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Hurricane Damage Sustained by the Oyster Industry and the Oyster Reefs Across the Galveston Bay System with Recovery Recommendations

Prepared by Extension Specialists in the Departments of Agricultural Economics and Wildlife and Fisheries Sciences

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Hurricane Damage Sustained by the Oyster Industry and the Oyster Reefs Across the Galveston Bay System with Recovery Recommendations [a]

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Acknowledgment

Initially, the goal of this project was to quantify the damage sustained by oyster-dependent firms within the Galveston Bay system. However, as additional information about the condition of publicly-managed oyster resources became available, the scope of this report expanded to address the various environmental benefits oyster habitat creates for all users who directly or ultimately depend upon this resource to generate economic impacts from their particular uses of the bay.

We hope that this information can be used by industry, various organizations, agencies, and lawmakers to begin a process that re-establishes the oyster reefs. These reefs are the essential habitat that allows this water body to meet a daily mix of multiple uses.

Measuring industry-wide damage requires the trust and cooperation of impacted industry members. Virtually all were quick to commit to this project. In this instance though, more than cooperation was required. The leadership and clear-thinking necessary to push this project forward came from the oyster industry. We were humbled by the invitation of Clifford Hillman on October 1st to spend several hours discussing our plans and approaches for conducting this benchmarking study for the oyster-dependent industry. Early on, we attempted to collect damage estimates by meeting with operators at their businesses or homes. During a brief meeting in San Leon, Lisa Halili reminded us that industry had the information we requested and was willing to share it, but like most everyone else her days were filled with crushing time demands – such as meeting the basics of everyday life in a community that was turned upside down, making multiple trips to home centers for building supplies, and meeting with adjusters – and she just could not take the time to discuss the damage her family's operation sustained. Instead of dismissing us, she asked for a questionnaire that could be completed as time allowed. The industry-wide damage estimate reflected in this report ultimately resulted from Lisa's forward thinking and her presence of mind to make that suggestion. We are also indebted to Tracy Woody at Jeri's Seafood. Tracy provided us with historic articles from the *Galveston Daily News* from November, 1929 that detailed the *"new"* leasing program in Galveston Bay for oyster production.

The successful development of this report stems from the willingness of operators to contribute their most private of financial information. The last time we undertook a project that relied on contributions of private financial data, identity-related crime was nothing more than an isolated occurrence. Today, however, identity theft is a major crime category, and we are warned to be very guarded with all private data. That said, we reiterate our pledge to survey participants that only industry-wide values will be presented, whether in this report or through other avenues. Such an approach enables the collective damages to be quantified and reported, but protects the privacy and anonymity of contributors.

As the scope of this project broadened to present as complete a picture as possible of storm impacts upon the oyster-dependent industry, we sought the help of those more familiar with issues surrounding resource management and food safety. Lance Robinson and Page Campbell, both with the Coastal Fisheries Division of Texas Parks and Wildlife, played major roles in (a) helping us answer important questions about the industry and (b) providing us with detailed cross-sectional time-series landings information. Lance Robinson, the Regional Coastal Fisheries Director in Dickinson, proved invaluable as we attempted to understand many of the idiosyncracies of the oyster industry. Robinson was articulate and precise in his explanations and so well organized with the varied information sources at his disposal that virtually all questions were answered the day they were asked. As if cut from the same cloth, Page Campbell, who manages the collection, analysis, and summary of commercial landings from Rockport, patiently assisted us repeatedly because the type and time frame of landings data we sought changed as the analysis and summary broadened. Kirk Wiles, who leads the Seafood and Aquatic Life Group within the Texas Department of State Health Services was the first one called after the storm to get contact information for all operators. Gary Heideman, also with the Seafood and Aquatic Life Group, answered numerous questions about the food safety aspects of the oyster industry and worked to provide us with current acreage of approved and unapproved oyster grounds across the state. All four of these individuals have demonstrated an exemplary cooperative spirit, and a willingness to help the industry regain it's footing. In today's world, when every resignation or retirement within a public-sector organization brings additional responsibility and work to those who remain, these professionals honored our requests with expediency, and followed up to make sure what we asked for was what we received.

Most importantly, we are deeply indebted to all who gave their time to move this effort forward during the dark days after Ike made landfall, and sincerely hope this work can help to fund restoration of the oyster reefs damaged by Hurricane Ike.

Executive Summary

Three weeks after landfall, faculty with the Texas A&M System began assessing damages to the assets controlled by oyster-dependent firms across the Galveston Bay system (GBS). Operators quickly committed to this effort. Damage estimates are based on 62% of all firms and 74% of leased acreage so an accurate portrayal has been created of the work required to help industry regain its *"pre-Ike"* footing. However, the damages to private assets are but a fraction of the total losses that will continue to impact the Texas oyster industry and others who depend upon the bay. In late Fall, Texas Parks and Wildlife biologists began a survey of the public oyster grounds across the bay and concluded that about 60% of the oyster crop had smothered under sediments and debris deposited by the storm surge.

The impacts of damaged reefs extend far beyond those who depend upon oysters. Reef damage in the GBS is a significant concern to the long-term ecological health of the estuary because this habitat provides numerous environmental benefits. Chief among these is ensuring environmental water quality despite receiving millions of gallons of municipal wastewater and storm runoff each day. Good environmental water quality translates into a wide mix of large, direct economic impacts. For example, the GBS supports commercial shrimp, crab, and oyster fisheries as well as a tourism industry predicated on boating, contact water sports, and sportsfishing. Reef habitats are productive sportsfishing grounds. In Louisiana 23% of angling days each year were spent over oyster reefs.

This report (a) addresses the importance of Texas and the GBS to the US Eastern oyster industry, (b) outlines the environmental benefits oyster reefs contribute to this multiple-use estuary, (c) reports on damage sustained by the oyster-dependent industry, and (d) recommends restoring damaged oyster ground which ultimately benefits all who depend upon this habitat to generate economic impacts from their particular uses of the bay.

An Essential, Nationwide Supplier of Eastern Oysters

Anchored by production from the GBS, Texas has been the second-largest supplier of Eastern oysters in the US since 1991, annually providing 18% of total domestic supply. This bay is unique among other Texas bays because portions of the bottom can be leased from the state to create oyster reefs. Leaseholders seek to improve productivity each year by creating a substrate upon which oyster larvae can attach. Leaseholders also transplant oysters from closed areas which allows them to meet federal food safety standards prior to harvest. These efforts increase productivity! Since 1981, public oyster grounds within the GBS have annually produced 132 lb. of meat per acre while harvests from the leases averaged 435 lb. over the same 27-year interval.

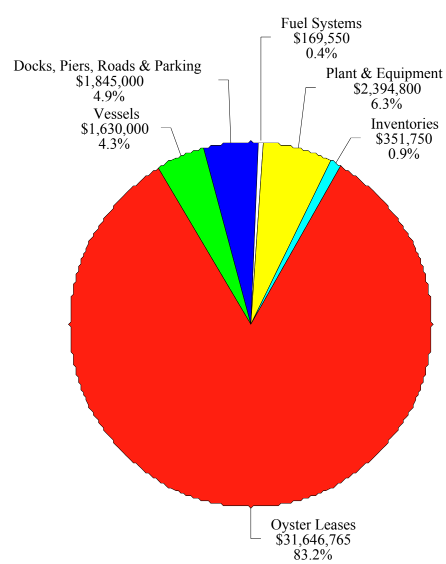
Damage to Galveston Bay Oyster Industry Assets

Respondents are quite dependent upon the productivity of the public and private oyster reefs within the GBS for most of their annual revenue. In the 12 months preceding Ike, 62% of annual revenues ($18.6 million) were generated from oyster products that originated from the GBS, and another 4% from other GBS seafoods ($1.24 million). When asked to report actual and expected revenues for the 12 months after landfall, the collective responses amounted to just $6.9 million; 23% of the $30.1 million generated the 12 months prior to landfall.

Most of the dollar damage (83%) to industry occurred on the 1,713 acres of leased bottom. Leaseholders reported some 930,000 sacks on the leases prior to the storm, but could only account for roughly 305,000 sacks afterwards, a loss of $13.1 million. Leaseholders estimated that another $18.6 million would be required to rebuild those leases torn apart or buried under sediment and debris. Damage to other owned assets are shown in the table and figure below.

Estimated Losses and Costs to Repair or Replace All Damaged or Destroyed Assets

Asset Class	Dollars	Percent
■ Oyster Leases (1,713 acres)	$31,646,765	83.2%
■ Vessels	$1,630,000	4.3%
■ Docks, Piers, Roads & Prkg	$1,845,000	4.9%
■ Fuel Systems	$169,550	0.4%
■ Plant & Equipment	$2,394,800	6.3%
■ Inventories	$351,750	0.9%
Total Repair / Replacement Cost	$38,037,865	100.0%



Oyster-dependent firms sustained a massive economic blow from Hurricane Ike. The major source of revenue-generating capacity – the privately-created and publicly-managed oyster reefs across the GBS – were compromised by the storm surge that (a) covered large portions with silt and debris, (b) scattered living inventory, and (c) broke apart segments of the substrate upon which oyster larvae attach. Any major casualty loss can be crippling, but the loss of oyster habitat and inventory that was in varied stages of growth is crushing and potentially long-lived.

Environmental Benefits Provided by Oyster Reefs

Oyster reefs play a major role in ensuring the health of estuarine ecosystems. To feed, oysters pump and filter large quantities of water. One average-sized oyster can filter up to 50 gallons of water per day. This physiological process reduces phytoplankton biomass generated as a result of nutrient loading and suspended solids. Oysters initiate a food web by passing converted nutrients and metabolites up the food chain: first to microphytobenthos (microscopic, unicellular algae) that live on sediment surfaces which become forage for bottom-feeding fish and crabs; which in turn become forage for predators prized by anglers. Oyster reefs also promote the expansion of preferred habitats such as submerged aquatic vegetation by minimizing the negative effects of eutrophication. Reefs rise above the bay bottom and form a complex habitat that provides shelter and forage for juvenile fish and crustaceans.

