

Abstract

Oysters are a prominent feature of estuaries in northeast Florida and they provide numerous ecological and economic benefits. Besides their importance as recreational and commercial fisheries, oysters provide ecosystem services including water filtration, sediment creation, habitat formation, and shoreline protection. Oyster reefs also influence estuarine hydrodynamics, plankton structure and productivity, and water quality. The prevalence of oysters in northeast Florida suggests that they have even more ecosystem influence than has been documented in other systems. Unfortunately, information on the status and trends of local oysters is scarce and we do not understand the current condition (and value) of our oyster resources. Therefore, the GTM Research Reserve (GTM) and Northeast Florida Aquatic Preserves (NEAP) are assessing oyster population conditions throughout northeast Florida.

Through two sampling periods, summer 2015 and winter 2015-16, oyster population structure metrics were collected on reefs, throughout Nassau, Duval, St. Johns, and Flagler counties. Summer sampling preliminary analysis indicates the majority of the oyster reefs percent cover is dead oyster shell and a higher percent cover of live oysters within the more southern reefs sampled. Analysis also indicates there is no regional difference of white barnacle, porcelain crab, or black ribbed mussel density on reefs sampled. However, there is a higher density of gastropods on the most southern reef sampled than any other reefs.

This Oyster Condition Assessment project is building upon the current and past research efforts of the GTM Research Reserve and complements oyster mapping efforts conducted by the St. Johns River Water Management District and the University of Central Florida to protect the water quality and restoration of oysters. This information will support the baseline condition development of oyster reefs in northeast Florida and the current and future monitoring of the oyster reefs.

Goals

- Assess the oyster population condition throughout northeast Florida to better understand current condition and value of local oyster resources
- Provide baseline information on the current condition of the northeast Florida oysters

