

The effects of oyster harvest on resident nekton communities and oyster reef habitat characteristics in coastal Louisiana

Steve Beck¹ and Megan La Peyre²

¹School of Renewable Natural Resources, Louisiana State University AgCenter, sbeck2@lsu.edu

²U.S. Geologic Survey, Louisiana Fish and Wildlife Cooperative Research Unit, School of Renewable Natural Resources, Louisiana State University AgCenter



BACKGROUND

Oyster reefs provide diverse ecological services in estuaries including the creation of refuge and foraging habitat for numerous organisms, and maintenance of water quality. Oyster harvest may result in changes to structural habitat complexity, but the extent of these changes and how they affect resident nekton organisms is unclear and has not been thoroughly examined. Furthermore, the effects of harvest on the provision of critical habitat has not been examined. Oyster management in Louisiana provides a unique opportunity to study the effects of oyster harvest on oyster reef communities because both harvested and un-harvested oyster reef areas exist.

OBJECTIVE

To compare resident nekton communities, reef structural complexity, and water quality at un-harvested and harvested oyster reefs across coastal Louisiana.

METHODS

Study site/Sample times: Four sites across coastal Louisiana with similar salinity ranges were selected for comparison. Sites were located in public seed grounds; two sites in areas that are open to harvest, two sites in areas that are closed to harvest (Figure 1). At each site, 3 stations were established. Sabine and Sister Lakes were sampled twice in spring (April/May) and twice in summer (July/August) of 2010. Calcasieu Lake sites were sampled twice in fall (September/October) of 2010.

