Oyster Monitoring (2014-2016)

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Oyster Monitoring Objectives

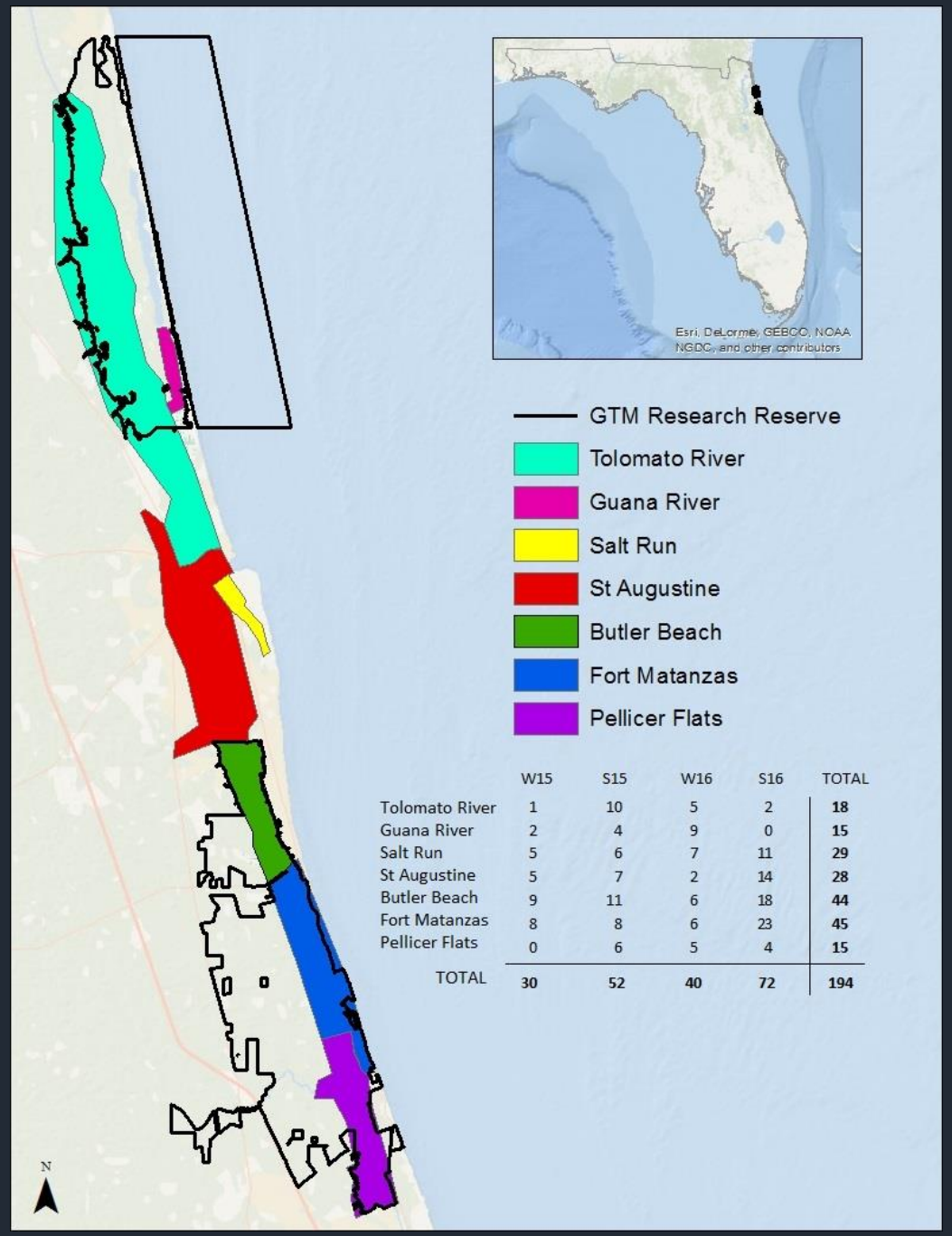
1) *Evaluate the status of GTM oysters*
2) *Estimate ecosystem services*