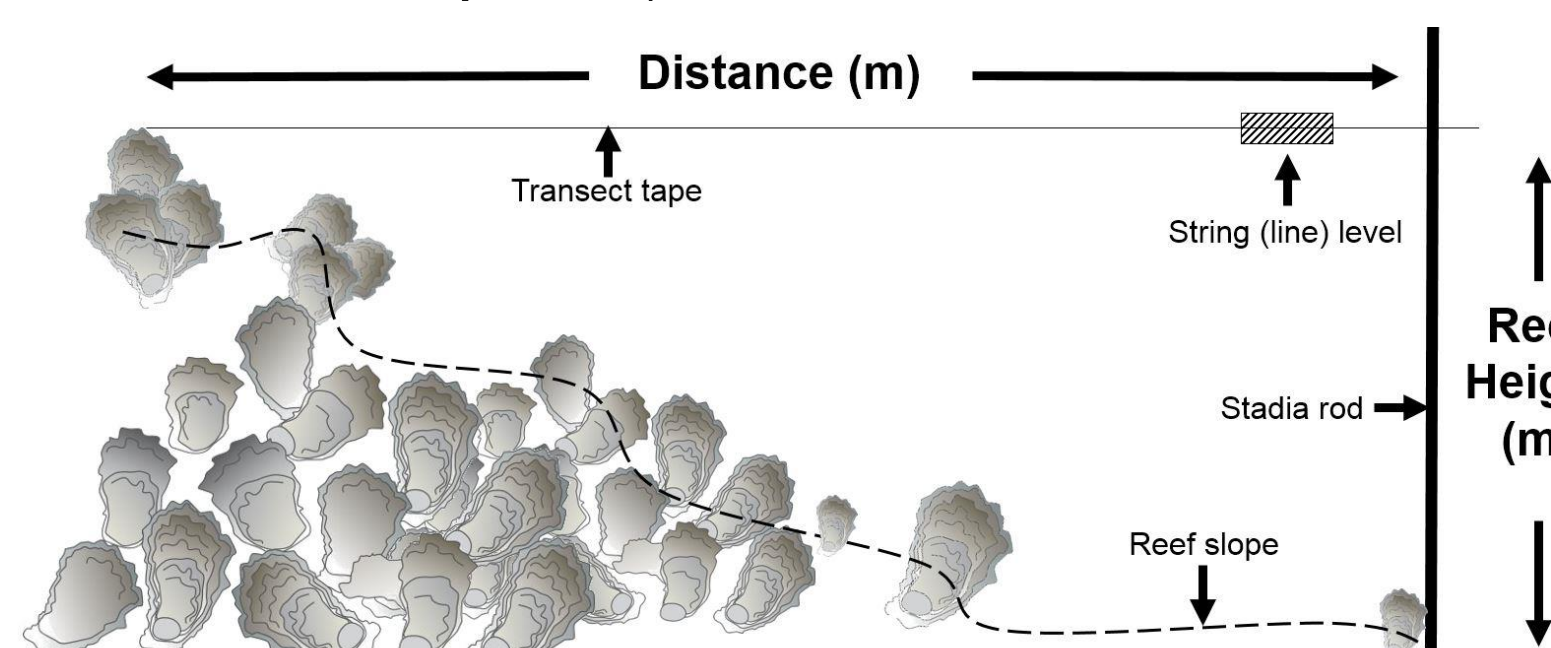
Methods

Sites

- Northeast Florida sampling counties include: Nassau, Duval, St. Johns, & Flagler
- Sampled reefs were randomly selected by St. Johns River Water Management District to cover study area
- All intertidal reefs including patch, fringing, & string reef types
- Sites were sampled in two sampling seasons: summer (June-August 2015) & winter (December 2015-March 2016)

Physical Reef Characteristics

- Sampling transect laid along the densest area of live oysters (reef transects less than 5m were not sampled)
- Reef height measured using a string and string (line) level (pictured right)
- Five randomly generated numbers were selected based on transect length & represented the five sampling locations along the transect
- Percent Cover
 - A constructed 1m x 1m quadrat placed along the transect at the random number provides 100 intersecting points
 - Substrate directly below the intersecting points was recorded as live oyster, oyster shell, benthos (mud), or other
- Reef Thickness
 - A constructed 0.25m x 0.25m quadrat (pictured right) placed along the transect at the random number provides a finer scale sampling area
 - Thin, non-flexible rod was placed adjacent to the highest point (single oyster or cluster) to gather the maximum height above the mud (mm)
 - Thin, non-flexible rod was randomly placed within the quadrat and height (mm) was taken to average together for quadrat thickness



Biological Characteristics

- Within the 1m x 1m quadrat, the number of clusters and mollusks were recorded (clusters ≥ 5 visible, live, adult oysters)
- Within the 0.25m x 0.25m quadrat, sampling included:
 - Count & lengths of live oysters (mm)
 - Counts & lengths of mollusks & associated fauna (mm)
 - Oyster & cluster burial depth (mm)
- All live oysters and clusters were returned to their original locations upon completion of measurements and counts. Invasive species were preserved in 95% ethanol.



