



LOUISIANA OYSTER

2022 Stock Assessment Report of the Public Oyster Seed
Grounds and Reservations of Louisiana

Oyster Data Report Series No. 28



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STATEWIDE OVERVIEW

Introduction

Louisiana's vast coastal wetlands provide ample habitat where Eastern oysters (*Crassostrea virginica*) thrive under a variety of environmental conditions. Louisiana's Eastern oyster stock is one of the largest oyster stocks in the nation, supporting one of the state's largest and most valuable fisheries and providing important ecological services to the state. The Louisiana Department of Wildlife and Fisheries (LDWF) is charged with managing the state's oyster resource by closely monitoring the size and health of oyster populations on nearly 1.7 million acres of public oyster areas (Figure 1) as well as setting oyster seasons, monitoring harvest levels and enhancing habitat (e.g., cultch planting, reef building, etc.).

The oyster industry has historically used Louisiana's public oyster areas as a source of seed oysters (less than 3 inches in length) to transplant to private oyster leases and grow to market size. In Louisiana, there are approximately 404,000 acres of private oyster leases. The public oyster areas also yield a supply of market-size oysters (greater than or equal to 3 inches in length), which may be taken directly to market during oyster seasons. Louisiana leads the nation in oyster production primarily due to this public/private oyster production system. Annual dockside sales have reached as much as \$85 million as recently as 2017, and the value of Louisiana's 2021 production was around \$53 million (Figure 2)

Louisiana's public oyster areas are defined in one of two ways. The Louisiana Wildlife and Fisheries Commission (Commission) is entrusted with designating Public Oyster Seed Grounds (POSGs). Currently, the POSGs are comprised of Lake Borgne, Chandeleur/Breton Sound, Barataria Bay, Little Lake, Deep Lake, Lake Chien, Lake Felicity, Lake Tambour, Lake Mechant, and Vermilion/Cote

Blanche/Atchafalaya Bays. The Louisiana Legislature designates Public Oyster Seed Reservations (POSR), which include Bay Gardene, Hackberry Bay, Sister (Caillou) Lake and Bay Junop. Other public oyster areas designated by Louisiana Legislature include Calcasieu and Sabine Lakes.

LDWF manages public oyster areas to balance the fishery's economic opportunity with the resource's biological sustainability. Management depends on obtaining the best fishery dependent and independent data available through monitoring harvest and resource availability throughout the oyster season and performing yearly stock assessments. The annual individual Coastal Study Area (CSA) oyster stock assessment reports help fulfill these data needs as they provide estimates of the current stock size of the oyster resource within their respective basin. The information these data provide allows resource managers to effectively implement management changes to use the current resource and protect its long-term viability.

Oysters also play an essential ecological role in the estuarine ecosystem. Oyster reefs provide the majority of hard substrate required by other sessile invertebrate species such as barnacles, bryozoans, tunicates and anemones. Many invertebrates and fish also use oyster reefs as shelter and forage habitat. In addition, the oyster's filter-feeding activities enhance estuarine water quality, and reefs can help stabilize shorelines.

Louisiana Oyster Landings

Louisiana regularly leads the nation in commercially harvested oyster landings. From 2002 through 2021, Louisiana accounted for 33% of the nation's oyster landings. In 2021, Louisiana produced

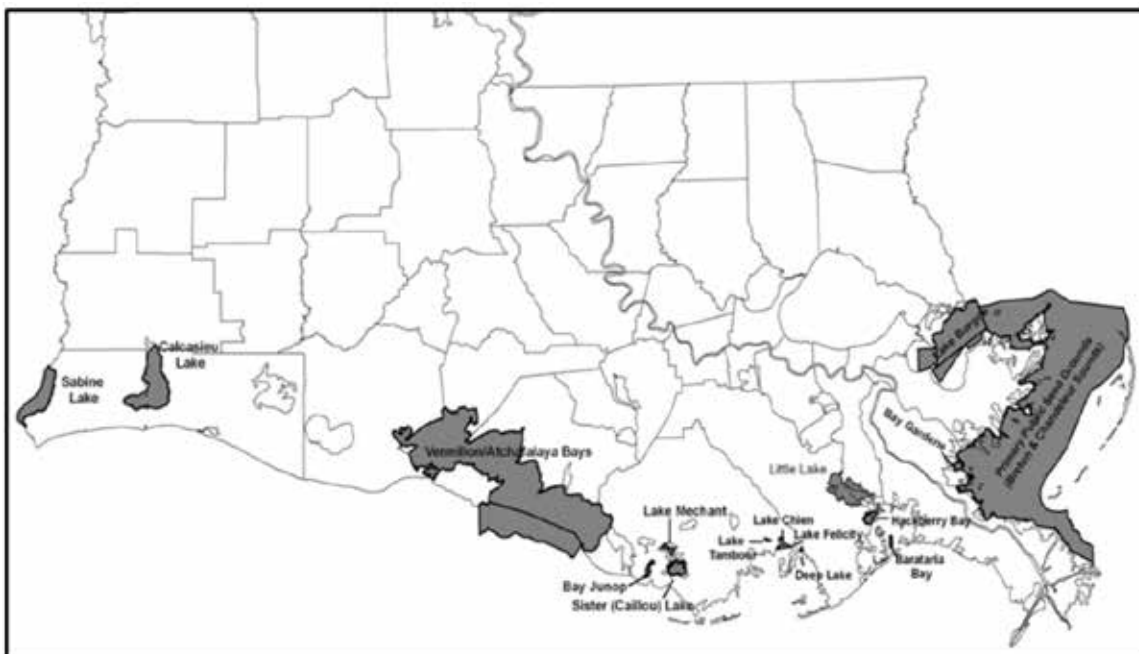


FIGURE 1. Public oyster areas of Louisiana.

27% of annual landings by weight (Figure 2) and 23% by value (Figure 3). Of that production, approximately 24 thousand pounds came from public oyster reefs, while private oyster reef landings totaled approximately 6.6 million pounds. Total landings in 2021 were reported at approximately 6.7 million pounds of meat (Figure 4) which led the nation for Eastern oyster annual production.

Stock Assessment Methods

Management of the public oyster grounds and reservations relies heavily upon data gathered through a comprehensive biological monitoring program. State biologists use two gear types when sampling the public reef areas. One is a 24-inch hand dredge and the other is a square-meter (m²) frame. Data is analyzed to determine the overall health of the oyster resource through-

out the year. Approximately 1,700 dredge samples are collected statewide during each calendar year. Data are used to monitor the overall health of the oyster stock and assess recruitment of new age classes of oysters. Over 1,000 m² samples are collected per calendar year. That includes samples collected as part of the Coastal Protection and Restoration Authority (CPRA) System-Wide Assessment and Monitoring Program (SWAMP). Collected m² data are used to measure the annual oyster stock size, which is the basis on which yearly oyster season recommendations are made to the Commission. Additionally, field biologists routinely gather hydrological data on public oyster areas and develop harvest and fishing effort estimates by conducting boarding report surveys of oyster boats during open oyster seasons.

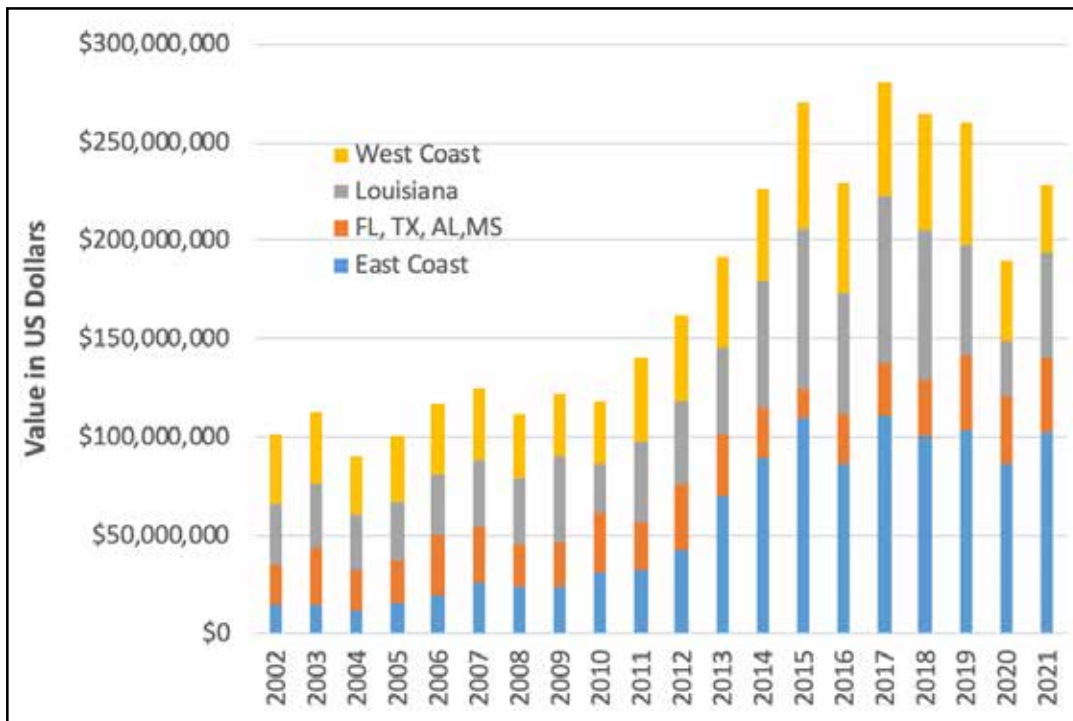


FIGURE 2. Annual commercial oyster landings (all species) in dockside value. Data provided by NOAA Fisheries.

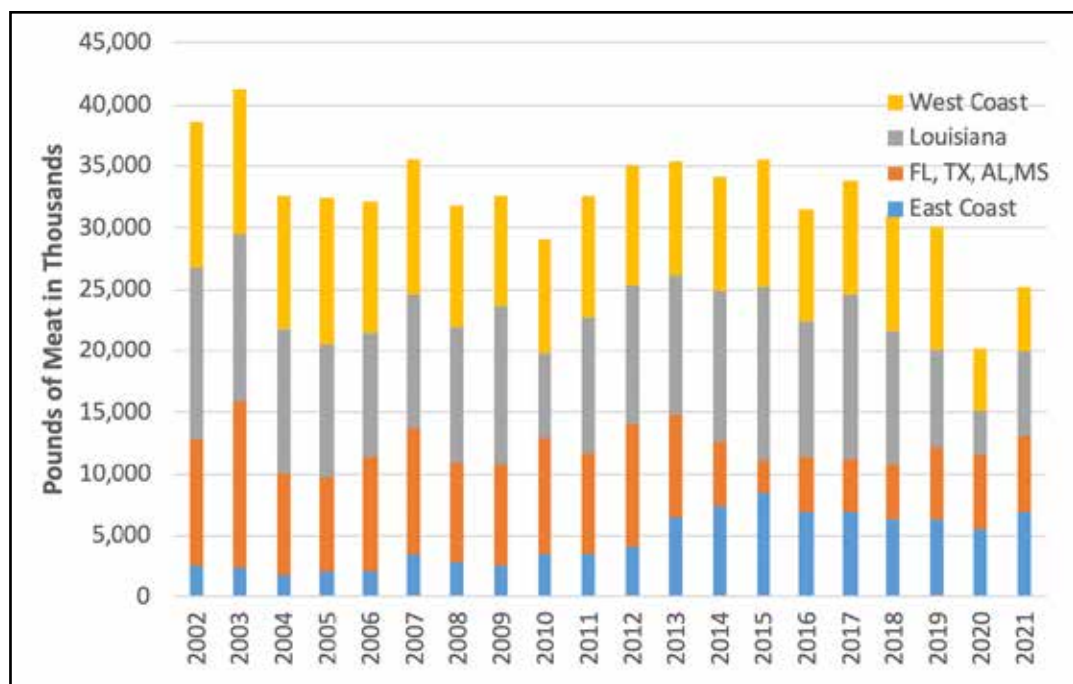


FIGURE 3. Annual commercial oyster landings (all species) in pounds of meat. Data provided by NOAA Fisheries.

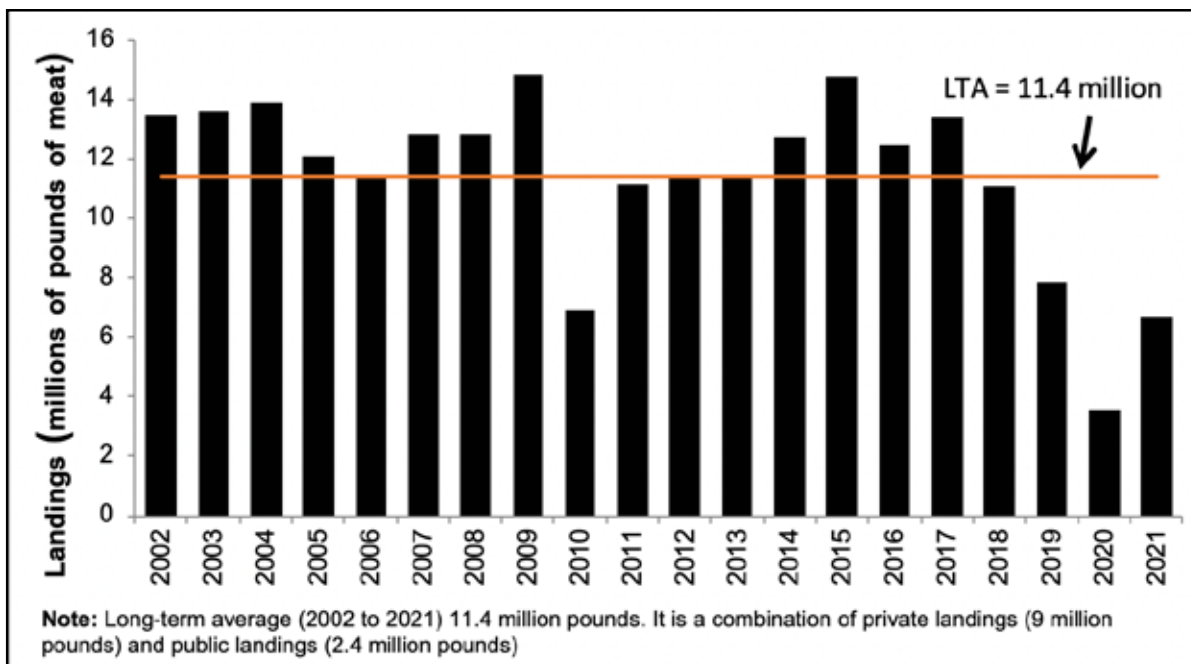


FIGURE 4. Louisiana oyster landings for public oyster areas and private oyster leases, 2002- 2021 (LDWF and NOAA Fisheries data).

Sampling for annual stock assessments occurs in July. LDWF biologists SCUBA dive on designated m² sampling stations within each CSA (Figure 5). An aluminum square-meter frame (quadrat) is randomly placed at each sampling station on the oyster reef. All live and dead oysters, reef-associated organisms and exposed reef material are collected by hand from the upper portion of the substrate within the quadrat. This process is replicated for a total of five samples taken per sampling station. With the collected data a catch per unit effort (CPUE) for each reef is determined from the five replicates. Using the CPUE per square meter, this data is extrapolated across each reef or reef complex to determine the abundance of oyster resource. Each reef acreage has been determined through departmental or contractor side-scan bottom assessments which are used for the CPUE extrapolation. Water temperature, dissolved oxygen and salinity data are collected at each station and cultch material types are identified and weighed.

LDWF biologists visited sampling stations during the oyster stock assessment, gathering individual samples. The assessment presents sampling data by CSA. During assessment sampling, CSA 1 South had the most sampling stations (26), while CSA 5 East had the fewest (3). There is a higher sampling density in the Black Bay (CSA 1 South) and Sister Lake (CSA 5 West) areas due to their high oyster production in past years and historical importance to the oyster industry. Twenty of the sampling stations were located on cultch plants constructed since 2004 by LDWF.

The southern oyster drill (*Stramonita haemastoma*) is a marine gastropod known to prey on oysters using a small tooth-like scraping organ called a radula to bore a hole through the oyster shell. Oyster drills occur in coastal waters with a salinity gradient of 15 ppt or higher. Oyster drill numbers are documented during the stock assessment sampling to access this predator's impacts to each reef complex.

Several crab species are also known predators of oysters. Mud crabs (Family *Xanthidae*), blue crabs (*Callinectes sapidus* and *Callinectes similus*) and stone crabs (*Menippe adina*) are known oyster predators along the Louisiana coast. These crabs will pry or crush oyster

shells to access their softer inner tissues. Crab numbers are documented during the stock assessment sampling to access their impacts to each reef complex.

Perkinsus marinus, is a protozoan parasite, commonly called Dermo. Dermo infects live oyster tissue and is known to cause extensive oyster mortalities especially in high salinities and elevated water temperatures. Oysters are sent off to contracted laboratories to be tested for the prevalence of Dermo to help manage its impacts on reef populations.

The hooked mussel (*Ischadium recurvum*) is a reef-associated benthic bivalve species that competes with oysters for food and settlement surfaces. Large numbers of hook mussels on a reef can impact oyster growth and lower settlement raise of oyster larvae. Hooked mussel numbers are documented during the stock assessment sampling to access this competitor's impacts to each reef complex.

Sampling conducted as part of the annual oyster stock assessment plays a valuable role in predicting the success of the upcoming oyster season, which can open as early as September and runs through the end of April of the following year. However, the season may be closed or delayed if biological concerns or enforcement problems are encountered. LDWF uses oyster stock assessment information to make recommendations regarding setting the oyster season to the Commission.

In addition, Sustainable Oyster Shellstock Models are being improved and utilized to provide harvest thresholds for the public oyster areas of Louisiana. These models will help maintain reef material over time and were created in partnership with Dr. Thomas Soniat at The University of New Orleans (UNO). This computerized model guides fisheries management to conserve the oyster reef base. Oyster stock assessment sampling provided model input data such as estimates of reef mass (grams per m²) and size-frequency of oysters. Utilizing additional data on oyster growth, mortality, salinity and estimated commercial harvest rates, the model estimates the amount of oyster harvest allowed

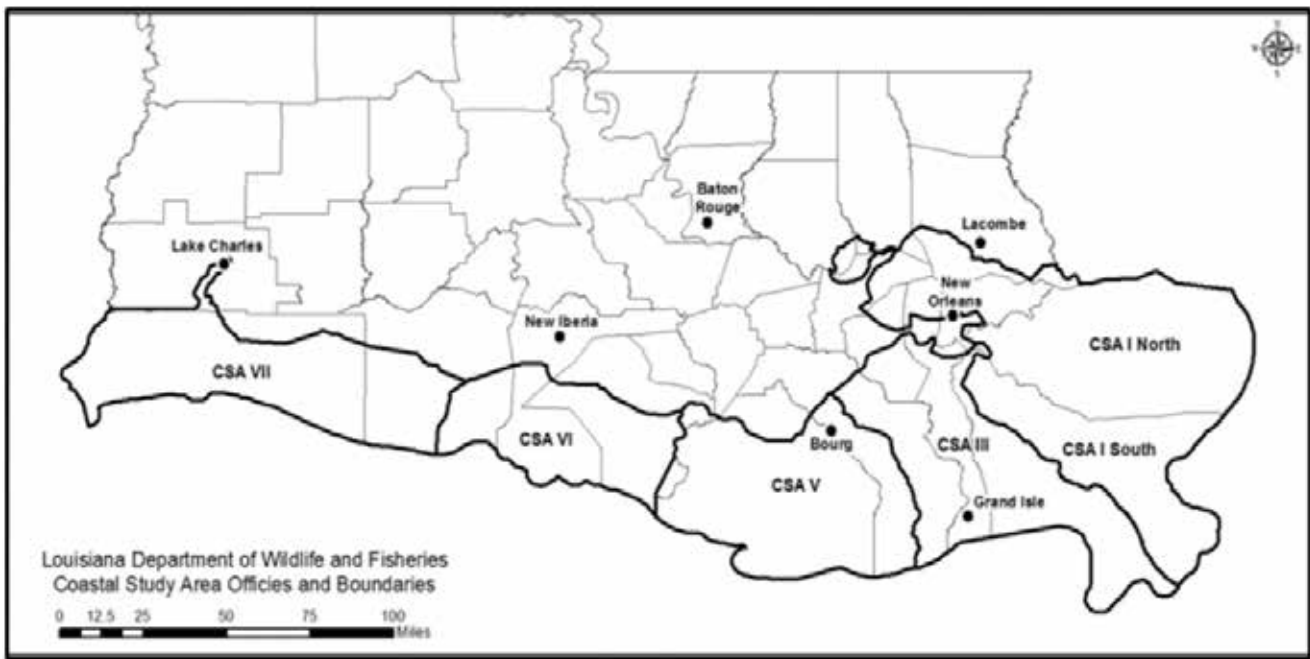


FIGURE 5. Louisiana Wildlife and Fisheries Coastal Study Areas (CSAs).

on each reef while preserving sufficient reef mass to keep the reef viable. The models simulate based on three different conditions - low, medium and high salinity patterns for each basin. The model has been tested statewide and showed promising results. At this time, Sustainable Oyster Shellstock Models are applied to reefs in CSA 1N, 1S, 3, 4 and 5. CSA 6 has no known reef acreage to apply to model outputs; and CSA 7 (Calcasieu Lake) is already managed otherwise with restrictive gear and daily quota measures. Oyster harvesting is prohibited in Sabine Basin by law.

Annual Stock Size

The 2022 estimated oyster stock in Louisiana’s public oyster areas is approximately 472,381 barrels of oysters (Table 1) which is an approximate increase of 27% from the 2021 stock. Similar to recent years, most of the live oyster stock is in Calcasieu Lake (CSA 7), which holds 55% of the 2022 estimated availability (Figure 7). Statewide, seed oysters increased by 4%, while market-size oysters increased by 51% compared to 2021. While significant increases were observed in east of Mississippi River (south of MRGO), Hackberry Bay and West Cove of Calcasieu Lake, the 2022 Public Oyster area resource is 66% below its 20-year (LTA) average (Figure 6) and is still considered severely stressed.

Harvest Monitoring Methods

During the oyster season, LDWF monitors commercial harvest through boarding surveys of vessels working the Public Oyster Seed Grounds. Biologists record vessel location, past and current catch rates, and an estimate of future fishing effort. The boarding data is summarized weekly to maintain a cumulative harvest estimate for specific reef complexes. The data is projected over the number of fishable days (winds less than 25 mph) to determine a total harvest estimate of seed and market-size oysters for the week. Biologists routinely board vessels collecting seed oysters to determine if they are harvesting excessive amounts of non-living reef material.

LDWF also obtains harvest data via its trip ticket system. However, trip ticket data provide limited resolution as they are consolidated by geographic region and are considered preliminary until well after the season.

LDWF collects fishery independent data via monthly oyster dredge sampling 11 months of the year to assess the health and condition of the resource. Data from those samples further inform management of the impact harvest activity has on the public grounds.

2021/2022 Oyster Season

The goal for the 2021-2022 oyster season was to allow for resource recovery, set fixed short openings in Sister Lake to allow better harvest assessment and reduce fleet concentrations, with the intent to minimize reef degradation. The 2021-2022 Oyster Season opened on Oct. 25, 2021, and closed on April 30, 2022 (Table 2).