Guiding Questions

NE FL Oyster Research Meeting
May 2014

Guiding Questions

- How many oysters (areal coverage * density) are in the GTM/St. Augustine region?
- How do oyster abundances and size class frequencies change over space and time?
- What are the relative influences of temperature, food availability, salinity, disease, predation, and harvesting on spatial and temporal patterns in oyster abundance and size?
- How do estimates of oyster abundance and size compare to past estimates and to oysters in other systems regionally and globally?
- Where are restoration efforts most needed and most likely to succeed?



	W15	S15	W16	S16	TOTAL
Tolomato River	1	10	5	2	**18**
Guana River	2	4	9	0	**15**
Salt Run	5	6	7	11	**29**
St Augustine	5	7	2	14	**28**
Butler Beach	9	11	6	18	**44**
Fort Matanzas	8	8	6	23	**45**
Pellicer Flats	0	6	5	4	**15**
TOTAL	**30**	**52**	**40**	**72**	**194**

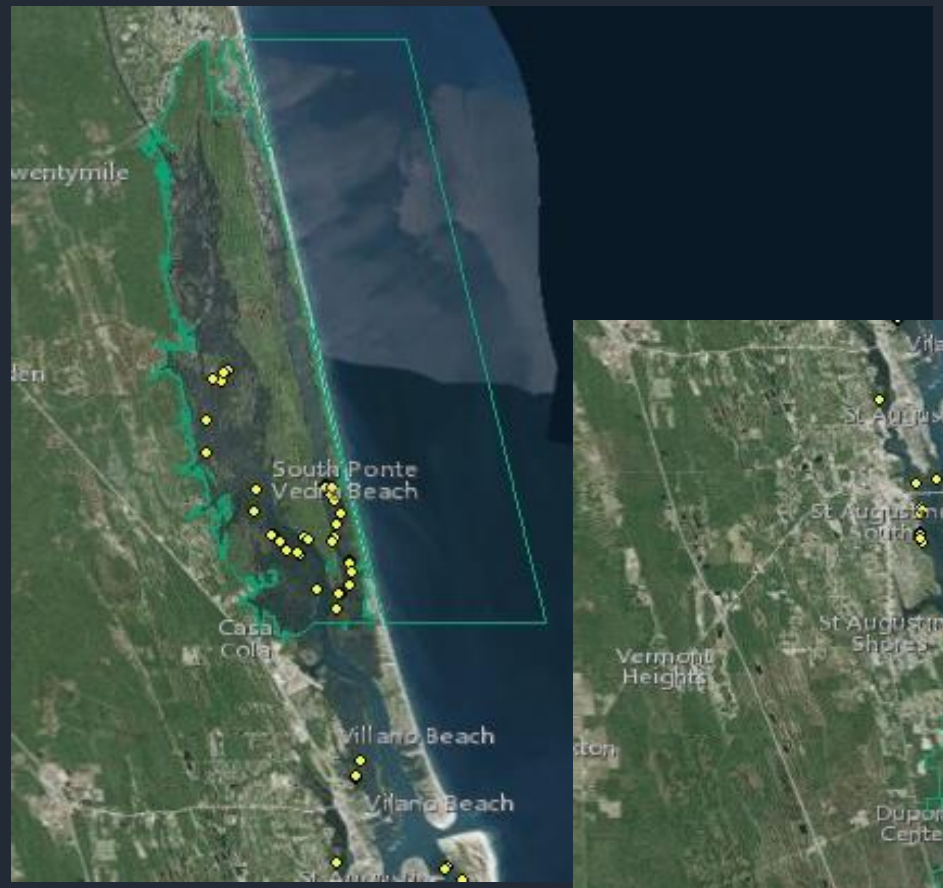
A Regional Approach to Guide Future Monitoring