Preliminary Results

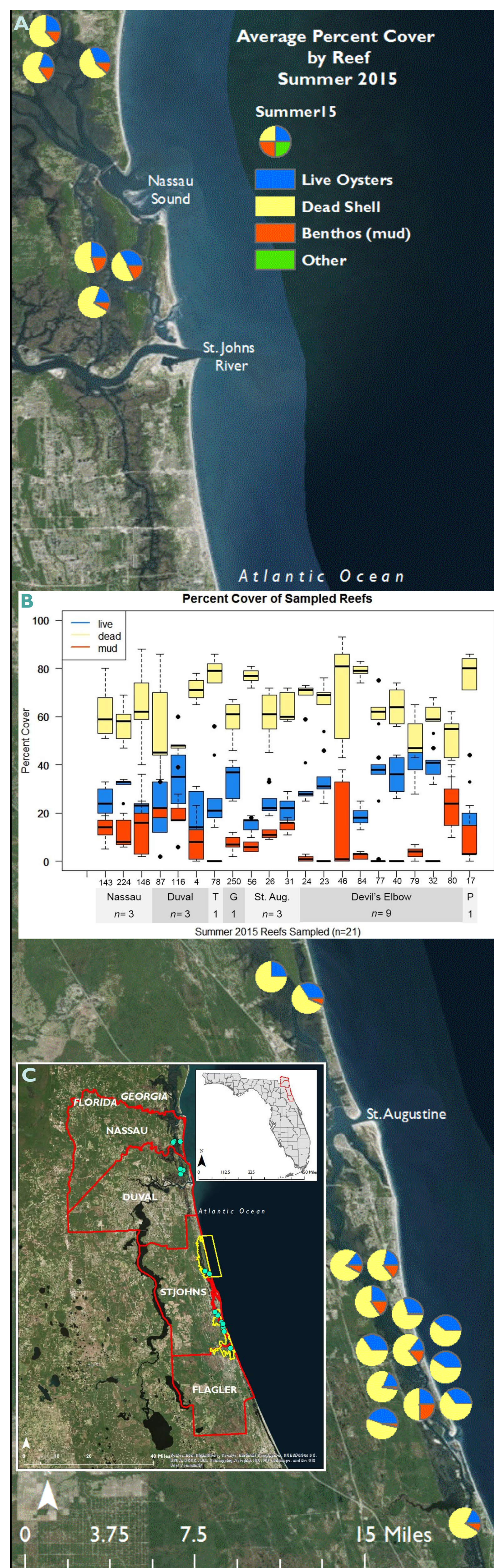


Figure 1 (A) Map of summer 2015 (n=21) sampled reefs within the northeast Florida counties (Nassau, Duval, St. Johns, and Flagler). Each pie chart reflects the average percent cover (from five randomly selected quadrats along the transect) of each sampled reef. (B) Boxplot of sampled reefs percent cover. (C) Map of study site (includes FL counties: Nassau, Duval, St. Johns, & Flagler, in red; GTM Research Reserve boundaries are in yellow; sampled reefs are in teal).

Table 1: Physical and biological characteristics measured on the oyster reefs by region. Regions are organized north to south. n is the number of sampled reefs. *All values are averages unless otherwise noted.

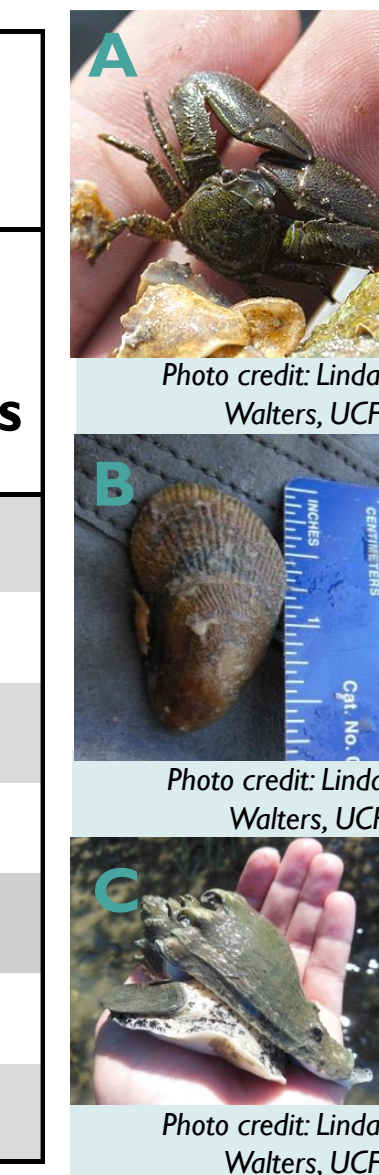
Region	n	Physical Characteristics						Biological Characteristics					
		Percent Cover			Reef Height (cm)	Reef Thickness (mm)	Burial Depth (mm)		Clusters	Oysters	Oyster Lengths*		
		Live	Shell	Mud			Above	Below			Min	Mean	Max
Nassau	3	25	61	13	104.6	58.9	71.8	-69.4	18	47	6.5	40.2	92
Duval	3	26	59	15	378.3	88	107.8	-81.9	18	41	4	45.3	124.2
Tolomato River	1	25	75	0	63.5	101.5	111.0	-74.6	13	40	5.1	42.2	101.7
Guana River	1	34	59	7	109.2	61.1	93.3	-37.5	14	50	3.9	40	87.1
St. Augustine	3	20	67	13	66.5	65.9	70.5	-78.2	18	44	2.6	39.9	100.8
Devil's Elbow	9	31	63	5	76.3	83.3	79.0	-54.6	18	43	2.9	44.4	99.9
Pellicer Creek	1	18	73	9	144.8	69.6	68.5	-58.4	18	44	5.4	32.6	62.4



Figure 2 The 1m x 1m quadrat above shows the percent cover point-intercept method as well as the cluster and gastropod data recording. This quadrat was 11% live oysters, 76% dead shell, and 13% benthos (mud). There were 6 live oyster clusters within this quadrat.