The estimated commercial harvest totaled 21,132 sacks (10,566 bbl.) overall. This was a significant increase from the 2020-2021 oyster season which only recorded 685 sacks of harvest. Over the past 10 years, heavy localized harvest, high mortality events, strong tropical events, environmental changes and lack of recruitment have contributed to an ongoing downturn in the oyster resource in the public seed grounds. Scarce oyster availability resulted in closed seasons in CSA 1 North, CSA 1 South, CSA 3 and CSA 6.

Special Oyster Management Projects

LDWF biologists continue to participate in several important projects to increase oyster production on the POSG. Since 1917, LDWF has placed over 1.5 million cubic yards of cultch material on nearly 30,000 acres with positive results. Cultch material provides a substrate for oyster larvae to settle on. Areas that are planted with cultch are referred to as “cultch plants.” Recent cultch plants include: a 100-acre cultch plant in Calcasieu Lake (2017); a 100-acre addition to the 2012 Lake Fortuna cultch plant (2018); a 200-acre cultch plant in Caillou Lake (Sister Lake) in 2021; four 10-acre brood stock reefs east of the Mississippi River in Petit Pass, Karako Bay, Lake Machias and Mozambique Point; and an approximate 200-acre cultch plant in Drum Bay (2022).

The 2021/2022 projects were funded through *Deepwater Horizon* Natural Resource Damage Assessment (DWH NRDA) settlement dollars to restore for injuries to oysters that occurred as a result of the 2010 *Deepwater Horizon* oil spill. The Louisiana Trustee Im-

TABLE 1. Estimated oyster stock (in bbl.) on Louisiana’s public oyster areas by basin. Percentages are change from previous year. Green indicates increase, red indicates decrease.

CSA	Basin	Seed	Seed % Change	Market-Sized	Market-Size % Change	Total	Total % Change
1N	Lake Borgne/MS Sound	25,175	-24%	7,960	-65%	33,135	-40%
1S	East of MS River, South of MRGO	46,144	204%	11,648	1196%	57,792	260%
3	Hackberry Bay	14,558	585%	2,698	135%	17,256	428%
5E	Lake Chien/Felicity	0	n/a	0	n/a	0	n/a
5W	Sister Lake/Bay Junop	72,385	-39%	30,873	28%	103,258	-29%
7	Calcasieu - East Side	15,034	404%	12,296	-28%	27,330	36%
7	Calcasieu - West Cove	29,716	53%	203,894	81%	233,610	77%
Statewide Totals		203,011	4%	269,368	51%	472,381	27%

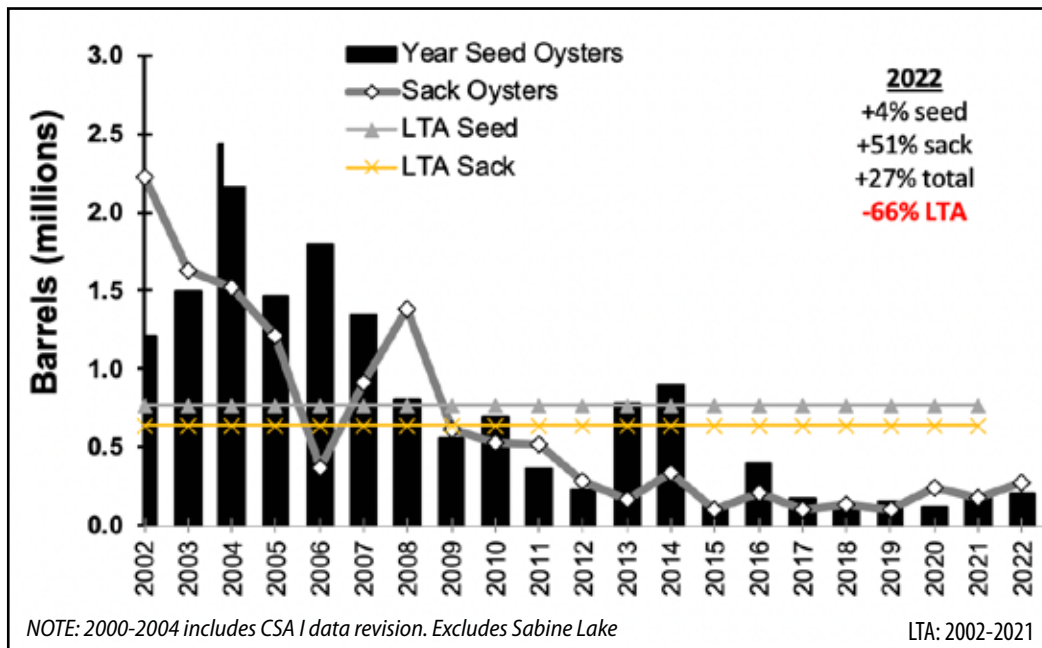


FIGURE 6. Seed and market-size oyster stock availability in Louisiana’s public oyster areas. LTA denotes the long-term average from 2002 through 2021. Percentages indicate change from 2021.

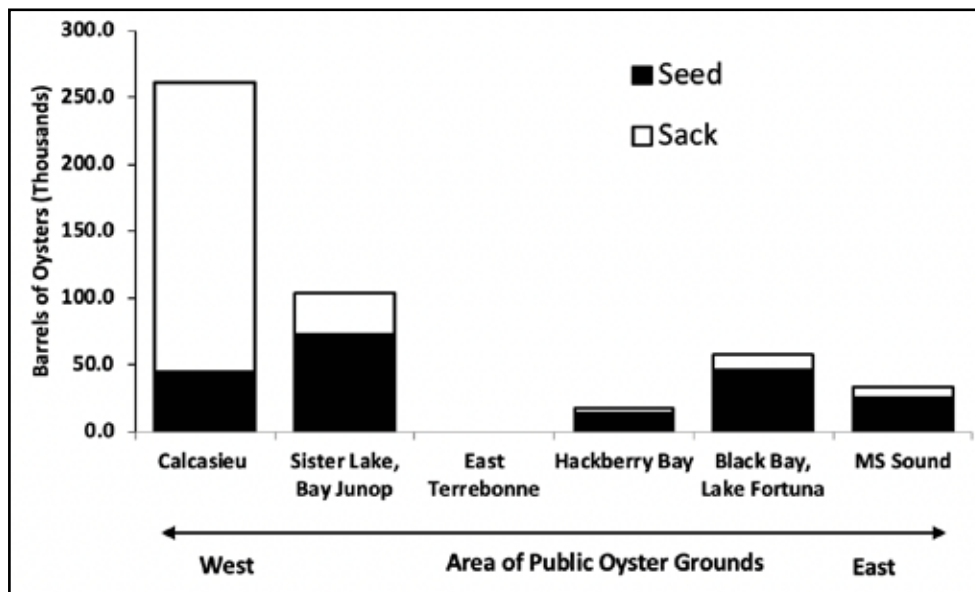


FIGURE 7. 2022 Oyster stock distribution in Louisiana’s public oyster areas by basin.

TABLE 2. Harvest estimates for the 2021/2022 oyster season on Louisiana’s public oyster areas. Harvest estimates, based on LDWF conducted surveys of oyster harvesting vessels during the oyster season. Data derived from fishery dependent surveys of harvesting vessels.

2021-2022 LDWF OYSTER SEASON SUMMARY						
CSA	Area	Season Opening	Season Closure	Season/Type	Days Open	Harvest (sacks)
1	PSOG East of Mississippi River and North of MRGO	CLOSED				
	POSG East of Mississippi River and South of MRGO					
3	Hackberry Bay	CLOSED				
	Little Lake, Barataria Bay					
5	Deep Lake, Lake Chien, Lake Felicity and Lake Tambour	CLOSED				
	Bay Junop, Lake Mechant	CLOSED				
	Sister Lake multiple openings	Oct. 25	Oct. 25	Seed Harvest	1	2,210
		Oct. 26	Oct. 29	Market Harvest	4	1,334
		March 7	March 10	Market Harvest	4	2,764
March 21		March 23	Market Harvest	3	2,699	
6	Vermilion Bay	CLOSED				
7	Calcasieu Lake	Nov. 1	April 30	<i>East Side: Market Harvest</i>	181	3,437
		Nov. 1	April 30	<i>West Cove: Market Harvest</i>	181	9,941

plementation Group (LATIG) approved 26 million dollars in oyster projects, including enhancing oyster recovery using brood reefs, cultch-plant oyster restoration and hatchery-based oyster restoration. LDWF will monitor the performance of the reefs through regularly scheduled sampling events, and anticipates further enhancement of the reefs with hatchery-raised juvenile oysters as opportunities arise.

The Michael C. Voisin Oyster Hatchery located on Grand Isle, Louisiana, is operated through a collaborative effort between LDWF and Louisiana Sea Grant (LSG). LSG assists with facility operations, provides technical guidance, manages the LSG Breeding Program, and supports the oyster industry through extension, outreach and research projects. LDWF focuses on the production of diploid and triploid seed and larvae for state restoration projects, as well as commercial sales to support the industry.

The Hatchery produces diploid oyster larvae for setting on shell, which is then referred to as spat-on-shell and is used for State oyster restoration projects. To prepare for setting on shell, 3-foot mesh bags are filled with recycled oyster shell which has been obtained through a collaboration with the Coalition to Restore Coastal Louisiana’s Oyster Shell Recycling Program (CRCL). In the spring 2022 season there were two spat-on-shell deployments. Four hundred fifty bags of spat on shell were deployed to Karako brood stock reef on May 17, 2022; and a similar deployment (estimated 8 million larvae) were deployed to Machias Brood reef on June 7, 2022. Marine Fisheries contracted-out assessments on these deployments for Month 1, 6 and 18 to assess the survival success.

Recent Legislation

Louisiana House Concurrent Resolution 26 of the 2021 Regular Session of the Louisiana legislature directed the Louisiana Department of Wildlife and Fisheries (LDWF) to conduct a study to deter-

mine the final destination of oyster shells removed from Louisiana waters. In the autumn of 2021, the LDWF conducted a survey of Louisiana oyster dealers to assess the sales of oysters in two different forms (whole oysters or shucked oysters) to purchasers in Louisiana or in other states to address this issue. The survey results support the observation that most of the oysters harvested in Louisiana are shipped out of state in a form that makes the recovery of their shells for return to the state costly and logistically complicated. An estimated three quarters of the oysters handled by Louisiana’s seafood dealers are sold directly out of the state as whole or sack oysters. Further, previous research of Gulf oyster processors suggests that significant amounts of the dealers’ sales to Louisiana processors (5.4% of respondents’ sales) and dealers (9.0% of respondents’ sales) are shipments of whole oysters to out-of-state buyers.

Conclusion and Acknowledgments

The biological stock assessment, historical oyster landings statistics and a brief synopsis of each CSA’s most recent oyster season are all included in the report that follows. Biological data were generated from quantitative square-meter sampling, while landings data were generated from boarding surveys and trip ticket information. This report was prepared by Carl Britt, Willie Chermie, William Hano, Denise Kinsey, Ty Lindsey, Jeff Marx, George Melancon and Troy Sehlinger. Biologists from each CSA spent extensive time gathering samples and producing the report. Additionally, Chris Schieble and Christian Winslow assisted with editorial review and preparation of this document. Efforts of the field and office staff are greatly appreciated, as this report could not be produced without their hard work and dedication. Please direct questions and comments to Robert Caballero, Oyster Program Manager, at 504-286-4054 or rcaballero@wlf.la.gov.

COASTAL STUDY AREA 1 NORTH

(East of Mississippi River and North of MRGO)

Introduction

The Public Oyster Seed Grounds in CSA 1 North (North Pontchartrain Basin) consist of approximately 690,000 acres of water bottom located within Lake Borgne, the Louisiana portion of Mississippi Sound, Chandeleur Sound, the Biloxi Marsh, and adjacent waters. Louisiana, Mississippi and Texas fishermen harvest oysters from this area, which has historically been an area of high oyster production within the state of Louisiana. Although the state of Louisiana has managed this area as Public Oyster Seed Grounds for many decades, the Commission did not designate the majority of this area by rule until 1988. The Commission designated much of Lake Borgne as public oyster seed ground in 1995 and expanded the grounds in 2004. LDWF expands and enhances the public oyster reefs through the placement of cultch material (e.g. shell, limestone, crushed concrete) on suitable water bottoms. LDWF completed cultch plants in Three Mile Pass and Drum Bay in 2013 as part of the 2010 *Deepwater Horizon* oil spill Natural Resource Damage Assessment (DWH NRDA) Early Restoration Program. In early 2020, LA Wildlife & Fisheries collaborated with NGOs to complete construction of four artificial reefs in CSA 1 North. Limestone, oyster shell and reef balls were deployed at sites near Cabbage Reef, Grand Banks, eastern Lake Borgne and West Karako Bay, with the intention of creating habitat for oyster brood stock. In July 2022 LDWF completed the construction of two oyster reefs totaling approximately 230 acres in Drum Bay (St. Bernard Parish). This project was also funded through DWH NRDA settlement dollars to restore for injuries to oysters that occurred as a result of the DWH spill. Drum Bay was chosen due to its more remote location from any Mississippi River outflow and its higher resiliency to recent stressors.

Methods

LDWF biologists collected field samples for this oyster stock assessment between July 6-19, 2022, from a total of 18 stations within CSA 1 North according to the methodology described in the Statewide Overview of this report. Sampling stations included 17 historical stations and the 2013 NRDA Early Restoration cultch plant at Three Mile Pass (*Figure 1.1*).

To better locate and assess the oyster stock in the Public Oyster Seed Grounds, LDWF has conducted a number of side-scan sonar studies of water bottoms in these areas. These studies coupled with historical reef and cultch plant information resulted in a more up-to-date and realistic designation of productive water bottoms for use in the annual oyster stock assessment (*Table 1.1*). The 2022 CSA 1 North oyster stock assessment is based on a reef assessment of 22,196 acres of water bottom, which includes 449 acres of cultch plants.

Only productive Public Oyster Seed Grounds for which an accurate acreage can be determined are included in the oyster stock assessment. For this reason, some areas, such as Public Oyster Seed Grounds located within Lake Borgne, are not included in this oyster stock assessment.

Results and Discussion

Seed- and Market-Size Stock

The 2022 estimated oyster stock size for CSA 1 North is 25,175.3 bbl of seed oysters and 7,959.8 bbl of market-sized oysters, for a total of 33,135.1 bbl of overall stock (*Table 1.1*). This total assessed oyster stock for 2022 is down 40.4% from 2021. This decrease in available resource is especially concerning when considering the growth that was seen during the 2021 stock assessment. Compared to 2021, there was a 24.1% decrease in the seed estimate. The current estimated market-sized stock is calculated to be 64.6% below the market-sized estimate of 2021. With the decreases in predicted oyster stock in this year's assessment, seed stock is down 86% from the previous 10 years' average (2012-2021) while market-sized stock fell to 88.0% below the previous 10 years' average. Total assessed oyster stock for 2022 is 86.5% below the previous 10 years' average. The oyster densities observed on the Three Mile Pass Cultch Plant and the Drum Bay reef complex drove this year's stock estimate. The Three Mile Pass Cultch Plant accounted for 36.0% of the seed oyster stock in CSA 1 North, with a mean density of 10.2 seed oysters per square meter. A large density of seed oysters was also observed on the Shell Point reef, with 5.8 seed oysters per square meter. In all, six of the 18 stations sampled held seed oysters. The Drum Bay reef complex held 88.4% of the market-sized oyster estimate, with a mean density of 0.4 market-sized oysters per square meter. Drum Bay, Shell Point and the Three Mile Pass Cultch Plant were the only three reefs found to hold market-size oysters during this assessment.

It is important to note variability both within and among stations when comparing estimates. This variability is magnified when extrapolating small sample sizes to large areas. In short, changes between annual assessments can be dramatic on an individual reef basis, and only limited areas of significant resource availability are often identified.

Since 2012, CSA 1 North has experienced periods of heavy localized harvest, high mortality events, strong tropical events (Hurricane Isaac in 2012, Hurricane Nate in 2017, Hurricane Zeta in 2020 and Hurricane Ida in 2021), the 2010 *Deepwater Horizon* oil spill and related spill response activities, and devastating spring flood events prompting the opening of the Bonnet Carré Spillway five times in the past 10 years (2016, 2018, twice in 2019, and 2020). These continual limits to recruitment and survival have severely reduced oyster resources across the Pontchartrain Basin. As a result, both the estimated seed- and market-sized oyster stocks continue to fall well below the previous 10 years' average (*Figure 1.2*).

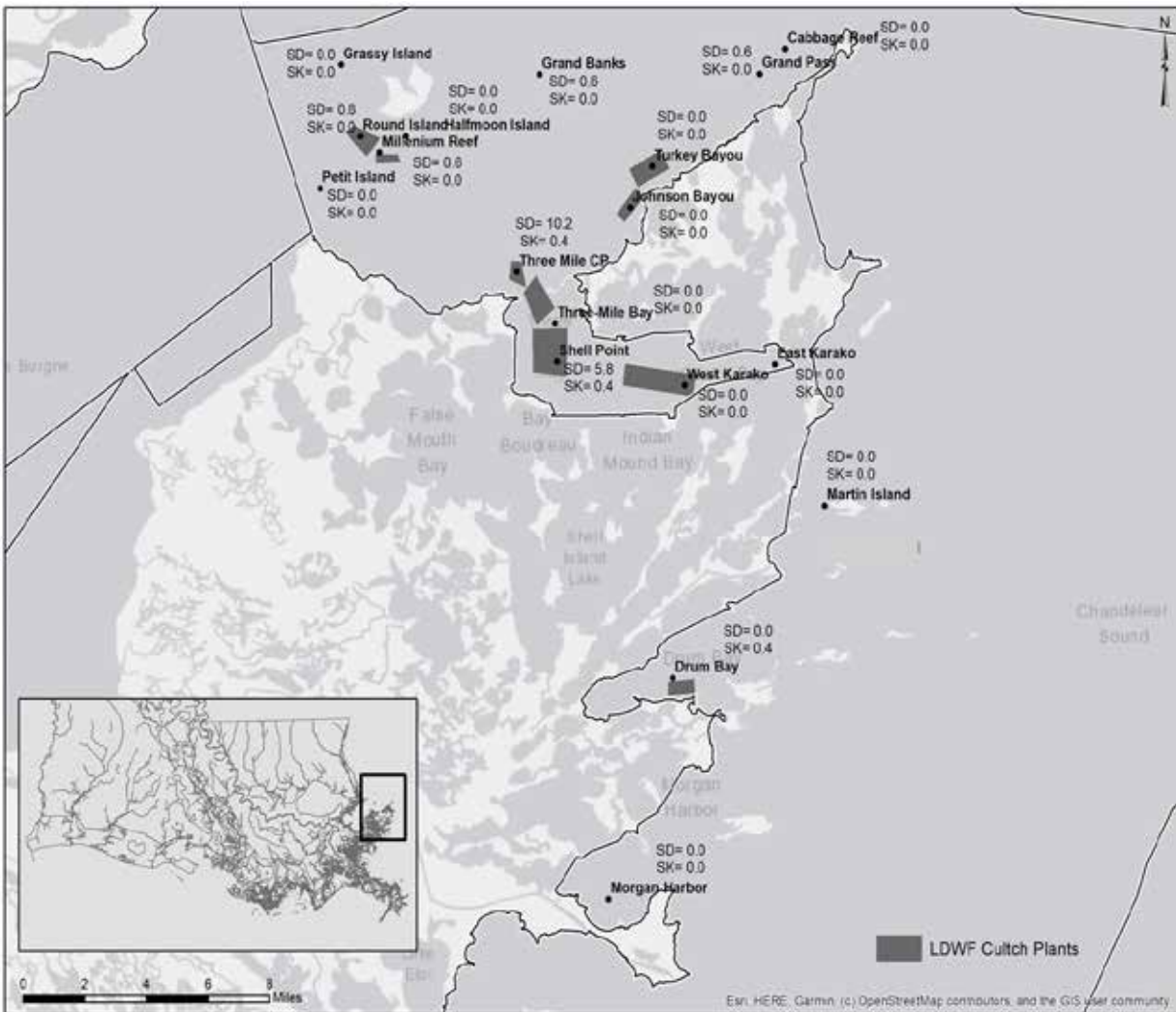


FIGURE 1.1. 2022 CSA 1 North oyster stock assessment sampling stations with average seed and Market-sized sampling densities for the 2022 stock assessment, square-meter sampling.

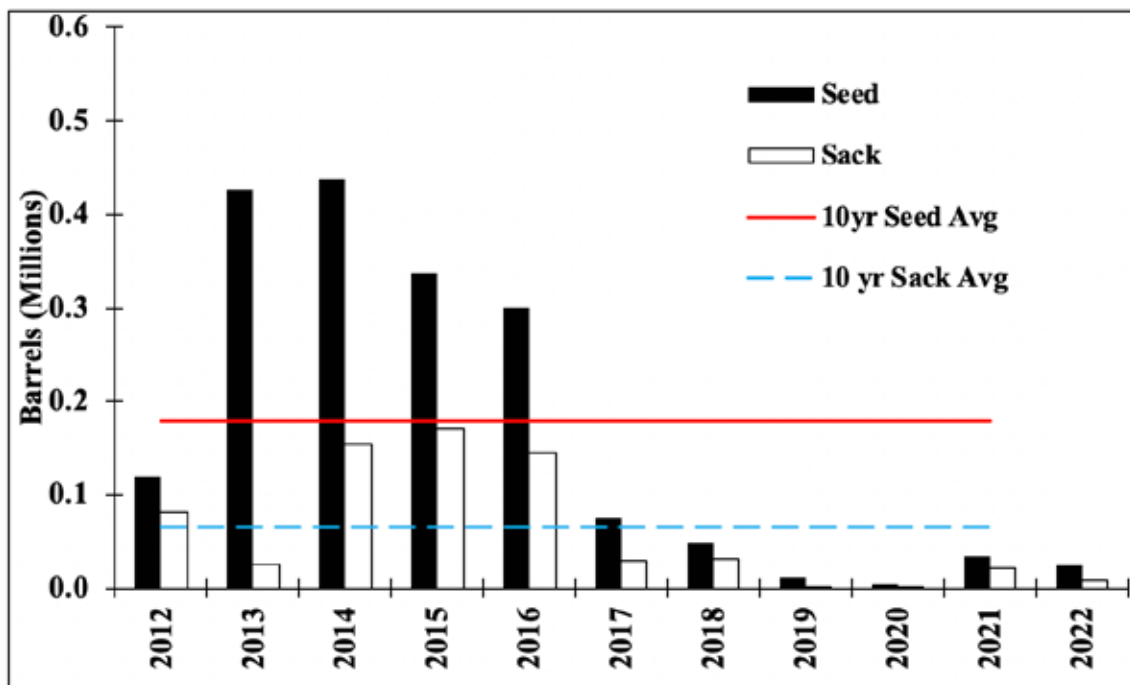


FIGURE 1.2. Current and historical seed and market-size stock size estimates in CSA 1 North. Horizontal lines represent the previous 10-year' seed and market-size stock size estimate averages.