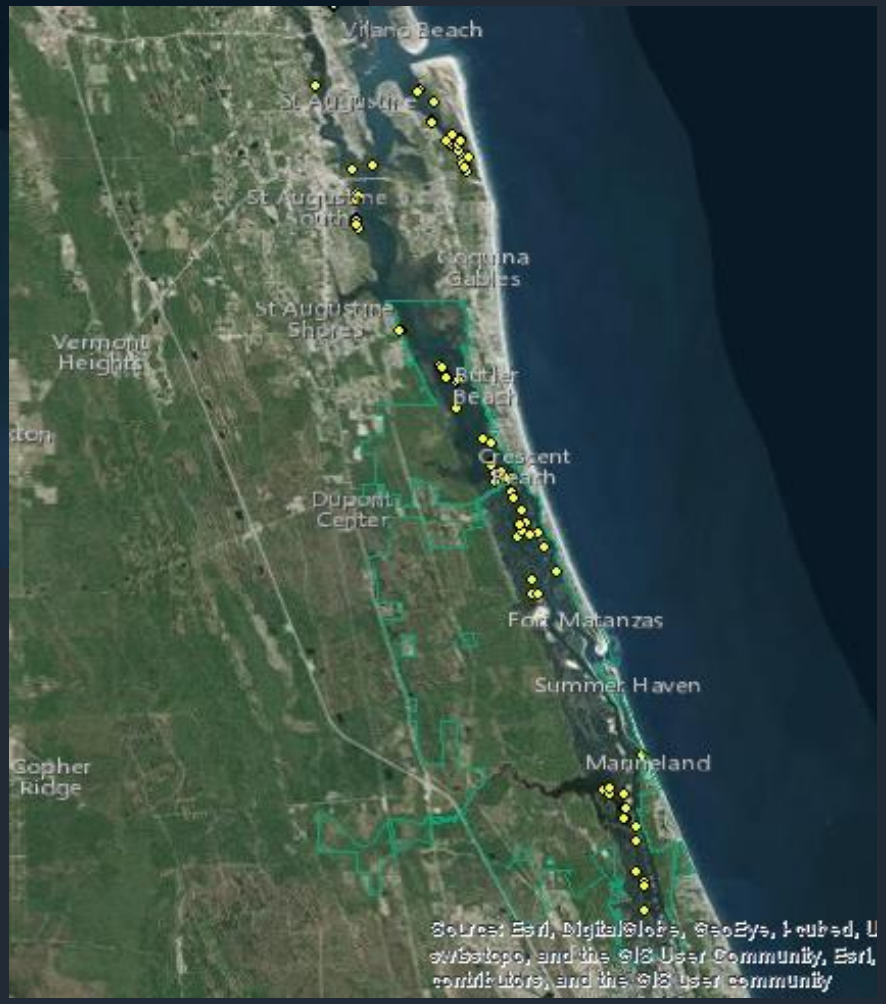
Water quality

Hydrodynamics

Harvesting

Management





2015 – 2016

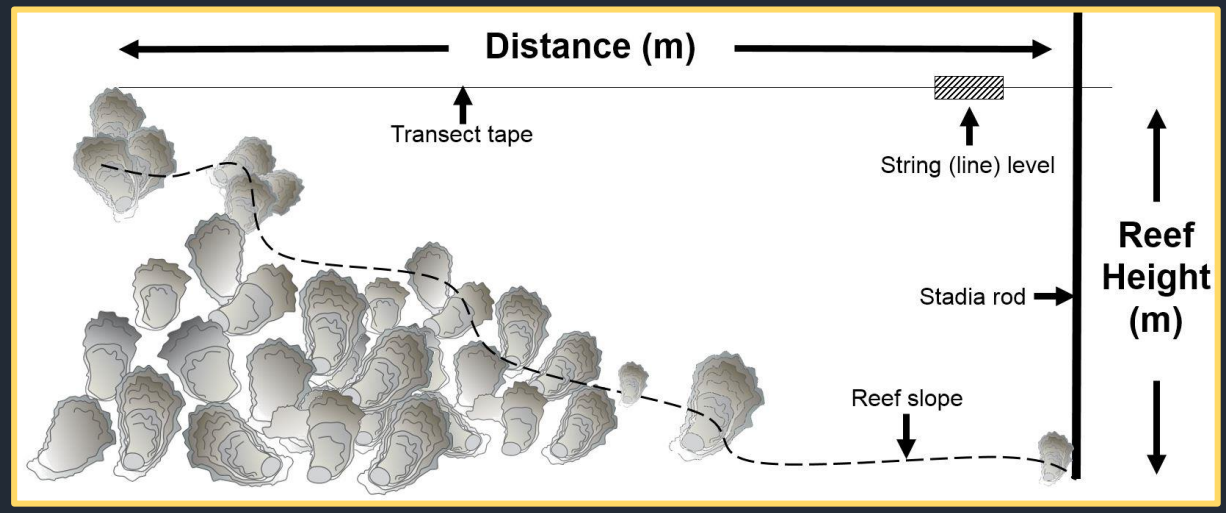
Summer (~July-Aug)

Winter (~Dec-Feb)

Reef Condition

Metrics

reef height
reef slope
clusters
crown conchs
% live, dead, mud