Table 2: Commensal fauna measured on the oyster reefs by region (organized north to south). All values are totals unless otherwise noted. Superscript letters correspond with pictures on right.

Region	n	Oysters	Average Oyster Length (mm)	Porcelain Crabs ^A	Black Ribbed Mussels ^B	Crown Conch ^C	White Barnacles
Nassau	3	47	40.2	1	7	0	1
Duval	3	41	45.3	0	0	0	7
Tolomato River	1	40	42.2	3	2	0	1
Guana River	1	50	40.0	1	1	0	5
St. Augustine	3	44	39.9	1	2	0	0
Devil's Elbow	9	43	44.4	0	1	0	3
Pellicer Creek	1	44	32.6	0	2	6	3



Seasonal Comparisons

Table 3: Physical characteristics measured on the oyster reefs by resampled reefs and region. Regions are organized north to south. All values are averages unless otherwise noted.

Reef, Region	Percent Cover						Reef Height (cm)		Reef Thickness (mm)		Burial Depth			
	Live		Shell		Mud						Above (mm)		Below (mm)	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Reef 146, Nassau	20	36	65	46	15	18	96.5	125	72.2	57.6	73.3	72.4	59.3	70.4
Reef 4, Duval	20	20	71	67	9	14	101.6	112	121.5	84.1	103.3	52.3	51.5	63.0
Reef 250, Guana River	34	34	59	62	7	4	109.2	132.1	61.1	69.6	93.3	92.1	37.5	53.1
Reef 80, Devil's Elbow	24	17	52	24	24	60	32.4	85.2	105.3	42.7	70.0	83.9	86.6	51.7
Reef 17, Pellicer Creek	18	16	73	61	9	21	144.8	38.1	69.6	50.0	68.5	99.6	58.4	42.1

Table 4: Biological characteristics measured on the oyster reefs by resampled reefs and region. Regions are organized north to south. *All values are averages unless otherwise noted.

Reef, Region	Percent Live Cover		Clusters		Oysters		Oyster Lengths (mm)*					
	Summer	Winter	Summer	Winter	Summer	Winter	Min		Mean		Max	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Reef 146, Nassau	20	36	18	22	49	37	6.5	11.0	41.7	49.8	86.6	104.3
Reef 4, Duval	20	20	15	12	35	14	4.6	15.9	41.5	51.3	112.8	86.7
Reef 250, Guana River	34	34	14	22	50	59	3.9	3.4	40.0	42.4	87.1	99.3
Reef 80, Devil's Elbow	24	17	19	7	24	21	14.6	6.2	50.9	50.2	94.4	98.8
Reef 17, Pellicer Creek	18	16	18	16	44	51	5.4	2.7	32.6	25.6	62.4	55.4