TABLE 1.1. 2022 Oyster availability by sampling station or reef complex in CSA 1 North.

Station	Reef (Acres)	Average Number Seed Oysters/m ²	Average Number Market- Size Oysters/m ²	Seed Oysters (bbl)	Market-Sized Oysters (bbl)
Grassy Island	5,328	0	0	7,187.2 (14,374.4 sacks)	0.00
Halfmoon		0	0		
Petit		0	0		
Grand Banks		0.6	0		
Millennium		0.6	0		
Halfmoon Reef Complex Cumulative		0.24	0		
Three Mile Bay	3,059	0	0	0.00	0.00
East Karako		0	0		
West Karako		0	0		
3 Mile Bay Complex Cumulative		0	0		
Grand Pass	5,411	0.6	0	6,082.6 (12,165.2 Sacks)	0.00
Cabbage Reef		0	0		
Turkey Bayou		0	0		
Cabbage Reef Complex Cumulative		0.2	0		
Martin Island	3,183	0	0	0.00	0.00
Shell Point	47	5.8	0.4	1,538.7 (3,077.4 Sacks)	212.2 (424.4 Sacks)
Johnson Bayou	200	0	0	0.00	0.00
Drum Bay	1,565	0	0.4	0.00	7,037.1 (14,074.1 Sacks)
Morgan Harbor	2,954	0	0	0.00	0.00
Round Island	291	0.8	0	1,308.5 (2,617.0 sacks)	0
Three Mile Pass	158	10.2	0.4	9,058.3 (18,116.6 Sacks)	710.5 (1,421 Sacks)
Total	22,196			25,175.3 (50,350.6 Sacks)	7,959.8 (15,919.5 Sacks)
			LTA (2012-2021)	2022	% Change
		Seed	179,208.20	25,175.30	-86.0%
		Market-Size	66,233.54	7,959.80	-88.0%
		Overall	245,441.74	33,135.10	-86.5%

Spat Production

Live spat were observed at 10 of the 18 sample stations sampled during this assessment. At these sample stations, mean densities ranged from 0.4 to 10.4 individuals per square-meter, with the highest average occurring at Grand Pass. Occurrence of spat oysters greatly increased from the previous year's assessment with an increase of 483.9%. While this is an increase from the previous year, there continues to be a persistent trend of a lack of spat set on most CSA 1 North reef areas during spring spawning events. These periods of poor recruitment can be attributed to several different factors, such as freshets, hypoxia, overburden, dissolution of cultch, or a combination of these stressors. It is noted that annual square-meter samples may occur between seasonal spawning events in some areas. It is further noted that spat numbers can be somewhat biased by the amount of substrate collected in a given sample.

Hydrological Data

On Aug. 29, 2021, Hurricane Ida made landfall at Port Fourchon as a Category 4 hurricane with maximum sustained winds of 150mph. Dredge samples were conducted a week after the storm had passed and it was documented that there was minimal overburden on the oyster reefs in Mississippi Sound and in Drum Bay. It was documented that there was moderate to heavy overburden on the 3 Mile Pass Cultch Plant and the 3 Mile Reef Complex. The only mortality that was documented was minimal spat mortality at Cabbage Reef. Hurricane Ida inundated southeast Louisiana and Mississippi with widespread rain and caused freshwater flooding along local rivers which attributed to the lower than average salinities for Fall 2021. Starting in January 2022, according to the U.S. Drought Monitor, the Pontchartrain Basin experienced abnormally dry to moderate drought conditions. With these drought conditions, the Basin experienced slightly higher than average salinity

and water temperatures for the late winter and spring seasons. Spring 2022 marked the second year since 2017 without a Mississippi River flood event necessitating the opening of the Bonnet Carré Spillway (Figure 1.3).

Fouling Organisms

During 2022 Oyster Stock Assessment sampling, the hooked mussel (*Ischadium recurvum*) was observed at 10 of the 18 sampling stations. The highest density of mussels was 51.0/m² on the Millennium Reef. There was a marked increase in hooked mussel densities when compared to the previous year's observations. All observations of hooked mussels during this year's assessment were on reefs located in the western portion of Mississippi Sound and Three Mile Bay. This was likely due to the more favorable growing conditions that the area experienced during this time along with the increase of mature animals from the previous year. Although there is no documentation of barnacle fouling on oyster shells in the assessment, there has been documentation of light to moderate barnacle fouling of oyster shells in the monthly samples prior to the assessment at a few sampling stations. In addition, there were no observations of bryozoans on the exposed substrate at the sampling stations. All of these forms of fouling limit the ability of oyster larvae to attach to available cultch.

Oyster Predators and Disease

During this year's sampling event, oyster drills were observed at two of the 18 sampling stations. The highest densities of oyster drills was 1.0/m² at East Karako Reef and 0.4/m² at the West Kara-

ko Reef. No stone crabs (*Menippe adinia*) or blue crabs (*Callinectes* spp.) were collected in the square-meter samples. Other (*Xanthid*) mud crabs were noted in numerous samples that contained shell for substrate.

Mortality

Overall, mortality estimates slightly increased from the previous year's stock assessment. This is due to a higher percentage of spat mortality that was observed at the Cabbage Reef Complex (47.4%) and the West Karako Reef (37.5%). There were no seed or market-size-sized oyster mortalities recorded during this sampling event. It is important to consider that mortality estimates are often based on an extremely small number of animals. Further, for some annual stock assessments, samples may be taken shortly after large mortality events that have either diminished or severely depleted abundances, so that neither the mortality nor the prior abundance is fully captured in the assessment sampling.

2021/2022 Oyster Season

No portion of CSA 1 North public oyster seed grounds was made available for commercial harvest during the 2021/2022 oyster season. When compared to the previous year, the 2021 oyster stock assessment showed that oyster stocks in CSA 1 North were still in a state of recovery from mortalities resulting from the 2019 spring flood event. Resource managers recommended that the Basin be allowed an additional year of growth prior to resuming harvest on the Public Seed Grounds within CSA 1 North.

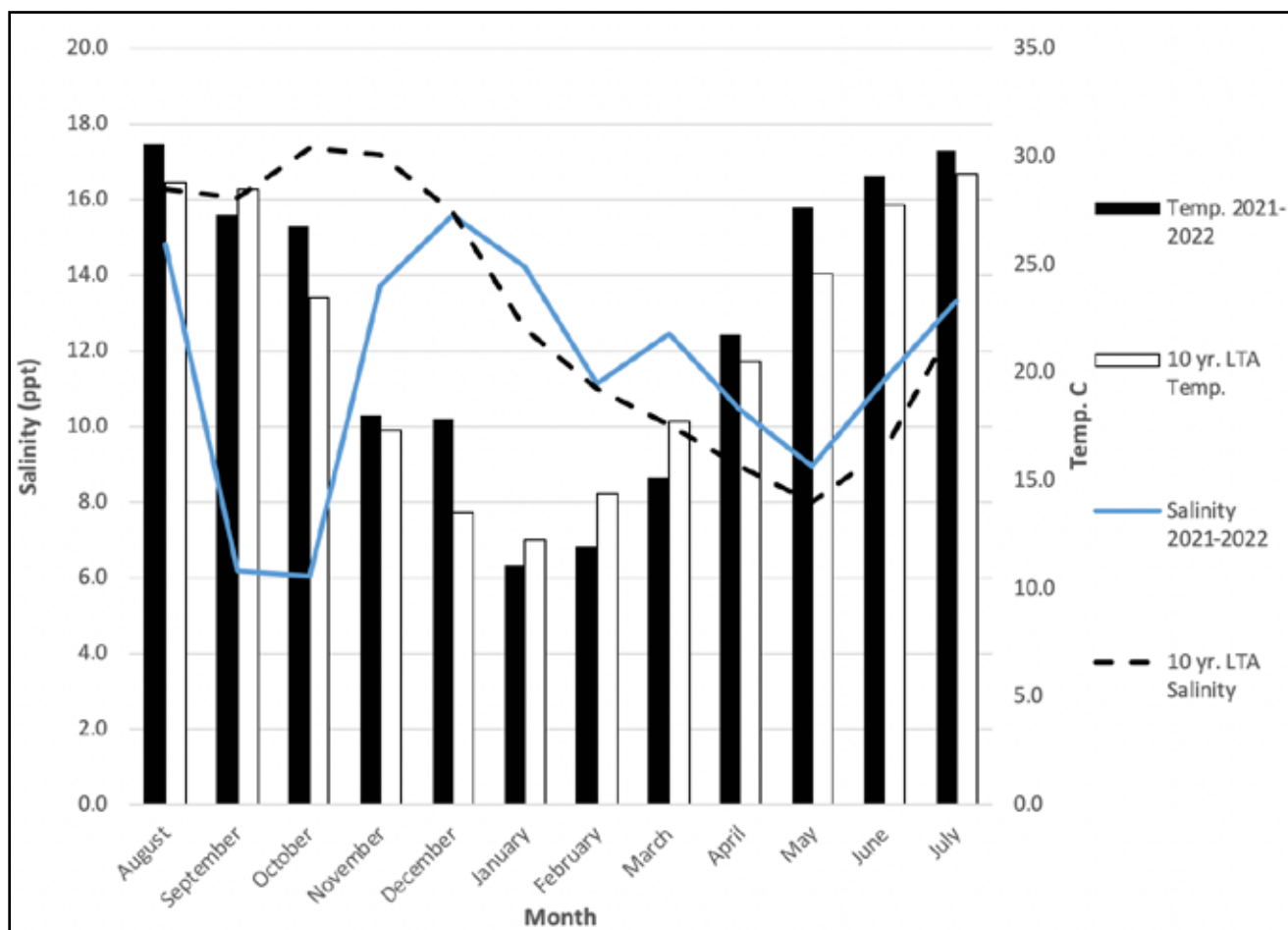


FIGURE 1.3. Mean salinity and temperature for Northern Lake Pontchartrain Basin Public Oyster Seed Grounds from August 2021 - July 2022.

COASTAL STUDY AREA 1 SOUTH

(East of Mississippi River and South of MRGO)

Introduction

The Public Oyster Seed Grounds in CSA 1 South (South Pontchartrain Basin), formerly CSA 2, consist of approximately 300,000 acres of water bottom. The grounds are located from the Mississippi River Gulf Outlet (MRGO) southward to South Pass in the Mississippi River delta and eastward from the eastern extent of private oyster leases east of the Mississippi River to the Breton National Wildlife Refuge. These Public Oyster Seed Grounds include Bay Gardene Public Oyster Seed Reservation, as well as areas designated as sacking only in Bay Long. Historically, this area has provided seed and market-size oysters for oyster fishermen from Louisiana, Mississippi and Texas. Mississippi River stages influences hydrology in the area by discharges through gaps in the Mississippi River levee south of Pointe a la Hache and through the Bohemia Spillway, discharge from the Caernarvon and Bayou Lamoque freshwater diversion structures, and main-stem river distributaries in the southern portion of the Basin.

LDWF continually expands and enhances public oyster reefs through the placement of cultch material (e.g. shell, limestone, crushed concrete) on suitable water bottoms. Numerous cultch plants have been constructed throughout CSA 1 South. The most recent cultch plants completed were in Bay Crabe and Lake Fortuna in 2012, as part of the 2010 *Deepwater Horizon* oil spill NRDA Early Restoration Program. In 2018, LDWF, NOAA and the St. Bernard Parish Government worked together to enhance a 100-acre portion of the (~300 acre) 2012 Lake Fortuna Cultch Plant by deploying 16,154 cubic yards of oyster shell.

Methods

LDWF biologists collected field samples for this oyster stock assessment between July 11-18, 2022, from 26 stations within CSA 1 South according to the methodology described in the Statewide Overview. Sampling stations included 25 regular sampling stations and the 2012 Lake Fortuna Cultch Plant (*Figure 2.1*). With its enhancements, the 2012 Lake Fortuna Cultch Plant remains significantly different from the surrounding Lake Fortuna Reef Complex; as a result biologists assess this area separately (*Table 2.1*).

To better locate and assess the oyster stock in the public oyster seed grounds, LDWF has conducted a number of side-scan sonar studies of water bottoms in CSA 1 South. These studies, coupled with historical reef and cultch plant information, have resulted in a more up-to-date and realistic designation of productive water bottoms for use in the annual oyster stock assessment. The 2022 oyster stock assessment has updated reef acreage of 27, 762.3 acres of water bottom.

Beginning with the 2013 oyster stock assessment, oyster reefs within CSA 1 South merged into reef complexes based on location, hydrology, oyster productivity and response to environmental stressors. There were 12 reef complexes, each with one to four representative m² sampling stations (*Table 2.1*). Water bottom

assessments have identified an additional 1,524 acres of oyster habitat (reef and scattered shell), but this acreage is not included in the total acres of water bottom or the annual oyster stock assessment acreage, as no current oyster sampling station adequately describes this acreage.

Results and Discussion

Seed- and Market-Size Stock

The 2022 estimated oyster stock for CSA 1 South consists of 46,143.6 bbl. of seed oysters and 11,647.7 bbl. of market-sized oysters, total: 57,791.3 bbl. of overall stock. Total estimated oyster stock for 2022 is up 260.0% from 2021. This represents the largest oyster stock assessment for the South Pontchartrain Basin since 2014. Compared to 2021, there was a 204.5% increase in the seed stock estimate. The 2022 market-size oyster stock increased nearly 12 times over the previous year's estimate. Due to low stock numbers in recent years, seed stock in CSA 1 South is now 24.5% over the previous 10 years' average (*Figure 2.2*). The current market-sized stock is down 29.0% from the previous 10 years' average. Total assessed oyster stock for 2022 is 8.1% above the previous 10 years' average (2012-2021). The Lake Fortuna reef complex and the 2012 Lake Fortuna cultch plant accounted for 73.9% of all oyster stock in CSA 1 South during this year's assessment. The oyster densities observed at South Lake Fortuna and the 2012 Lake Fortuna Cultch Plant drove this year's seed stock estimate, with mean densities of 2.4 and 4.6 seed oysters per square meter, respectively. Lake Fortuna reef complex also held the entire market-size oyster estimate, with a mean density of 0.3 market-size oysters per square meter. The remaining seed oyster stock resource observed in CSA 1 South came from reefs at South Black Bay reef complex and Wreck.

Spat Production

All live spat found in the 2022 oyster stock assessment samples were found at the Lake Fortuna, Wreck, 2012 Lake Fortuna Cultch Plant and the two South Black Bay Reef Complex stations; which had an average density of 0.4, 0.4, 0.2, 0.6, 0.2 and 0.4 spat per square-meter respectively. Biologists noted evidence of recent spat mortality at three sampling stations. Bayou Lost, Wreck and 2012 Lake Fortuna Cultch Plant recorded 100%, 50% and 25% spat mortality rates, respectively; however, the overall CPUE for spat in the area was low, at 0.08. Although these sampling events may occur outside of the peak spawning period, it is evident that there has been only minimal spat catch on these reefs. This marks a continuation of poor recruitment and survival within CSA 1 South. Long periods of poor oyster production needed to replenish available shell stock, have largely degraded reef areas to mud and heavily fouled shell hash with mussels and other organisms. This lack of suitable substrate to enable spat attachment adds another stressor to the population in this area. Fifteen of the 26 stations sampled did not have any measurable reef material, and several noted to have material almost completely buried under sediments.

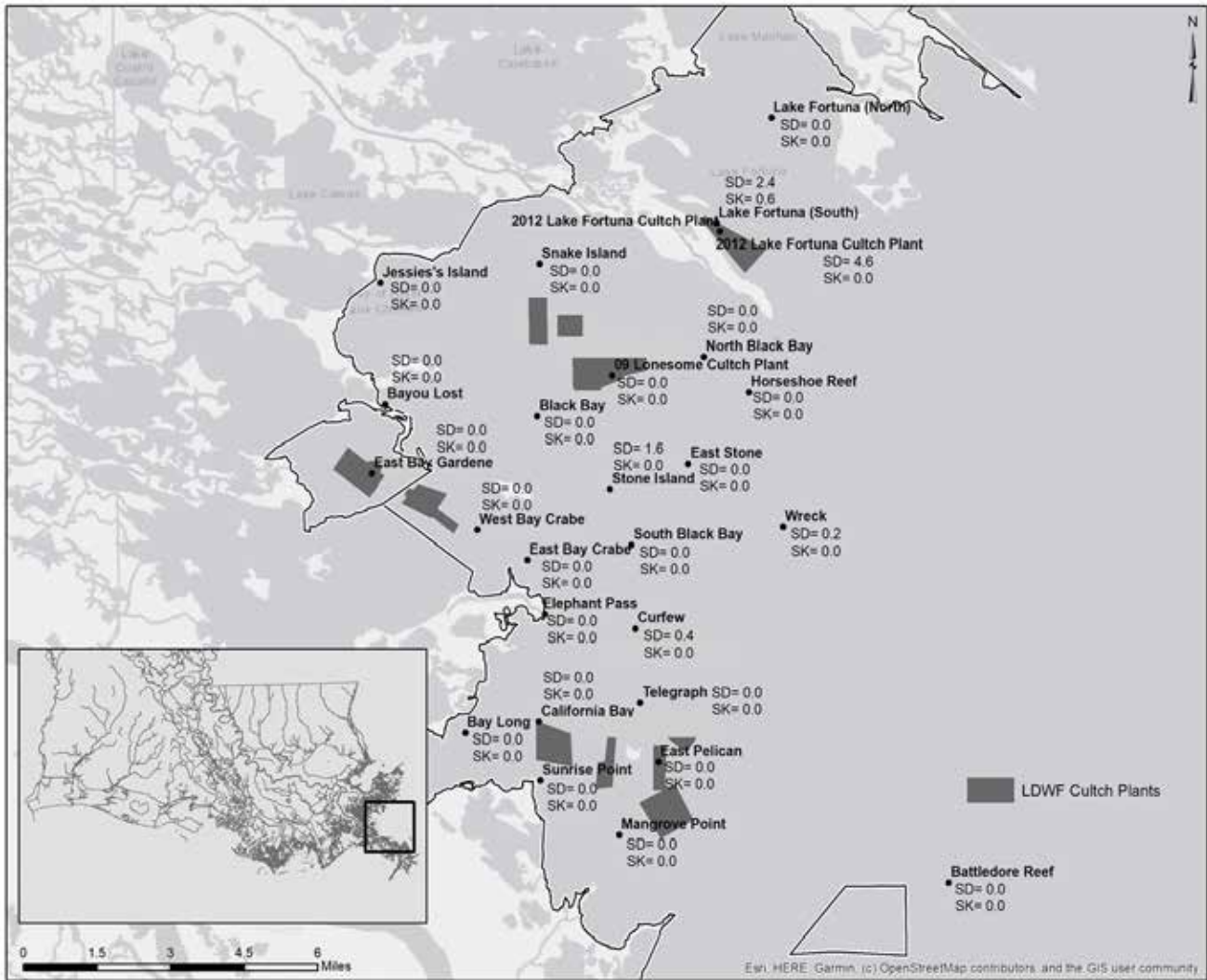


FIGURE 2.1. 2022 CSA 1 South oyster stock assessment sampling stations with average seed and market-sized sampling densities for the 2022 stock assessment, square-meter sampling.

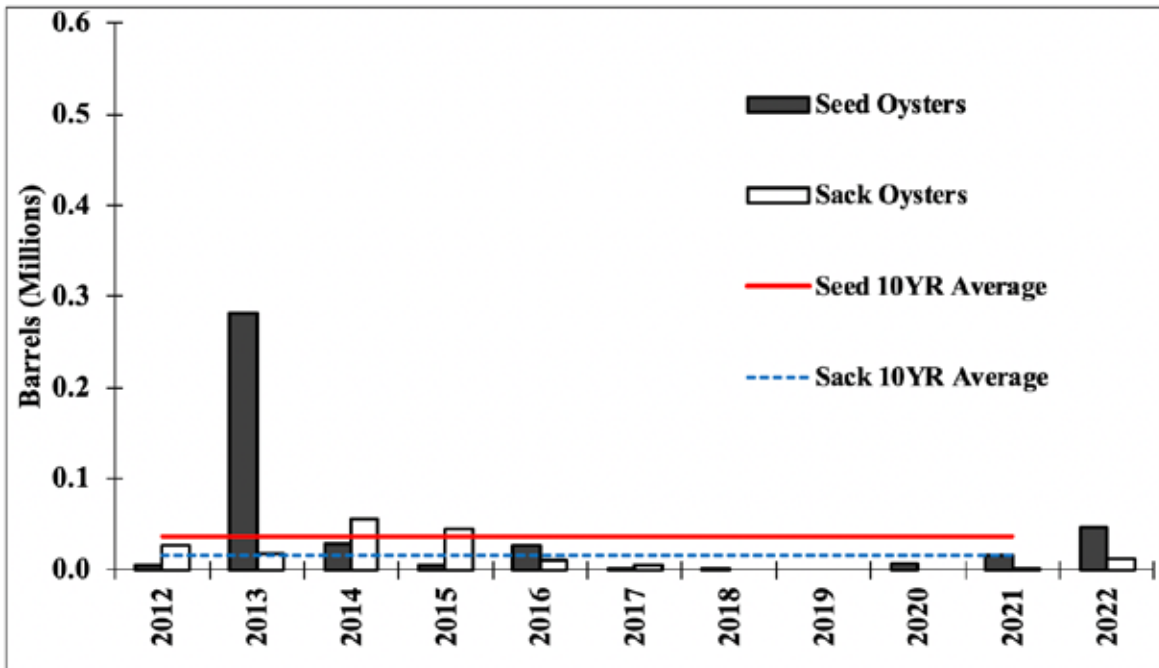


FIGURE 2.2. Current and historical seed and market-sized stock size estimates in CSA 1 South. Horizontal lines represent the previous 10-year's seed- and market-sized stock estimate averages.