# oysters
oyster shell height
barnacles
mussels
mussel shell height
clams



Oyster Abundance & Population Structure

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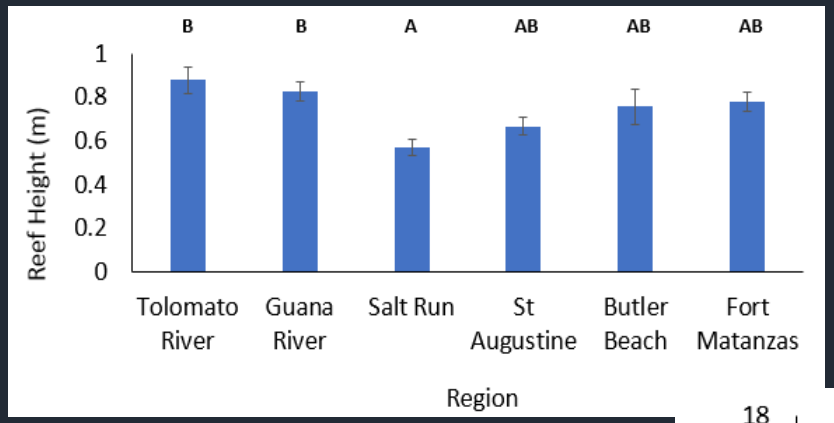
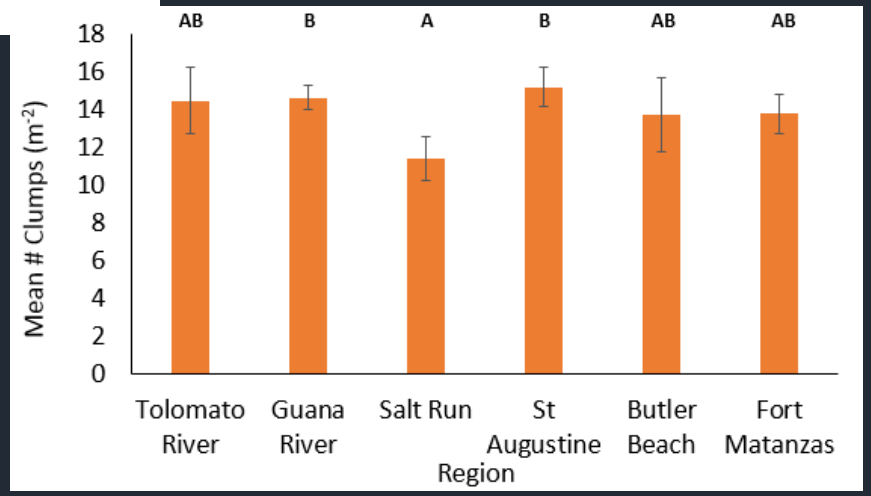
Faunal Associates