Oyster reefs have inexpensively ensured the health and productivity of estuarine areas for thousands of years. Today, reduced abundance of oysters has left many estuaries like Chesapeake Bay suffering from degraded water quality, loss of submerged aquatic vegetation, and even prohibitions against contact water sports.

Most estuarine areas support multiple uses. The GBS is a water body that continuously receives huge volumes of municipal wastewater and storm runoff but also supports commercial fisheries and a recreational economy built around sportsfishing, boating, and water-contact activities. These two uses might seem at odds, and would be, were it not for the oyster reefs.

Though the cost of restoring GBS oyster reefs may seem high – initially estimated at between $161 million and $480 million – the benefits will be realized by virtually all who rely on the Galveston Bay system.

Recommended Courses of Action

Respondents were queried about their preferences for four potential recovery projects funded from public sources. The most important issue was removal of debris off the bay bottom. This work is underway. The second-most important recovery project was to plant shell on public reefs. Everyone connected with the oyster business or charged with ensuring estuarine water quality would agree on the importance of this work since establishing suitable substrate is the first step in restoring oyster populations. However, the cost is high, and many not familiar with either the industry or estuarine ecosystems have asserted that investing millions for an industry that generates about $10 million in annual dockside value (the amount paid to fishermen) does not represent the best use of public monies. This assertion ignores the fact that oyster reefs ensure a diverse mix of significant, measurable economic benefits in addition to the market value of oysters.

A strong, scientifically-based argument has been made for restoring oyster populations within the GBS because of the environmental benefits reefs provide. Biofiltration reduces algal blooms and initiates a food-web that results in higher-order predators like red drum. Finally, reefs support other beneficial estuarine habitats that establish the basis for the large economic impacts derived through various uses of the GBS. The question remains how to pay for such a project.

- Industry, organizations, agencies, and lawmakers need to explore the use of "shovel-ready" efforts established as part of the President's stimulus package. Because of the GBS, Texas is the second-largest supplier of Eastern oysters in the country. The bay also supports other commercial fisheries and a water-based recreation and tourism industry. Each of these uses depends upon oyster habitat. Planting shell on public oyster grounds would address restoration of essential coastal habitat while creating jobs and stimulating the economy.

Annually, leaseholders rebuild and improve private reefs. The difference in per-acre productivity between leased and publicly-managed bottom is testimony to the effectiveness of annual shell-planting and transplanting efforts. However, leaseholders are continually plagued by the inability to protect the value of the oyster inventory on private reefs. Hurricane Ike demonstrated that reefs in a shallow bay system are no match for the destructive power of waves created by hurricane-force winds, or a storm surge.

- Leaseholders need to explore a Group Risk Plan for oysters offered under the authority of the Federal Crop Insurance Corporation, a USDA-owned corporation. This Spring, such a program was created for leaseholders in Louisiana. A subsidized, catastrophic damage policy would offer some economic protection and may enable leaseholders to obtain financing to support annual reef-improvement and maintenance activities.

Hurricane Damage Sustained by the Oyster Industry and the Oyster Reefs Across the Galveston Bay System with Recovery Recommendations

Introduction

Three weeks after Hurricane Ike made landfall, faculty with the Texas AgriLife Extension Service and the Sea Grant College Program – both part of the Texas A&M University System – began assessing the damages sustained by oyster-dependent firms that rely on the Galveston Bay system for most of their annual revenue. At industry's request a questionnaire was created to gather individual loss estimates for the complement of assets oyster-dependent firms use in their operations.

This survey of oyster-dependent firms began by measuring damages to the private oyster leaseholds across the Galveston Bay system. This step included (a) the loss of oysters on leases which were at various stages of growth as well as (b) damage to the oyster reefs that have been painstakingly created, improved and expanded by leaseholders over the years. Damage assessment then progressed to the fleet of commercial vessels used by owners to work leases and harvest oysters. A large segment of the survey centered on shore-based infrastructure: bulkheaded docks and piers, roads and parking areas, fuel storage and distribution systems, processing and office buildings, and processing equipment. The dollar damage to purchased inventories – raw materials, packaging materials, and finished goods – was also estimated. Beginning with the asset category commercial vessels and progressing through each element of shore-based infrastructure, respondents were also asked to estimate the time required to put the damaged or destroyed asset(s) back on line. In addition, the survey requested information about revenues, employment, and payroll for the twelve months that <u>preceded landfall</u> as well as actual and expected values for the twelve months <u>since landfall</u>. Oyster-dependent firms across the Galveston Bay system were quick to commit to the damage assessment project, and we believe that an accurate portrait has been developed of the damages the industry must address to regain its *"pre-Ike"* footing.

Importantly though, the firm-specific damage estimates collected through the survey process are but a fraction of the total losses that have, and will continue to impact, the Texas oyster industry which is anchored by the larger, public oyster resource across the Galveston Bay system. At about the same time that our survey of oyster-dependent firms was getting started, the Texas Parks and Wildlife Department initiated a physical, SONAR-based survey of the publicly-managed oyster reefs throughout the bay. The conclusion drawn from their efforts was that damage to the oyster reefs within the Galveston Bay system was dramatic, with as much as 60 percent of the oyster crop smothered under sediments and debris that were deposited on the reefs by Hurricane Ike's storm surge [1].

Damaged oyster reefs have far-reaching impacts. Obviously those who depend upon leased or publicly-managed habitat for their livelihoods have, and will continue to experience the direct economic repercussions of reduced revenues coupled with large expenditures required to return to *"pre-Ike"* circumstances.[1] This segment of the economy is the focus of our work to quantify the damages sustained from Hurricane Ike, but oyster-dependent firms are not the only ones impacted by damaged oyster reefs! In addition to impacting those who harvest, process, and market oysters, damage to the oyster resources of the Galveston Bay system is also a significant concern to the long-term ecological health of the bay. The ecological benefits oyster reefs provide to multiple-use estuaries like the Galveston Bay system are well documented in the scientific literature, and will be discussed in a later section. These ecological benefits translate into direct economic impacts. In addition to supporting several directed commercial fisheries (e.g., shrimp, blue crab, and oysters),

1. In fact, there is no distinction between damage to oyster reefs on leases or found on publicly-managed areas. The only difference is the property right established by the leasehold.

the Galveston Bay system is also home to a recreational economy predicated on boating, sportsfishing, and contact, water-based, recreational activities. **Therefore, we ask the reader to remember that thriving oyster reefs not only provide various aquatic foods, but are also at the heart of maintaining estuarine water quality – the precursor of sustained, multiple uses which translates into a wide mix of direct economic impacts.**

Before addressing the collective damage to this segment of the seafood-linked sector in the Galveston Bay system, it is important to review a few details about Hurricane Ike and the overall damage created across this segment of heavily-populated coastline. The purpose of such a recap is to place the total extent of damage to residences and businesses into some perspective before addressing the impacts of the storm on one specific segment of the overall economy.

In addition, two "stage-setting" discussions seem pertinent before addressing the damages caused by Hurricane Ike to the Galveston Bay oyster industry. The first is a review of the historic contribution Texas and the Galveston Bay system make to the nationwide market for Eastern oysters. The second consideration touches on the varied ecological benefits oyster reefs provide to multiple-use estuarine environments like the Galveston Bay system. Each year this particular bay system receives huge volumes of municipal wastewater and untreated storm water, while simultaneously supporting several directed commercial fisheries and a multi-faceted, water-based recreational economy (e.g. sportsfishing, boating, and swimming). These two uses – receiving large volumes of wastewater while supporting seafood harvesting and a host of water-based recreational activities – seem at odds, and would be, were it not for the oyster reefs. Oyster reefs quietly and inexpensively provide critical environmental services to estuarine ecosystems including (a) biofiltration, (b) conversion of nutrients and suspended materials into foods that support higher trophic-level species of commercial and recreational value, and (c) creation of habitat that provides both foraging grounds and shelter for juvenile fishes and crustaceans.

Background Remarks about Hurricane Ike

Hurricane Ike made U.S. landfall at Galveston on September 13th as a Category 2 storm with winds of 110 mph [2]. At about 3 a.m. it then passed over San Leon and made its final landfall near Baytown at about 4 a.m. Hurricane Ike had a large footprint. Hurricane-force winds extended across a 240 mile diameter, and tropical-storm force winds more than doubled the diameter of the cyclone to about 550 miles [2,3]. This massive storm impacted 29 of the 254 counties in Texas. About 12 of the 29 affected counties experienced hurricane-force winds.[2] Hurricane-force winds generated significant physical damage to residences, buildings, and public infrastructure (e.g., electrical service, drinking water services, wastewater handling, roads, etc.) [3]. Shortly after landfall, as many as 2 million customers lost electrical service. Many residents across Galveston, Chambers, and Harris counties were without electrical power for several weeks, or longer. The size of Hurricane Ike – a 550 mile diameter cyclone with a 46-mile wide eye – created a storm surge 17 to 20 feet high that topped the Galveston seawall in a few places and all but swallowed much of the island, the Bolivar Peninsula, and other low-lying areas around the Galveston Bay system. Those low-lying areas include large fractions of Chambers, Galveston, and Jefferson counties. Parts of Brazoria and Harris Counties also sustained damage from the storm-surge. Suspended in the roiling storm surge were what once had been houses and commercial buildings (along with the contents thereof), commercial and recreational boats, and thousands of acre-feet of seabed sediments and upland soils. As this storm surge pushed inland it literally covered large upland segments of Chambers, Galveston, and Jefferson counties. Storm debris washed onto

2. Counties experiencing hurricane-force winds included Brazoria, Chambers, Fort Bend, Galveston, Hardin, Harris, Jefferson, Liberty, Montgomery, Orange, Polk, and San Jacinto. Counties experiencing tropical storm-force winds included Angelina, Austin, Cherokee, Colorado, Grimes, Houston, Jasper, Madison, Matagorda, Nacogdoches, Newton, Rusk, Sabine, San Augustine, Smith, Waller, and Wharton [3].

Interstate 10 in Chambers County. The *"built environment"*[3] along the shores of the Galveston Bay system suffered major damage from the combined impacts of hurricane-force winds and the storm surge, with many houses, buildings, marinas, and vessels – both recreational and commercial – declared total losses. As the storm surge transported debris from the Bolivar Peninsula, much of it was deposited across the bottom of the Galveston Bay system; the historic hub of the Texas oyster industry.