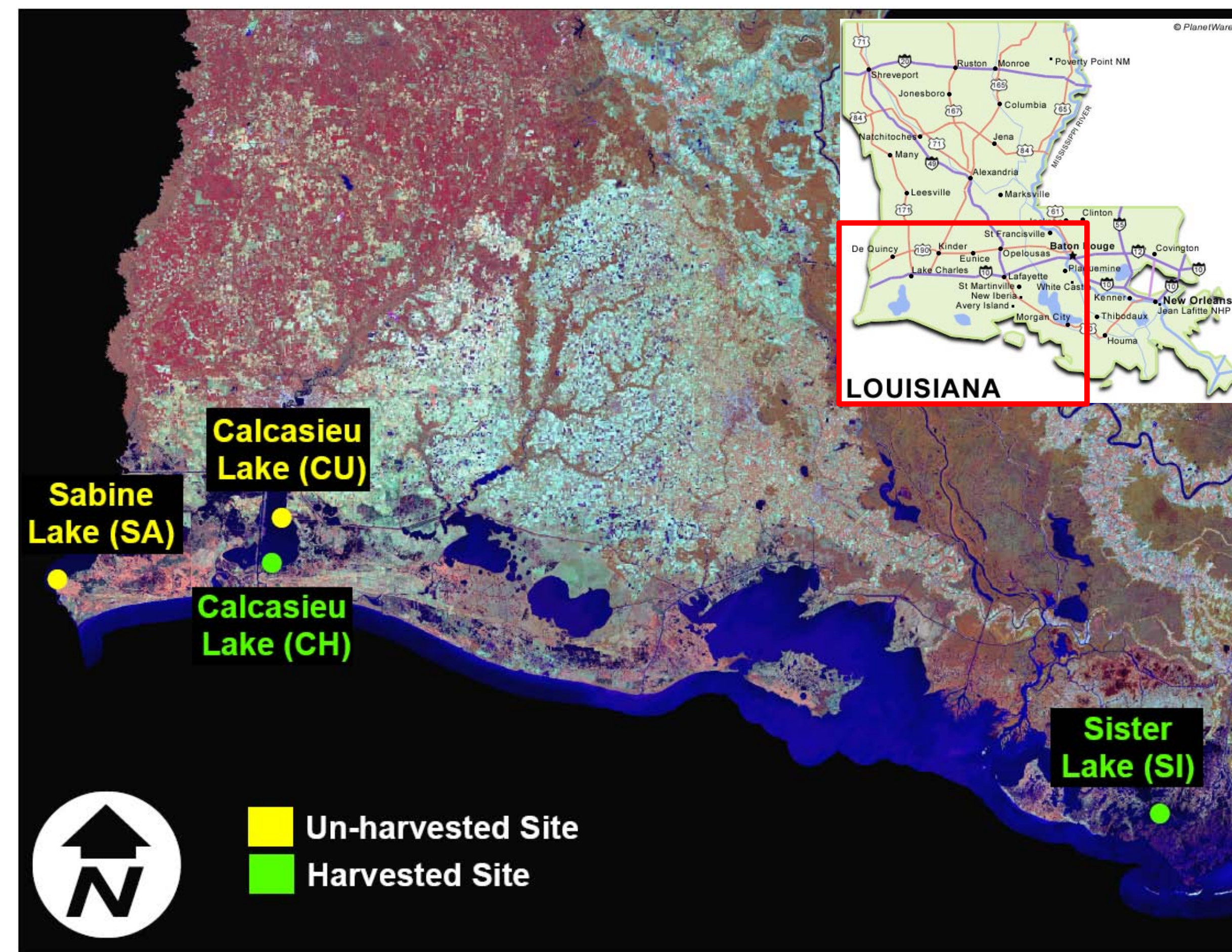


Figure 1: Sample sites in coastal Louisiana.

Resident community sampling: A minimum of three modified sampling trays (Figure 2) were deployed at each station in order to characterize the resident nekton community. Each tray (0.22 m²) was filled with 5 liters of oyster reef substrate hand-dredged on-site. Trays were sampled approximately 2 weeks and 4 weeks after deployment. During each sampling event, all nekton was collected from trays and placed on ice for laboratory identification. Two-sample t-tests were used to compare mean tray abundance [catch per unit effort (CPUE)] and species richness for paired harvested and un-harvested sites: Sabine and Sister Lake (spring and summer) and Calcasieu Lake sites (fall).

Reef characterization: Reef physical characteristics were described during summer and fall sampling by total volume of oyster shell and oyster cluster, number and size range of live oysters, and number of box shells. Volumes were determined using displacement. To characterize the oyster reef present at each station, 20 random depth measurements and 20 random pole estimates of bottom type (mud, shell/mud mix, and solid reef) were taken.

Water quality: Salinity, temperature (°C), dissolved oxygen (mg L⁻¹) were measured with a YSI-85 during tray sample collection. Chlorophyll-a (µg L⁻¹) samples were collected with each sampling event.



Figure 2: Modified sampling trays (0.22 m²) used for this project were fitted with a collapsible drawstring mesh bag (1.6 mm) that enclosed the sample before retrieval.

PRELIMINARY RESULTS

Resident Community: A total of 21 species of nekton were collected during sampling, including 10 fish species and 11 invertebrate species (Table 1). Dominant species include the naked goby (*Gobiosoma bosc*), flatback mud crab (*Eurypanopeus depressus*), and grass shrimp (*Palaemonetes* spp.). In spring, nekton abundance (p=0.04) was greater at the harvested site, Sister Lake as compared to the un-harvested Sabine Lake, but no differences occurred in summer samples (Figure 3). In both spring and summer sampling, the harvested Sister Lake had higher species richness as compared to the un-harvested Sabine Lake (p<0.01). Within Calcasieu Lake, there was no difference in abundance or species richness between harvested and un-harvested sites.

Table 1: Number of each species collected at each site during spring, summer, and fall sampling. A dash (-) indicates no individuals were collected at that site. Total trays collected differs by site due to loss of trays during deployment. Harvested Sites are in yellow, un-harvested sites are in green.