Reef Condition

- Regional differences in reef height and clumps

Season	Reef Height (m)	Reef Slope*	Mean # (m^{-2}) Clumps*	% (m^{-2}) Live Cover	Dead Cover*	Mud Cover*
Summer	0.73	0.18	13.40	26.82	41.28	30.93
Winter	0.75	0.17	14.11	29.03	49.91	17.46
p-value	0.677	0.8411	0.62	0.1461	0.0116	6.88E-05
Region						
Tolomato River	0.88	0.21	14.47	26.24	54.00	13.86
Guana River	0.83	0.18	14.62	30.51	43.69	24.45
Salt Run	0.57	0.18	11.40	26.20	43.96	28.71
St Augustine	0.66	0.19	15.18	26.18	34.44	37.25
Butler Beach	0.76	0.13	13.69	27.62	47.89	24.00
Fort Matanzas	0.78	0.16	13.76	28.58	48.44	22.61
p-value	4.75E-05	0.398	0.0262	0.3593	0.0817	0.0688





Reef Condition

- Regional differences in reef height and clumps
- Seasonal differences in % cover

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Reef Condition

- Regional differences in reef height and clumps
- Seasonal differences in % cover
- Oyster density moderately correlated with clumps and % live cover
- Strong inverse correlation b/w % dead and % mud

Spearman Correlations
non-transformed data

	# Barnacles	# Mussels	# Clams	# Oysters	% Fishery Size Oyster	% Spat Size Oyster	Reef Height	Reef Slope	# Clumps	% Cover Live	% Cover Dead	% Cover Mud
Reef Height	0.13	0.19	0.14	0.17	-0.08	0.09	1.00					
Reef Slope	0.06	0.11	-0.09	0.06	0.12	-0.01	0.49	1.00				
# Clumps	0.07	0.49	0.31	0.55	0.14	0.10	0.20	0.12	1.00			
% Cover Live	0.23	0.39	0.31	0.51	0.15	-0.04	0.13	0.06	0.58	1.00		
% Cover Dead	-0.09	-0.01	0.21	0.11	-0.47	0.34	0.04	-0.22	-0.15	0.07	1.00	
% Cover Mud	-0.04	-0.18	-0.32	-0.31	0.32	-0.25	-0.12	0.16	-0.13	-0.48	-0.88	1.00

weak correlation [0.21 - 0.4] | moderate correlation [0.41 - 0.70] | strong correlation [0.71 - 1.0]

Oyster Abundance & Population Structure

- No significant seasonal or regional differences in oyster density were found from randomly sampled reefs
- Oyster density showed seasonal patterns on repeated reefs in Year 1

	Mean # ($0.0625m^{-2}$)		% ($0.0625m^{-2}$)	
Season	One-Way ANOVA*	Repeated Measures MANOVA*	Fishery Sized*	Spat Sized*
Summer	103.76	63.27	0.07	0.42
Winter	96.83	88.10	0.07	0.29
p-value	0.5733	0.001905	0.3516134	3.52E-06
Region				
Tolomato River	94.71		0.05	0.37
Guana River	106.95		0.11	0.35
Salt Run	86.91		0.07	0.38
St Augustine	115.86		0.06	0.39
Butler Beach	109.31		0.03	0.40
Fort Matanzas	96.96		0.05	0.33
p-value	0.2397		0.0004658	0.0825

*analyses performed on square root transformed data, all means were calculated from non-transformed data

