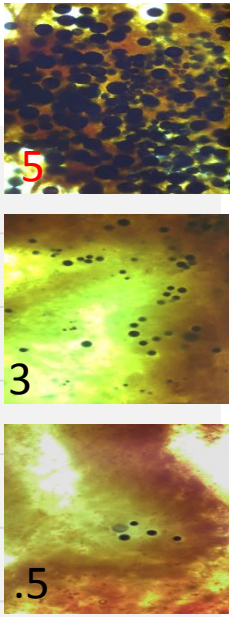
Presence/Absence of Pest and Parasite Species in *C. virginica* in the IRL along a North to South Gradient

Region		Percentage of Individuals Infested by Pest Species				Percentage of Individuals Infected by Parasite Species				
		Total	*Pinnotheres ostreum* (Pea Crab)	*Polydora websteri* (Mud Blister)	*Cliona* spp. (Boring Sponge)	Total	*Nematopsis* spp.	*Tylocephalum* spp.	*Bucephalus* spp.	Unidentified Trematode
North	Natural (n = 90)	5.62%	1.12%	2.25%	1.12%	84.44%	77.78%	40.00%	0.00%	6.67%
	Restored (n = 88)	5.62%	1.12%	0.00%	0.00%	93.18%	87.50%	31.82%	0.00%	0.00%
Central	Natural (n = 90)	8.89%	4.44%	4.44%	0.00%	58.89%	38.89%	28.89%	2.22%	0.00%
	Restored (n = 120)	22.50%	3.33%	14.17%	9.17%	66.67%	36.67%	40.00%	0.00%	0.83%
South	Natural (n = 89)	26.97%	6.74%	20.22%	0.00%	70.79%	60.67%	23.60%	1.12%	0.00%
	Restored (n = 60)	41.67%	35.00%	16.67%	0.00%	50.00%	18.33%	38.33%	5.00%	0.00%

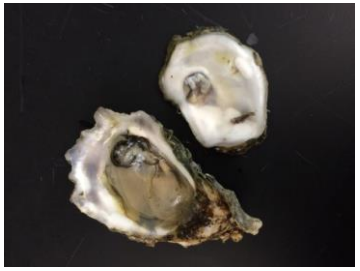
Perkinsus marinus

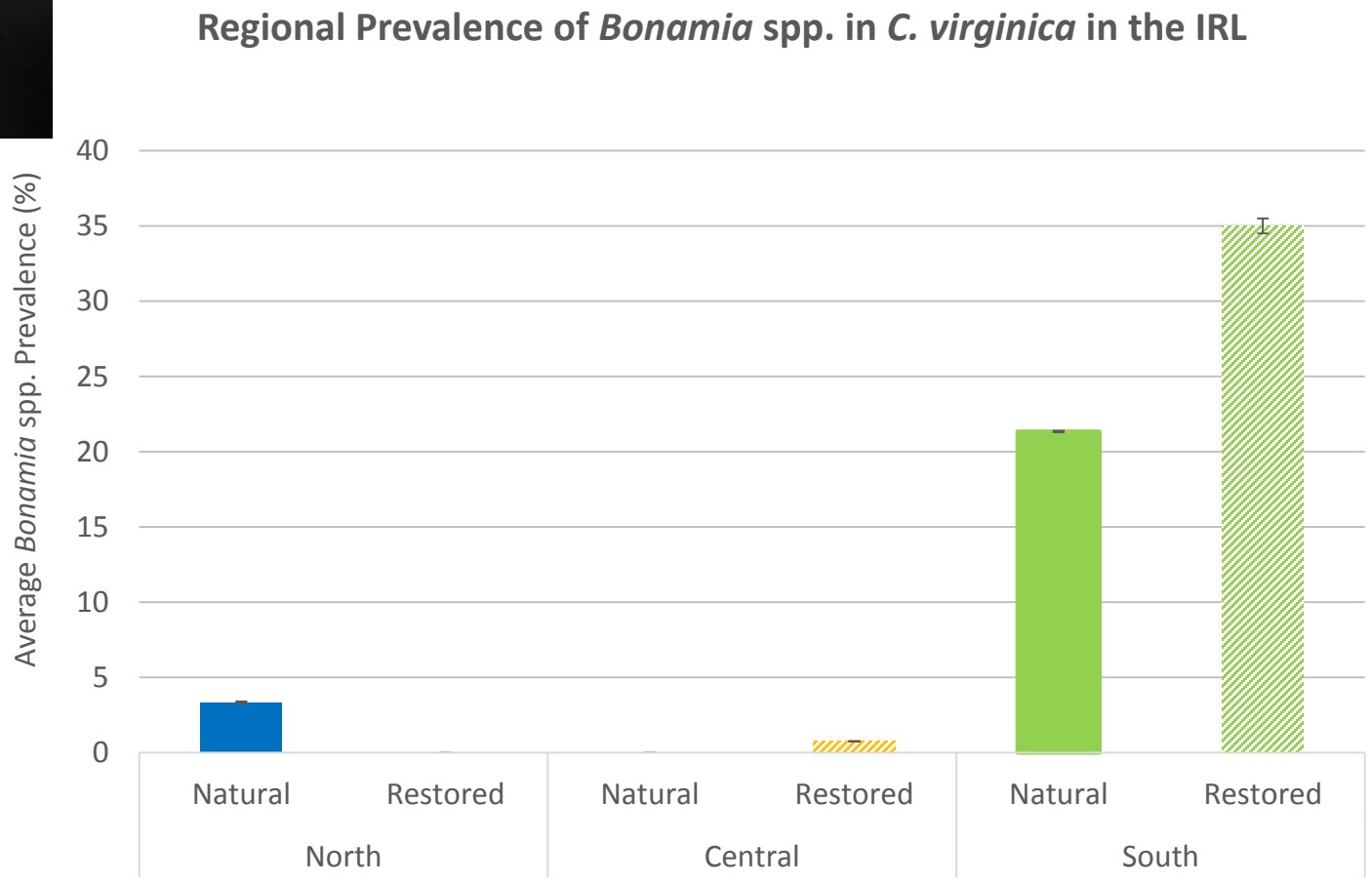


Perkinsus marinus



Bonamia spp.




Regional Prevalence of *Bonamia* spp. in *C. virginica* in the IRL
Average *Bonamia* spp. Prevalence (%)
40
35
30
25
20
15
10
5
0
Natural
Restored
Natural
Restored
Natural
Restored
North
Central
South

Implications/Discussion

- Integrating histological assessments into natural reef monitoring? Restored reefs?
- How might this help oyster restoration? When/how does health matter?
- Changing trends in disease prevalence (changing climate, oceanographic characteristics, water quality, human activity)
- Identifying reefs with low/high reproductive output
- Temporal scales (strategic planning), restored reefs - how long before they are “functioning” reef?
- Funding for histology

Acknowledgments

Thank you

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