TABLE 2.1. 2022 Oyster availability by sampling station or reef complex in CSA 1 South

Station	Reef (Acres)	Average Number Seed Oysters/m ²	Average Number Market-Sized Oysters/m ²	Seed Oysters (bbl)	Market-Sized Oysters (bbl)
Jessie's Island	549.9	0	0	0.0	0.0
Bayou Lost	(~2,225,335 m ²)	0	0		
East Black Bay Reef Complex		0.0	0.0	0.0	0.0
East Bay Gardene	1262.6 (~5,109,744 m ²)	0.0	0.0		
West Bay Crabe	1,732.0	0	0		
East Bay Crabe	(~7,009,022 m ²)	0	0		
Bay Crabe Reef Complex		0.0	0.0		
Elephant Pass	202.2 (~818,318 m ²)	0	0	0.0	0.0
Sunrise Point	3,692.8 (~14,944,212 m ²)	0	0	0.0	0.0
California Bay		0	0		
Bay Long		0	0		
California Bay Reef Complex		0.0	0.0	0.0	0.0
Mangrove Point	2,889.1	0	0		
East Pelican	(~11,691,861 m ²)	0	0		
Mangrove Reef Complex		0.0	0.0		
Stone Island	3,575.7 (~14,470,566 m ²)	1.6	0		
South Black Bay		0	0		
Curfew		0.4	0		
Telegraph		0	0		
South Black Bay Reef Complex		0.5	0.0	0.0	0.0
Snake Island	2,861.9 (~11,581,908 m ²)	0	0		
09 Lonesome Cultch Plant		0	0		
Black Bay		0	0		
Lonesome Island Reef Complex		0.0	0.0	23,295.5 (46,591.0 Sacks)	11,647.7 (23,295.5 Sacks)
Lake Fortuna (South)	3,453.9	2.4	0.6		
Lake Fortuna (North)	(~13,977,292 m ²)	0	0		
Lake Fortuna Reef Complex		1.2	0.3	0.0	0.0
North Black Bay	2,485.8 (~17,344,129 m ²)	0	0		
Horseshoe Reef		0	0		
East Stone		0	0		
Horseshoe Reef Complex		0.0	0.0	5,042.6 (10,085.2 Sacks)	0.0
Wreck	4,485.8 (~18,153,422 m ²)	0.2	0		
Battledore Reef	270.6 (~1,094,962 m ²)	0	0	0.0	0.0
2012 Lake Fortuna Cultch Plant	300.0 (~1,214,062 m ²)	4.6	0	7,756.5 (15,513.1 Sacks)	0.0
Total				46,143.6 (92,287.2 Sacks)	11,647.7 (23,295.5 Sacks)
			LTA(2012-2021)	2022	% Change
Seed			37,076.00	46,143.60	24.5%
Market-Size			16,408.00	11,647.70	-29.0%
Total			53,484.00	57,791.30	8.1%

Hydrological Data

Since 2010, CSA 1 South has experienced periods of heavy localized harvest, high mortality events, strong tropical events (such as Hurricane Isaac in 2012, Hurricane Nate in 2017, Hurricane Zeta in 2020 and Hurricane Ida in 2021), the 2010 *Deepwater Horizon* oil spill and related spill response activities, and increasing freshwater influence from the Mississippi River. All of these factors appear to have severely reduced oyster abundance in the southern Pontchartrain Basin. As a result, oyster stock estimates continue to be below the long-term averages despite the increases observed for the current year (Figure 2.2).

Aside from occasional extreme events (oil spills, tropical storms), extended periods of low spring salinities and possibly periods of hypoxia in the summer and fall decrease spawning success and increase risk of mortality, inhibiting oyster production in this area.

On Aug. 29, 2021, Hurricane Ida made landfall at Port Fourchon as a Category 4 hurricane with maximum sustained winds of 150mph. CSA 1 South staff conducted dredge samples at five Public Oyster Reef locations on Sept. 9, 2021 to assess hurricane impacts. Varying degrees of overburden from marsh vegetation were observed. Heaviest amounts of overburden were found on the Lake Fortuna reef. Light overburden was noted on the 2012 Lake Fortuna cultch plant. Live oysters were found at the South Lake Fortuna sampling station and on the Lake Fortuna EROC shell plant. Only minimal spat mortality at one station on the Lake Fortuna EROC shell plant. Hurricane Ida inundated southeast Louisiana and Mississippi with widespread rain and caused freshwater flooding along local rivers which attributed to the lower than average salinities for Fall 2021.

Spring 2022 marked the second year in a row without a Mississippi River flood event necessitating the opening of the Bonnet Carré Spillway (following three years of back to back openings 2018-2020). However, with heavy rainfall across the Pontchartrain Basin tremendous amounts of fresh water was introduced into the southern Pontchartrain Basin. As a result, salinities on oyster growing areas throughout CSA 1 South decreased to below what is required for effective oyster growth and viability during the months of April and May 2022 (Figure 2.3).

Fouling Organisms

During the 2022 oyster stock assessment, hooked mussels were present at 10 of the 26 sampling stations and ranged in density from 0.6 to 181.8 individuals per m². Overall, hooked mussel density has increased since the previous assessment (seven out of 26 stations in 2021), and likely attributed to the return of more stable hydrological conditions through much of the seed ground area. While hooked mussel density decreased at four sampling stations in 2022, there was an increase in hooked mussel density at eight sampling stations. Most notably there was a 606% increase in hooked mussel fouling at the 2012 Lake Fortuna Cultch Plant.

Oyster Predators and Disease

No live oyster drills, stone crabs, nor blue crabs were found during the 2022 oyster stock assessment.

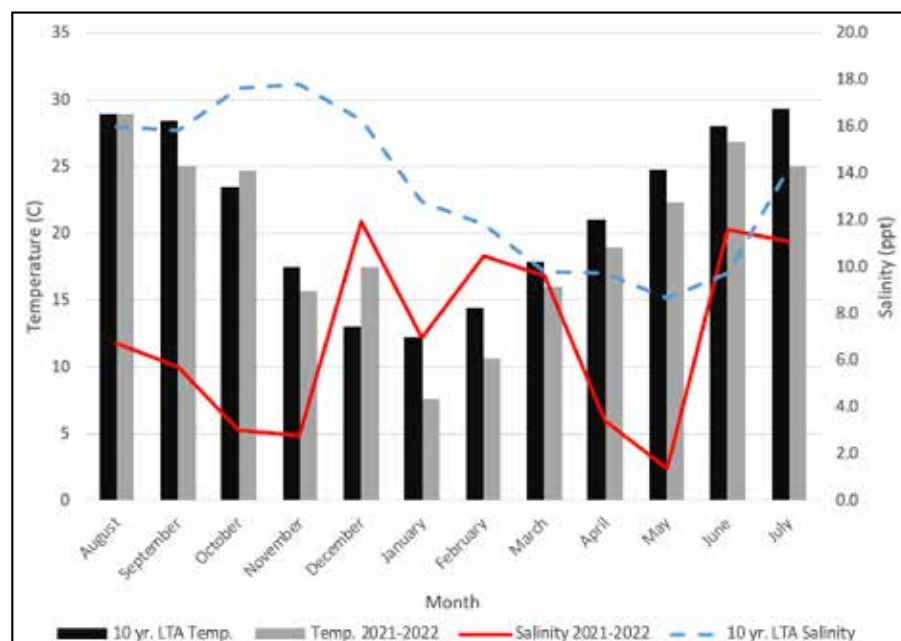
Mortality

Overall, during the 2022 oyster stock assessment, observed mortality estimates showed a decrease compared to the previous year's stock assessment. Biologists observed oyster mortality at four of the 26 sampling stations. Bayou Lost, Lake Fortuna South, Wreck and 2012 Lake Fortuna Cultch Plant have mortality observations of oysters. At Bayou Lost, biologists also noted 100% mortality of spat oysters. Additionally, South Lake Fortuna had 7.7% mortality of seed-size oysters. Wreck had mortality of 50% of spat oysters and 83.3% of seed-size oysters. The 2012 Lake Fortuna Cultch Plant lost 25% of spat oysters and 12% of seed-size oysters. There was no observed market-size oyster mortality during this sampling event.

2021/2022 Oyster Season

No portion of CSA 1 South public oyster seed grounds were available for commercial harvest during the 2021/2022 oyster season. This was the fifth consecutive season that public oyster areas in the south Pontchartrain Basin remained closed. The 2021 oyster stock assessment estimated there was only a minimal stock of seed or market-sized oysters found in CSA 1 South. In addition, 81.2% of all estimated seed stock found was at the 2012 Lake Fortuna Cultch Plant, which was not available for harvest due to its use for an NOAA Early Restoration project.

FIGURE 2.3. Mean salinity and temperature for Southern Lake Pontchartrain Basin Public Oyster Seed Grounds from August 2021 - July 2022.



COASTAL STUDY AREA 3

(Barataria Basin)

Introduction

Coastal Study Area 3 (CSA 3) consists of three public oyster areas distributed generally in a north-south direction within the Barataria Bay estuary:

1. Hackberry Bay Public Oyster Seed Reservation
2. Barataria Bay Public Oyster Seed Grounds
3. Little Lake Public Oyster Seed Grounds

Hackberry Bay, in Jefferson and Lafourche parishes, is a 4,402-acre mesohaline embayment with a primarily soft silt and clay bottom of which only 14.7 acres is naturally occurring reef material. The three historical sampling stations within Hackberry Bay are the Upper, Middle and Lower Hackberry Sampling stations. The Middle Hackberry Bay station is the only sampling station located over existing natural reef, while the Upper and Lower stations are located over former cultch plants placed on top of historical reefs. The Upper Hackberry Bay station was the result of a 1994 cultch plant using federal disaster funds from Hurricane Andrew in 1992. The 1994 Cultch Plant totaled 145 acres and was comprised of six different sections of substrate including crushed concrete, shucked shell, reef shell, clamshell, Kentucky limestone and Bahamian limestone. This station was also the location of cultch plants in 1943 (140 acres), 1945 (70 acres), 1946 (92 acres) and 1981 (67 acres). The Lower Hackberry Bay station is on a reef that was part of a 450-acre 1973 Cultch plant. Since very little natural reef exists on the Hackberry Bay Public Oyster Seed Reservation, production is highly dependent upon and reflective of when and where cultch plants are placed in the bay. It is unknown how much, if any, cultch material from the 1994 and earlier cultch plants remains exposed above the surface of the mud. Therefore, the acreage of these previous cultch plants is not factored into the annual oyster stock assessment.

Since 2004, LDWF has constructed five cultch plants in Hackberry Bay. LDWF constructed two cultch plants totaling 35 acres in 2004 and one of 50 acres in 2008. Two additional plants, a 2012 Cultch Plant of approximately 200 acres, and a 2014 Cultch Plant of 30 acres, combined with the other three, have increased the reef acreage on the Hackberry Bay Public Oyster Seed Reservation to its current estimate of 329.7 acres.

The Commission designated the Barataria Bay Public Oyster Seed Grounds as such in response to possible changes in the salinity regime of the estuary stemming from the Davis Pond freshwater diversion project. Davis Pond is a large Mississippi River diversion that aims to reintroduce freshwater and nutrients into the Barataria Bay estuary to help restore the Louisiana coast. As this diversion was anticipated to reduce salinities in the estuary, LDWF estimated that additional public oyster seed grounds farther down-estuary might be productive during years with high freshwater input. The only known existing reef on the Barataria Bay Public Oyster Seed Grounds is a 40-acre cultch plant constructed

of 7,536 cubic yards of crushed concrete in the northeast section of the area in May 2004. The reef is vulnerable to predators such as oyster drills and the protozoan parasite Dermo during periods of higher salinities. LDWF does not expect reliable oyster production from this area until salinity regimes in the basin can remain at consistently lower ranges brought about by natural forces or by coastal restoration efforts.

The Little Lake Public Oyster Seed Grounds had previously been used as a temporary natural reef area and once contained private oyster leases. These leases all fell within the Davis Pond freshwater diversion impact area and were either purchased or moved by the state and federal governments prior to the opening of the Davis Pond diversion. The Davis Pond diversion has not been consistently used to its maximum capacity since it first opened in 2002, and environmental conditions during some years have allowed oysters to continue to exist in Little Lake. In an effort to have LDWF actively manage the public oyster grounds, and to allow the harvest of oyster by the public, the Commission designated this area as a public oyster seed ground in 2007. The location of the Little Lake Public Oyster Seed Grounds makes it vulnerable to depressed salinities from rainfall, inflow from the Intracoastal Waterway and discharge from the Davis Pond diversion. Reduced salinities from increased freshwater input can negatively impact oyster survival and availability. However, when salinities are higher, the Little Lake Public Oyster Seed Grounds have provided the oyster industry with additional seed and market-size oysters in Barataria Basin.

Methods

For the 2022 Oyster Stock Assessment, biologists collected field samples according to the methodology described in the State-wide Overview of this report. Between July 7-18, 2022, nine stations were sampled and 45 replicate samples were collected (*Figure 3.1*). Biologists did not conduct sampling efforts in the Little Lake Public Oyster Seed Grounds due to a lack of information on reef acreage.

Results and Discussion

Seed- and Market-Size Stock

The 2022 stock assessment estimated the amount of oysters available for harvest on the Hackberry Bay Public Oyster Seed Reservation and the Barataria Bay Cultch Plant as 17,255.4 barrels (bbl), of which 14,557.5 bbl are seed oysters and 2,697.9 bbl are market-sized (or sack) oysters. Seed oysters were only recorded at the 2008 and 2012 Hackberry Bay Cultch Plants. The seed availability in July 2022 was 585% higher than seed availability from July 2021 (2,124.6 bbl), and 47.0% above the 10-year average (2012-2021) (9,882.6 bbl) (*Figure 3.2*). The 2012 Hackberry Cultch Plant had the highest CPUE (11.80) and highest available barrels of seed (13,264.8 bbl) (*Table 3.1*).

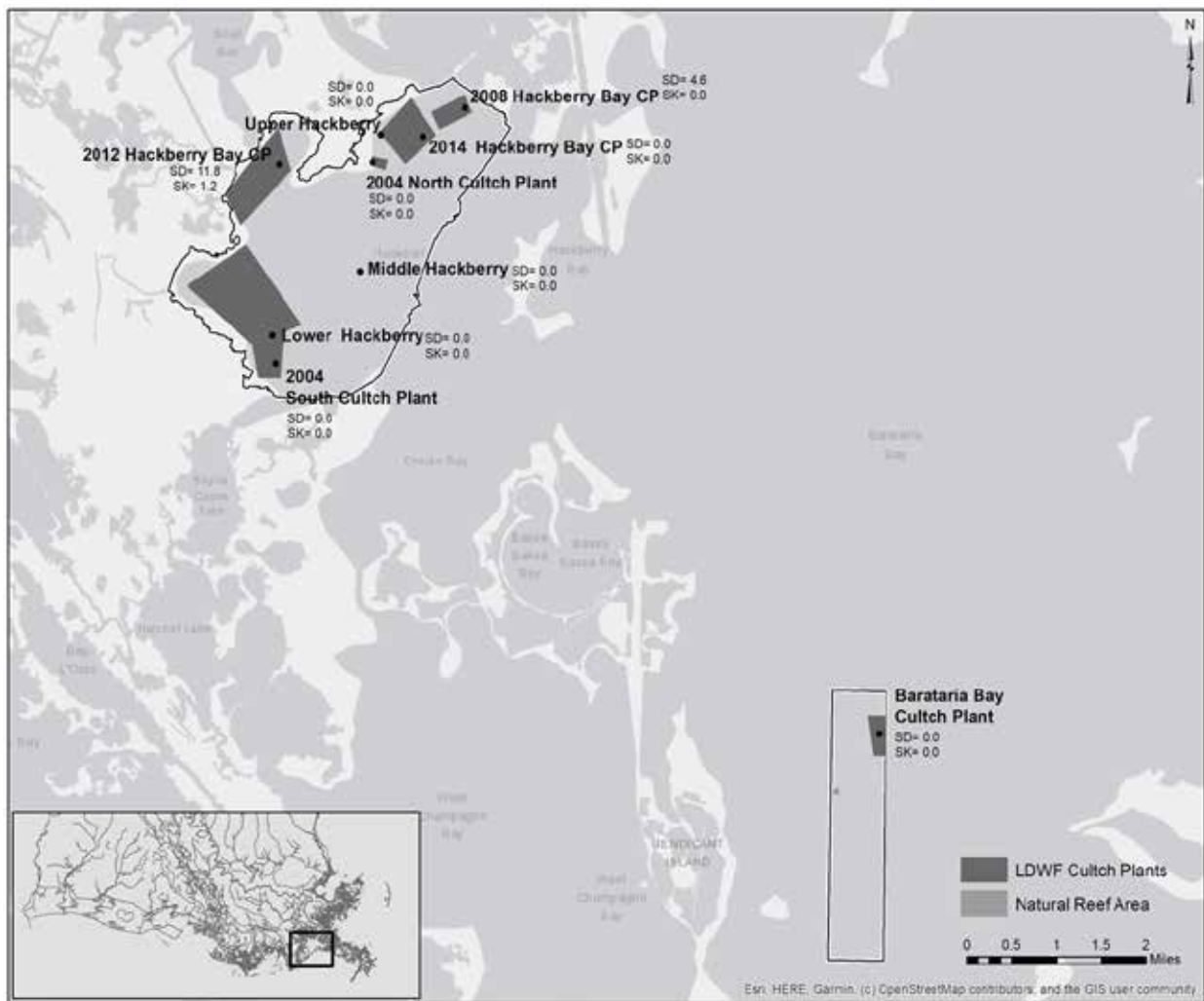


FIGURE 3.1. 2022 CSA 3 oyster stock assessment sampling stations with average seed and sack sampling densities for the 2022 stock assessment, square-meter sampling

TABLE 3.1. 2022 oyster availability by sampling station in CSA 3.

Station	Reef (Acres) (~m ²)	Average Number Seed Oysters/m ²	Average Number Market-size Oysters/m ²	Seed Oysters (bbl)	Market-Size Oysters (bbl)
Lower Hackberry	4.9 (~19,829.6 m ²)	0.0	0.0	0.0	0.0
Middle Hackberry	4.9 (~19,829.6 m ²)	0.0	0.0	0.0	0.0
Upper Hackberry	4.9 (~19,829.6 m ²)	0.0	0.0	0.0	0.0
N. Hackberry Bay Cultch Plant	10.0 (~40,468.6 m ²)	0.0	0.0	0.0	0.0
S. Hackberry Bay Cultch Plant	25.0 (~101,171 m ²)	0.0	0.0	0.0	0.0
2008 Hackberry Bay Cultch Plant	50.0 (~202,343 m ²)	4.6	0.0	1,292.8 (2,585.5 sacks)	0.0
2012 Hackberry Bay Cultch Plant	200.0 (~809,371 m ²)	11.8	1.2	13,264.8 (26,529.6 sacks)	2,697.9 (5,395.8 sacks)
2014 Hackberry Cultch Plant	30.0 (~121,406 m ²)	0.0	0.0	0.0	0.0
Barataria Bay Cultch Plant	40.0 (~161,874 m ²)	0.0	0.0	0.0	0.0
Total	369.7 (~1,496,123 m²)			14,577.5 (29,155 sacks)	2,697.9 (5,395.8 sacks)

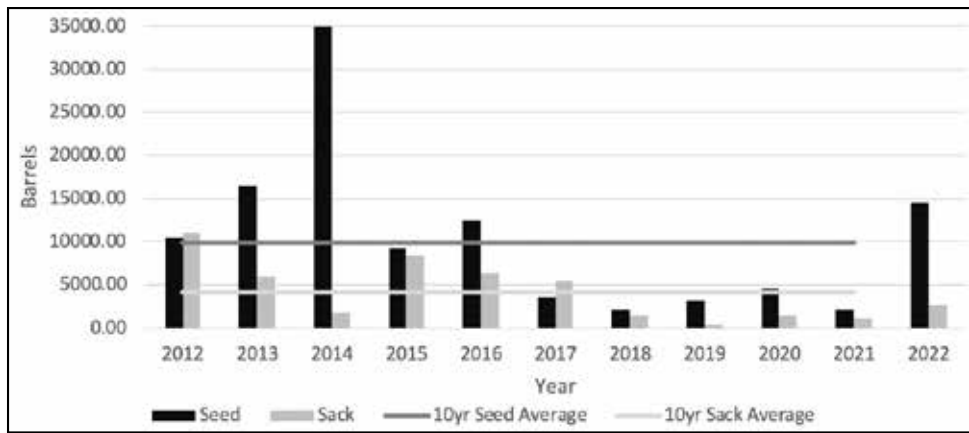


FIGURE 3.2. Hackberry Bay Oyster Seed Grounds historical oyster stock availability.

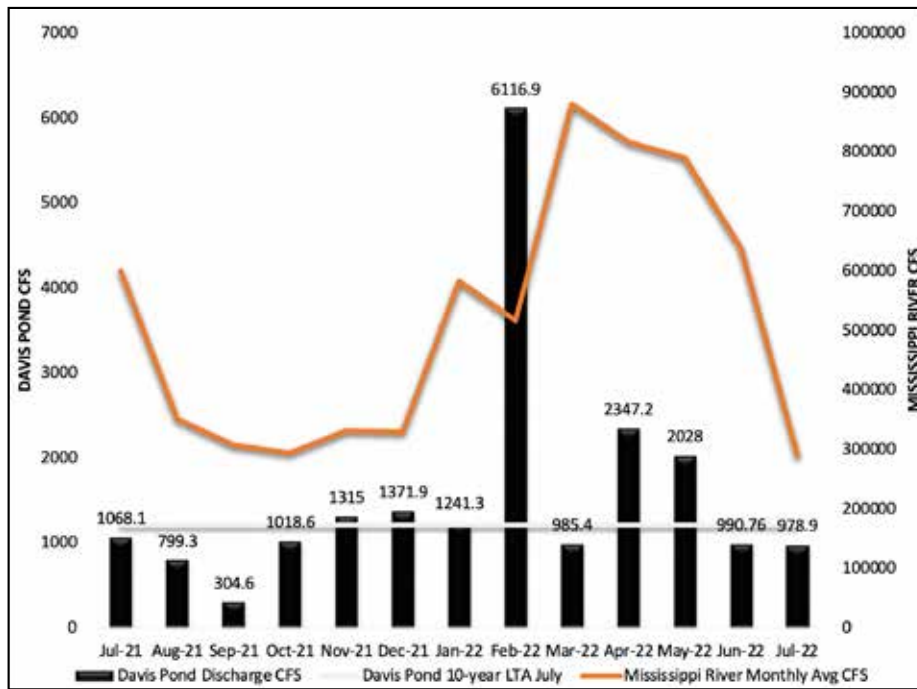


FIGURE 3.3. Davis Pond Diversion (cfs) and Mississippi River flow at Tarbert Landing (cfs).

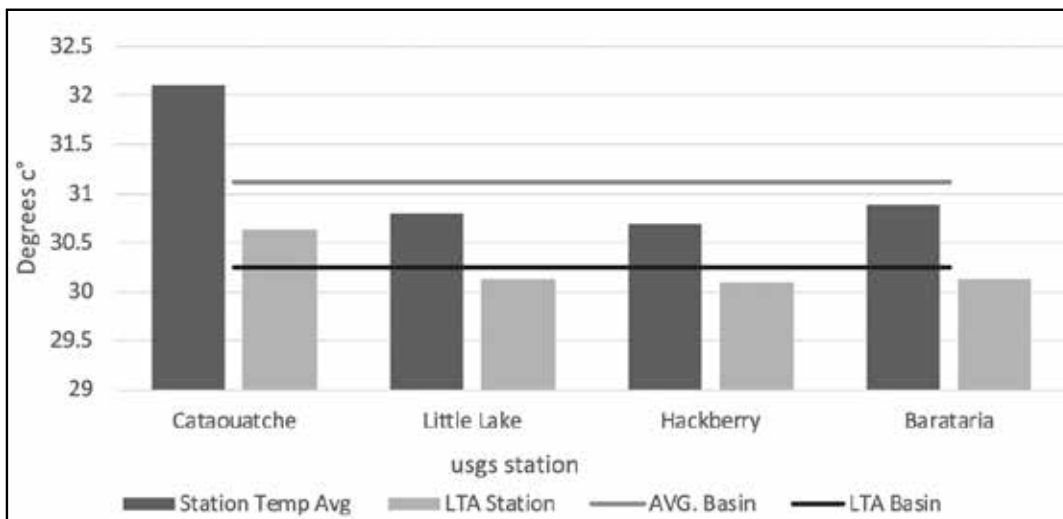


FIGURE 3.4. July 2022 water temperature averages in comparison to 10-year July LTA for the Barataria area from four USGS stations at Lake Cataouatche, Little Lake, Hackberry Bay* and Grand Terre Island.

