Panel 2: Lessons Learned and Recommendations for Oyster Restoration/Enhancement Project Directions, Designs, and Downfalls

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NC Oyster Reef Workshop

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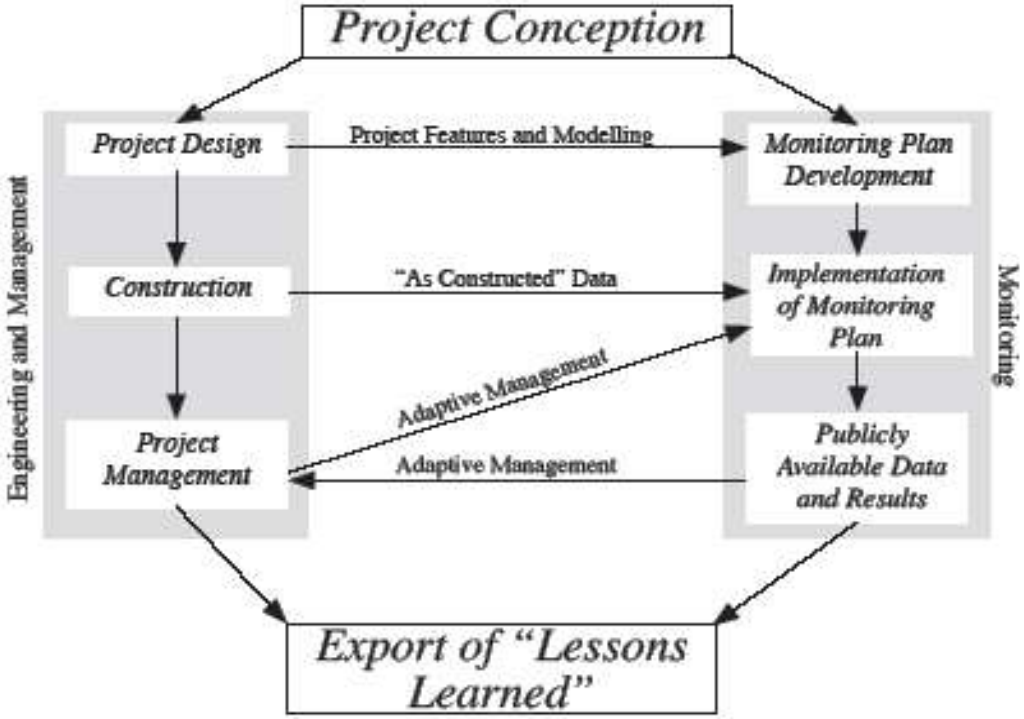
Stock Enhancement & 'Restoration'

- For oyster populations valid fisheries management objective, **but** at odds with most other restoration services for oyster habitats.
- Limiting restoration to "reestablishment of a species or habitat to replace lost ecosystem function" eliminates **any** inclusion of many fishery enhancement activities as 'restoration'.

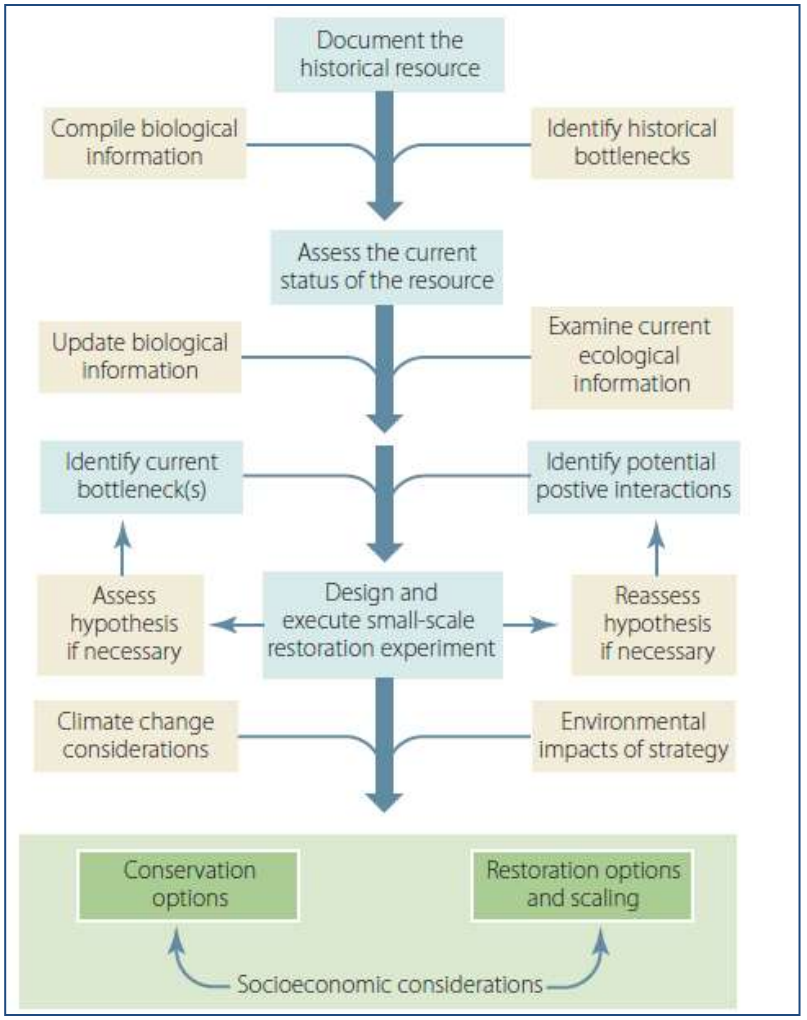
From: Powers and Boyer, 2014. Marine Restoration Ecology. Bertness, et al., Eds., Marine Community Ecology and Conservation.