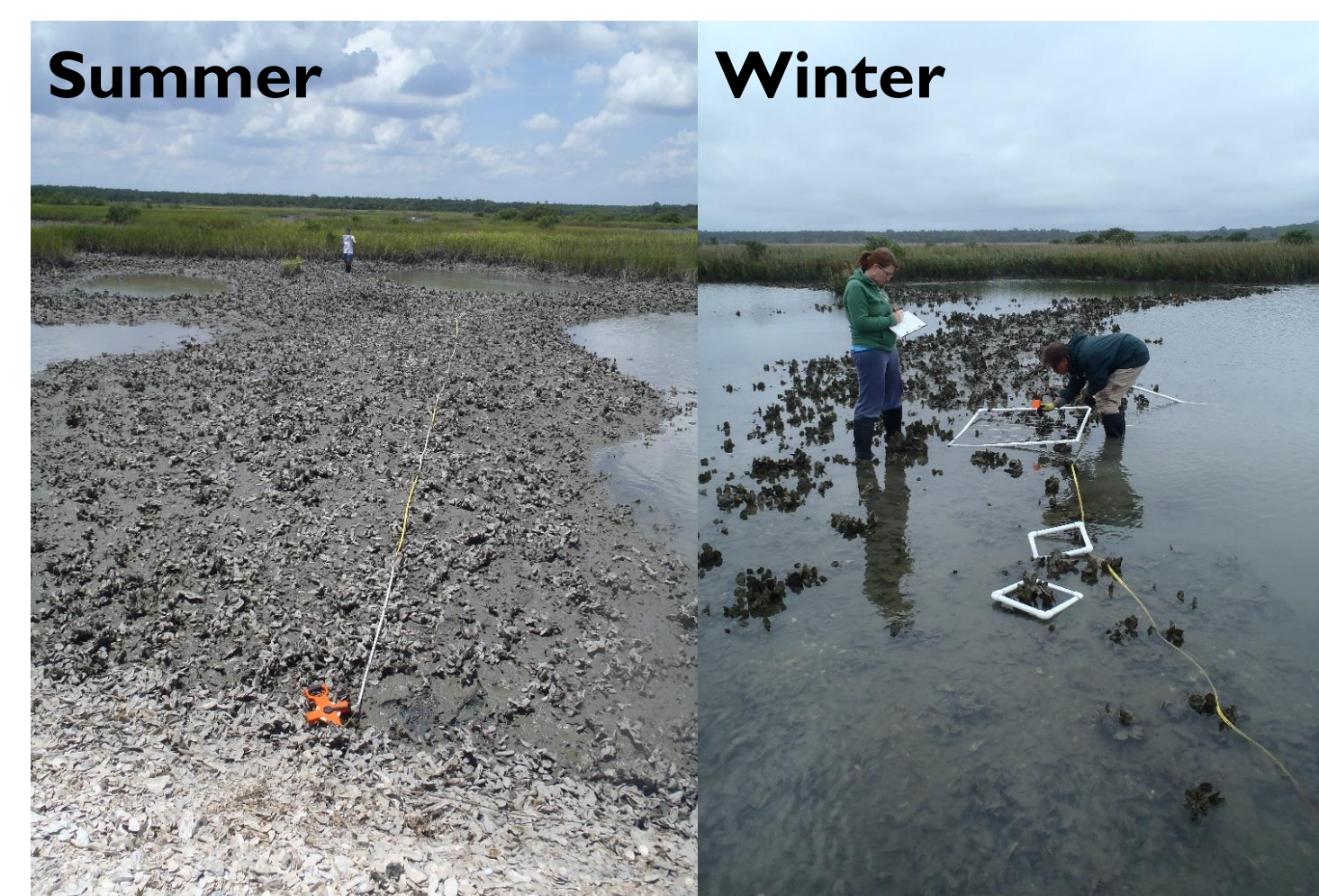


Figure 3 Field photos taken from reef 80, located in the Devil's Elbow region south of St. Augustine, FL. Left is summer 2015 sampling and right is winter 2016 sampling. Storms and nor'easter winds prevented the tides from going out in many of the winter collections.