*The average temperature from the square-meter sampling in Hackberry Bay was substituted for Hackberry USGS gauge in July 2022 due to gauge currently being offline.

Market-size oysters were only present on one sampling station, the 2012 Hackberry Cultch Plant. Market-size availability was up 124.5% in comparison to July 2021 (1,146 bbl) but 33.0% below the 10-year average (4,031.5 bbl) (*Figure 3.2*).

The combined stock of 17,255.4 bbl of seed and market-size oysters showed a 427.5% increase from the 2021 estimate (3,271.2 bbl), and a 24% increase from the 10-year average (13,914 bbl). In Hackberry Bay, cultch material was collected at five of the eight sampling stations, while at the other three sampling stations, the only cultch material found was buried under 6 inches, or greater, of mud. Market-size oyster availability has not been documented in Barataria Bay since the creation of the Barataria Bay Cultch Plant station in 2004.

Spat Production

There was a marked increase in spat CPUE in 2022 (23.6) compared to 2021 (0.4). One thousand sixty total live spat were collected in 2022. The highest number of spat was found at the 2008 Cultch plant (701). This was 66.1% of the total spat sampled. The other stations that had spat were the 2012 Hackberry Bay Cultch Plant (259), the Barataria Bay Cultch Plant (99) and the 2014 Hackberry Bay Cultch Plant (1). Spat numbers are considerably higher this year due to increased salinity levels (>10ppt) in Hackberry Bay during spawning season (April-June).

Hydrological Data

Oyster habitat suitability for the Barataria-area seed grounds is highly influenced by the Mississippi River discharge and the Davis Pond diversion discharge. The United States Army Corps of Engineers (USACE) Tarbert gauge recorded Mississippi River discharge from July 1, 2021 to July 1, 2022 averaging 517,586 cubic feet per second (cfs), reaching a peak discharge of 956,000 cfs during March 2022. The United States Geologic Survey (USGS) constant recorder located near the Davis Pond diversion structure recorded a monthly average discharge of 1,582.0cfs of Mississippi River flow being diverted through the structure into Davis Pond (July 2021 - July 2022). The highest monthly average discharge over this time period was 6,116.9cfs during February 2022 (*Figure 3.3*).

Oyster habitat suitability is also highly influenced by the salinity and temperature of the surrounding water. Water quality was gathered from three USGS stations at Lake Cataouatche, Little Lake and Grand Terre Island during July 2022. The USGS gauge in Hackberry Bay was damaged during Hurricane Ida and has not yet come back online. In an effort to compensate, the average temperatures and salinities from the square-meter sampling in Hackberry Bay was substituted for Hackberry USGS gauge in *Figures 3.4 and 3.5*. The water temperature in the Barataria area during July 2022 averaged 31.1oC, which was warmer than the 10-year long-term July average (LTA) 30.3oC (*Figure 3.4*). Salinity averaged 9.4ppt and the 10-year LTA was 6.8ppt (*Figure 3.5*).

The 2021 Hurricane Season generated 21 named storms, with Louisiana experiencing three named storms (Claudette, Ida and Nicholas). Hurricane Ida caused the most destruction in the Barataria basin, compared to other basins statewide, making landfall on Aug. 29, 2022. Ida produced sustained winds of 150 mph and brought ashore storm surges of up to 10 feet in parts of southeast Louisiana. Overall oyster mortality increased post-Hurricane Ida from 6.0% in August to 7.4% in September. This increase may be attributed to our oyster reefs becoming buried due to Hurricane Ida; only four of our 12 sample stations had oysters in September 2021, most of the others were buried either by mud or by detritus.

Fouling Organisms

A total of 16 hooked mussels were present at two of the nine sampling stations (2012 Hackberry Bay Cultch plant and 2008 Hackberry Bay Cultch Plant). The highest density (3.0 mussels per square-meter) was observed at the 2012 Hackberry Bay Cultch plant, whereas at the 2008 Hackberry Bay Cultch Plant there were 0.2 mussels per square-meter. In comparison, during square-meter sampling in 2021, 29 hooked mussels were collected at three different stations, with 0.7 mussels occurring per square-meter.

Oyster Predators and Disease

For the 2022 stock assessment, no oyster drills were collected; however, a single oyster drill was collected in a dredge sample taken during April 2022 at the Barataria Bay Cultch Plant. In the last 10 years (2013-2022), biologists have been collected 51 oyster drills during dredge and square-meter sampling; most of these have come from the 2004 Barataria Bay Cultch Plant. The low number of oyster drills found in LDWF samples can be correlated to the relatively low salinity levels typically found in Hackberry Bay. The LTA (2013-2022) for July salinity in Hackberry Bay is 7.2 ppt.

Mortality

Spat mortality was documented at three sampling stations - Barataria Bay Cultch Plant, 2012 Hackberry Bay Cultch Plant and 2008 Hackberry Bay Cultch Plant. Seed mortality was observed only at the Barataria Bay Cultch Plant sampling station; four dead seed and no live seed were found in the five replicate samples. No market-sized oyster mortality was recorded at any station.

Spat mortality was highest at the Barataria Bay Cultch Plant (40.4%) and the 2012 Hackberry Bay Cultch Plant had the lowest (1.1%). The combined overall spat, seed and market-sized oyster mortality was 7.2%, which was an increase from the 1.6% in the 2021 assessment. Monthly dredge samples have provided an additional source of oyster mortality data. Between August 2021 and June 2022, dredge samples revealed an average monthly mortality of 9.3% for spat, seed and market-size oysters (*Figure 3.6*). *Figure 3.6* shows high spat mortality rates in August 2021 and April 2022; however, these percentages may be inflated due to small sample sizes (n=14, n=7, respectively). This 9.3% average mortality was an increase from the same time-frame for the prior year - August 2020 to June 2021 (5.7% mortality). No definitive cause was found for these unusual mortality events over a wide portion of the basin. Low Dissolved Oxygen and Red Tide were ruled out, but no other cause was ever determined.

2021/2022 Oyster Season

The Hackberry Bay Public Oyster Seed Reservation and the Barataria Bay Cultch Plant were closed to harvest during the 2021/2022 oyster season.

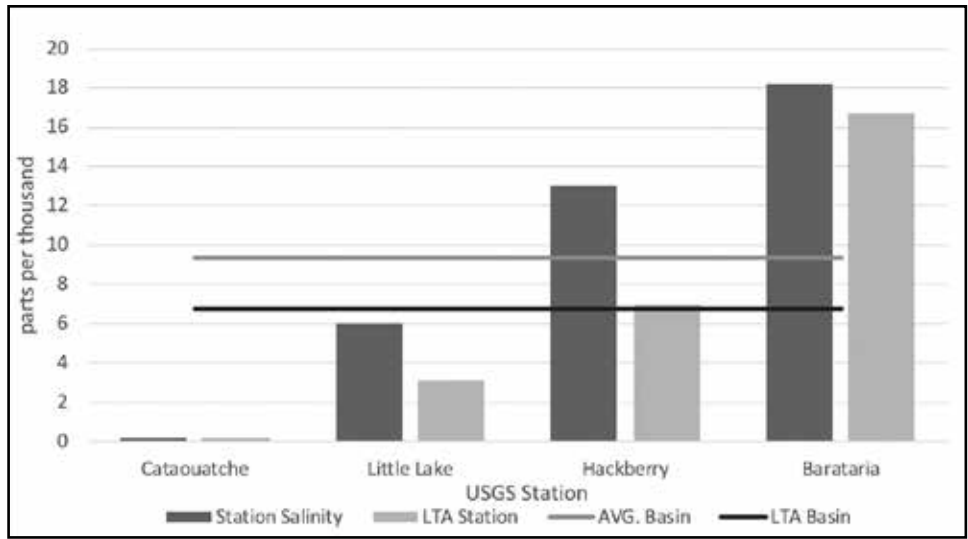


FIGURE 3.5. July 2022 water salinity averages in comparison to the 10-year July LTA for the Barataria area from four USGS stations at Lake Cataouatche, Little Lake, Hackberry Bay* and Grand Terre Island. *The average salinity from the square-meter sampling in Hackberry Bay was substituted for Hackberry USGS gauge in July 2022 due to gauge currently being offline.

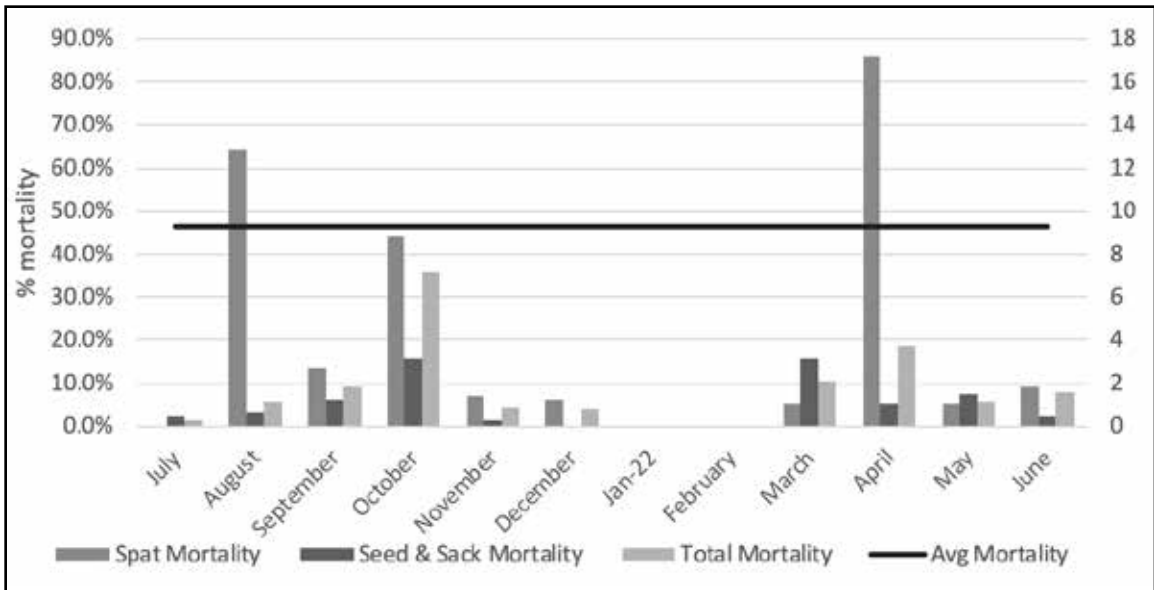


FIGURE 3.6. Oyster mortality from monthly dredge sampling in Barataria Basin - August 2021 to June 2022.

COASTAL STUDY AREA 5

(Terrebonne Basin)

Introduction

CSA 5 is comprised of the Terrebonne Basin from Bayou Lafourche west to the Atchafalaya River, including Terrebonne Bay, Timbalier Bay, Sister Lake, Lake Mechant and Caillou Bay. CSA 5 oyster stock assessments are divided into eastern and western portions of the Terrebonne Basin. There are currently seven different Public Oyster Seed Reservations (POSR) and Public Oyster Seed Grounds (POSG) within CSA 5. Sister Lake POSR, Bay Junop POSR and Lake Mechant POSG are located in the western Terrebonne Basin (Figure 5.1). Deep Lake POSG, Lake Felicity POSG, Lake Chien POSG and Lake Tambour POSG are found in the eastern Terrebonne Basin (Figure 5.2).

The Commission designated Sister Lake as a public oyster seed reservation in 1940; this area includes 9,150.5 acres of water bottom. (Figure 5.1). Recent Sister Lake cultch plants include a 365-acre site in 2012 and a 200-acre site in 2021. The 2012 and 2021 cultch plants were funded through *Deepwater Horizon* Natural Resource Damage Assessment (DWH NRDA) settlement dollars to restore for injuries to oysters that occurred as a result of the spill. The current total reef acreage for Sister Lake is estimated to be 2,575.4 acres.

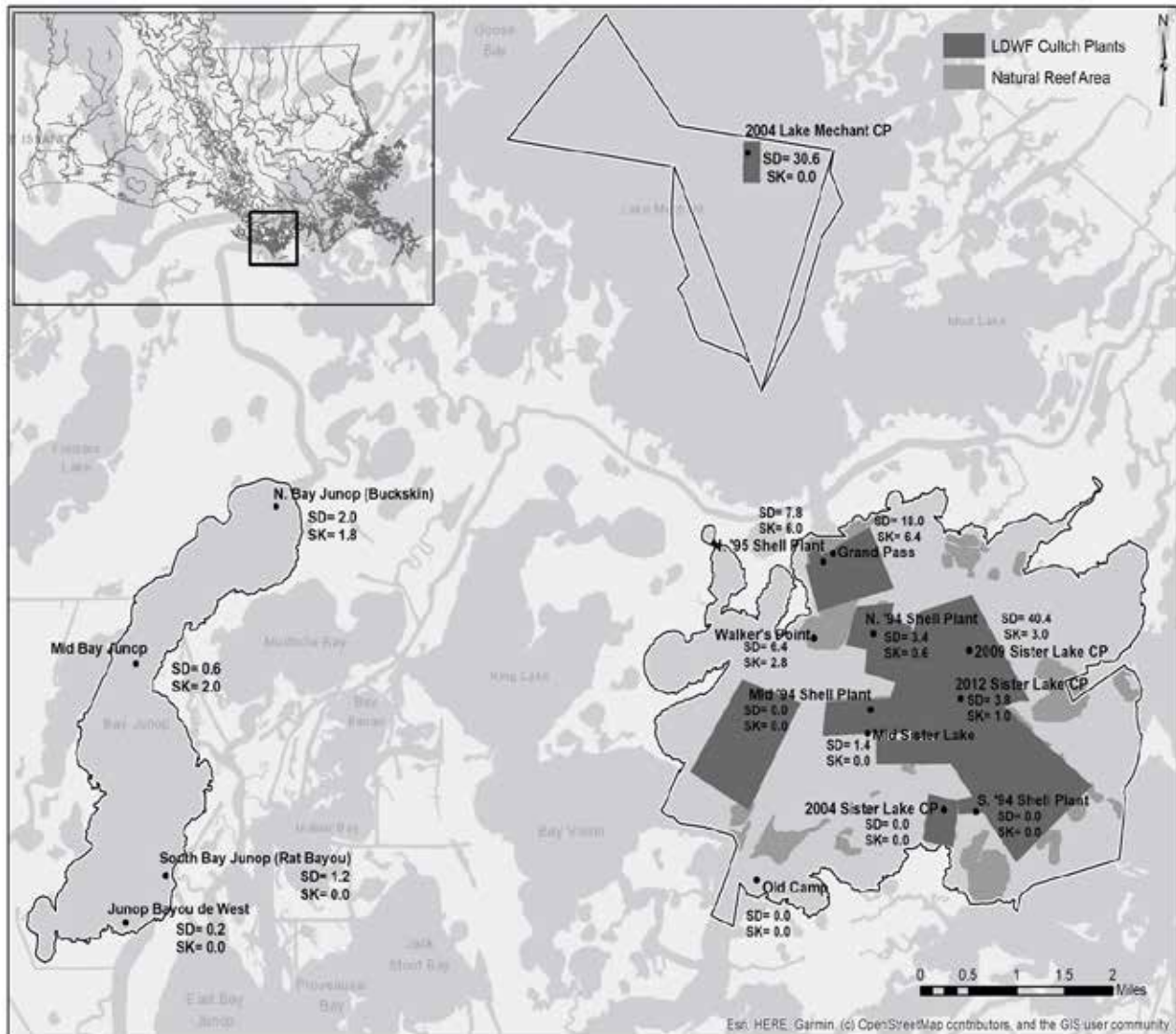


FIGURE 5.1. Western Terrebonne Basin - Sister Lake and Bay Junop POSR and Lake Mechant POSG - with average seed and market-size sampling densities for the 2022 stock assessment, square-meter sampling.

The Commission established the Bay Junop POSR (*Figure 5.1*) in 1948; it consists of approximately 2,646.5 acres of water bottom. Due to the shallow water depth of the bay and the inability of barges and tugs to enter for cultch plants, LDWF has not been able to construct artificial reefs in this area to augment natural oyster reef production. Available public reef acreage in Bay Junop is estimated to be 252 acres.

The Commission established the Lake Mechant Public Oyster Seed Grounds (*Figure 5.1*) in 2001; constructed a 30-acre cultch plant in 2004; and added acreage of unleased water bottoms between the designated public oyster seed grounds and private oyster leases in 2007. In total, the Lake Mechant POSG consists of 2,583 acres, with the 30-acre cultch plant as the only known reef acreage within the area.

The Commission established the Lake Tambour, Lake Chien, Lake Felicity and Deep Lake POSGs in 2001; this area includes roughly 2,340 acres of water bottom in Lake Chien and Lake Felicity (*Figure 5.2*). Prior to the more current public seed ground establishment, the areas of and around Lake Felicity had been used as oyster seed reservations in the 1940s and early 1950s, but had been discontinued. Salinities in Lake Tambour, Lake Chien, Lake Felicity and Deep Lake are consistently at a higher range than what is considered tolerable for oyster production, but future planned coastal freshwater diversion projects may return the area to a more favorable salinity regime.

Three cultch plants have been built within the Eastern portion of CSA 5: 1) a 16-acre cultch plant in Lake Chien completed in 2004, 2) a 40-acre cultch plant in Lake Felicity completed in 2004, and 3) a 22-acre cultch plant due east of the initial Lake Chien cultch plant completed in May 2009 (*Figure 5.2*). LDWF has not developed any reefs in Lake Tambour or Deep Lake.

Methods

LDWF biologists collected field samples for the 2022 oyster stock assessment on July 5-7, 2022, from 19 stations within CSA 5 according to the methodology described in the Statewide Overview of this report. Sampling stations included existing oyster reefs in Lake Felicity, Lake Chien, Sister Lake, Bay Junop and Lake Mechant.

Results and Discussion

Seed- and Market-Size Stock

The 2022 oyster stock assessment estimated the stock for CSA 5 at 72,384.6 bbl of seed oysters and 30,872.7 bbl of market-size oysters in the western Terrebonne Basin, and 0 bbl of seed oysters and 0 bbl of market-size oysters in the eastern basin (*Tables 5.1-5.3*).

In Sister Lake, the most productive oyster area in CSA 5, estimated seed availability for 2022 was 18.1% below long-term average (2012-2021), and the estimated market size availability was 19.6% above long-term average. The 2022 oyster stock assessment estimated 66,520 bbl of seed and 28,878 bbl of market-size oysters on the Sister Lake Public Oyster Seed Reservation, of which 53.1% (35,315 bbl) of available seed and 18.2% (5,245 bbl) of available market-size oysters were located on the 2009 Cultch Plant (*Figure 5.3; Tables 5.1 and 5.4*). Monthly oyster dredge sampling for the time-frame between the 2021 oyster stock assessment and the 2022 oyster stock assessment (August 2021 - June 2022), indicated the highest spat count in November and the lowest in April in Sister Lake. Overall seed and market-size oyster mortality was 1.3%

and 0.2% for this same period, respectively. The southern shoreline of Sister Lake continues to erode, creating more sedimentation over once productive oyster reefs and causing increased salinities which introduce an increasing number of natural oyster predators. The northern portion of Sister Lake remains productive due to less overburden and more exposed cultch material.

In Bay Junop, estimated seed oyster availability for 2022 was 19.7% below the long-term average and estimated market-size oyster availability was 86.6% above the long-term average (2012-2021). The 2022 oyster stock assessment estimated 706 bbl of seed and 1,995 bbl of market-size oysters on the Bay Junop Public Oyster Seed Reservation. In Lake Mechant, estimated seed oyster availability for 2022 was 191.4% above the long-term average (2012-2021). The 2022 oyster stock assessment estimated 5,160 bbl of seed on the Lake Mechant Public Oyster Seed Ground (*Figures 5.4 and 5.5; Tables 5.2 and 5.4*). Lake Mechant and the northern portion of Bay Junop, near Buckskin Bayou (Sample Station 3038), receive input from the Atchafalaya River via Blue Hammock Bayou on an annual basis. This continues to have a large influence on salinity levels, which inhibits and affects oyster growth and productivity in this area due to high Atchafalaya River levels in recent years. From August 2021 through June 2022, the highest spat concentrations in monthly oyster dredge sampling were observed in November in Bay Junop and in October and February in Lake Mechant. Overall seed mortality was 0.7% and no market-size oyster mortality was observed in Bay Junop during the sampling year. No market-size oysters were recorded in Lake Mechant sampling. In Bay Junop, although having much exposed cultch material available, there is also a high presence of hash material which may be limiting oyster production. As in Sister Lake, the southern shoreline of Bay Junop is continuing to degrade, allowing salinities to fluctuate based on prevailing wind direction and river discharge.

Lakes Chien and Felicity in the eastern Terrebonne Basin had no available seed and no available market-size oysters for the 2022 oyster assessment (*Figures 5.6 and 5.7; Tables 5.3 and 5.4*). Additionally, no spat, seed, or market-size oysters were recorded in Lake Chien and Lake Felicity in monthly oyster dredge sampling for the time-frame between the 2021 oyster stock assessment and the 2022 oyster stock assessment

Continued marsh degradation in the eastern Terrebonne Basin allows salinities to fluctuate based on prevailing wind direction. The constant erosion from marsh degradation added sediment to the system, which can increase reef burial. The majority of the Lake Felicity cultch plant was covered with sediment and the cultch plant has shown zero productivity of market-size oysters in the last nine years.

Spat Production

In the 2022 stock assessment, the number of oyster spat ranged from zero to 65 per sampling replicate. The 2009 Lake Chien Cultch Plant had the highest site average of 13.0 per square meter. In the western Terrebonne Basin, Lake Mechant had the most spat at 53 overall. Sister Lake and Bay Junop had overall totals of 51 and 37 spat, respectively. No spat were collected at the Lake Felicity sample station.