Specific Monitoring and Data Inventory Protocols Now for Funded



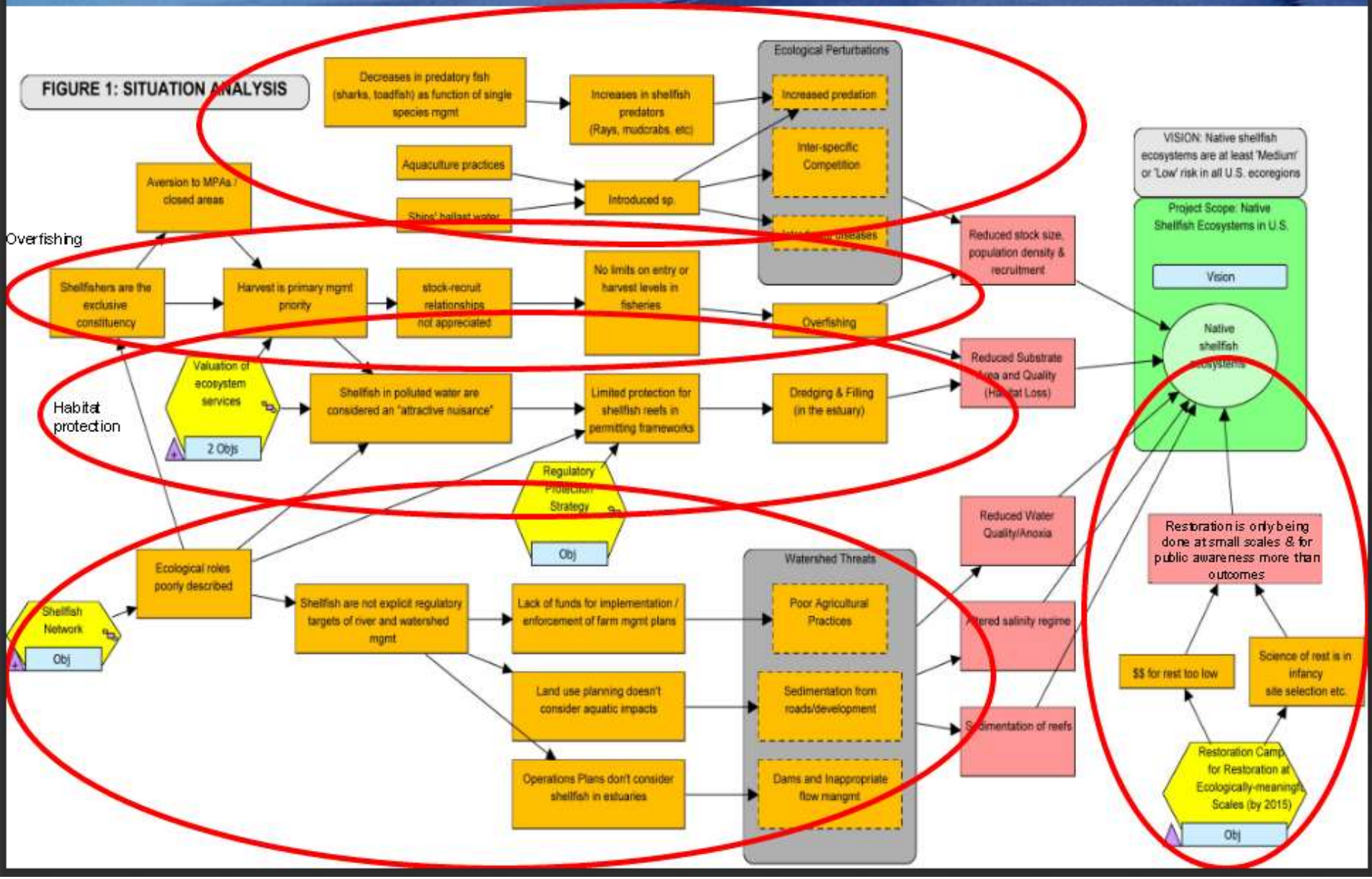
Thayer et al., 2003. Vol. 1, Restoration Monitoring, NOAA