For most living on the Bolivar peninsula, the damage to their properties can best be categorized as sudden and complete. National Public Radio noted that the Bolivar Peninsula was virtually *"raked clean"* by the storm surge. Many residents of Dickinson, Seabrook, San Leon, Oak Island, and parts of Baytown had storm waters in their houses along with significant damage to roofs, fences, mature trees, automobiles, boats, and landscaping. Some residents in these areas literally lost all of their personal property to Hurricane Ike. Even residents living in the far northwestern parts of greater Houston experienced power outages for several days along with lost fences, downed trees, and damaged roofs. In short, Hurricane Ike created staggering physical and economic damage across a heavily-populated region of Texas. Few residents in the 29-county area weathered the storm without some property damage. Hurricane Ike was the third-most costly hurricane with estimated property damage exceeding $24 billion [2].[4]

The Historic Importance of the Galveston Bay System to the Eastern Oyster Industry

This report quantifies both physical and economic damage to the oyster industry situated across the Galveston Bay system. Those who culture, harvest, process, and market oysters are just one segment of the larger seafood-linked sector located on the Southeast Texas coastline that was impacted by the hurricane – and will remain impacted – for some time. It is not our intent to ignore or minimize the widespread damage that other elements of the Southeast Texas seafood-linked sector sustained. Those damages are estimated and reported in other works. Rather, it is our intention to focus on the losses sustained across the entire set of assets required to grow, harvest, process, and distribute oysters since the heart of this industry – the natural and created reefs across the Galveston Bay system – were severely damaged. Physical damages to the oyster reefs occurred either by the force of the wave action and storm surge which broke apart significant segments of reefs or by the smothering effects of silt and debris deposited as the surge swept across the bay.

Industry Dependence upon Galveston Bay System Oyster/Seafood Resources

In all seafood-dependent industries, damage to the built environment from hurricanes has dramatic impacts upon continued operations. For example, loss of power affects processors' opportunities to hold fresh or frozen products already processed that await distribution. Storms also derail other shore-based services demanded by the commercial fleet such as access to commercial harbors, manufacture of ice, sale of fuel, the ability to offload and process products, etc. Oyster-dependent enterprises within the Galveston Bay system were affected by these sorts of disruptions because of damage to their built environments.

In contrast to the shrimp industry which harvests and processes a free-swimming product produced across a wide geographic range (i.e., within the coastal bay complex, the nearshore Gulf, and deep, offshore Gulf waters), oystermen harvest an organism that remains permanently attached to bottom substrate. Thus, in addition to contending with physical damage to their fleets and shoreside infrastructure, oystermen were also concerned about the more fundamental type of damage – the condition of both public and private reefs. In

3. The phrase "built environment" refers to the man-made surroundings that provide the setting for human activity, ranging from the large-scale civic surroundings to the personal places.

4. To date the most costly U.S. hurricane was Katrina, with damage estimated at $89.6 billion. Andrew, which made landfall south of Miami in 1992, created damages estimated at $40.7 billion [2].

their physical assessments of the publicly-managed reefs within the Galveston Bay system the Texas Parks and Wildlife Department suggests that as much as 60 percent of the oyster crop has been smothered by sediments and debris [1].

The magnitude of this damage to a sessile, bottom-dwelling resource has important, long-term consequences for those who grow, harvest, process, and market oysters. Damage to oyster resources is acute for oyster firms within the Galveston Bay system because 62 percent of the revenues generated in the twelve months prior to Hurricane Ike were derived from shellstock ($5.44 million) and shucked meats ($13.2 million) harvested off publicly-managed and privately-created reefs in the Galveston Bay system. Adding in another 4 percent for revenues earned from the sale of other Galveston Bay seafoods, two-thirds of annual revenues for oyster-dependent firms that responded to this survey are generated from the bay (Table 1, Figure 1).[5] Oyster-dependent firms collectively reported gross revenues of $30.1 million for the twelve months preceding Hurricane Ike, but the reported mix of actual and estimated quarterly revenues generated for the twelve months since the storm (September, 2008 through August, 2009) amount to $6.9 million; just 23 percent of $30.1 million generated in the previous twelve months (Table 2).

Table 1. Sources of Revenue for the Galveston Bay System Oyster Industry prior to Hurricane Ike: September, 2007 – August, 2008

Revenue Sources: Sept. 2007 – Aug. 2008	Dollars	Percent
■ Galveston Bay system (GBS) Shellstock	$5,439,710	18%
■ Galveston Bay system (GBS) Shucked Meats	$13,199,024	44%
■ Galveston Bay system (GBS) Other Seafoods	$1,242,956	4%
■ Non-Galveston Bay system Seafoods.	$10,062,862	33%
■ Non-Seafoods (fuel, slip rental, etc.)	$160,000	1%
Total Revenues: Sept. 2007 – Aug. 2008	$30,104,552	100%

5. Revenue information was also collected with the damage-assessment survey instrument created to quantify damages to the assets controlled by the Galveston Bay system oyster industry.

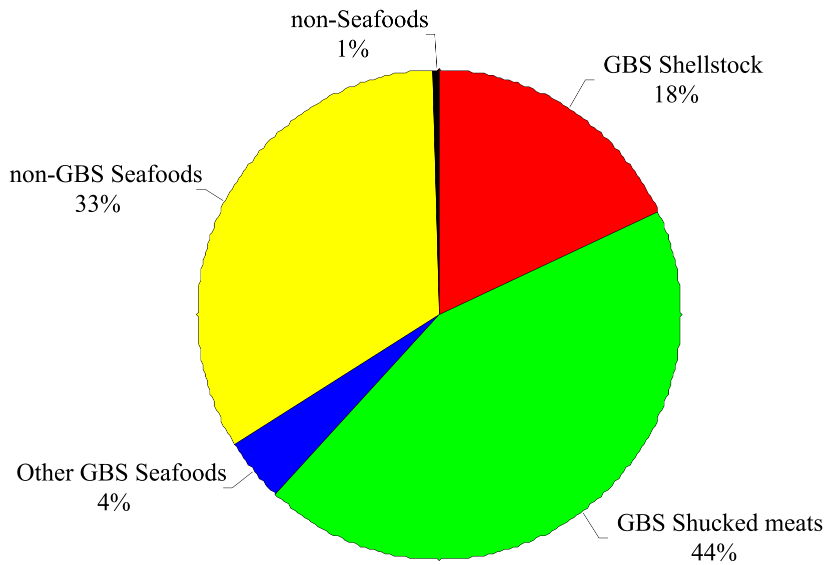


Figure 1. Sources of Revenue for the Galveston Bay System (GBS) Oyster Industry Prior to Hurricane Ike: September, 2007 – August, 2008

Table 2. A Comparison of Quarterly Revenues for the Twelve Months Preceding Hurricane Ike vs. the Twelve Months After Hurricane Ike

12-Month Quarterly Time Frames: "Pre-Ike"	Quarterly Revenues	12-Month Quarterly Time Frames: "Post-Ike"	Quarterly Revenues	Pct. Revenue Difference: "Post-Ike" vs. "Pre-Ike"
Sept. 07 – Nov. 07	$7,806,761	Sept. 08 – Nov. 08 (act.)	$2,397,197	31%
Dec. 07 – Feb. 08	$7,997,146	Dec. 08 – Feb. 09 (act. & est.)	$3,492,352	44%
March 08 – May 08	$7,654,644	March 09 – May 09 (est.)	$506,186	7%
June 08 – August 08	$6,646,001	June 09 – August 09 (est.)	$502,118	8%
'07-'08 Total Revenue	$30,104,552	'08-'09 Total Revenue	$6,897,853	23%

Importance of Texas to the Nationwide, Eastern Oyster Market

The Eastern oyster, *Crassostrea virginica*, is found throughout the coastal bay systems across the Atlantic and gulf coasts. Both history and the popular press remember Chesapeake Bay (Maryland and Virginia) as the hub of the Eastern oyster industry, with annual harvest volumes supplying oysters for both the fresh market as well as highly-processed products like canned soups and stews. In fact, several national food processors located in the Chesapeake Bay area primarily because of the historic abundance of oysters that originated from the nation's largest estuary. Between 1968 and 2007 oyster production from the Chesapeake bay plummeted, and a strong, negative trend in oyster production is evident (Table 3, Figure 2) [4].[6] In fact, trend accounts for 88 percent of total variation in annual Chesapeake Bay oyster production across the forty-year time series, and statistically, is highly significant. The regression analysis indicates that the combined harvests of Maryland and Virginia exhibit an average, annual decline of roughly 790,000 meat weight

6. Trend is the long-term component of a time series that underlies growth, decline, or both. In this instance, testing statistically for the presence or absence of trend uses two variables: time (year in this case) which is the independent variable, and the annual harvest expressed in meat weight lb. which is the dependent variable [5].

pounds[7] over the forty-year time series. Over this same forty-year interval, Louisiana and Texas have become more important sources of supply for the Eastern oyster.[8] Between 1968 and 1990, Texas and Florida alternated as the third or fourth largest supplier behind Chesapeake Bay and Louisiana. Florida oyster harvests exceeded those from Texas in 13 of 20 years between 1968 and 1987, but thereafter beat the annual Texas oyster harvest only once between 1988 and 2007.[9] Since 1991, Texas has consistently produced the second-largest Eastern oyster crop in the country, making the Lone Star state a primary, nationwide supplier.