Hydrological Data

The monthly average water temperature for Sister Lake ranged from 8.7 to 30.4°C and monthly average salinity ranged from 8.9 to 17.2 ppt, with the long-term mean (2012-2021) being 22.4°C

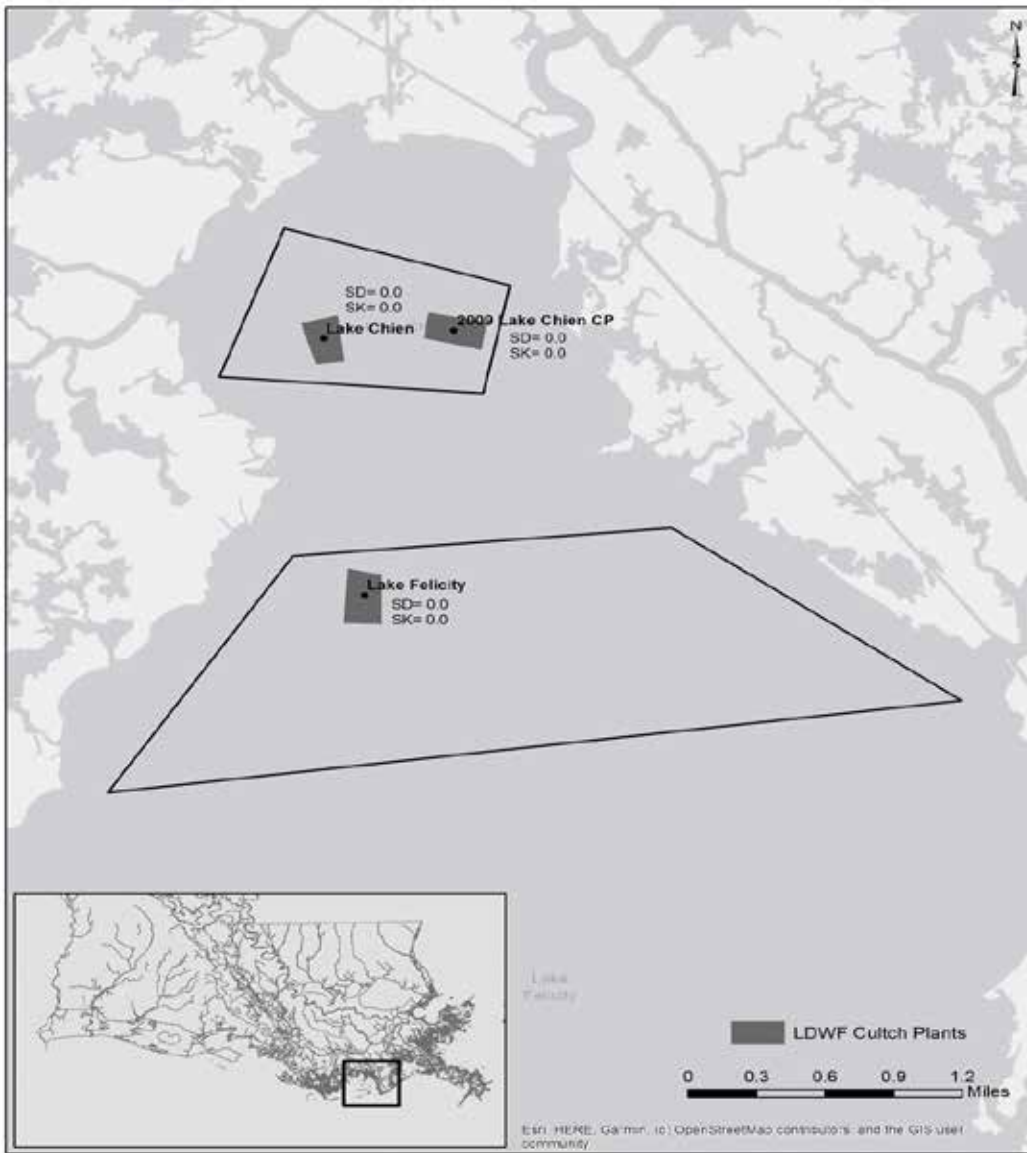


FIGURE 5.2. Eastern Terrebonne Basin - Lake Chien and Lake Felicity POSG - with average seed and market-size sampling densities for the 2022 stock assessment, square-meter sampling.

TABLE 5.1. 2022 Sister Lake oyster availability by sampling station.

Station Name	Reef (Acres)	Average Number Seed Oysters/m ²	Average Number Market-Size Oysters/m ²	Bbls Seed Oysters	Bbls Market-Size Oysters
Grand Pass	320 (~1,296,249m ²)	18.0	6.4	19,323.7 (38,647.4 Sacks)	18,243.5 (36,487.0 Sacks)
Walker's Point		6.4	2.8		
N. '95 Shell Plant		7.8	6.0		
Grand Pass Reef Complex Cumulative		10.7	5.1		
Old Camp	140 (~568,300m ²)	0.0	0.0	0.0	0.0
Mid-Sister Lake	56 (~225,693m ²)	1.4	0.0	438.9 (877.8 Sacks)	0.0
N. '94 Shell Plant	191 (~773,112m ²)	3.4	0.6	3,650.8 (7,301.6 Sacks)	1,288.5 (2,577.0 Sacks)
Mid '94 Shell Plant	552 (~2,235,645m ²)	0.0	0.0	0.0	0.0
S. 94' Shell Plant	513 (~2,075,188m ²)	0.0	0.0	0.0	0.0
2004 Sister Lake CP	82 (~332,894m ²)	0.0	0.0	0.0	0.0
2009 Sister Lake CP	156 (~629,367m ²)	40.4	3.0	35,314.5 (70,629.0 Sacks)	5,244.7 (10,489.4 Sacks)
2012 Sister Lake CP	365 (~1,476,293m ²)	3.8	1.0	7,791.6 (15,583.2 Sacks)	4,100.8 (8,201.6 Sacks)
Total	2,375 (~9,612,741m²)			66,519.5 (133,039.0 Sacks)	28,877.5 (57,755.0 Sacks)

TABLE 5.2. 2022 Bay Junop/Lake Mechant oyster availability by sampling station.

Station Name	Reef (Acres)	Average Number Seed Oysters/m ²	Average Number Market-size Oysters/m ²	Bbls Seed Oysters	Bbls Market- Size Oysters
North Bay Junop (Buckskin)	17 (~69,606m ²)	2.0	1.8	193.4 (386.8 Sacks)	348.0 (696.0 Sacks)
South Bay Junop (Rat Bayou)	67 (~272,596m ²)	1.2	0.0	265.0 (530.0 Sacks)	0.0
Junop Bayou de West		0.2	0.0		
South Bay Junop Reef Complex Cumulative		0.7	0.0		
Mid Bay Junop	73 (~296,473m ²)	0.6	2.0	247.1 (494.2 Sacks)	1,647.1 (3,294.2 Sacks)
2004 Lake Mechant CP	30 (~121,406m ²)	30.6	0.0	5,159.7 (10,319.4 Sacks)	0.0
Total	187 (~760,081m²)			5,865.2 (11,730.4 Sacks)	1,995.1 (3,990.2 Sacks)

TABLE 5.3. 2022 Lake Chien/Lake Felicity oyster availability by sampling station.

Station Name	Reef (Acres)	Average Number Seed Oysters/m ²	Average Number Market-size Oysters/m ²	Bbls Seed Oysters	Bbls Market- Size Oysters
Lake Chien	16 (~64,750m ²)	0.0	0.0	0.0	0.0
Lake Felicity	40 (~161,874m ²)	0.0	0.0	0.0	0.0
2009 Lake Chien CP	22 (~90,245m ²)	0.0	0.0	0.0	0.0
Total	78 (~316,869m²)			0.0	0.0

TABLE 5.4. 2022 Oyster availabilities and percent change from 2021 and from the (10-year) long term average for both regions of CSA 5.

Region	Area	Bbls of Seed Oysters				Bbls of Market-Size Oysters			
		LTA	2022	Change from LTA	Annual Change	LTA	2022	Change from LTA	Annual Change
Western Terrebonne Basin	Sister Lake	81,243.3	66,519.5	-18.1%	-42.6%	24,147.4	28,877.6	19.6%	23.4%
	Bay Junop	878.0	705.4	-19.7%	-3.0%	1,069.1	1,995.1	86.6%	203.5%
	Lake Mechant	1,770.5	5,159.7	191.4%	128.4%	0.0	0.0	0.0%	0.0%
Eastern Terrebonne Basin	Lake Chien	647.1	0.0	-100.0%	0.0%	267.2	0.0	-100.0%	0.0%
	Lake Felicity	296.8	0.0	-100.0%	0.0%	9.0	0.0	-100.0%	0.0%

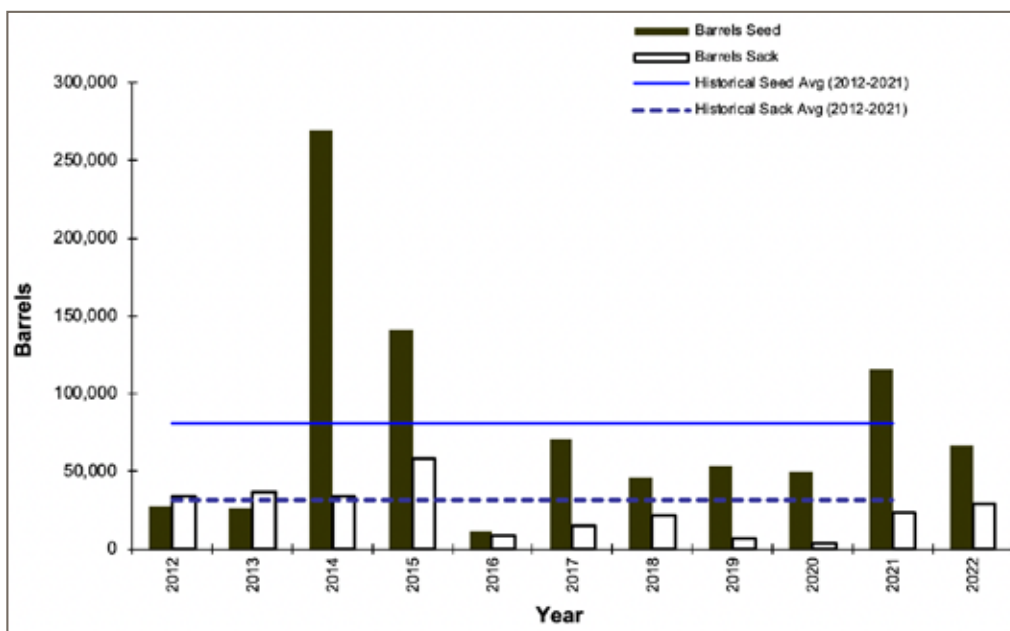


FIGURE 5.3. Sister Lake historical oyster stock availability.

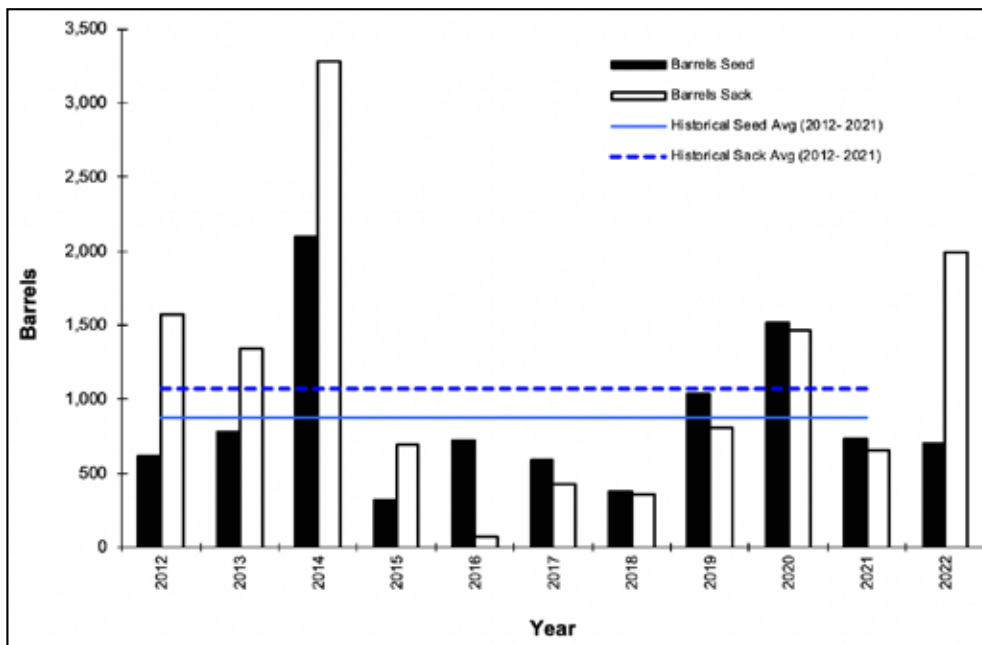


FIGURE 5.4. Bay Junop historical oyster stock availability.

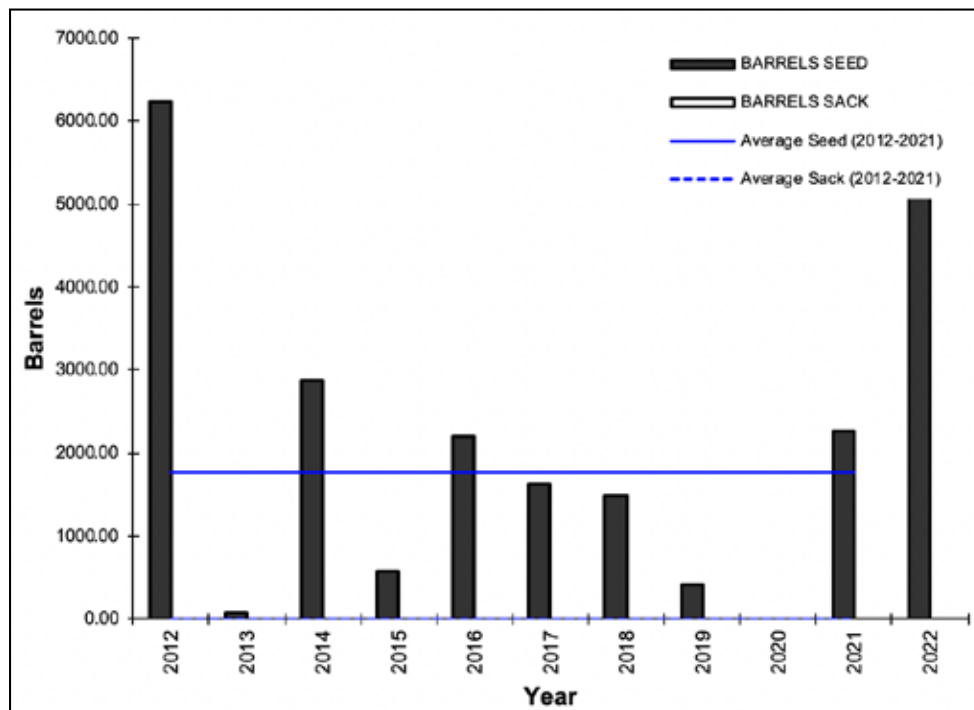


FIGURE 5.5. Lake Mechant historical oyster stock availability.

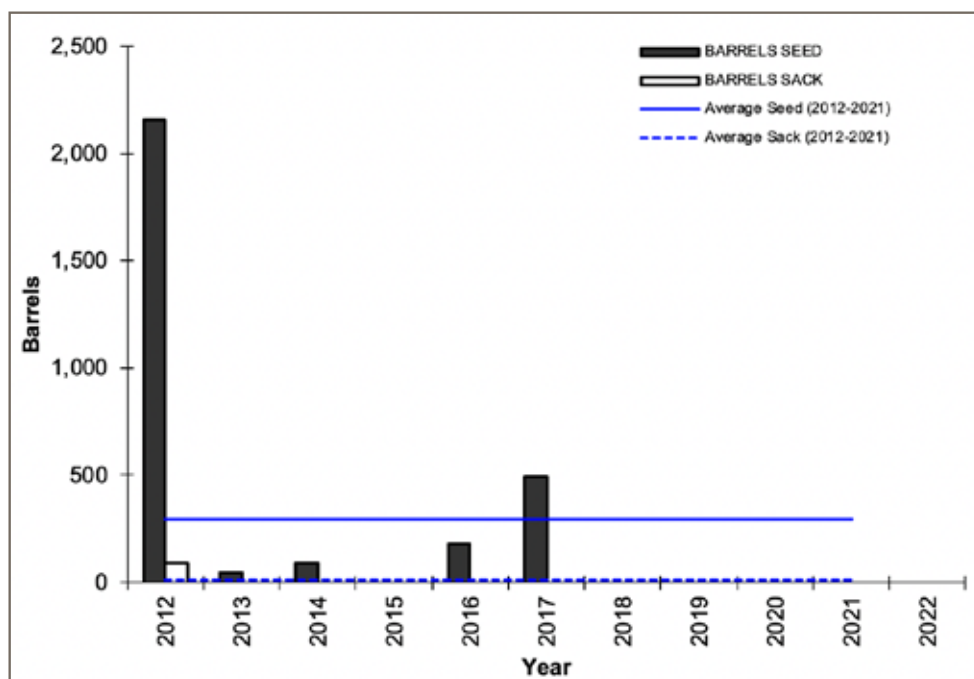


FIGURE 5.6. Lake Felicity historical oyster stock availability.

and 12.3 ppt, respectively. Biologists collected this data during dredge sample events from August 2021 through June 2022 and July 2021 square-meter samples. Temperature and salinity measurements collected concurrently with 2022 square-meter sampling in July averaged 29.5°C and 20.8 ppt in the eastern Terrebonne Basin, respectively. In the western Terrebonne Basin, average temperature and salinity measurements collected concurrently with July 2022 square-meter sampling in Sister Lake, Bay Junop and Lake Mechant averaged 28.9°C and 8.7 ppt, 28.0°C and 10.3 ppt, and 28.0°C and 2.0 ppt, respectively. *Figures 5.8-5.11* contain hydrological data from the 2021-2022 sampling year with long-term averages of salinity and temperature.

Louisiana had an active tropical season in 2021 with three tropical systems affecting the coast. Of the three storms that affected Louisiana (Tropical Storm Claudette, Hurricane Nicholas and Hurricane Ida), Hurricane Ida caused the most damage in the Terrebonne Basin. Tropical Storm Claudette and Hurricane Nicholas brought only rain to the area. Neither storm affected the oyster resource or industry. Hurricane Ida made landfall on Aug. 29, 2021 as a Category 4 storm and caused severe infrastructure damage to the Terrebonne Basin. Local oyster dealers and processors suffered structural damage and loss of electrical power and water for nearly a month. Several oyster fishing vessels were also damaged due to the severe weather; however, Hurricane Ida had minimal effects on POSR's and POSG's in the Terrebonne Basin. Vegetative overburden was observed in some post-storm dredge samples; however, no increase in oyster mortality was noted.

Fouling Organisms

Hooked mussels were the most abundant incidental species and were more prevalent in western Terrebonne Basin samples with an overall average of 9.3 hooked mussels per sample. Of this overall average, Sister Lake had the highest occurrence with 11.4 hooked mussels per sample.

June dredge data for Sister Lake, Lake Mechant and Bay Junop averaged 312.1, 3.0 and 22.8 hooked mussels per dredge sample, respectively. No hooked mussels were present in Lake Chien and Lake Felicity dredge samples in June.

Oyster Predators and Disease

Biologists collected two types of predator species (mud crabs and oyster drills) during 2022 square-meter sampling. Western Terre-

bonne Basin samples showed an average of 0.6 mud crabs and 0.1 oyster drills per sample. Eastern Terrebonne Basin samples showed an average of 0.1 oyster drills per sample.

June dredge data for Sister Lake averaged 4.0 mud crabs and 0.1 oyster drills per dredge sample, respectively. No mud crabs or oyster drills were present in Lake Chien and Lake Felicity dredge samples in June.

Results of Dermo tests are presented in Appendix I.

Mortality

Biologists observed no market-size oyster mortality throughout square-meter samples. Seed and spat mortality was noted in the western Terrebonne basin. Overall seed and spat mortality in Sister Lake was 0.2% and 1.9%, respectively. Overall seed and spat mortality in Bay Junop was 16.7% and 19.6%, respectively. No seed or spat mortality was observed in Lake Mechant.

For June 2022 dredge sampling, there was no market-size oyster mortality observed in Sister Lake and Bay Junop; Sister Lake seed and spat mortality was 0.3% and 2.1%, respectively; and there was no seed and no spat mortality in Bay Junop. Lake Mechant had no seed or spat mortality; nor were there any market-size oysters collected.

Sister Lake, overall seed and market-size mortality for the yearly dredge sampling was 1.3% and 0.2%, respectively. Overall seed mortality was 0.7% and no market-size oyster mortality was observed in Bay Junop during the sampling year. No market-size oysters were sampled and recorded in Lake Mechant during the sampling year.

2021/2022 Oyster Season

The Commission opened Sister Lake on Oct. 25 for a one-day bedding season. The Commission opened Sister Lake again Oct. 26-29 for market-sized harvest season with a daily take and possession limit of 25 sacks per day. Market-size harvest then resumed on March 7-10 and March 21-23 with a daily take and possession limit of 25 sacks per day. There was no market-size harvest provided from trip ticket data for publication.

The Commission did not open Bay Junop, Lake Mechant, Lake Chien, or Lake Felicity during the 2021-2022 season.

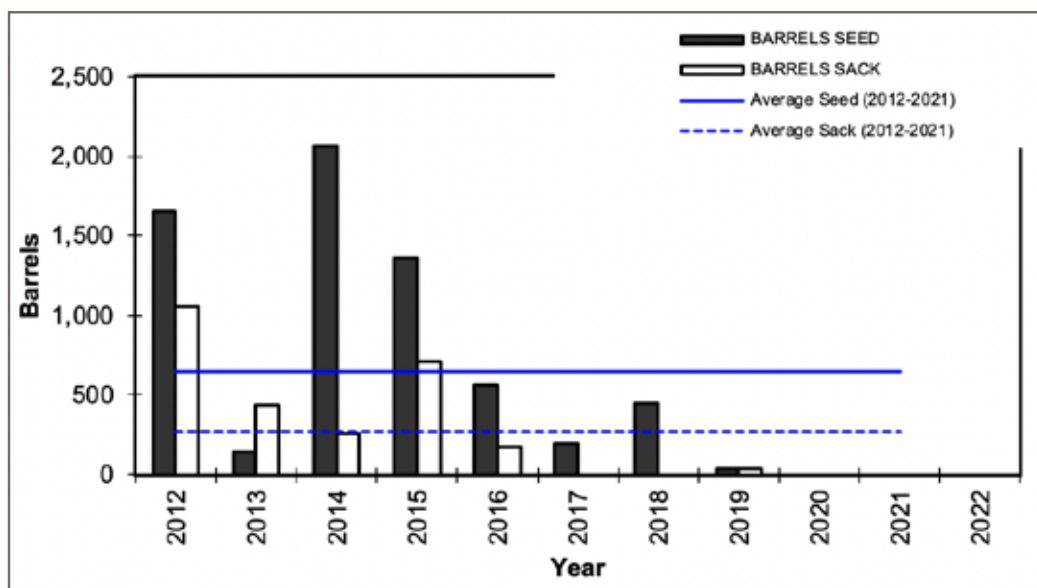


FIGURE 5.7. Lake Chien historical oyster stock availability.