Stages for the Development and Assessment of a Restoration Plan



From: Powers and Boyer, 2014. Also M. Palmer et al. 2005, 2006, etc.

Situation Analysis – National Shellfish Strategy

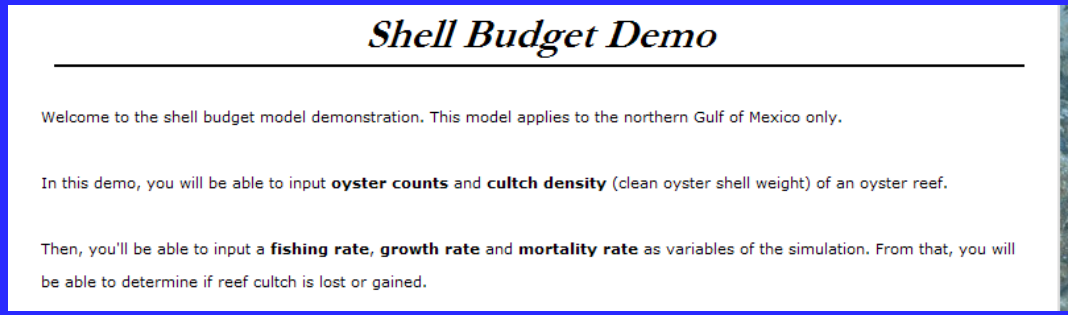


Regional Paradigms

Oyster Sentinel in GOM

Subtidal oyster distributions used to:

- Evaluate the salinities for oysters, control parasites and predators
- Model the impact of freshwater (salinity) alterations
- Select sites for reef restoration
- Estimate sustainable harvests



Assumptions: Optimum salinities for subtidal oysters 10-20 psu. Higher salinities (>15 psu) are optimum for *Perkinsus* and reduce the oysters ability to resist Dermo

Inputs: reef size, cultch density, fished or closed, oysters removed (by size/mo), growth, etc.

http://gbic.tamug.edu/partner_pif.ASP?pif=TAMUG-24
http://www.oystersentinel.org/