Table 3. Annual Production of Eastern Oysters by Maryland/Virginia, Louisiana, Texas, and Florida between 1968 and 2007

	Meat weight pounds					Meat weight pounds			
Year	Md. /Va.	La.	Tx.	Fl.	Year	Md. /Va.	La.	Tx.	Fl.
1968	22,678,500	13,121,200	3,302,000	5,568,700	1988	5,335,800	13,253,772	2,269,572	2,217,076
1969	22,157,800	9,178,900	3,763,700	5,152,600	1989	4,303,100	11,605,856	2,407,427	1,858,777
1970	24,668,500	8,638,900	4,674,700	3,786,600	1990	4,515,113	8,153,371	1,904,693	2,250,809
1971	25,558,400	10,527,300	4,744,300	3,710,700	1991	3,381,160	7,265,084	2,915,986	1,918,491
1972	24,067,200	8,805,400	3,934,400	3,357,200	1992	2,194,468	9,183,295	2,747,909	2,605,640
1973	25,401,700	8,954,100	2,348,000	2,531,400	1993	571,393	10,314,823	2,964,374	2,790,000
1974	25,022,000	9,971,600	1,243,700	2,751,400	1994	1,118,410	11,327,730	4,580,186	2,111,459
1975	22,639,500	13,686,900	1,756,000	2,213,100	1995	1,595,979	13,800,076	4,670,598	1,522,656
1976	20,964,400	12,334,400	3,880,700	2,714,400	1996	1,048,469	12,934,925	5,705,412	1,448,514
1977	18,013,700	10,065,500	2,600,500	4,197,600	1997	1,732,768	13,221,705	4,687,029	1,905,399
1978	22,460,200	9,661,769	1,907,011	5,973,863	1998	2,683,729	12,856,173	3,437,926	1,578,223
1979	21,685,500	7,714,450	888,795	6,206,259	1999	2,786,229	12,128,187	6,411,229	2,347,269
1980	22,791,100	6,947,458	1,738,494	6,853,310	2000	2,531,302	12,718,438	6,187,818	2,571,995
1981	21,606,200	9,092,576	1,306,584	7,269,384	2001	1,482,830	15,132,631	4,700,475	2,596,410
1982	17,524,700	12,621,484	3,633,147	5,232,356	2002	664,182	13,961,579	4,707,968	1,980,836
1983	11,637,500	13,224,445	7,940,749	4,404,453	2003	236,512	13,608,565	6,813,469	1,792,736
1984	12,364,000	13,951,652	5,167,731	6,729,698	2004	87,233	13,901,869	5,568,870	1,684,610
1985	13,121,518	14,347,231	5,133,937	4,404,612	2005	737,853	12,098,654	5,007,472	1,455,528
1986	13,742,039	12,653,509	5,649,314	2,201,087	2006	289,354	11,417,297	4,922,882	2,449,184
1987	8,647,600	12,026,508	2,843,619	3,790,888	2007	470,351	12,856,632	5,187,631	2,990,095

7. Meat weight refers to the edible portion of the mollusk. The edible portion of the oyster accounts for about 5 percent of the weight of the live organism.

8. Upward trends exist for annual production from Louisiana and Texas but not nearly as obvious as annual production declines from the Chesapeake Bay. Specifically, trend accounts for just 21 percent of total variation in the Louisiana time series, but is statistically significant. Visually, it seems a bit easier to discern trend for Texas oyster landings, and the regression model is slightly stronger than for Louisiana's oyster harvest, accounting for 22 percent of total variation in annual production. The trend is statistically significant for annual landings from Texas too.

9. A downward trend also exists in the forty-year history of Florida oyster landings, explaining almost 33 percent of total variation over the 1968 – 2007 time interval.

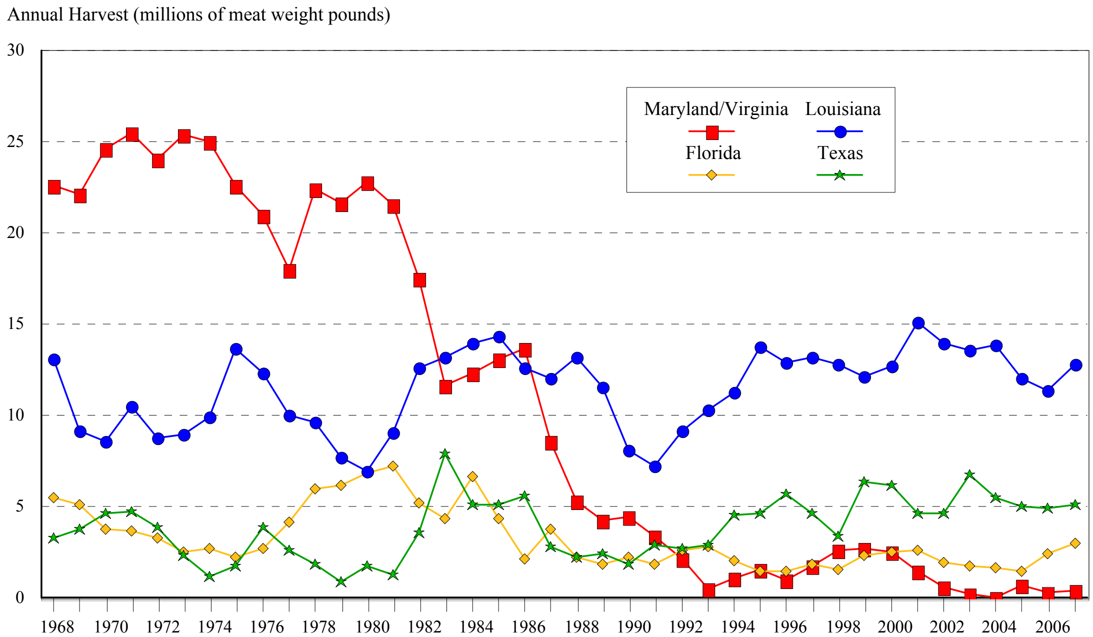


Figure 2. Annual Production of Eastern Oysters by Maryland/Virginia, Louisiana, Florida, and Texas between 1968 and 2007

The Significance of the Galveston Bay System to Texas Oyster Production

Oysters are harvested on public reefs between November 1 and April 31. Harvests during the open season may be stopped for either resource protection concerns or to ensure public health. The harvesting and marketing of oysters is a highly-regulated segment of the seafood industry brought about to ensure food safety. Even during an open season, public health considerations ultimately control the oyster harvest, and officials with the Seafood and Aquatic Life Group within the Texas Department of State Health Services (DSHS) have the final word about whether to close a water body (or a part of it) to oyster harvesting because of degraded, environmental water quality standards. Degraded water quality generally results from episodic rainfall in the watersheds that feed the coastal bays.[10] The quality of growing waters are routinely verified by DSHS using a rigorous sampling regimen.

Since the Eastern oyster prefers the brackish waters of enclosed bay systems, virtually all oyster production in Texas occurs across some fraction of the 49,248 acres of public oyster grounds in Galveston Bay, Matagorda Bay, San Antonio Bay, and Aransas Bay as well as 2,321 acres of private oyster leases that exist only within the Galveston Bay system.[11] Fisheries-dependent landings data from the Coastal Fisheries Division of the Texas Parks and Wildlife Department demonstrate that the Galveston Bay system – with a number of public and privately-maintained oyster reefs – has historically been the largest producer of oysters in Texas (Table 4, Figure 3). Between 1981 and 2007 Galveston Bay produced roughly 77 percent of the

10. With respect to shellfish growing waters, degraded environmental water quality standards that result in closure of areas to shellfish harvesting reflect the presence of pathogenic bacteria above threshold levels established by FDA.

11. Resource managers note that oysters are found across 49,248 acres of the Texas coastal bay system. This habitat includes oyster reefs and shelly sediment. What is not known as of the release date of this report are the total acres of oyster habitat that are **approved** for harvest. Another estimate of the total acres of oyster ground came from an article that appeared in the September, 2003 issue of *Texas Parks and Wildlife Magazine* entitled "The Oyster's Odyssey" [6]. The statewide acreage of oyster ground suggested in this article was 22,760 acres. Therefore, the total acreage of **approved** oyster ground is somewhere between the 22,760 acres quoted in the magazine article and the 49,248 acres where the resource is found.

Texas oyster crop. Between 1981 and 2007, Galveston Bay was the major source of oyster production in 23 of those 27 years.[12]

Table 4. Annual Production of Eastern Oysters from Galveston Bay and the Other Texas Bays between 1981 and 2007

	Meat weight pounds				Meat weight pounds		
Year	Galveston Bay	Other Tx. bays	Total	Year	Galveston Bay	Other Tx. bays	Total
1981	985,411	321,173	1,306,584	1995	4,096,195	574,392	4,670,587
1982	3,253,765	379,382	3,633,147	1996	4,892,240	693,919	5,586,159
1983	6,967,064	973,685	7,940,749	1997	3,495,877	1,191,152	4,687,029
1984	2,360,205	2,807,526	5,167,731	1998	2,969,106	468,820	3,437,926
1985	3,285,112	1,848,825	5,133,937	1999	6,132,635	278,594	6,411,229
1986	3,541,048	2,108,266	5,649,314	2000	6,008,542	179,276	6,187,818
1987	2,174,865	722,199	2,897,064	2001	4,506,039	269,406	4,775,445
1988	1,452,365	816,944	2,269,309	2002	4,251,171	456,797	4,707,968
1989	718,565	1,672,848	2,391,413	2003	6,123,748	709,602	6,833,350
1990	1,166,652	694,013	1,860,665	2004	4,865,826	653,641	5,519,467
1991	2,331,384	656,842	2,988,226	2005	3,164,570	1,896,955	5,061,525
1992	2,581,127	124,555	2,705,682	2006	2,732,161	3,284,956	6,017,117
1993	2,832,420	94,434	2,926,854	2007	2,775,225	2,858,187	5,633,412
1994	4,230,787	350,699	4,581,486				