Species	Site/Season					
	Spring		Summer		Fall	
	Sabine Lake	Sister Lake	Sabine Lake	Sister Lake	Calcasieu Lake	Calcasieu Lake
Fish						
<i>Chaetodipterus faber</i>	-	-	1	1	-	-
<i>Chasmodes bosquianus</i>	-	-	2	6	5	3
<i>Gobiosox strumosus</i>	2	3	10	28	13	3
<i>Gobionellus boleosoma</i>	-	2	-	1	-	-
<i>Gobiosoma bosc</i>	23	143	29	271	165	194
<i>Hypsoblennius ionthas</i>	3	6	24	48	5	3
<i>Lutjanus griseus</i>	-	-	-	1	2	-
<i>Myrophis punctatus</i>	1	5	-	7	-	-
<i>Opsanus beta</i>	4	4	10	4	-	1
<i>Paralichthys lethostigma</i>	-	-	1	-	-	-
Invertebrates						
<i>Alpheus</i> sp.	-	9	2	24	1	17
<i>Callinectes sapidus</i>	-	17	-	37	46	58
<i>Clibanarius vittatus</i>	-	4	-	-	-	-
<i>Eurypanopeus depressus</i>	175	231	230	223	571	639
<i>Farfantepenaeus aztecus</i>	-	-	1	4	-	3
<i>Litopenaeus setiferous</i>	2	-	-	-	-	-
<i>Menippe mercenaria</i>	0	1	1	12	7	22
<i>Micropanopeus sculptipes</i>	0	32	2	53	-	-
<i>Palaemonetes</i> spp.	200	148	639	333	437	245
<i>Panopeus herbstii</i>	49	26	69	33	3	59
<i>Petrolisthes armatus</i>	-	-	-	-	-	1
Number of tray samples per site (n)	14	9	14	12	15	17