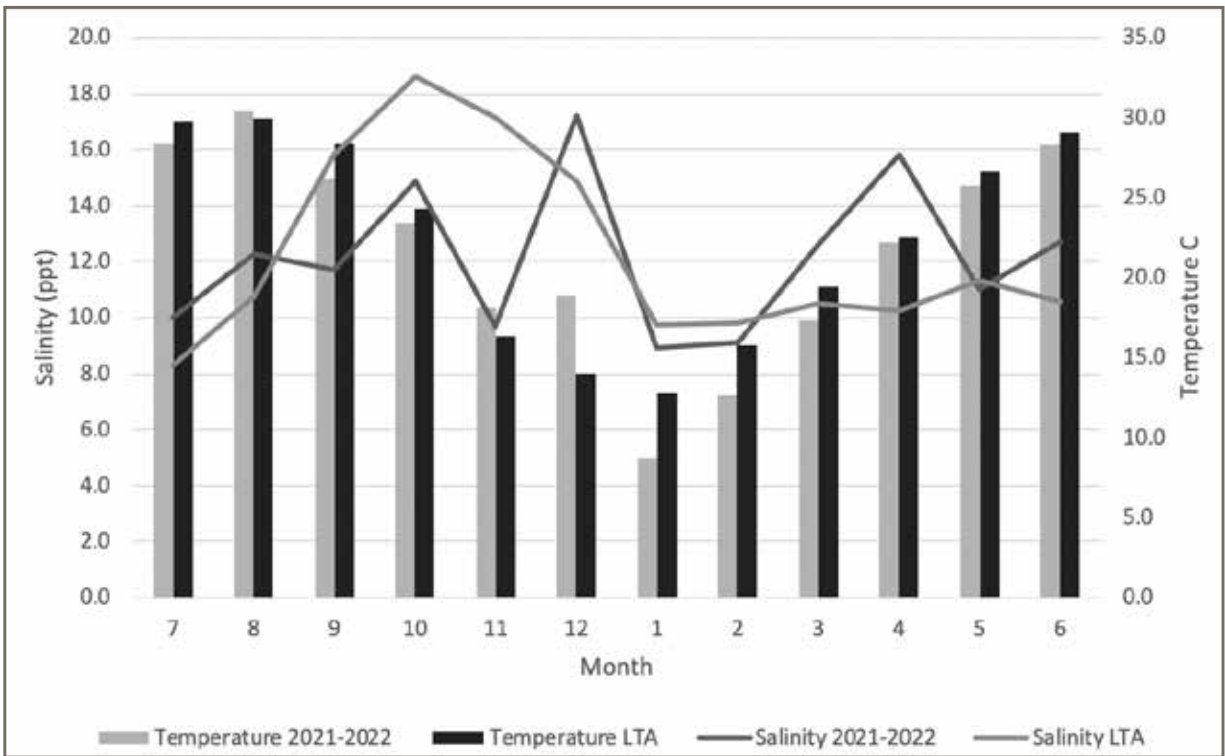


FIGURE 5.8. Salinity and temperature levels recorded during dredge and square-meter samples of the Sister Lake Public Oyster Seed Reservation in 2021-2022, with the long-term average (2012-2021).

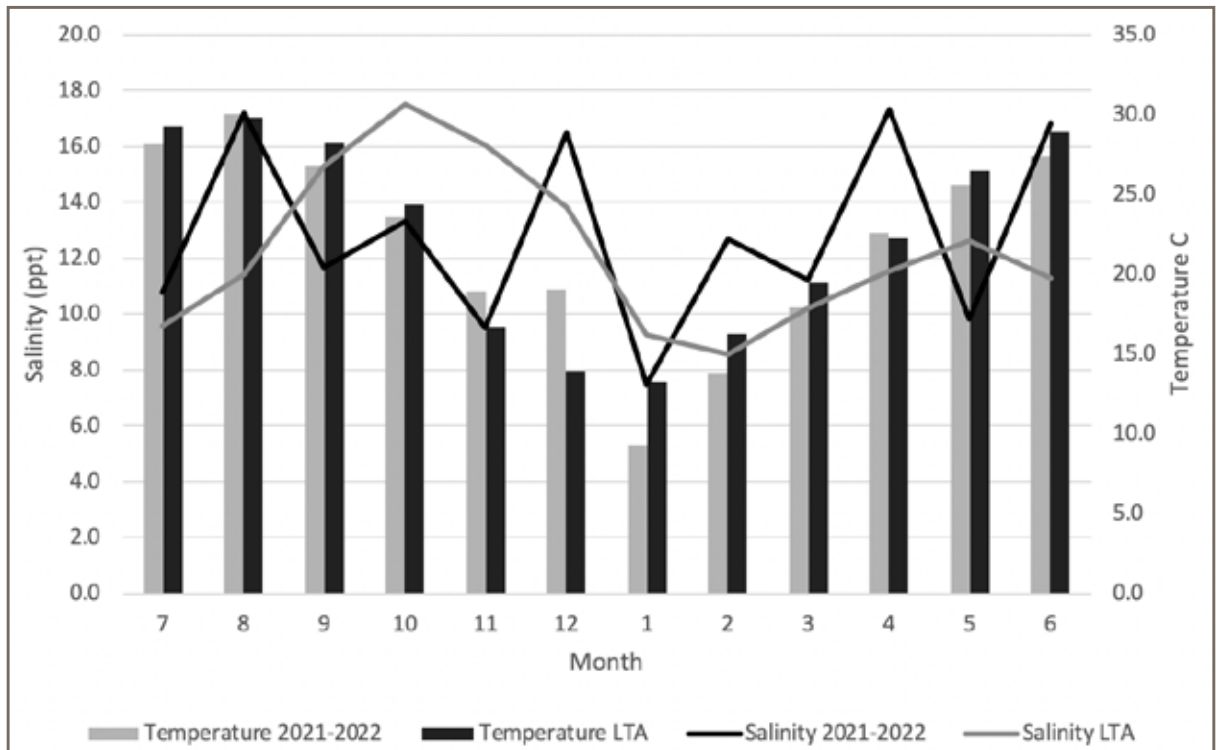


FIGURE 5.9. Salinity and temperature levels recorded during dredge and square-meter samples of the Bay Junop Public Oyster Seed Reservation in 2021-2022, with the long-term average (2012-2021).

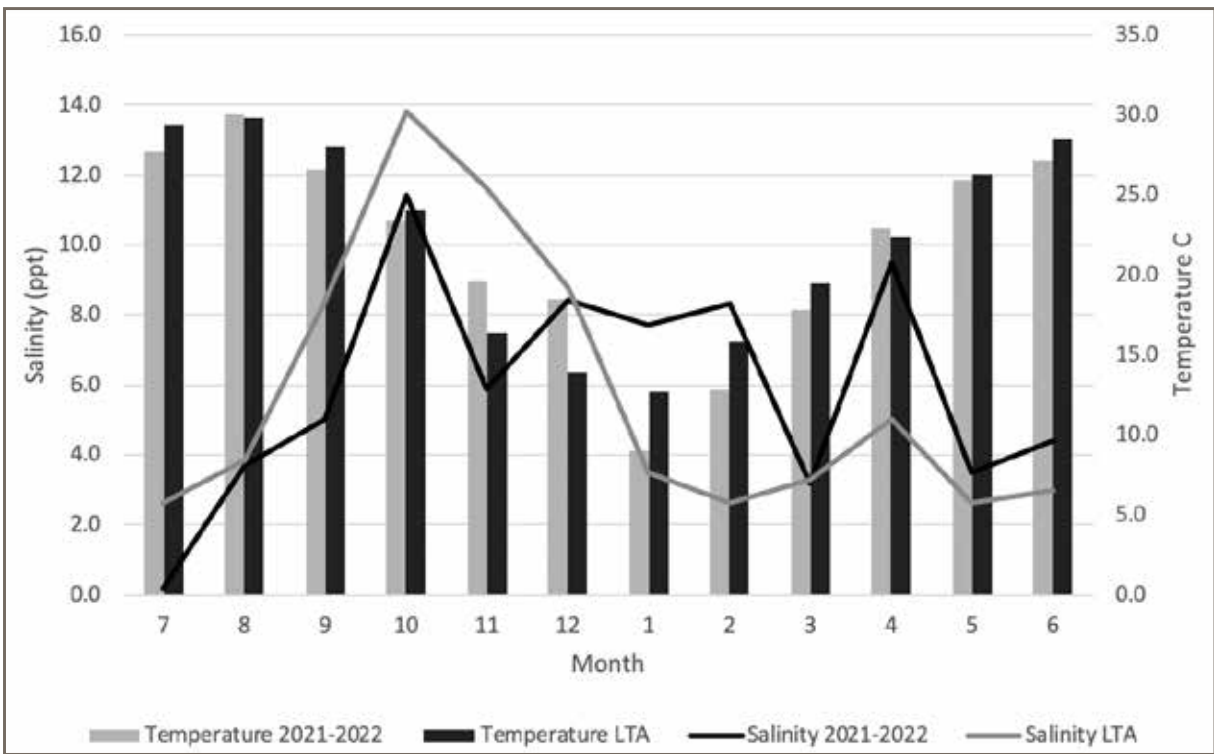


FIGURE 5.10. Salinity and temperature levels recorded during dredge and square-meter samples of the Lake Mechant Public Oyster Seed Ground in 2021-2022, with the long-term average (2012-2021).

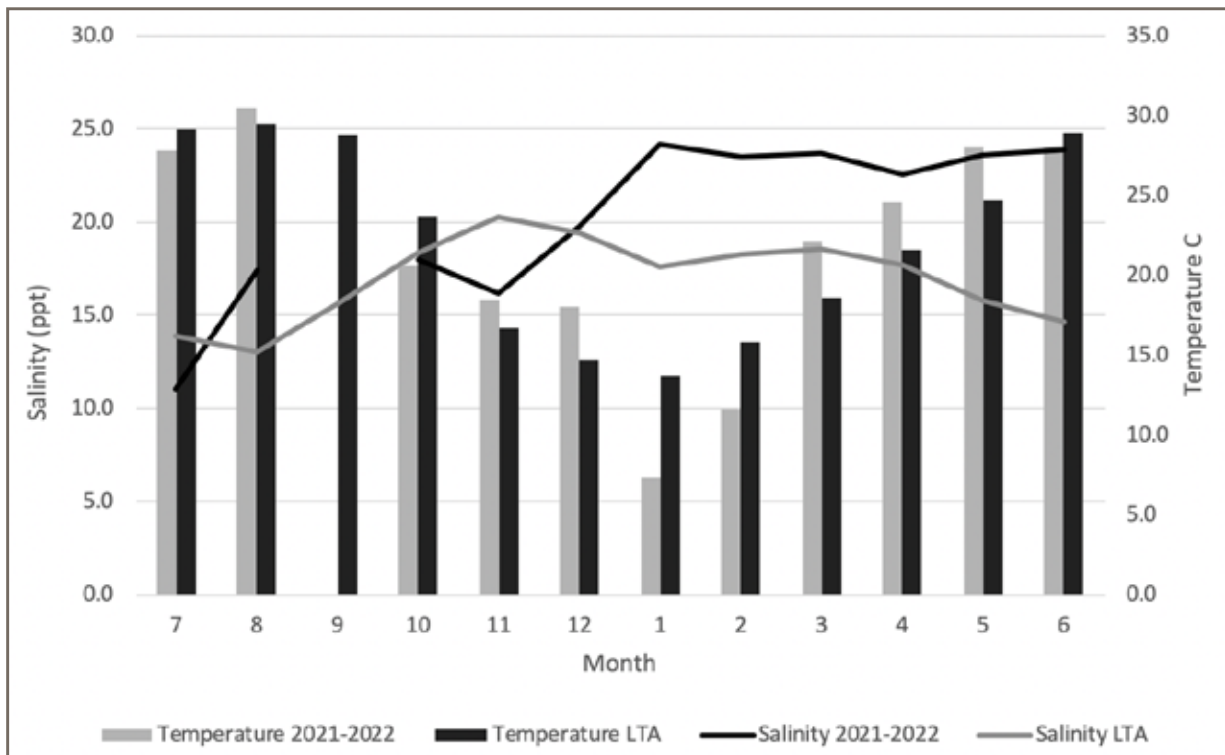


FIGURE 5.11. Salinity and temperature levels recorded during dredge and square-meter samples of the Lake Felicity and Lake Chien Public Oyster Seed Ground in 2021-2022, with the long-term average (2012-2021). No salinity and temperature data for September 2021 due to Hurricane Ida.

COASTAL STUDY AREA 6

(Vermilion/Atchafalaya Basin)

Introduction

CSA 6 includes oyster reefs found in the Vermilion/East and West Cote Blanche/Atchafalaya Public Oyster Seed Grounds. The Commission established the inside portion of these Public Oyster Seed Grounds in 1990; this area consists of state water bottoms found generally north of a line from the western shore of Vermilion Bay and Southwest Pass eastward to Point Au Fer. The Commission established the outside portion of these Public Oyster Seed Grounds in 1988; this area consists of Louisiana State Territorial Waters from the private oyster lease boundary near Mound Point/Marsh Island eastward to Point Au Fer. LDWF managed the oyster resources found on local state water bottoms in a manner similar to current management procedures for public oyster seed grounds. Management allowed limited harvest/relays from the Vermilion Bay area reefs when oyster abundance and distribution permitted.

The Vermilion/East and West Cote Blanche/Atchafalaya Bays complex is a large, primarily open-water brackish system; the Public Oyster Seed Grounds in this area consist of approximately 541,787 acres of water bottom (*Figure 6.1*). Primary influences on the bays' dynamic salinity regime are the Gulf of Mexico, Atchafalaya River and the adjacent Wax Lake Outlet, and the Vermilion River. In general, freshwater discharge from the Atchafalaya River highly influences the Public Oyster Seed Grounds within CSA 6. Independent of local rainfall, biologists have noted a correlation between increasing Atchafalaya River flow and decreasing salinity levels in the bay system. Typically, oyster reproduction occurs in the fall after the river stage abates, with oysters growing to seed size (1 inch to less than 3 inches) by the following spring. However, spring and early summer floodwaters depress salinities, placing extreme physiological stress on the organisms. These low salinities, coupled with high water temperatures through the summer months, typically result in extensive oyster mortalities on the public grounds. Occasionally, however, reduced freshwater inflow from the Atchafalaya River leads to higher-than-normal salinities, and the normal annual cycle of extensive oyster mortalities is broken, leading to a harvestable population of seed oysters during the following oyster season (September through April). Such was the case in 2013, 2014 and 2017 when sizable quantities of seed oysters were available for harvest. LDWF manages these seed grounds similar to other areas allowing limited harvest and relays when oysters are in abundance.

An overall oyster stock assessment for CSA 6 is not possible at this time, as figures relative to oyster reef sizes are not available. This report compares square-meter CPUE data collected from the 2022 oyster stock assessment sampling to previous years' square-meter sampling data, with a look at hydrologic conditions, marine fouling and oyster predators on sampled reefs. Observations of monthly dredge data collected during August 2021 through June 2022 are included. In addition, the report also presents information regarding the 2021/2022 oyster season on CSA 6 Public Oyster Seed Grounds.

Methods

LDWF biologists collected field samples for this report on July 5 and 6, 2022, from 11 sampling stations (*Figure 6.1*) within CSA 6 according to the methodology described in the Stock Assessment Methods.

Results and Discussion

Seed- and Market-Size Stock

Biologists found live seed oysters at seven of the 11 sampling stations (*Figure 6.1*). Densities of live seed ranged from 1.2 per replicate to 4.8 per replicate. Biologists collected market-size oysters only at Lighthouse Point and Nickle Reef with densities of 0.2 and 0.4 oysters per replicate, respectively. There was a 212.5% increase in the mean density of seed oysters in 2022 square-meter samples compared to 2021 and a 28.9% increase compared to the 10-year, long-term average (2012-2021). There was a 16.7% decrease in the mean density of sack oysters in 2022 compared to the 10-year, long-term average. Due to the lack of water bottom assessments in CSA 6, data is reported in mean density per sample shown in *Figure 6.2*.

Catch per unit effort (CPUE) of seed oysters in CSA 6 was highest during March 2022 dredges with a value of 12.5 per replicate. The lowest CPUE of seed oysters occurred in the August 2021 dredges with a value of 2.9 per replicate. The CPUE of sack size oysters in CSA 6 dredge samples was lowest in August 2021 at 0.2 per replicate and highest during March 2022 at 2.0 per replicate.

Spat Production

There was suitable substrate at all sampling stations and biologists found live spat at seven of 11 sampling stations. The density of spat there ranged from 0.6 per replicate to 5.4 per replicate. Low spat productivity during periods of low salinity conditions is common in this bay system. However, this year was conducive for spat production. Spat were recorded in high numbers during routine dredge samples beginning in October 2021 and numbers remained high through the winter and spring. The CPUE of spat in CSA 6 dredge samples was highest in October 2021 with a value of 7.8 spat per replicate. During January 2022, the CPUE of spat dropped to a low of 3.3 spat per replicate. However, the CPUE of spat steadily increased to a value of 6.4 spat per replicate by June 2022.

Hydrological Data

The Atchafalaya River levels remained near their 10-year average from August 2021 through June 2022. The observed river levels during spring 2022 increased as expected, but there was no large decline in average salinities within the area of CSA 6. The average salinities during March through May 2022 were near three parts per thousand compared to the LTA salinities of near one part per thousand. The deviation seen from this normal pattern of higher Atchafalaya River levels resulting in lower salinities could be attributed to a more southerly wind pattern seen during the spring of

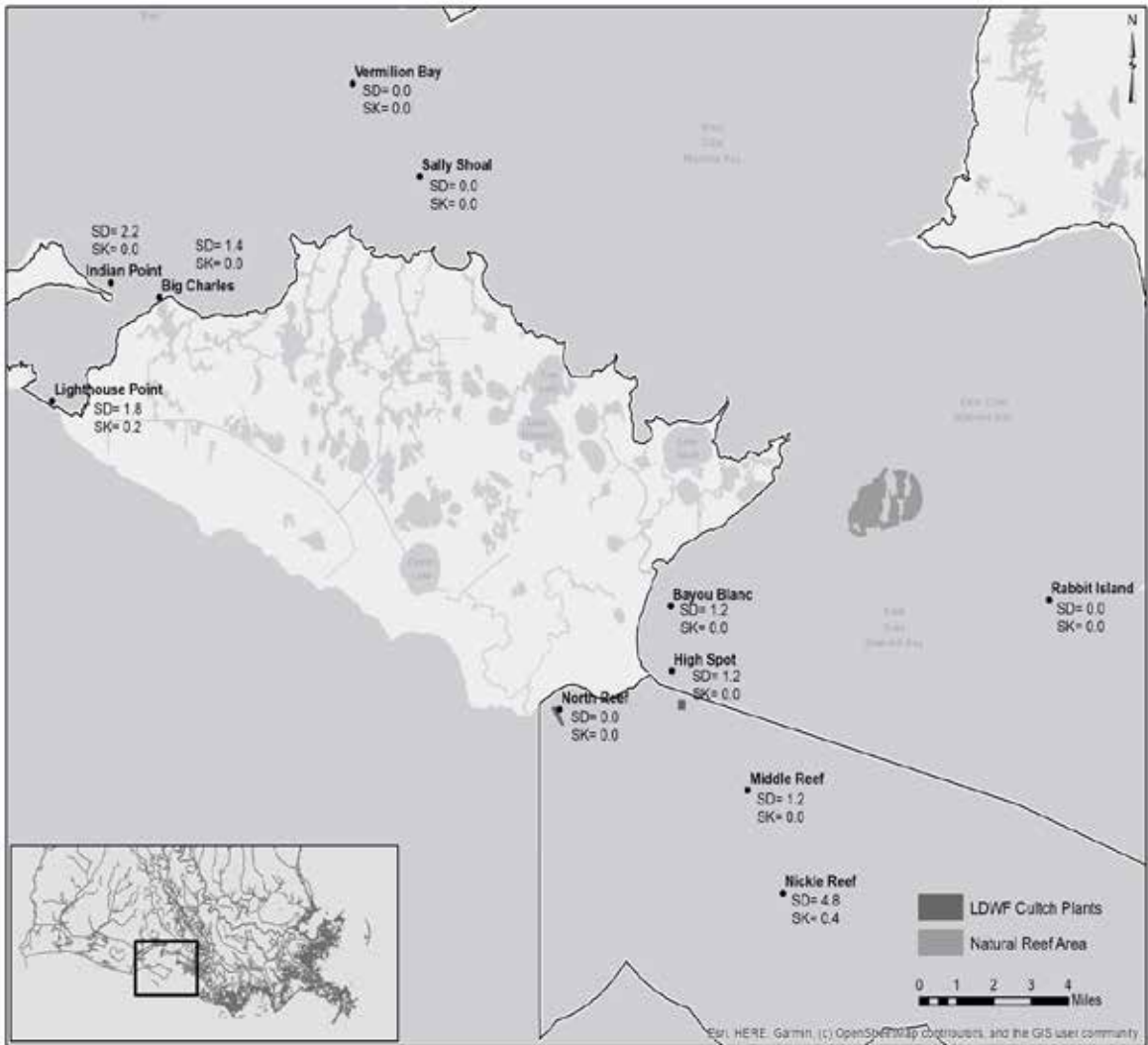


FIGURE 6.1. 2022 Coastal Study Area 6 oyster square-meter sampling stations of the Vermilion/East and West Cote Blanche/Atchafalaya Bays Public Oyster Seed Grounds with average seed and market-size sampling densities per square-meter.

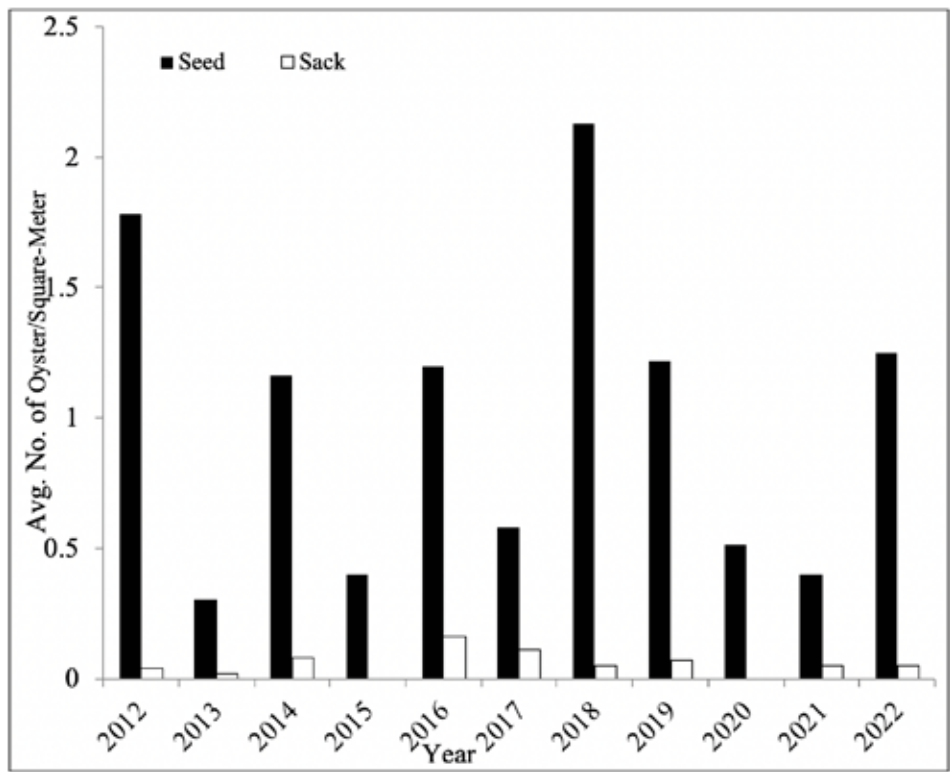


FIGURE 6.2. Mean density of live seed and market-size oysters collected in Coastal Study Area 6 square-meter samples by year.

2022. Then there was a steep drop in river levels during July when the average river level was approximately half of the 10-year average of 10 feet. October 2021 was an outlier as well, with low river levels but low salinities as well. This was most likely due to the high amount of rainfall seen during the latter part of September 2021.