Observed Local Paradigms

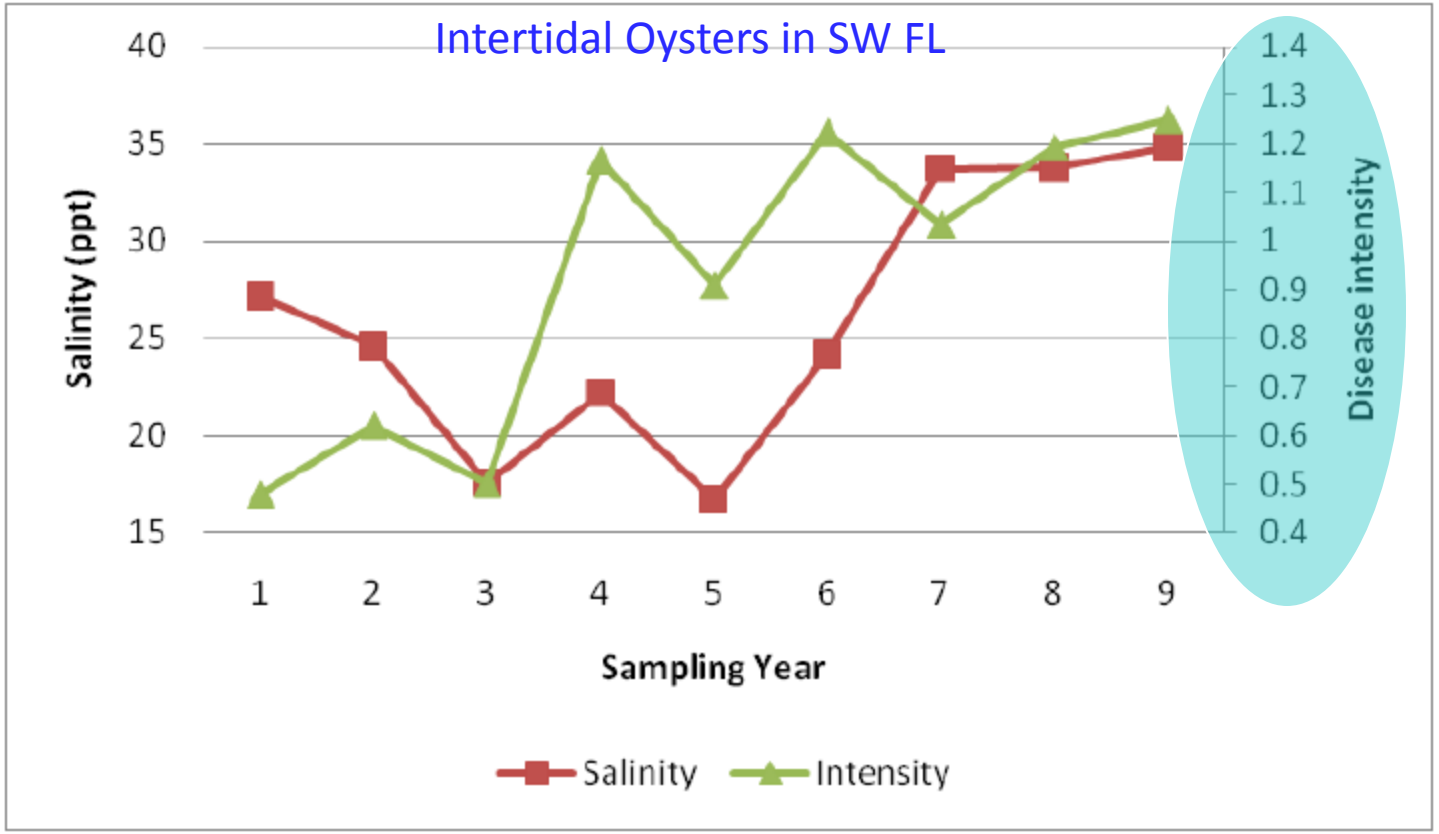


Figure 6: Mean *Perkinsus marinus* intensity (on a scale of 0-5) and salinity averaged across all the sampling locations in the Caloosahatchee Estuary during the sampling period. Sampling years 1-9 are 2001-2009, respectively.

(TB) are from upstream to downstream within the estuary.

http://www.evergladesplan.org/pm/ssr_2009/ssr_pdfs/hc_oyster_ne_caloos_pi_report_2009.pdf

SC Workshop
Goals & Most Relevant Metrics

RESTORATION GOAL(S)

METRIC	Habitat	Shoreline	WQ	Harvesting	Broodstock	Education
Reef Size	X	X	X	X	X	
Reef Condition						
Density	X	X	X	X	X	X
Size Frequency	X	X	X	X	X	?
Associated Fauna	X					X
Reef Architecture	X	X	?	X		X
Reef Fragmentation	X	X	?	X	X	
Salinity	X		X	X	X	X
DO	X (sub)		X	X	X	X
Chlorophyll *a*			X			
Turbidity/TSS			X			X
Temperature	X (Int.)		X		X	

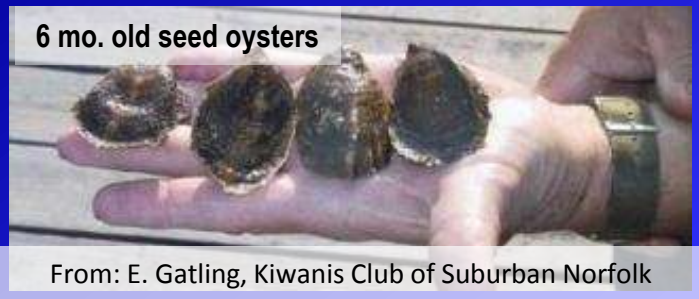
Top Ten Ranked Site Selection Criteria Based on Responses from *C. virginica* Restoration Practitioners