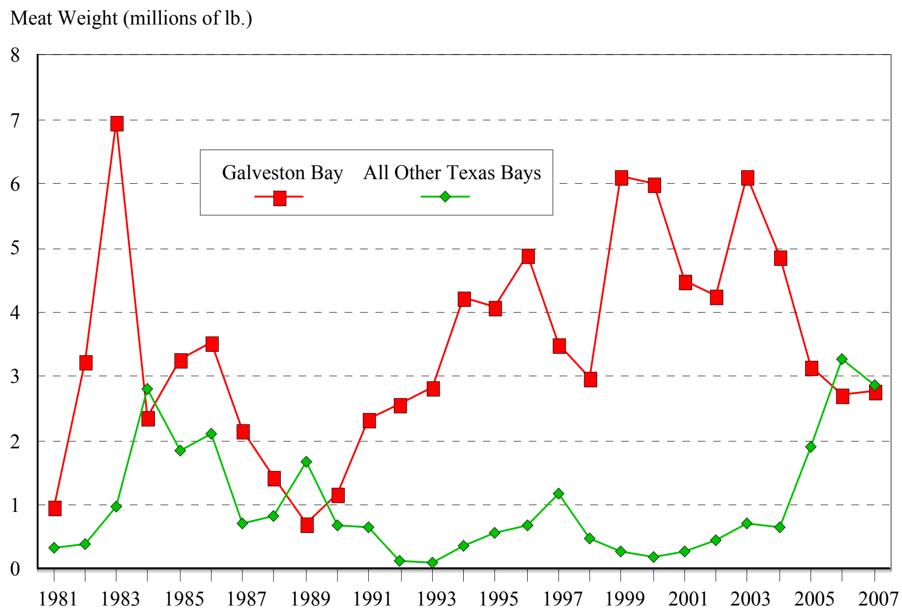


Figure 3. Annual Production of Eastern Oysters from Galveston Bay and the Other Texas Bays Between 1981 and 2007

Private Oyster Leases in the Galveston Bay System

Early in the last century, the Texas Game, Fish, and Oyster Commission [the precursor to the Texas Parks and Wildlife Department] allowed for the creation of private oyster beds in areas where *"nature had failed to produce them"* [7]. This suggests that anyone interested in leasing bay bottom for the purpose of creating a private oyster reef must assume all responsibility for improving the area so that oysters can become

12. In fact, annual oyster production from the Galveston Bay system exceeded annual harvests from Maine, Massachusetts, Rhode Island, New Jersey, Delaware, North Carolina, and Georgia 100 percent of the time between 1981 and 2007. Over the same 27 year interval, annual production from the Galveston Bay system exceeded harvests 96 percent of the time (i.e., in 26 of 27 years) in New York, South Carolina, Alabama, and Mississippi. Annual harvests from the Galveston Bay system were greater than those in Connecticut 78 percent of the time (21 of 27 years), in Florida 63 percent of the time (17 of 27 years), and in the combined states of Maryland and Virginia 59 percent of the time (16 of 27 years).

established. Unlike clams which burrow into the bottom, oysters live slightly above the bay bottom.[13] Thus, a hard, elevated substrate is required so that when the free-floating oyster larvae sink, they can attach to other oyster shells or rocks. Oyster larvae which do not become attached to a rigid structure are lost. Leaseholders in Texas expect oysters to reach marketable size within 18 to 24 months. In cooler waters like Long Island Sound, 48 to 60 months are required to reach marketable sizes [9].

Annually, leaseholders make investments to improve the productivity of their leases. The first step required to improve the productivity of an oyster lease is to create a suitable substrate so oyster larvae can settle on it and grow. After elevated substrates are created, leaseholders annually refurbish them by distributing oyster shell back onto those elevated parts of their leases. Texas Parks and Wildlife magazine noted that *"The private lease-holders are the only ones putting something back into the bay system ...they are farmers. They are actually growing oysters."* [6]. In addition to shell-planting each year, leaseholders also participate in the highly-regulated oyster transplant program (i.e., harvesting oysters from areas that do not meet minimal national water quality standards and placing them on private leases so that with time, they can meet national food safety standards, and thus become marketable).

Planting shell and transplanting unsaleable oysters seems like a basic set of activities; yet, leaseholders operate in a high-risk environment. Every year lessees literally *"cross their fingers"* in hopes that (a) the existing oysters will have a good spat set which will set the stage for subsequent crops, (b) the impact of oyster diseases and predators will be muted, (c) water quality will remain acceptable to public health authorities during the harvest season, and (d) tropical storms will not sweep the private reef away or cover it with silt and debris. Adding to the risk of growing oysters on leased bottom is the fact that at any point in time, a lease holds a size range of oysters. In any given year, some oysters are ready for harvest, but others require a few months to two years before being of marketable size. Thus risk to the leaseholder is heightened because varied amounts of time are required before the standing crop is large enough to harvest. While oysters do reach marketable sizes quickly in the Gulf states (18 to 24 months), having to wait increases the risk of a crop failure from a variety of sources including hurricanes.

Oysters harvested from the 2,321 acres leased in Galveston Bay have exceeded the production from all other Texas bays in 15 out of 27 years between 1981 and 2007 (Table 5, Figure 4).[14] Between 1981 and 2007 the average annual harvest across the lower bound of publicly-managed oyster ground (22,760 acres) was 152 pounds of meat per acre. Using the upper bound which includes all acres in the public domain where oysters can be found (49,248 acres), the average annual harvest drops to 70 pounds of meat per acre.[15] Over the same 27-year interval, the average harvest from leased bottom in the Galveston Bay system was 435 meat weight pounds per acre; either 2.9 times greater than harvests off the publicly-managed areas if the lower acreage value is used (22,760 ac.) or 6.2 times greater if the higher acreage value (49,248 ac.) is used.[16]

13. The life cycle of the Eastern oyster includes a period of planktonic larval development where the embryos are free swimming for approximately twenty-one days before they settle and attach to a hard substrate above the bay bottom [8].

14. Recall that the opportunity to lease bottom for the cultivation of oysters was always limited to the Galveston Bay system, so oysters harvested from any of the other bay systems (e.g., Sabine Lake, East Matagorda Bay, Matagorda Bay, Lavaca Bay, Espiritu Santo Bay, San Antonio Bay, Copano Bay, Aransas Bay, Upper and Lower Laguna Madre) are exclusively from publicly-managed reefs.

15. Please see footnote 11 for an explanation of why two different acreage values are used.

16. When average, per-acre, harvests are compared across leased bottom and approved, publicly-managed reefs **within the Galveston Bay system (18,599.4 ac.)**, the public reefs averaged 132.5 meat weight pounds per acre; just 30.5 percent of average productivity from the leases between 1981 and 2007.

Table 5. Annual Production (meat weight) of Eastern Oysters from the Public Reefs[17] and Private Leases in Galveston Bay as well as Other Texas Bays Between 1981 and 2007

Year	Galveston Bay System (GBS) Public Reefs	Private Leases	GBS Total	Public (% GBS)	Private (% GBS)	Other Bays	Statewide Total	GBS Public (% Tot.)	GBS Leases (% Tot.)
1981	521,095	475,700	996,795	52.3%	47.7%	324,199	1,320,994	39.4%	36.0%
1982	2,755,261	502,300	3,257,561	84.6%	15.4%	375,787	3,633,348	75.8%	13.8%
1983	6,101,794	864,300	6,966,094	87.6%	12.4%	959,331	7,925,425	77.0%	10.9%
1984	1,816,405	543,800	2,360,205	77.0%	23.0%	2,807,526	5,167,731	35.1%	10.5%
1985	2,899,712	385,400	3,285,112	88.3%	11.7%	1,842,978	5,128,090	56.5%	7.5%
1986	2,054,948	1,486,100	3,541,048	58.0%	42.0%	2,108,073	5,649,121	36.4%	26.3%
1987	1,004,760	1,164,400	2,169,160	46.3%	53.7%	716,787	2,885,947	34.8%	40.3%
1988	678,065	774,300	1,452,365	46.7%	53.3%	807,262	2,259,627	30.0%	34.3%
1989	11,906	717,300	729,206	1.6%	98.4%	1,592,102	2,321,308	0.5%	30.9%
1990	462,452	704,200	1,166,652	39.6%	60.4%	723,096	1,889,748	24.5%	37.3%
1991	1,428,784	902,600	2,331,384	61.3%	38.7%	651,503	2,982,887	47.9%	30.3%
1992	1,796,932	763,300	2,560,232	70.2%	29.8%	120,931	2,681,163	67.0%	28.5%
1993	2,354,268	515,673	2,869,940	82.0%	18.0%	94,434	2,964,374	79.4%	17.4%
1994	3,004,025	1,225,455	4,229,480	71.0%	29.0%	350,706	4,580,186	65.6%	26.8%
1995	2,756,645	1,339,555	4,096,200	67.3%	32.7%	574,398	4,670,598	59.0%	28.7%
1996	3,553,918	1,457,593	5,011,510	70.9%	29.1%	693,920	5,705,430	62.3%	25.5%
1997	2,508,825	987,053	3,495,877	71.8%	28.2%	1,191,152	4,687,029	53.5%	21.1%
1998	2,554,496	414,610	2,969,106	86.0%	14.0%	427,904	3,397,010	75.2%	12.2%
1999	4,645,398	1,487,238	6,132,635	75.7%	24.3%	278,594	6,411,229	72.5%	23.2%
2000	4,411,929	1,549,870	5,961,799	74.0%	26.0%	179,276	6,141,075	71.8%	25.2%
2001	3,277,452	1,228,588	4,506,039	72.7%	27.3%	269,406	4,775,445	68.6%	25.7%
2002	2,817,856	1,410,600	4,228,456	66.6%	33.4%	456,797	4,685,253	60.1%	30.1%
2003	4,387,555	1,706,758	6,094,312	72.0%	28.0%	732,510	6,826,822	64.3%	25.0%
2004	3,281,463	1,578,430	4,859,893	67.5%	32.5%	719,599	5,579,492	58.8%	28.3%
2005	2,030,530	1,134,040	3,164,570	64.2%	35.8%	1,896,955	5,061,525	40.1%	22.4%
2006	1,531,031	1,224,265	2,755,296	55.6%	44.4%	3,284,956	6,040,252	25.3%	20.3%
2007	1,880,450	894,775	2,775,225	67.8%	32.2%	2,858,187	5,633,412	33.4%	15.9%

