

Recent declines in eastern oyster (*Crassostrea virginica*) reefs in the Indian River Lagoon, FL

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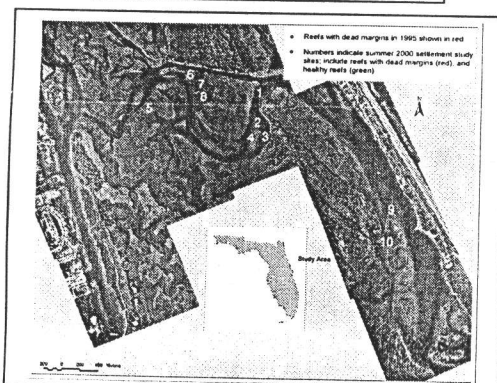
Introduction & Objectives

Our goal is to determine if intertidal reefs of the commercially important oyster *Crassostrea virginica* are declining along the east coast of central Florida. We are currently undertaking two areas of research that may positively correlate any decline to increases in boating activity. Working in conjunction with the National Park Service at Canaveral National Seashore (CANA), we are comparing reefs of major boating channels versus unimpacted areas by: 1) using ArcView GIS software to understand historical changes in reef spatial patterns, and 2) monitoring recruitment and early juvenile survival.

Historical Changes in Reefs in Canaveral National Seashore

Methods: A previously geo-referenced set of aerial photographs was obtained from St. Johns Water Management District. This imagery was used to determine coordinate information needed to rectify higher resolution aerials from 1943 – present that were used to characterize reef size and condition using ArcView and ArcInfo GIS software. A vector polygon was then manually constructed around each reef in the 1943 and 1995 imagery. Next, a second polygon was constructed around the dead margin. Total reef areas and areal extent of dead margins were then automatically calculated.

Number of Reefs with Dead Margins



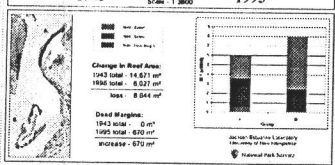
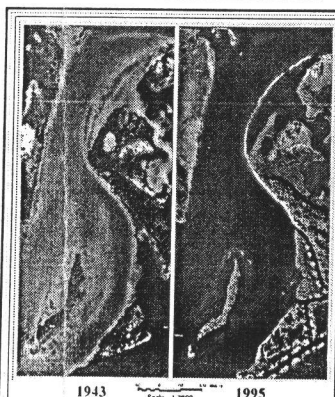
Results

To date, the 1943 and 1995 aerial photographs have been analyzed. In 1995, approximately 30 reefs had dead margins. All of these reefs were adjacent to major boating channels. No reefs in the entire study area had dead margins in 1943.



Examples of oyster reefs with dead margins (mounds of disarticulated shells).

Changes in Reef Dimensions



Results

A comparison of 5 reefs with dead margins indicated that a >50% decrease in total reef area as well as the appearance of dead margins had occurred during the 52-year interval from 1943 to 1995. In 1995, dead margins occupied a surface area covering approximately 10% of the total reef coverage by the 5 reefs.

Recruitment and Juvenile Survival of *Crassostrea virginica*

Life-History of *Crassostrea virginica*

Fertilization is external in *Crassostrea virginica*; millions of eggs are released in the water, where they are fertilized and develop into veliger larvae. Gregarious larvae then move with the currents for approximately 3 weeks before attaching to shells of conspecifics.



Methods: Two frames (25 shells/frame) were submerged at each of the 10 study sites. One frame was placed at the most exposed region of the fore reef and one frame was placed in the protected back reef area at each site. Five sites had significant dead margins; 5 were unimpacted. Frames were submerged on May 27, 2000 and recruitment and juvenile survival were recorded weekly for the next 11 weeks on transparency sheets. Temperature (HOBOS), water motion (dissolution of plaster-of-Paris) and sediment movement (10 cm diameter, 25 cm deep PVC pipe sediment traps) were also recorded. All data were analyzed with ANOVA. Survival refers to early post-settlement survival for 4 weeks after recruitment was first recorded.

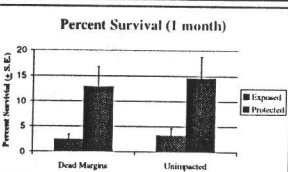
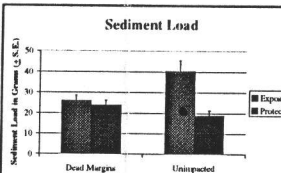
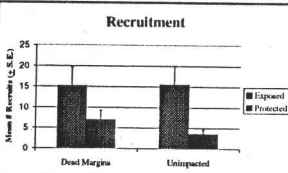
Data collection in the field:

- Weeks are shown in different colors
- Oyster recruits = open circles, X = died
- Barnacles = closed circles
- (*Balanus eburneus*, *B. amphitrite*)

Results: 3-way ANOVAs

	Flow Rate	Sediment Load	Max. Temperature
Week:	p = 0.2611	p = 0.4678	p = 0.0019*
Margin:	p = 0.9477	p = 0.3382	p = 0.7356
Exposure:	p = 0.0008*	p = 0.0024*	p = 0.0029*
Week X Margin:	p = 0.9659	p = 0.7223	p = 0.0698
Week X Exposure:	p = 0.9972	p = 0.8813	p = 0.2623
Margin X Exposure:	p = 0.2174	p = 0.0119*	p = 0.1188
Week X Margin X Exposure:	p = 0.9323	p = 0.9032	p = 0.0296*
	Exposed > Protected	Exposed > Protected	Week 3 > 9, 1, 5
Range:	≈ 3 - 6 cm/s	See Figure	33.2 - 35.2°C

Week = weeks 1-11 of study; Margin = reefs with dead margins vs unimpacted reefs; Exposure = most exposed portion of fore reef vs protected back reef area



Acknowledgments

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Results: 3-way ANOVAs

	# Recruits	% Survived 1 month
Week:	p = 0.0001*	p = 0.0056*
Margin:	p = 0.5662	p = 0.6733
Exposure:	p = 0.0002*	p = 0.0002*
Week X Margin:	p = 0.9852	p = 0.7238
Week X Exposure:	p = 0.0024*	p = 0.4083
Margin X Exposure:	p = 0.4812	p = 0.8780
Week X Margin X Exposure:	p = 0.6079	p = 0.4392
	Week 1, 2 > 6	Week 2, 3 > 8
	Exposed > Protected	Exposed > Protected

Range: See Figure See Figure

Week = weeks 1-11 of study; Margin = reefs with dead margins vs unimpacted reefs; Exposure = most exposed portion of fore-reef vs protected back reef area

Conclusions

- Between 1943 and 1995, CANA oyster reefs adjacent to major boating channels decreased in overall area and developed dead margins along their exposed edges.
- There were no differences between reefs with dead margins and unimpacted reefs in terms of flow, sediment loads, temperature, recruitment or early post-settlement survival.
- The most exposed portions of each reef had significantly greater flow, sediment loads and recruitment. Protected areas on each reef had significantly higher temperatures and juvenile survival.
- Competition with barnacles was intense during the study, likely contributing to low survival.

Future Directions

- To continue to better understand the impact of boating on intertidal reefs of *C. virginica* including real-time monitoring of wave forces and sediment resuspension and manipulative competition experiments.
- To develop a low-cost, automated monitoring protocol to allow NPS to effectively manage oyster reef habitats.