SUBTIDAL		INTERTIDAL
Reef depth	1	Primary substrate
Harvest status	2	Boat traffic/wakes
Primary substrate	3	Average salinity
Substrate firmness	4	*Substrate firmness*
Water quality	5	Siltation/sedimentation
Average salinity	6	Harvest status
Elevation off bottom	7	Politics/jurisdiction/permitting
Disease	8	Height relative to MLW
Siltation/sedimentation	9	Typical recruitment
Ownership issues/permitting	10	Water quality

Broodstock Enhancement or Remote Setting to Jump-Start Reefs

Often goes hand in hand with shell ("cultch") planting

- Large or small-scale efforts
- Requires larvae ($$) to "remote" set larvae (then 'spat') onto substrates (SOS) for later deployment
- **Test hatchery "lines" that have disease-resistant, fast growth (2n or 3n), etc.**
- Jump-start reefs or use where recruitment is very limiting)
- Vary size of "seed" oysters (mm-cm but cost rises!!



Novel Approaches for Field Sets

Steppe, et al., 2010. *In situ* setting of hatchery reared eyed larvae on a restored *Crassostrea virginica bar.* *ICSR*. Charleston, Nov. 2010. http://www.scseagrant.org/content/?cid=468.

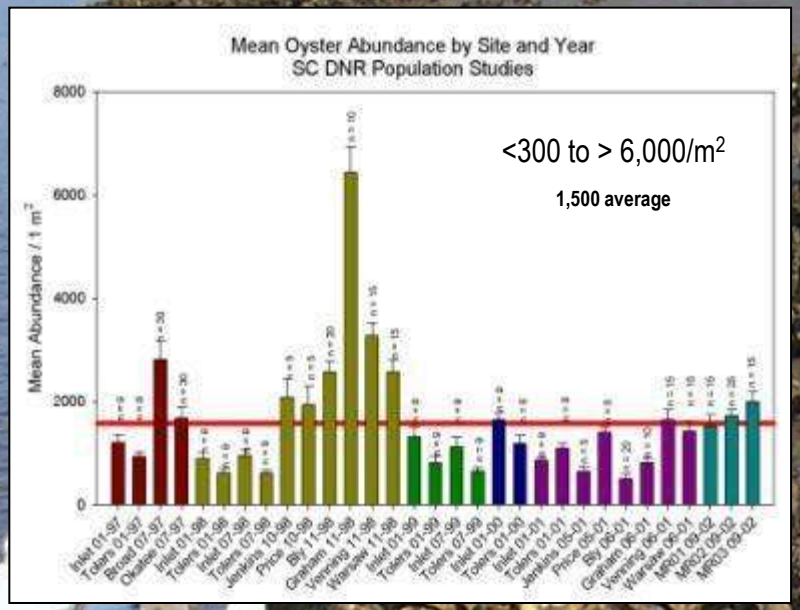
Fredriksson, et al. 2010. Aquacult. Engineering 42:57-69.

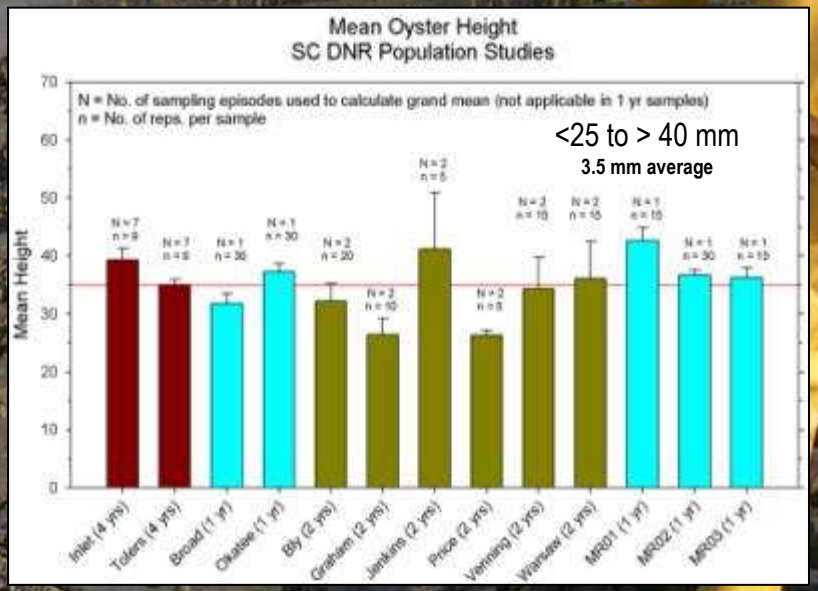
Figure 1. Completed sediment curtain deployment forming a larval release enclosure.