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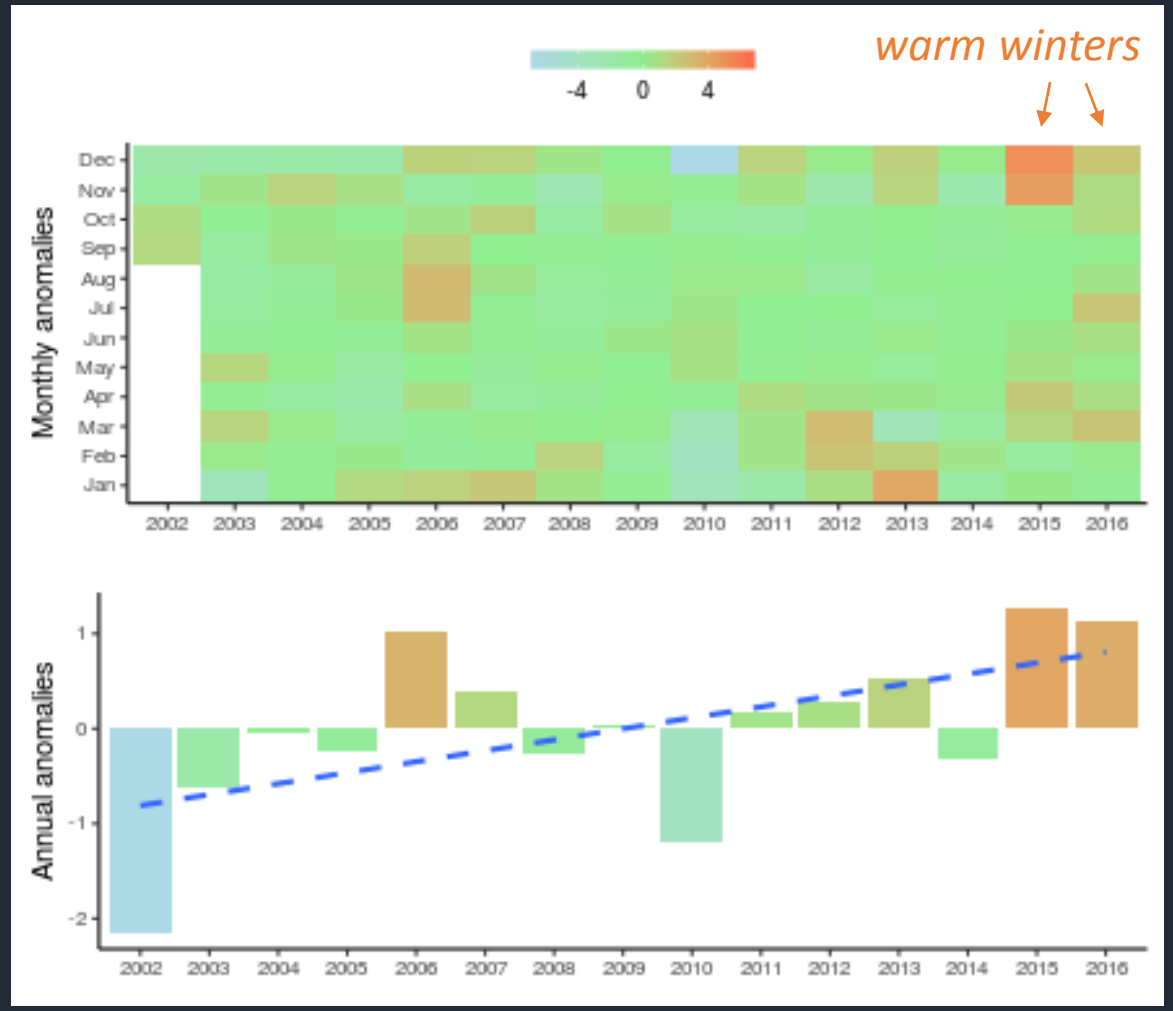

http://swmprats.net (FM station)

Oyster Abundance & Population Structure

- No significant seasonal or regional differences in oyster density were found from randomly sampled reefs
- Oyster density showed seasonal patterns on repeated reefs in Year 1
- Regional differences in proportion of fishery sized oysters
- Seasonal differences in proportion of spat sized oysters