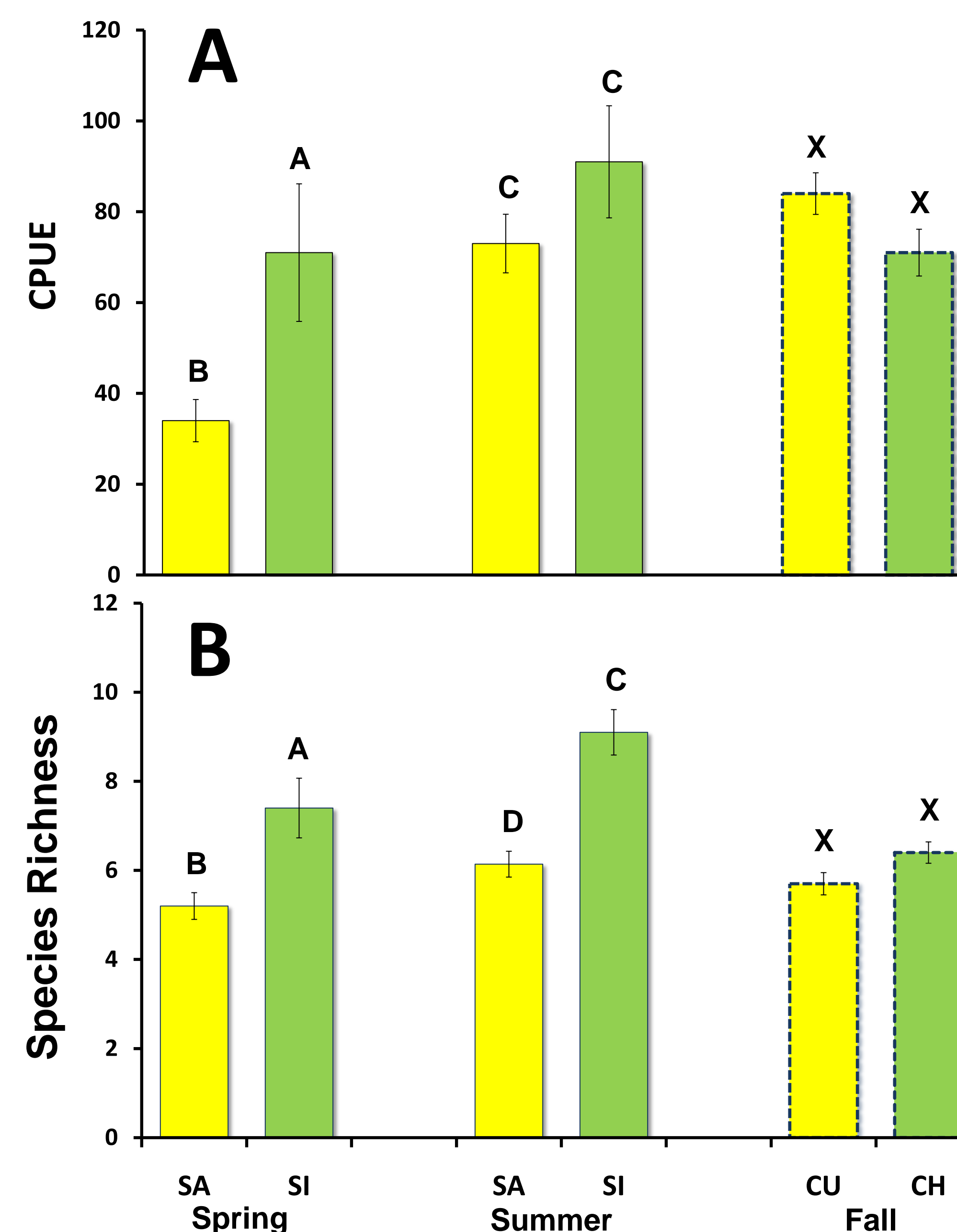


Figure 3: (A) Mean tray CPUE (±SE) for all sites. (B) Mean tray species richness (±SE). Comparisons were made between sites within each season. Statistical differences in means are indicated by different letters above each bar. Harvested sites are in green, un-harvested sites are in yellow.

RESULTS CONTINUED

Reef characterization: Harvested reef substrate consisted of greater oyster clusters, and larger oysters as compared to the un-harvested reef substrates (Table 2, Figure 4). Depth and poling measurements did not reveal any differences in vertical relief between sites.

Water quality: Chlorophyll a was elevated at harvested sites compared to un-harvested sites (Table 3). Dissolved oxygen, salinity, temperature and depth were similar between sites.

Table 2: Mean substrate contents of each tray deployed during summer and fall sampling during 2010. The remaining volume required to equal 5.0 liters per tray was typically loose live oysters and/or shell fragments.

Substrate Descriptors	Site			
	Un-harvested Sites		Harvested Sites	
	Sabine Lake	Calcasieu Lake	Calcasieu Lake	Sister Lake
Loose Shell Volume (L)	0.28	0.00	1.97	0.75
Oyster Cluster Volume (L)	3.89	4.37	1.83	2.91
Live Oyster (#)				
Market	32.29	17.47	12.59	9.17
Seed	34.71	43.07	6.00	101.50
Box Shell (#)	5.28	1.66	7.88	1.83