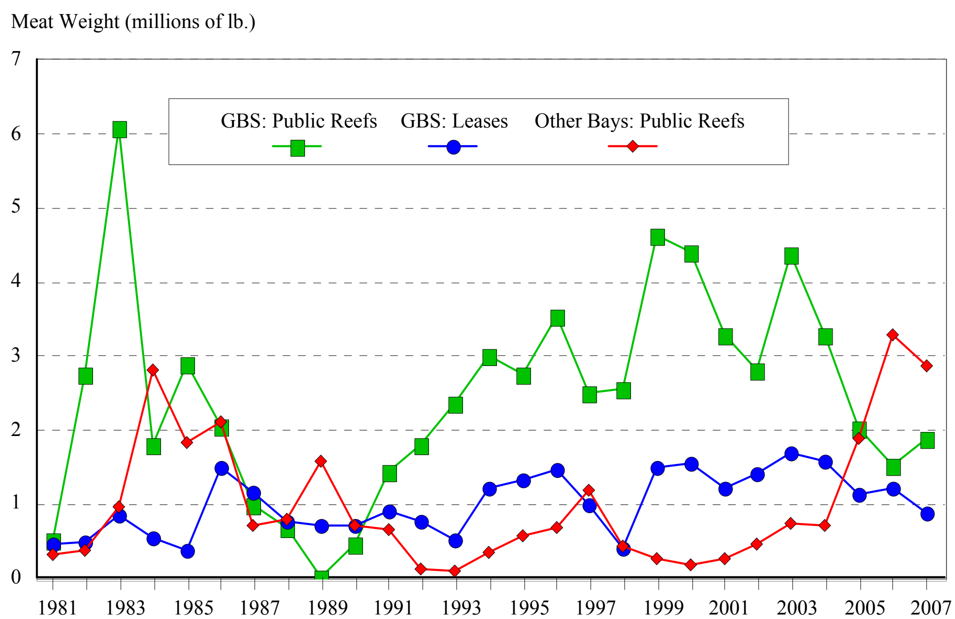


Figure 4. Annual Production of Eastern Oysters from the Public Reefs and Private Leases in Galveston Bay as well as Other Texas Bays Between 1981 and 2007

17. In this table and Figure 4, annual landings attributable to publicly-managed oyster grounds across the Galveston Bay system are the remainder after subtracting production off the leases from total Galveston Bay system landings. In 1989 the computed landings attributable to publicly-managed areas in the Galveston Bay system were an order of magnitude lower than the next lowest figure over the 27-year time series. This anomaly has not yet been reconciled.

Public Environmental Benefits Created within Estuarine Systems by Thriving Oyster Reefs

Oysters are among the world's first aquatic foods, being consumed by indigenous peoples for thousands of years. Aside from their role as both an ancient and modern food, oysters provide several public environmental benefits that are increasingly important to the health, productivity, and enjoyment of estuarine ecosystems. These include: (a) maintaining the environmental quality of estuarine waters, (b) maintaining conditions that promote the health of other essential estuarine habitats like submerged aquatic vegetation, and (c) providing habitat for recreationally- and commercially-important fishes.

Oyster Reefs as Biofilters

Oysters eat by pumping and filtering water. This physiological process plays a key role in maintaining the environmental water quality of estuarine ecosystems. Under ideal conditions, **one** average-sized oyster can filter up to 50 gallons of water per day. The biofiltering impact of thriving oyster reefs is not just arcane, scientific trivia; their impacts upon estuarine ecosystems are hugely beneficial. Experimental manipulation of oysters in controlled settings has documented that environmental water quality is improved when return flows from wastewater treatment systems and stormwater runoff pass across oyster reefs [10]. In particular, the physiological process of pumping and filtering water reduces both (a) phytoplankton biomass generated as a result of nutrient-loading from municipal wastewater treatment systems and runoff, and (b) the inorganic suspended solids in the water column [11]. The pumping and filtering process also casts off pseudofeces[18] which contribute to production of microphytobenthos[19], an important first step in the food web. Pesudofeces also facilitate denitrification which is the beneficial process of converting various nitrogenous compounds such as nitrate, nitrite, and ammonia (which serve as nutrients and contribute to eutrophication[20]) into nitrogen gas which is returned to the atmosphere [15].

Depending on estuarine circulation patterns, water quality is improved across a much wider area than the immediate reef vicinity. Likewise, filtering by oysters can improve water quality even beyond shore-based activities carried out to improve water quality such as (a) wastewater treatment facilities, (b) land use changes to reduce erosion and runoff, and (c) non-point pollution controls such as storm water retention ponds or pits.

Unfortunately, throughout the twentieth century oyster populations have declined in most U.S. locations due to over-harvesting and disease. Simultaneously, coastal development has rapidly increased. These two conditions have created the *"Perfect Storm"* for degrading estuarine water quality. Specifically, increased coastal development has increased the volume of nutrients entering the estuarine system while reduced oyster populations have diminished the historic biofiltration capacity at a time when it is most needed! In fact, an oft-quoted figure is that in the late 1800s oyster population in the Chesapeake Bay was large enough to filter a volume of water equal to that of the entire Bay in 3.3 days, whereas in 1987 – 1988 the reduced populations would take 325 days to complete the same task [16].

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18. Pseudofeces are a way that filter-feeding bivalve mollusks get rid of suspended particles which have been rejected as being unsuitable for food. The rejected particles are wrapped in mucus, and are expelled without having passed through the digestive tract. Bivalves can filter the particulate pollutants, and either eat them or discharge them as pseudofeces deposits onto the substrate, where they are relatively harmless [12].

19. This term refers to the microscopic, unicellular eukaryotic algae (Baccilariophyceae, Chlorophyceae and Dinophyceae) and the prokaryotic Cyanobacteria which live on sediment surfaces [13].

20. Eutrophication is an increase in chemical nutrients from sources like sewage effluent, stormwater run-off, and run-off carrying excess fertilizers – nitrogen and phosphorus – in an ecosystem that leads to excessive plant growth and subsequent decay. In aquatic environments algal (blooms) disrupt normal functioning of the ecosystem, causing a variety of problems such as a lack of oxygen in the water which fish and shellfish need to survive. The water then becomes cloudy; colored a shade of green, yellow, brown, or red [14].

There are several environmental consequences of this *"Perfect Storm."* One is the restructuring of traditional food webs. Historically, the filtration capacity offered by oyster reefs prevented phytoplankton blooms from entering nutrient-degradation loops which relied on microbial action to degrade this biomass. The production of pseudofeces by oysters as they filter estuarine water passes these converted nutrients or metabolites up the food chain; first as nutrients that support microphytobenthos, which then become forage for bottom-feeding fish and crabs, which then become forage for higher-order predators like red drum and tarpon which are prized by recreational anglers [17]. Today however, with a less-abundant oyster population to filter a growing volume of nutrient-dense wastewaters, the food webs of many estuaries have restructured. Food webs in most U.S. estuarine ecosystems are now dominated by phytoplankton, microbes and pelagic consumers. As microbes convert the phytoplanktonic biomass, estuarine water quality is degraded which reduces water-based, contact-recreational opportunities. Furthermore, many of these pelagic organisms, like jellyfish, are considered nuisance species with no value to either anglers or commercial fishermen.

Reduced capacity to promote the health of other estuarine habitats is another environmental consequence of reduced oyster populations at a time when increasing volumes of wastewater enter estuarine systems. In addition, estuaries like the Galveston Bay system that also support trans-ocean waterborne commerce, require periodic dredging to widen and deepen navigation channels. This maintenance has contributed to additional turbidity in the water column beyond that caused by eutrophication. By filtering sediments and phytoplankton from the water, oyster reefs maintain the conditions necessary to support the health of other estuarine habitats [18]. A classic example is submerged aquatic vegetation. Oysters minimize the negative effects of eutrophication and turbidity which increases light penetration thereby allowing submerged aquatic vegetation to thrive. Submerged aquatic vegetation within the Galveston Bay system was estimated to cover between 2,500 and 5,000 acres in the 1950s. By 1989, it had been reduced to about 700 acres [19].

Oyster Reefs as Fish Habitat

The biogenic structures formed by upright oyster aggregations create habitat for dense assemblages of other mollusks, as well as polychaete worms, crustaceans, and a host of other invertebrates. Juvenile fish and crustaceans recruit to, and utilize, oyster reefs as refuges and foraging grounds. It is estimated that a reef provides fifty times the surface area compared with a flat bottom. Crevices throughout the reef provide habitat for a variety of vertebrate and invertebrate species. Finally reefs are an important part of the estuarine landscape, providing hard substrate in an otherwise soft sediment environment, as well as corridors between shelter and foraging grounds [20].

Other Public Ecosystem Benefits Provided by Oyster Reefs

Oyster reefs reduce the force and energy of waves. This reduces erosion of valuable estuarine habitats such as fringing salt marshes as well as submerged aquatic vegetation. Such shoreline protection is critical in mitigating the effects of storm surges associated with hurricanes [21]. Importantly, oyster reefs accrete at rates far exceeding predicted sea level rise, forming living breakwaters. These living structures will buffer the effects of future storm surges on coastal property which contains critically-important emergent vegetation areas that fringe estuaries. Reefs also sequester carbon from the water to form calcium carbonate shells thus acting as a carbon sink to reduce the concentration of this greenhouse gas in the atmosphere [22].

Valuation of Ecological Benefits

Because of the inherent difficulties in generalizing the economic benefits associated with water quality improvement via biofiltration by oysters, one alternative approach has been to quantify the cost of providing a substitute for this service. As a natural biofilter that removes suspended solids and lowers turbidity, oyster reefs are analogous to wastewater treatment facilities. Thus the filtration rate of an individual unit of oyster reef can be quantified and compared with the cost of processing a similar amount of suspended solids and nutrients within a treatment facility [18]. Modern treatment plants are quite efficient in treating domestic and industrial wastewater. Quite often however, storm water runoff cannot be economically collected and treated. This is where oyster reefs become extremely cost-effective in improving estuarine water quality.

Oyster reefs work best in shallow waters, and large scale restoration efforts have shown that oysters can remove suspended sediment by tenfold. Removing suspended sediments promotes retention and/or development of beneficial submerged aquatic vegetation – extremely important nursery habitat for most of the commercially- and recreationally-important finfish and shrimp along the eastern seaboard and Gulf states.

The ecological benefits of oyster reefs have been sufficiently documented so that the U.S. Army Corps of Engineers (USACE) now considers constructed oyster reefs suitable as components in Section 204 (Ecosystem Restoration Associated with Dredging) and section 206 (Aquatic Ecosystem Restoration) projects, as well as mitigation for navigation projects [18]. Oyster reefs have been shown to have a relatively low marginal cost compared with marsh or seagrass restoration, and high marginal ecological benefits. In areas with a history of commercial oyster harvesting, the reefs also contribute to local, coastal heritage.