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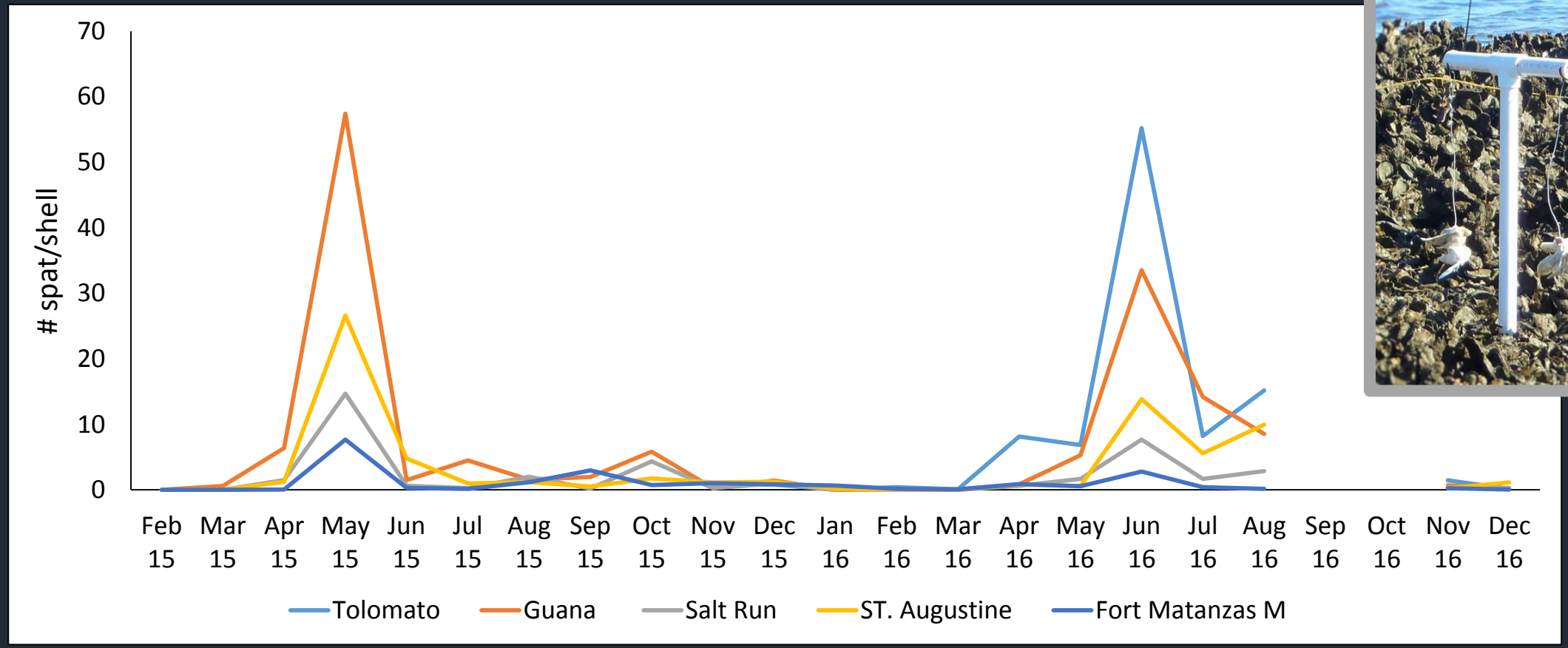
Oyster Abundance & Population Structure



Faunal Associates

- Seasonal differences for barnacle densities
- Regional differences for mussels and barnacles

	Mean # ($0.0625m^{-2}$)		
Season	Barnacles*	Mussels*	Clams*
Summer	11.43	15.57	2.40
Winter	19.45	9.95	2.75
p-value	0.0122	0.0855	0.35571
Region			
Tolomato River	13.35	5.94	2.13
Guana River	12.73	15.35	2.84
Salt Run	26.23	9.26	1.96
St Augustine	7.73	19.82	3.00
Butler Beach	11.46	5.69	2.25
Fort Matanzas	11.58	18.13	2.75
p-value	0.0425	4.03E-05	0.54542