Bottom dissolved oxygen recorded during July 2022 was in the normal range at 10 of 11 stations and ranged from 5.6 to 7.3 milligrams per liter (mg/L). The exception was Nickle Reef where the dissolved oxygen was 2.0 mg/L. Even though near-hypoxic conditions were observed at Nickle Reef, no significant mortality was noted.

Hurricane Ida made landfall as a category four hurricane near Port Fourchon, LA on Aug. 29, 2021 with sustained winds near 150 mph. Almost all of the devastation occurred east of the Atchafalaya River in the southeastern parishes of the state. Commercial fisheries infrastructure within CSA 6 were spared any damages. In fact, there was mostly low tides, low winds and low rainfall amounts west of the Atchafalaya River during landfall.

Hurricane Nicholas made landfall along the Texas coast on Sept. 14, 2021 with winds near 75 mph. The only effects felt in the CSA 6 area was heavy rains in small sections of the coast causing localized flooding in some areas.

Fouling Organisms

Biologists documented an overall 739.6% increase in hooked mussel abundance at the sampling stations compared to 2021 oyster stock assessment. They noted an increase in density at all stations except Rabbit Island and Nickle Reef. Rabbit Island had no change in hooked mussel abundance while Nickle Reef showed a decrease. The Bayou Blanc sampling station showed the largest increase in hooked mussel density, jumping from an average

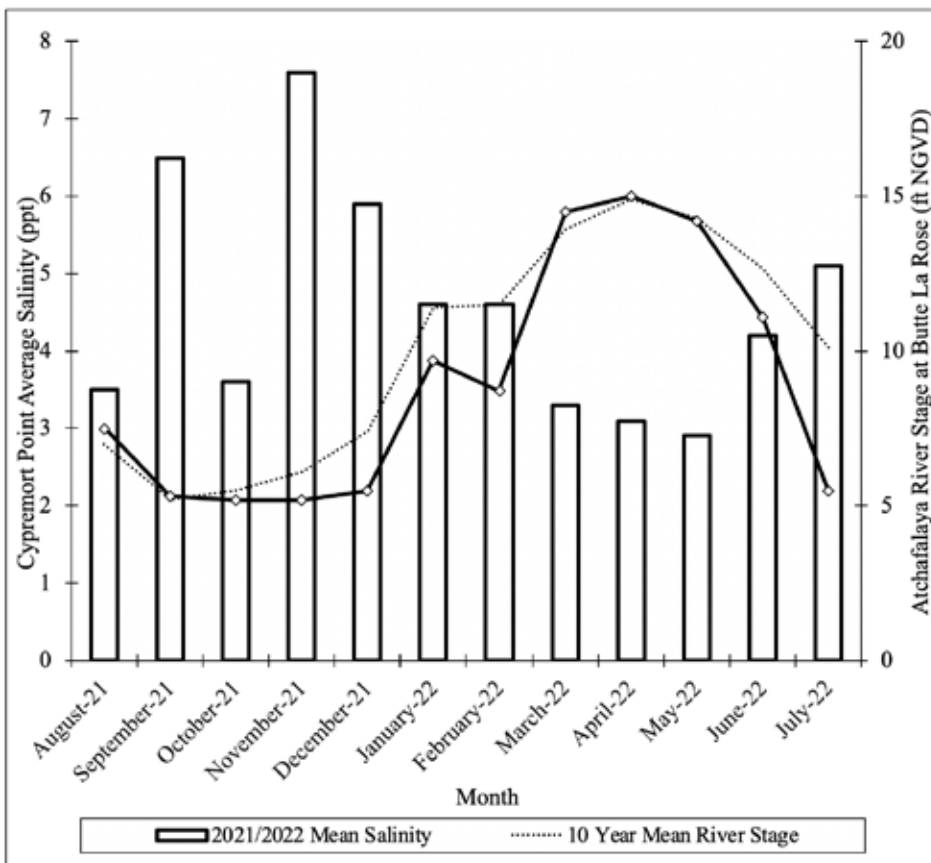
of 0.6 per replicate in the 2021 oyster stock assessment to 51.4 per replicate in the 2022 oyster stock assessment. The most likely cause for the large increase was salinities stayed near the low-end range for hooked mussels, which is four parts per thousand.

Oyster Predators

Biologists did not find any southern oyster drills during square-meter sampling. These marine snails are more often associated with high salinity waters where they are known to prey heavily on oysters and other bivalve species. The occurrence of mud crab on historically sampled reefs increased by 122.2% compared to the 2021 oyster stock assessment. Only one of the 11 sampled reefs had no mud crabs, but mud crab density reached a high of 4.2 crabs per replicate at Lighthouse Point. Biologists did not collect any blue or stone crabs during the 2022 square-meter sampling.

Mortality

There were no large-scale mortality events observed during 2021/2022 and conditions in the Vermilion-Teche basin were favorable for oyster growth most months. During most of 2021 and 2022, there were significant numbers of seed size oysters at Nickle, Middle, North, Lighthouse Point, Indian Point and Big Charles reefs, as observed in monthly dredge samples collected throughout the year. Those seed oysters sampled in October, November and December were sampled as sack size oysters in February, March and April. There was a mortality event observed during June 2022, most likely due to the rise in water temperature. Seven of 11 stations sampled during the 2022 square-meter sampling event contained live oysters. Only Big Charles, Indian Point and Nickle Reef contained notable numbers of live oysters. The oyster stock found in CSA 6 is highly vulnerable to low salinity/high turbidity conditions often seen as a result of extended freshwater conditions associated with high Atchafalaya River discharge (Figure 6.3).



2021/2022 Oyster Season

The Commission kept the Vermilion/East and West Cote Blanche/Atchafalaya Bay public oyster seed grounds closed for the entire 2021/2022 oyster season.

FIGURE 6.3. Atchafalaya River levels at Butte La Rose gauge and average salinity for Cypremort Point, LA during the period Aug. 1, 2021 - July 31, 2022. The 10-year average monthly river stage at Butte La Rose is included.

COASTAL STUDY AREA 7

(Calcasieu and Sabine Lakes)

Introduction

CSA 7 is located in Southwest Louisiana, from the Louisiana/Texas state line to Freshwater Bayou in Vermilion Parish. It is comprised of Calcasieu and Mermentau River basins and the eastern portion of the Sabine River Basin. Calcasieu Lake is located at the southern end of the Calcasieu River Basin in Calcasieu and Cameron parishes; the lake consists of approximately 58,260 acres of water bottom with oyster reefs located throughout, but concentrated in the southern end (*Figure 7.1*). There are no oyster harvesting areas in the Mermentau River Basin. Sabine Lake, located at the southern end of the Sabine River Basin in Cameron Parish, consists of approximately 55,057 acres of water bottom. Approximately 34,067 acres are located in the Louisiana portion of the lake; the remainder is in the Texas portion. The majority of oyster reefs on the Louisiana portion of Sabine Lake are located in the very southern portion of the lake.

For assessment purposes, Calcasieu Lake has always been divided into two areas - East Side and West Cove - with the Calcasieu Ship Channel being the dividing line. The Louisiana Department of Health (LDH) classified the areas as conditionally managed giv-

ing LDH the authority to close the areas to oyster harvest based on health-related concerns due to poor water quality. It has been established that health related closures of oyster harvest in Calcasieu Lake (East Side) will occur when the river stage reaches 13.5 feet, and the West Cove would close when the river stage reaches 9 feet. Once the river falls below these levels for 48 hours, the LDH reopens the areas for harvest. Additionally, the East Side of Calcasieu Lake and West Cove are classified as Growing Area 29 (GA29) and Growing Area 30 (GA30) (*Figure 7.1*), respectively. LDH seasonal closure lines also limit the amount of acreage available to harvest oysters. Oysters can only be harvested in the southern portion of the Lake due to the location of the LDH closure line.

LDWF oyster stock assessments in Calcasieu and Sabine Lakes have used acreage estimates which had been determined by side-scan sonar, water bottom assessments conducted in 2008 and 2011. LDWF identified all suitable oyster habitat and classified this habitat into one of two bottom types: reef or scattered shell. The results of the side-scan studies estimated that East Side has a total of 1,962.3 acres of suitable oyster habitat, including 1,435.8 acres of reef and 526.5 acres of scattered shell bottom. West Cove has a total of

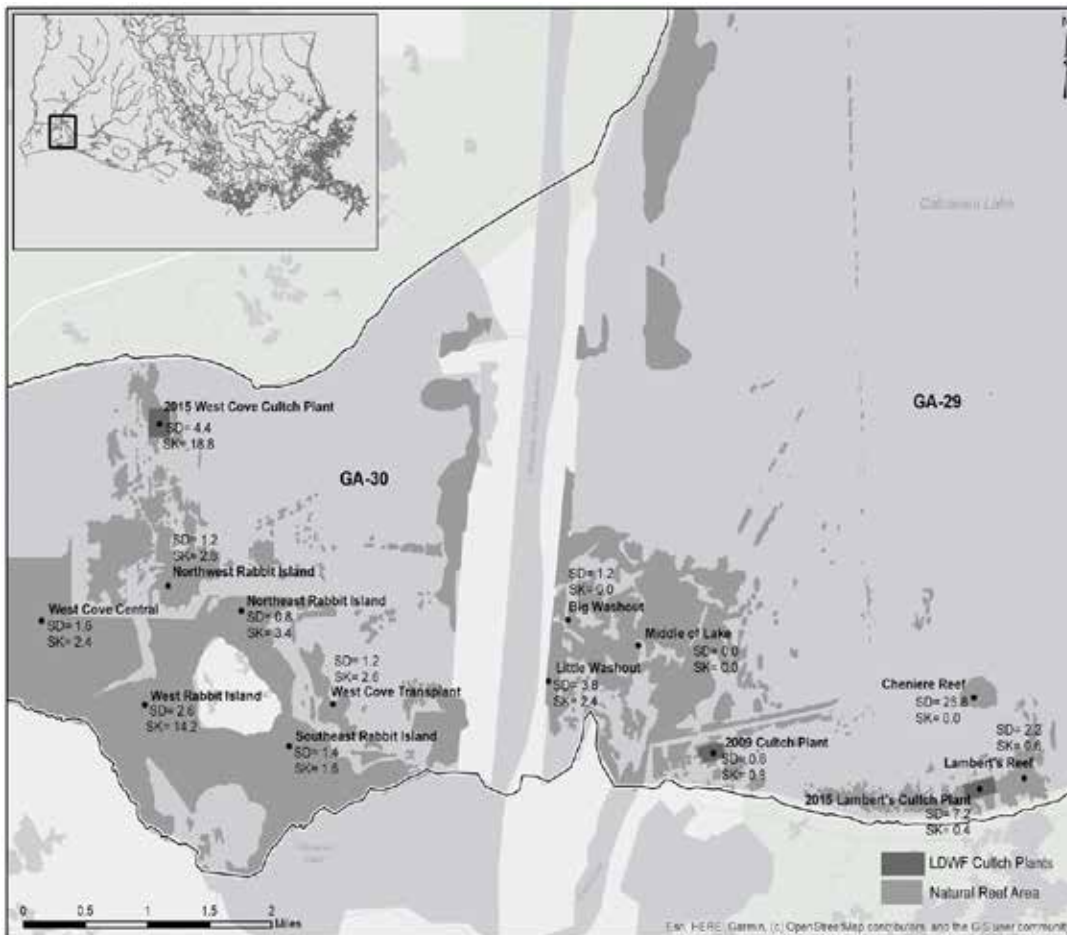


FIGURE 7.1. 2022 Coastal Study Area 7 oyster stock assessment sampling stations in Calcasieu Lake with average seed (SD) and market-sized (SK) oyster densities for each sampling station.

3,387.8 acres of suitable oyster habitat, including 1,119.6 acres of reef and 2,268.2 acres of scattered shell bottom (*Figure 7.1*).

In 2018 additional surveying and sampling on the scattered shell bottom type in the East Side determined that no suitable bottom-type material and no live oysters were present. Therefore, 526.5 scattered shell acreage was deleted from oyster habitat calculations; and beginning in 2019, stock assessment availability calculations (East Side) are based using 1,435.8 acres of reef habitat. The acreage estimates generated from the side-scan sonar studies only include reef acreage of Calcasieu Lake that lie within the LDH allowed harvest areas.

No stock-assessment sampling was conducted on Sabine Lake in 2022 as per an established odd-year only scheduling.

Methods

LDWF biologists collected field samples for the 2022 oyster stock assessment on July 6, 2022, from 14 stations within Calcasieu Lake according to the methodology described in the Statewide Overview of this report.

Considering there are no private oyster leases and no bedding (seeding) operations in Calcasieu Lake, all harvest is direct market and the unit of measure is in sacks. Historical data in this report (*Table 7.2*) is reported in sacks of market-size oysters. 2022 availability numbers (*Table 7.1*) are presented in barrels and sacks. One barrel of oysters equals two sacks of oysters.

Results and Discussion

Calcasieu Lake

Market-Size Stock

The 2022 stock assessment estimated that the current oyster stock in Calcasieu Lake was approximately 216,190.8 barrels of market-size oysters and 44,749.9 barrels of seed oysters (*Table 7.1*). This represents a 66.4% increase in market-size oysters from the 2021 estimate. Seed-sized oysters increased 99.6% from the previous year's assessment.

Spat/Seed Production

Seed-sized oysters are typically used to estimate recruitment and predict future market-sized oysters. Data collected during the 2022 stock assessment suggests a significant improvement in young oyster recruitment in Calcasieu Lake.

Seed-sized oysters on the East Side experienced a 403.8% increase in numbers and oysters in West Cove increased 52.9% compared to the 2021 assessment (*Table 7.2*). Seed-sized oyster populations on the East Side are currently 59.2% above the 10-year average (2012-2021) and oysters in West Cove are 24.8% below the 10-year average (*Table 7.2*).

Of particular note from this year's stock assessment sampling was the tremendous amount of spat-sized oysters recorded. It is estimated there are approximately 31,730 sacks of spat-sized oysters in West Cove. In last year's assessment, there were no spat-sized oysters recorded in any sample in West Cove. The East Side of Calcasieu Lake has approximately 297,000 sacks of spat-sized oysters. This represents a significant increase from the 2021 assessment of 631 sacks.

Spat-sized oysters are the most vulnerable oysters to adverse environmental conditions, disease and predation.

The amount of spat-sized oysters found during the 2022 stock assessment is highly unusual. They are typically the least abundant size-class group of oysters found during our stock assessment sampling due the timing of our sampling and the fact that the late summer/early fall months are the major spawning period for Calcasieu Lake oysters.

Warmer water temperatures and low rainfall in the late spring / early summer created optimum hydrologic conditions for an early spawning event. The highest density of spat-sized oysters were found on cultch plant sample stations on the East Side of Calcasieu Lake. The density reached as high as 277 spat per square-meter.

Oyster recruitment in lower Calcasieu Lake has struggled for nearly a decade. Only in the last few years have there been any notable improvement. Hopefully, the large amounts of spat recorded in sampling this year will survive and develop into the larger and more robust seed-size class.

LDWF biologists will continue to sample oyster populations throughout the year to monitor recruitment and survival.

Hydrological Data

Average water temperatures recorded during dredge samples for Calcasieu Lake in May and June were 27.1 and 28.5°C, respectively. The temperatures recorded in May were higher than the long-term average while the June temperatures were about normal (*Figure 7.3*). The average water temperature during the 2022 oyster assessment was 30.5°C, which is above the long-term average temperature of 29.7°C.

Average salinities recorded during dredge samples for Calcasieu Lake in May and June 2022 were 19.2 and 22.1ppt, respectively. Salinity levels during May and June sampling were higher than the long-term averages (*Figure 7.3*). The entire region of SW Louisiana was suffering from drought conditions from late winter to mid-summer, which is the likely cause of increased salinities.

Average salinity levels of stations during the stock assessment sampling events was 30.5ppt which is more than double the long term average of 14.9ppt.

Damages associated with the 2020 hurricane season and extremely low salinities during the early summer of 2021 had a significant negative impact on young oysters the following year. Following the 2021 stock assessment conditions improved, and during the spring/early summer of 2022 oysters experienced a highly successful early spawn.

2021/2022 Oyster Season

The Commission opened the Calcasieu Lake oyster harvest area on Nov. 1, 2021, with a daily sack limit of 10.

Participation in this year's oyster season was significantly higher than the season immediately after Hurricanes Laura and Delta. It was estimated approximately 10 boats per day were harvesting.

The oyster harvest area is classified as a LDH conditionally managed area. The number of closures to oyster harvesting in Calcasieu Lake due to LDH health concerns was below normal for a typical oyster season. West Cove was open to harvest 84% of the total oyster season at 152 harvestable days (*Table 7.3*). The East Side was opened 93% of the oyster season for 168 days (*Table 7.3*).

TABLE 7.1. 2022 estimated oyster availability between East Side and West Cove, Calcasieu Lake.

Station	Reef (Acres)	Average Number Seed Oysters/m ²	Average Number Market-Size Oysters/m ²	Bbls Seed Oysters	Bbls Market- Size Oysters
2015 Lamberts Cultch Plant	30 (~121,405.8 m ²)	7.2	0.4	2,782.2 (5,564.4 sacks)	67.4 (134.9 sacks)
Chenier Reef		25.8	0		
Cultch Plant Reef Total		16.5	0.2		
2009 Cultch Plant	1,179.80 (~4,774,485.428 m ²)	0.6	0.8	9,283.7 (18,567.4 sacks)	10,610.0 (21,219.9 sacks)
Big Washout		1.2	0		
Little Washout		3.8	2.4		
Middle of Lake		0	0		
East Side Reef Total		1.4	0.8		
Lamberts Reef	240 (~971,246.4 m ²)	2.2	0.6	2,967.7 (5,935.4 sacks)	1,618.7 (3,237.5 sacks)
East Side Total				15,033.6 (30,067.3 sacks)	12,296.2 (24,592.3 sacks)
NW Rabbit Island	1,097.20 (~4,440,214.79 m ²)	1.2	2.8	7,832.0 (15,664.1 sacks)	28,738.1 (57,476.1 sacks)
SE Rabbit Island		1.4	1.6		
West Cove Transplant		1.2	2.6		
West Cove Reef 1 Total		1.27	2.33		
NE Rabbit Island	2,265.60 (~9,168,566.016 m ²)	0.8	3.4	21,266.0 (42,532.0 sacks)	169,873.2 (339,746.3 sacks)
West Cove Central		1.6	2.4		
West Rabbit Island		2.6	14.2		
West Cove Reef 2 Total		1.67	6.67		
West Cove Cultch Plant	25 (~101,171.5 m ²)	4.4	18.8	618.3 (1,236.5 sacks)	5,283.4 (10,566.8 sacks)
West Cove Total				29,716.3 (59,432.6 sacks)	203,894.6 (407,789.2 sacks)
Calcasieu Lake Total				44,749.9 (89,499.9 sacks)	216,190.8 (432,381.5 sacks)

TABLE 7.2. Oyster stock assessments, in sacks, and percentage change of public oyster areas of East Side and West Cove, Calcasieu Lake.

Year	Market Oysters (≥ 3")		Seed Oysters (< 3")	
	GA29	GA30	GA29	GA30
2012	0	236,440	0	85,171
2013	0	169,038	0	59,511
2014	0	188,616	24,210	213,951
2015	16,862	54,509	47,763	36,075
2016	27,024	45,576	34,398	57,131
2017	11,236	92,884	13,776	31,322
2018	18,390	144,101	17,647	43,270
2019	23,334	166,735	32,227	124,010
2020	46,105	419,460	12,836	100,698
2021	34,370	225,525	5,968	38,867
2022	24,592	407,789	30,067	59,433
10-Year Average	17,732	174,288	18,882	79,001
<i>Change from Average</i>	38.7	134.0	59.2	-24.8
<i>Change from 2020</i>	-28.4	80.8	403.8	52.9

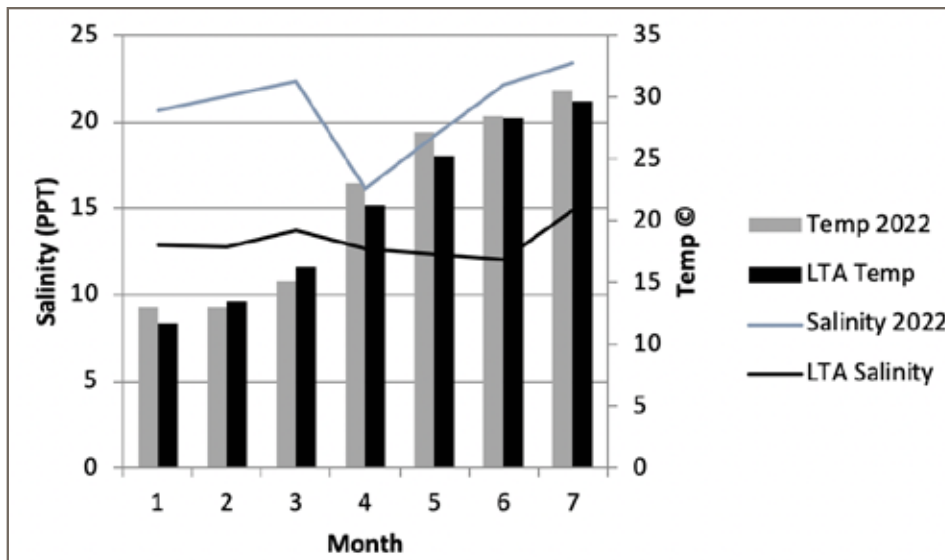


FIGURE 7.2. Salinity and temperature levels recorded during dredge and square-meter samples of the Calcasieu Lake public oyster areas in 2022.

TABLE 7.3. Public oyster season and number of days open to harvest as a percentage for East Side and West Cove in Calcasieu Lake

Season		Season Dates	Total Days	CALCASIEU LAKE			
				Eastside		West Cove	
				Days	% Open	Days	% Open
2012-13	East Side	Closed	Closed	0	-		
	West Cove	Nov. 1- April 30	181			82	45
2013-14	East Side	Closed	Closed	0	-		
	West Cove	Nov. 1- April 30	181			158	87
2014-15	East Side	Closed	Closed	0	-		
	West Cove	Oct. 26-April 30	187			111	59
2015-16	East Side	Closed	Closed	0	-		
	West Cove	Nov. 1- April 30	182			108	59
2016-17	East Side	Nov.1-Feb. 13	105	86	82		
	West Cove	Nov. 1- Jan. 24	85			54	64
2017-18	East Side	Closed	Closed	0	-		
	West Cove	Nov. 1- May 15	196			130	66
2018-19	East Side	Oct. 15- April 30	184	145	79		
	West Cove					88	48
2019-20	East Side	Nov.1-Jan 26	87	81	93		
	West Cove	Nov. 1- April 30	182			58	32
2020-21 ¹	East Side	Oct. 30- April 30	132	107	81		
	West Cove	Oct. 30- April 30	132			49	37
2021-22	East Side	Nov. 1- April 30	181	168	93		
	West Cove					152	84

1. WEEK DAY HARVEST ONLY PERMITTED DURING 2020-2021 HARVEST SEASON