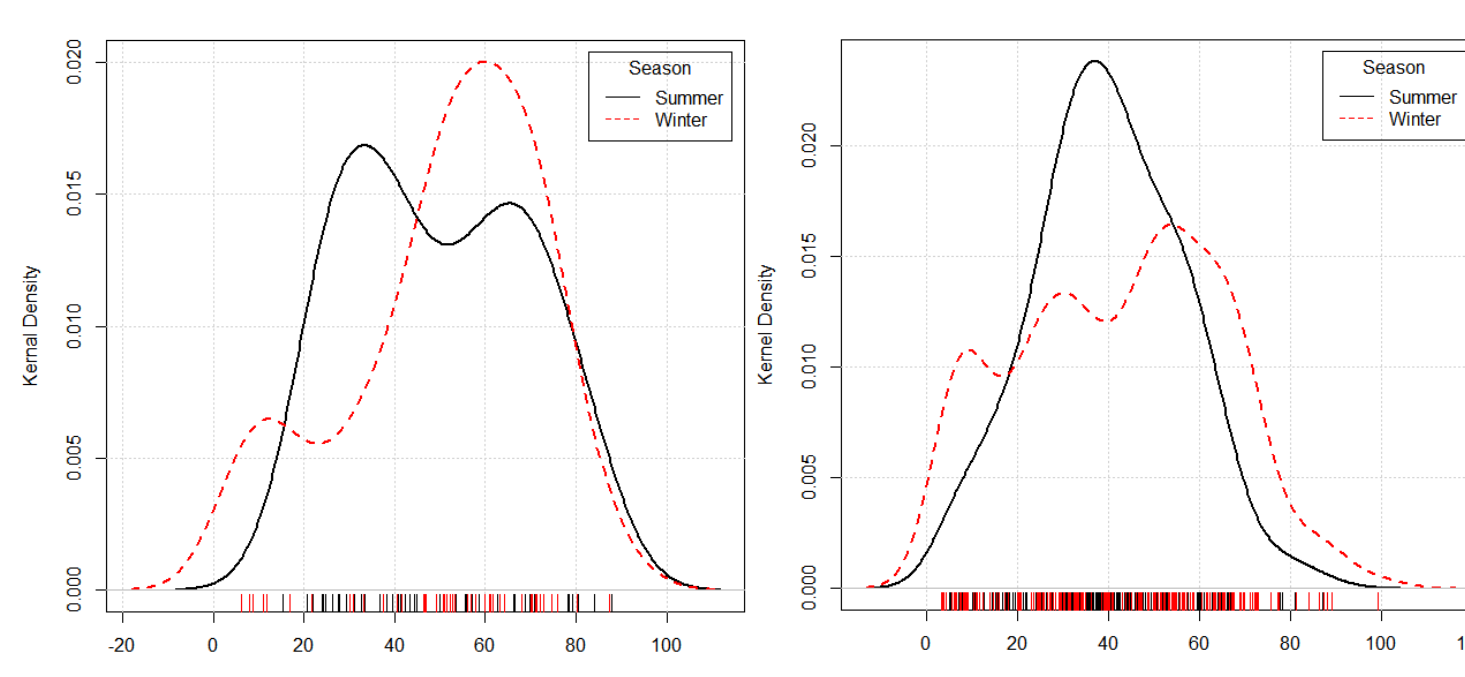


Figure 4 Kernel Density estimates show the seasonal differences of all oyster lengths from (left) Reef 80, located in the Devil's Elbow region (summer n=102; winter n=93); (right) Reef 250, located in the Guana River region (summer n=216; winter n=196).

Acknowledgements Thanks to Erica Hernandez and the St. Johns River Water Management District for help in mapping & reef selection as well as the Walters Lab at University of Central Florida for photos & project coordination. Thank you to our field sampling crew: Jeremy Wohlforth, Jonathan Boston, Remo Mondazzi, Chuck Snavey, John and Reagan Ratcliff, and many other staff & volunteers. Funding support from the Florida Coastal Management Program.

Further Discussion

Sampling efforts from Summer 2015 were impacted by summer storms, small craft advisories, and rapid tidal changes, therefore only 21 of the goal for 50 sampled reefs were completed. This led to low sample sizes in several regions including the Nassau, Duval, Guana, Tolomato, and St. Augustine regions. Sampling efforts from Winter 2015-16 are to include the original 21 summer reefs as well as 29 additional reefs to increase the sampling size in necessary regions. Seasonal comparisons will be conducted on the original 21 reefs that were sampled during both the summer and winter seasons. Of particular interest are seasonal differences in percent cover, physical reef characteristics (such as height), as well as oyster lengths (size classes).

Currently, the research staff at the GTM Research Reserve are also conducting oyster monitoring efforts that will be compared to the methods used in this oyster condition assessment project in order to develop a standardized protocol for future sampling of northeast Florida oyster reefs. This project not only provides baseline information on oyster reefs across the northeast Florida region, but will also aid in the establishment of a sampling protocol for future research on the oysters in this region.

A final report will be produced (June 2016) with the sampling protocol and comments, raw data, data analysis, and recommendations to sample efforts. Included in the analysis will be a correlation matrix, geospatial comparisons, analysis of similarity (ANOSIM), and general summary statistics to serve as baseline information of the northeast Florida oyster reefs. Additionally, this report will also include ArcGIS mapping to reflect geospatial data of reef physical characteristics, oyster lengths, and commensal faunal abundances.