Faunal Associates

- Regional differences for mussels and barnacles
- Seasonal differences for barnacle densities
- Clam and mussel densities were strongly correlated with oyster density
- Predatory crown conchs were not found on any reefs north of Pellicer Flats

Spearman Correlations
non-transformed data

	# Barnacles	# Mussels	# Clams
# Barnacles	1.00		
# Mussels	-0.04	1.00	
# Clams	-0.02	0.58	1.00
# Oysters	0.10	0.71	0.73
% Fishery Size Oyster	0.04	-0.03	-0.28
% Spat Size Oyster	-0.02	0.25	0.63
Reef Height	0.13	0.19	0.14
Reef Slope	0.06	0.11	-0.09
# Clumps	0.07	0.49	0.31
% Cover Live	0.23	0.39	0.31
% Cover Dead	-0.09	-0.01	0.21
% Cover Mud	-0.04	-0.18	-0.32

weak correlation [0.21 - 0.4]
moderate correlation [0.41 - 0.70]
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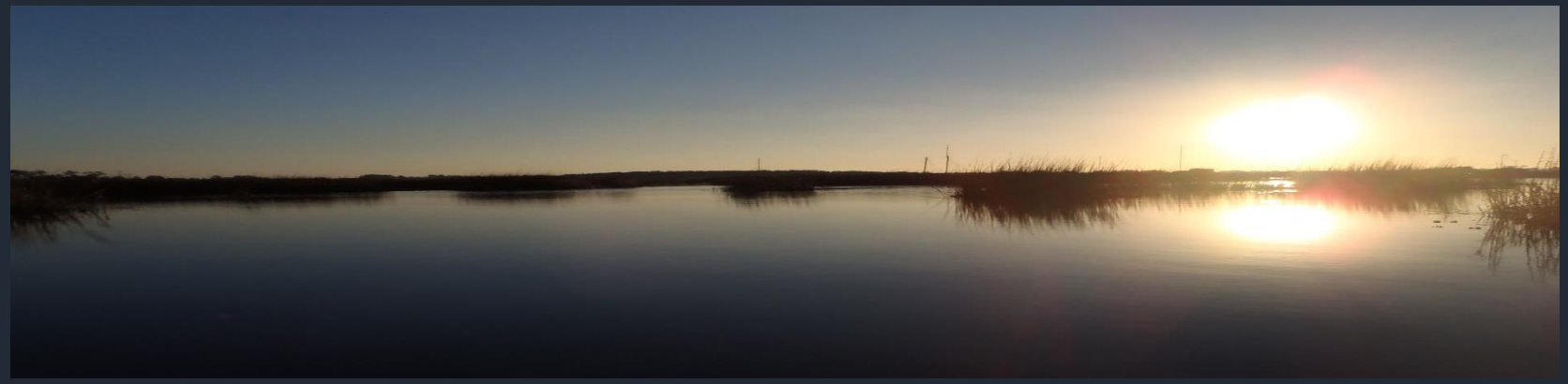
General Conclusions

- Non-destructive cover metrics may be suitable indicators of relative oyster abundance and reef condition
- Oyster density may be an appropriate indicator of habitat function
- Lack of regional and seasonal differences in oyster density suggest that for large-scale population structure estimates, annual sampling evenly distributed throughout the reserve might be appropriate and would save resources for more targeted, hypothesis-driven studies

Next Steps and More Questions…

- What monitoring frequency is appropriate for which questions?
- Is summer/winter appropriate?
- What spatial coverage is appropriate for which questions?
  - # quadrats needed to characterize a reef and # reefs to characterize a region
- Which non-destructive metrics can be used widely and what questions will they answer?
- Which metrics are good indicators of ecosystem services?



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