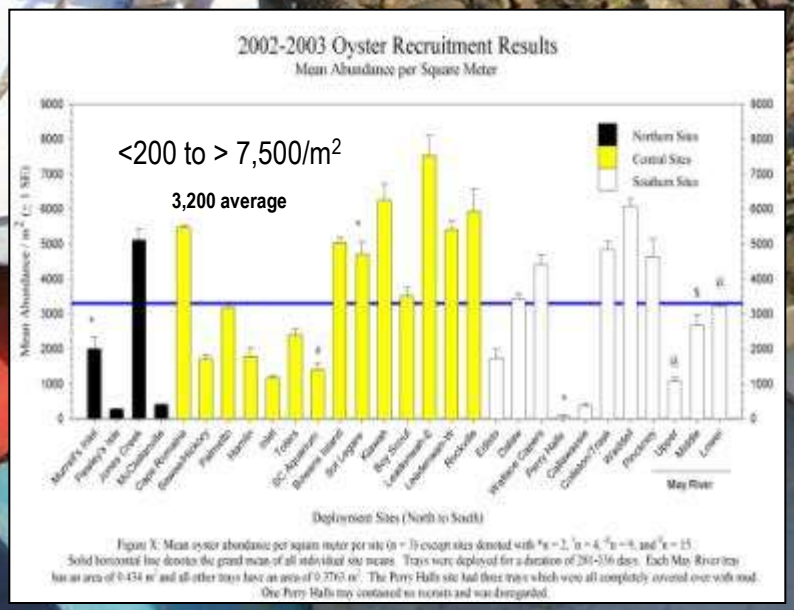
Leverone, et al., 2010. Increase in bay scallop (*Argopecten irradians)* populations following release of competent larvae in two west Florida estuaries. J. Shellfish Res. 29 395-406.

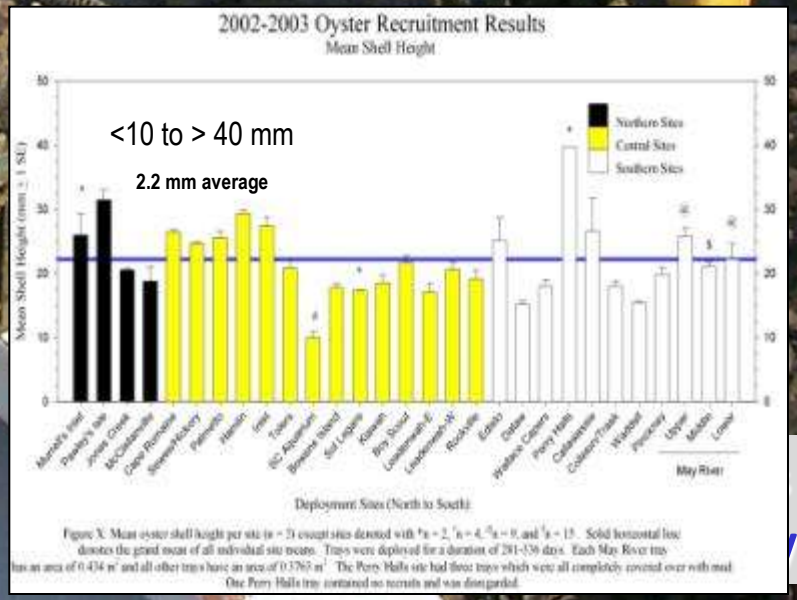
Assessing Oyster Recruitment, Growth, and Habitat Quality Across Sites

State-Wide Oyster Assessments









Collecting Reef-Associated "Transients"