Using 2001 – 2004 National Marine Fisheries Service dockside landings data from the southeastern U.S. and the Gulf of Mexico, the increased harvest weights of 13 fish species that were supported by oyster reefs were converted to commercial fish landings values. Using 2004 dollars, it was estimated that the additional value of commercial fisheries – made larger by **just a 10 square meter segment of an oyster reef** that lasts 50 years – would be $98.06 each year [23]. No mention was made as to the value of the reef to sports fishermen, although oyster reefs are notorious hotspots for recreational fishing. Trout and redfish are sought by anglers fishing around oyster reefs along the Gulf coast.

A Louisiana study of recreational anglers who regularly fished oyster reefs indicated a willingness to pay to fish over oyster reefs of $13.21 (2003 dollars) per angler. This same study indicated that approximately 23 percent of the total marine-angling days each year occurred over oyster reefs, resulting in an estimated $2 million in annual benefits for Louisiana coastal waters [18].

Ecological benefits translate into economic benefits. Public, ecological benefits provided by oyster reefs include water quality improvement, erosion prevention and stabilization, and creation of various types of beneficial habitat. Economic benefits include (a) the harvest of oysters, shrimp, fish, and crab from the reef or adjacent areas, (b) increased recreational use because of cleaner water (which leads to increased water-based, contact-recreational opportunities), and (c) cost savings for shoreline stabilization and dredged material disposal. Therefore, when considering the costs and benefits of oyster reef restoration projects, the USACE must now attempt to account for all ecological and economic benefits.

The Approach Used to Measure Damages to Oyster Production, Harvesting, Processing, and Marketing Operations

Background Comments about the Data Collection Process

Seventeen days after Hurricane Ike made landfall, an *"in-person"* damage-assessment information collection form was prepared with the intention of meeting individually with oyster industry members and talking one-on-one about (a) the physical damages they had experienced and (b) the revenue, employment, and payroll impacts they expected over the next twelve months. Several trips were made to Galveston and Chambers Counties to meet with industry. This was the wrong approach for gathering a comprehensive assessment of damages. Virtually every operator was juggling their time with insurance adjusters, upland debris removal, flood damage, and reconstruction across both business and personal assets, and could not break away for an extended interview. Industry members requested that a "stand-alone" survey be prepared and distributed that could be completed as time permitted. Creating this "one size fits all" damage-assessment document took roughly two months. It was distributed to industry in early January, 2009.[21]

Recipients of the Damage Assessment Survey

The damage-assessment questionnaire was distributed to all members of the oyster processing and marketing sector who were listed on the Interstate Shellfish Shippers List (ISSL). The ISSL is a constantly-updated FDA publication that allows corporate purchasers of oysters to verify the certifications of those who market oysters through interstate commerce. Typically firms on the ISSL are vertically integrated. For example, some operations begin by holding an oyster lease and complete every subsequent step including harvesting, processing, and in some instances distributing their own products. However, there are a number of leaseholders who have opted to focus on oyster production from their leases. A list of these firms who are engaged in just the culture and harvest of oysters was obtained from the Texas Parks and Wildlife Department, and all received the same survey as those found on the FDA Interstate Shellfish Shippers List. Twenty-four different firms were listed on the two information sources. Of those 24 firms, two exited the business as a result of Hurricane Ike, and all mail from another company was returned as undeliverable.

The questionnaire was mailed on January 9, 2009. Within one week, follow-up surveys were sent to those who had not responded.[22] Three weeks after the original mailing, follow-up surveys were sent to the remainder that had not yet responded. Site visits were made to several facilities to discuss the importance of the survey to the larger industry. A total of 13 firms responded (62 percent), but the total number of responses received was twenty-six because one firm had numerous subsidiaries that separately responded. Additionally, responses from industry reflected 1,713 acres of bay bottom leased for the production of oysters. This amounts to 74 percent of total acreage currently under leasehold.

Information Collected through the Survey

The damage estimate considered every element of the operation, beginning with leases within the Galveston Bay system and the fleet of commercial vessels required to maintain the leaseholds and harvest oysters. Damage assessment questions then moved on to the bulkheads, docks, and piers that facilitate moorage of the commercial fleet and offloading opportunities. Damage to roads and parking areas was also addressed as were fuel-storage facilities, processing/office buildings, processing equipment, and various types of inventory including raw materials, packaging products, and finished goods.

Throughout the assessment of physical damage, this survey sought comparisons of replacement value for an entire asset class vs. the cost of making required repairs and replacements wrought by Ike. Having total replacement cost for the asset class as well as the estimated cost to repair or replace that fraction of the asset class damaged by Hurricane Ike enabled us to measure the percentage impact the storm had on that particular asset. Beginning with the assets used to support oyster offloading, processing, and marketing, we also asked about whether insurance coverage existed, and if so what fraction of damages would be covered from those sources. Industry operators were also asked to estimate how much time would be required for a particular asset damaged or destroyed by the storm would be back on line.

21. The questionnaire prepared to obtain estimates of damage is found in Appendix 1. An editable version that can be printed in booklet format will soon be available at http://texas-sea-grant.tamu.edu/Outreach/extension.html which can serve as a starting point for subsequent damage assessment work with industry when the need again arises. Portions of this questionnaire may not meet every subsequent information need. However, having an editable survey that met with industry success will sharply reduce the required lead time the next time a damage assessment is required.

22. A unique identification number appeared on the cover of every survey that allowed a completed survey to be associated with a particular firm.

The Level of Detail Afforded by this Survey

The guarantee of an operator's anonymity and privacy is an essential component necessary to obtain accurate responses from the largest number of impacted firms. In conducting industry-oriented survey work for more than twenty years that has used financial statements to measure financial performance and progress, the pledge has always been that only industry-wide summaries would be released. Sometimes this guarantee of anonymity may frustrate local officials if the information cannot be delineated by political subdivisions like cities or counties. Such is the case here since subtraction could be used to identify a competitor's characteristics.

Estimated Damages to All Classes of Assets Reported Through The Survey

Damages to Oyster Leases

Half of survey respondents maintain leaseholds in the Galveston Bay system. These respondents collectively maintain 1,713 acres (2.7 square miles) of oyster leases. In 2008, leaseholders collectively planted some 53.8 million pounds of cultch material (comprised of oyster shell and river rock) across 727 acres of the 1,713 acres they control. The cost of planting shell in calendar 2008 was just over $1 million. According to the damage-assessment survey, all leaseholders participated in the highly-regulated oyster transplanting program monitored by the Seafood and Aquatic Life Group within the Texas Department of State Health Services. Leaseholders transplanted 17.9 million pounds of unmarketable oysters from unapproved waters at a cost of $641,000. Since shell planting and oyster transplants are annual maintenance activities, these expenses are considered "sunk"costs and therefore are not considered as part of the damage assessment. The intent in presenting this information was to show the type of commitment and the annual expense necessary to maintain the documented productivity of oyster leases.

When asked about their estimates of the quantity and value of oysters on their leases prior to Hurricane Ike, respondents indicated 930,028 sacks valued at $19,425,756 (with a computed average price of $21.00 per sack).[23] As soon as possible after the storm, virtually all leaseholders surveyed the condition of their leases and estimated their remaining oyster crop. Respondents were asked to estimate the percentage of their existing oyster crop that fit into each of three categories (Table 6, Figure 5).

Table 6. The Estimated Percentage of Oysters on Leases Classified by Type of Damage

Percentage of your crop falling into each of these three categories:	Pct.
■ Oysters seem OK – similar to pre-Ike conditions	33%
■ Oysters appear dead – buried under silt or debris	53%
■ Oysters are missing – apparently swept away	14%

23. Within the oyster industry a "sack" refers to a burlap bag containing roughly 110 pounds of shellstock (i.e., live oysters in their shells). There are about 5.8 pounds of oyster meats in each 110 pound sack of live oysters.

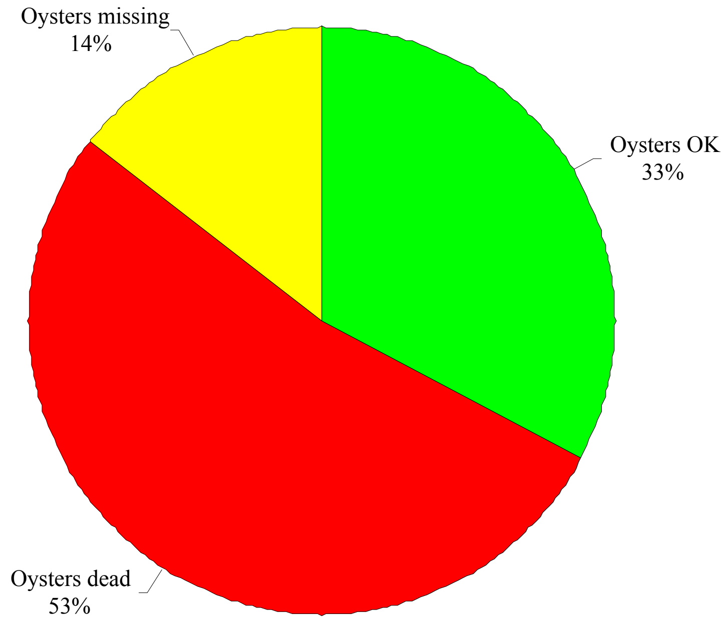

Figure 5. The Estimated Percentage of Oysters
on Leases Classified by Type of Damage

In just a few hours the wind-generated storm surge from Hurricane Ike buried over half the crop and swept away another 14 percent, leaving just one-third of the crop that existed prior to September 13th. Applying these percentage values to respondents' estimates of their *"Pre-Ike"* crops quantifies the rapid devastation generated by several hours of hurricane-force winds and a huge storm surge. Of the 930,028 sacks collectively held by leaseholders prior to Ike, 490,612 sacks were dead, 134,729 sacks were missing, and just 304,687 sacks remained after the storm. Of the $19.43 million in collective value just before the storm, $10.13 million were dead, $2.95 million were missing, and just $6.35 million remained (Table 7, Figure 6).