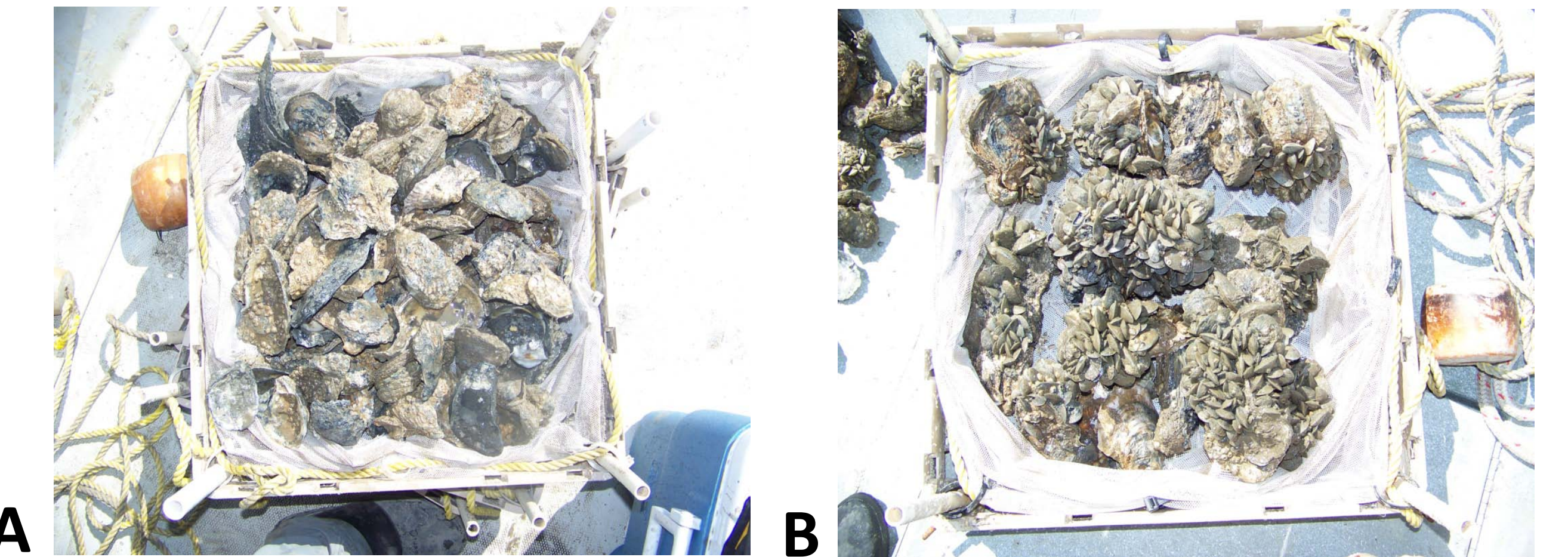


Figure 4: Differences in substrate between sites. A: Harvested site (CH). B: Un-harvested site (CU).

Table 3: Mean water quality measurements taken during spring, summer, and fall sampling. Un-harvested sites are in yellow, harvested sites are in green.

Water Quality Parameter	Site/Season					
	Spring		Summer		Fall	
	Sabine Lake	Sister Lake	Sabine Lake	Sister Lake	Calcasieu Lake	Calcasieu Lake
Dissolved Oxygen (mg/L)	5.32	5.43	5.11	4.83	6.86	6.44
Salinity	15.65	21.04	13.12	11.70	19.93	19.16
Temperature (°C)	24.32	24.32	31.02	31.23	26.17	24.02
Depth (m)	2.40	1.98	2.48	2.03	1.33	1.92
Chlorophyll a (µg/L)	5.84	15.22	8.12	18.66	8.57	16.62

CONCLUSIONS & FUTURE WORK

-Differences occurred in resident nekton community assemblage and reef substrate characteristics between sites.

-These differences could be regional, site-specific, and/or attributed to substrate alteration associated with oyster harvest. This study does not reflect habitat support of transient nekton species.

-Future work on species-specific comparisons, fish condition and trophodynamics (outlined below), and multivariate analyses of habitat characteristics and community assemblages will further elucidate differences between sites.

Fish Condition: Length-weight relationships and hepatosomatic indices of dominant fish species will be compared between harvested and un-harvested sites for summer and fall data.

Isotope Analysis: Additional samples for δ¹³C and δ¹⁵N stable isotope analysis that were collected include phytoplankton, zooplankton, sediment, dominant marsh plant, oysters, barnacles, and mussels. The δ¹³C and δ¹⁵N stable isotope values from sampled nekton will be used to determine if any differences in trophic structure or basal food source dependence exists across sites.

ACKNOWLEDGEMENTS

I would like to thank the Louisiana Department of Wildlife and Fisheries (Patrick Banks, Mike Harbinson, Steve Hein, Kieth Ibois) for their assistance with background and management information for each site. Also, my graduate committee for helping me design this project (Mike Kaller, John Fleeger, John Supan), and all those who helped me in the lab and field (Ben Eberline, Shea Miller, Lainey Pitre, Jessica Furlong, Gary Decossas, Cynthia Hodnett, Melissa Fries, Will Sheftall, Kris Brown, Derrick Klimesh, Charlie Brown, Holly Beck).