Block Nets, SC

From D. Allen, USC-Baruch Lab

Trawling, Encircling Nets, VA

From M. Luckenbach, Nestlerode

Lift Nets, SC

From L. Coen

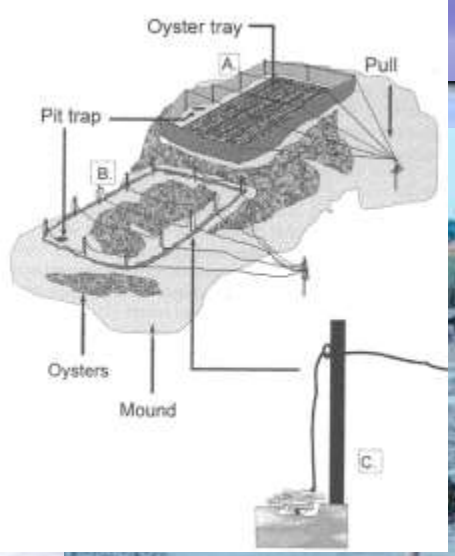
Video Recording, MD

Drop Cylinders, TX

From T. Minello, NMFS

Seining, VA

From M. Luckenbach, VIMS



See Wenner et al. 1996; Coen et al. 1999, ASMFC 2007

Summary of Intertidal Habitat Collections (n = 5): All Dates (Sept./May), Individuals and Biomass (Ranking)

Totals	Oyster Reef	Fringing Marsh	Mudflat
Abundance	3,988 (2)	9,021 (1)	1,550 (3)
Biomass (g/360 m2)	14,264 (1)	15,169 (1)	3,968 (3)

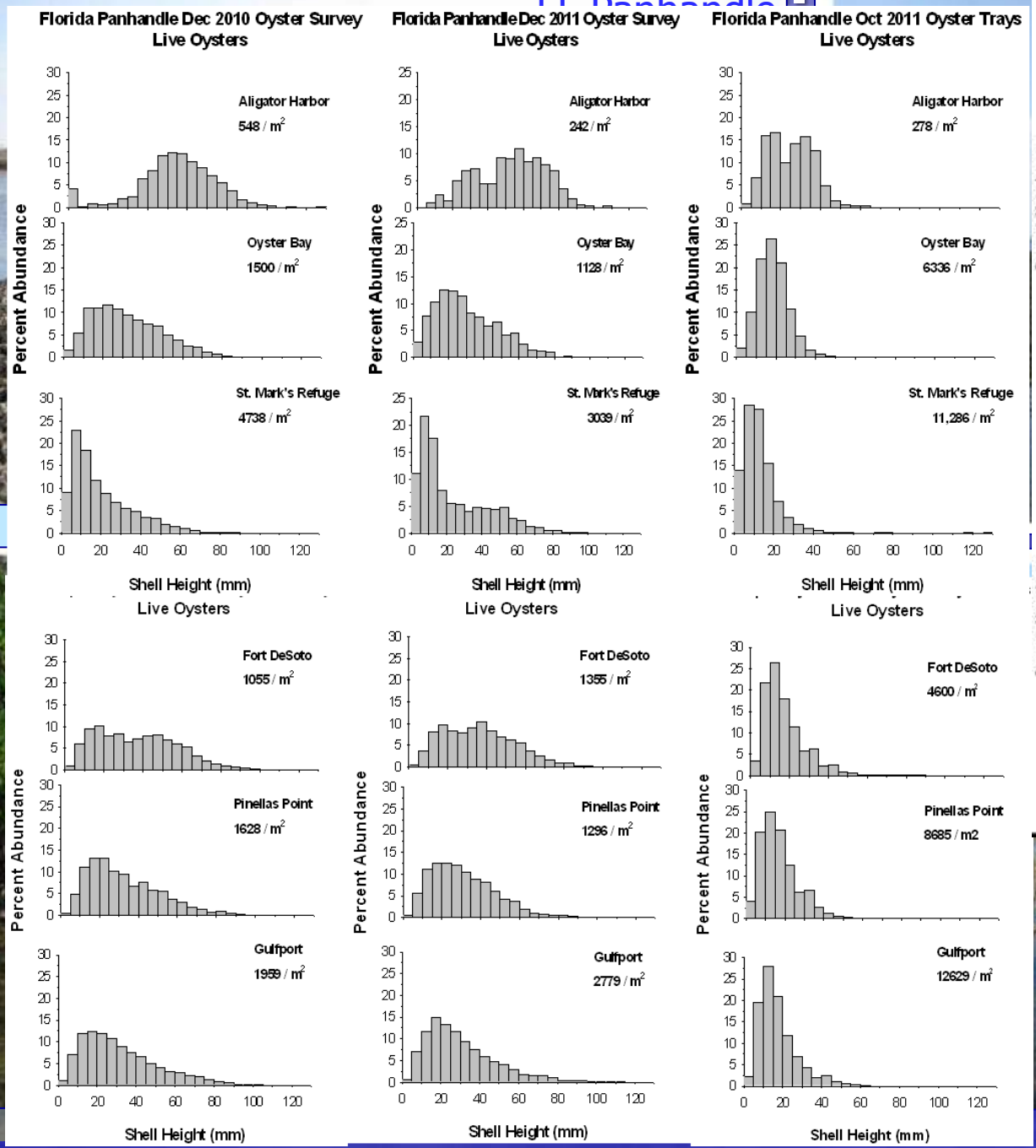


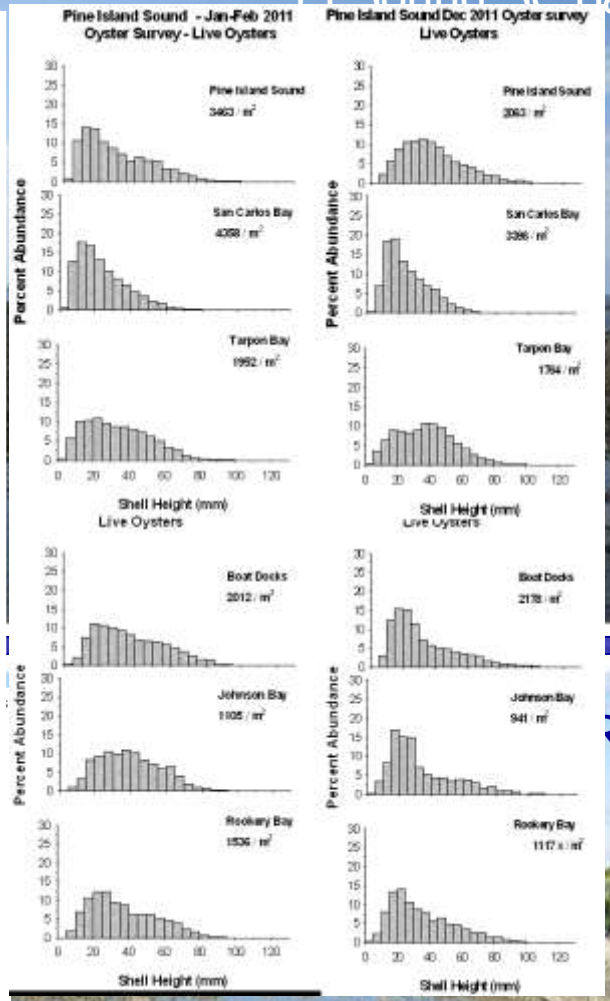





FL Panhandle

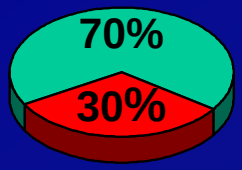
PI Sound-SC Bay





Oyster Habitat in "Closed Areas" & Non-Traditional Substrates

SC Shellfish Approved Harvesting Waters



Polluted Waters

- All of the natural 'Ecosystem Services'
- Administrative closures = 'Reserves'
- Enhancing genetic diversity of available populations.

Oyster Habitats in an Urban Landscape: Lynnhaven, VA

Value of Other Settlement Substrates

40% of live oysters found in "non-traditional" habitats that typically would NOT be sampled in a typical 'fishery-only based' assessment (Ross, Luckenbach, Birch and Coen, NSA 2006)

Enhancement of Adjacent Habitats (Regulating)

Protect and/or enhance shoreward vegetated habitats through wave attenuation and forming more "resilient" shorelines

- Can include *Living Shorelines (LS)*
- Reduced erosion via enhancement of natural plant survival through regrowth or novel plantings
- Often a "landscape" of two or more adjacent habitats

Causes

- Loss from boat wakes (anthropogenic causes)
- Tidal and wind driven flows (natural)
- Impacts from native and non-native plant herbivores, burrowers, etc.

Shoreline Stabilization Pilot Efforts

After 16 months, constructed intertidal reef's presence enhanced marsh regrowth

After 34 months