Table 7. The Estimated Volume and Value of Oysters on
Leases Classified by Type of Damage

Volume on your leases after the storm	Sacks	Percent
■ Oysters seem OK – similar to *"pre-Ike"* conditions	304,687	33%
■ Oysters appear dead – buried under silt or debris	490,612	53%
■ Oysters are missing – apparently swept away	134,729	14%
Total number of sacks (*"pre-Ike"*)	930,028	100%
Value on you leases after the storm	Dollars	Percent
■ Oysters seem OK – similar to *"pre-Ike"* conditions	$6,351,546	33%
■ Oysters appear dead – buried under silt or debris	$10,125,018	52%
■ Oysters are missing – apparently swept away	$2,949,193	15%
Total value (*"pre-Ike"*)	$19,425,756	100%

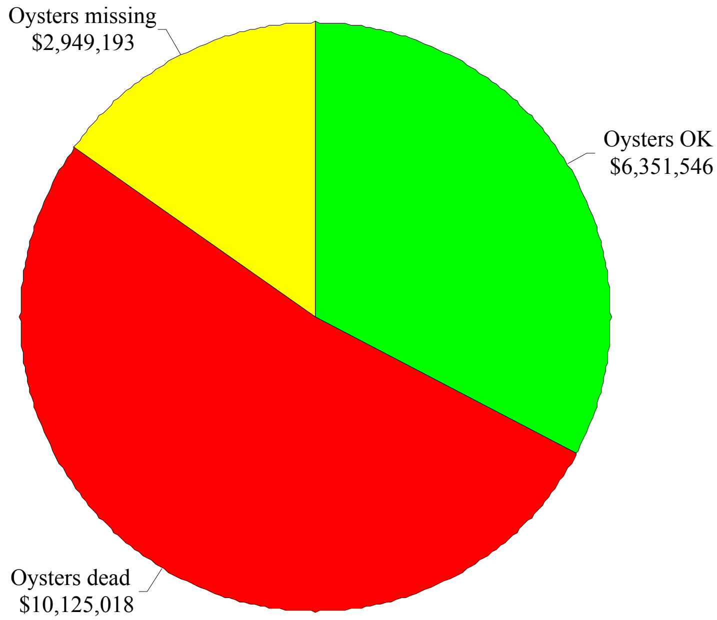

Figure 6. The Estimated Volume and Value of Oysters on Leases Classified by Type of Damage

The final question asked of respondents who hold leases within the Galveston Bay system to estimate the cost required to restore or rebuild the oyster crop on their leases that was damaged or destroyed by Hurricane Ike. Respondents indicated that $18,572,555 was needed to bring their leases back to levels that existed just prior to Ike. Thus, the cumulative losses to leaseholders from missing or dead oysters and the refurbishment necessary to set the stage for restoring the productivity of the leases is $31.65 million (Table 8, Figure 7).

Table 8. Cumulative Inventory Losses and the Cost to Recondition or Rebuild Productive Oyster-growing Substrate to Support Future Productivity

The value of dead or missing oysters on leases – crop loss	$13,074,210
Cost to restore productivity and rebuild reefs on leases	$18,572,555
Cumulative dollar losses to oysters and reefs on leased bay bottom	$31,646,765

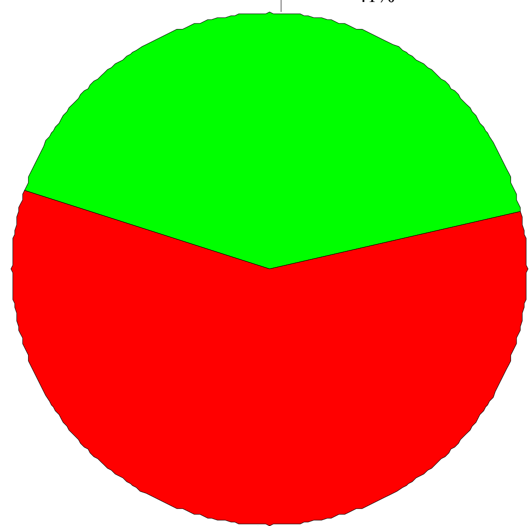

Figure 7. Cumulative Inventory Losses and the Cost to Rebuild or Repair Damage to Historically-productive, Oyster-growing Substrate

Hurricane Ike destroyed 67 percent of the oysters held on private leases. These losses are permanent and represent just over 40 percent of total dollar losses on the leaseholds. The cost to rebuild the elevated substrate damaged by the storm accounts for the remainder of cumulative damage to oyster leases (estimated at 59 percent of total leasehold damage). In the immediate future, should oysters remaining in unapproved waters be available for transplanting, this annual practice will provide a modicum of cash flow but several months will pass before the revenue effects are felt. Rebuilding or repairing damages to historically-productive, oyster-growing substrates is a practice that leaseholders themselves developed in the early years of the last century, but the costs to do so – estimated at $18.6 million – will make this restoration process a long-term project. Likewise, realizing the revenue effects from rebuilding or repairing private reefs will take years.

Damage to Commercial Vessels

Maintaining oyster leases and harvesting oysters requires a variety of commercial work boats. Leaseholders typically use "luggers" as their primary work boat. These are beamy, flat-bottomed vessels that can transport heavy loads while not drawing too much water. Luggers are used to dredge oysters and haul shell and other cultch materials during shell-planting season. In addition to luggers, leaseholders also maintain combination bay boats that can be used to dredge oysters as well as trawl for shrimp (if they hold the appropriate licenses). These combination bay boats are also used by those who hold oyster licenses and dredge for oysters during the open season. The third category of commercial craft which some leaseholders may own – shell-planting barges – are strictly relegated for planting cultch material. Although the survey delineated vessels across the categories mentioned above, all three vessel types have been collapsed into a single "vessels" category.

The 26 industry members who responded own and maintain 79 commercial vessels. Were all 79 vessels replaced, some $6.65 million would be required. Respondents were next asked to classify their commercial fleet across four damage categories (Table 9). Only 4 of the 79 vessels escaped Hurricane Ike without any damage. About 54 percent (43 vessels) sustained minor damage. One-third of the fleet (26 vessels) experienced substantial damage, and about 8 percent (6 vessels) were either lost or completely destroyed.

The estimated cost to repair or replace vessels amounted to $1.63 million, and represents a 25 percent casualty loss to respondents.

Table 9. Classification of Damage to the Oyster Fleet

Damage Classification:	Number of Vessels	Percent
■ No damage	4	5%
■ Minor damage – a few repairs needed	43	54%
■ Substantial damage – hull or engine repairs needed	26	33%
■ Destroyed or lost – replacement required	6	8%
Total number of vessels reported	79	100%

Table 10 presents respondents' expected time horizons required to return their damaged or destroyed assets to service. When asked about when the damaged or lost vessels would be returned to service, 15 commercial vessels (19 percent of the fleet reported) were back in service prior to January, 2009. As expected, quickly putting 15 vessels back to work with just 4 percent of total, expected cost ($65,000 vs. $1.63 million) suggests that many of these vessels sustained minor damage. Eight vessels (10 percent of the fleet that was damaged or destroyed) were expected to be back in service in time to participate in the May transplanting season. The cost to ready these vessels by May, 2009 was projected to cost $90,000, or 6 percent of the total forecasted repair and replacement budget. An additional 17 vessels (22 percent of the fleet) will be in service by October, 2009. Respondents expect to spend $340,000 to repair or replace those 17 vessels suggesting that these sustained much more damage. Owners of 36 vessels indicate a much longer lead time to return these vessels to commercial use: 15 should be operational by February, 2010, 10 vessels will take longer than 12 months to be ready, and owners of 11 vessels are uncertain about when these will be back on the water. Owners anticipate the cost to be $1.1 million; 68 percent of the total, forecasted repair and replacement budget.

Table 10. Summarizing Fleet Damage by Expected Time Vessels will Return to Service and the Estimated Cost to do so

	When vessels will be operational			Repair / Replacement Expense		
Time to repair or replace	Vessels	Percent	Cum. %	Expense	Percent	Cum. %
■ Already operational – prior to 01/09	15	19%	19%	$65,000	4%	4%
■ Ready in 2 mo. (Apr. 09)	1	1%	20%	$10,000	1%	5%
■ Ready in 3 mo. (May 09)	7	9%	29%	$80,000	5%	10%
■ Ready in 4 mo. (June 09)	3	4%	33%	$40,000	2%	12%
■ Ready in 5 mo. (July 09)	3	4%	37%	$50,000	3%	15%
■ Ready in 6 mo. (Aug. 09)	7	9%	46%	$120,000	7%	22%
■ Ready in 7 mo. (Sep. 09)	2	3%	48%	$90,000	6%	28%
■ Ready in 8 mo. (Oct. 09)	2	3%	51%	$40,000	2%	30%
■ Ready in 10 mo. (Dec. 09)	3	4%	54%	$25,000	2%	32%
■ Ready in 12 mo. (Feb. 10)	15	19%	73%	$700,000	43%	75%
■ Ready in > 12 mo.	10	13%	86%	$100,000	6%	81%
■ Don't Know	11	14%	100%	$310,000	19%	100%
Totals	79	100%		$1,630,000	100%	

Damage to Bulkheads and Finger Piers

Most of the docks and finger piers available to commercial fishermen around the Galveston Bay system are privately owned and maintained. Eleven industry members collectively own some 9,032 linear feet (1.7 miles) of bulkheaded shoreline which create a number of harbors for commercial vessels. Three types of construction material were used in constructing these bulkheaded areas. Over half of the linear footage (5,682 linear ft.)

was built using a combination of materials (e.g., treated wood, steel, concrete, vinyl), 3,000 ft. was constructed of just treated wood, and 350 ft. was concrete. Reported replacement cost for the entire system of bulkheaded shoreline was $3.394 million with a weighted average replacement cost of $302/ft.

Regarding damage to bulkheads, survey recipients were asked to measure the linear footage that was damaged, and then select one phrase from that survey question that best characterized the severity of damage. Of the 9,032 linear ft. of bulkheaded shoreline that oyster operators own, damage was sustained to 5,278 ft. which is over half (58 percent) of the total length of this important asset. The total cost to refurbish, repair, or replace damaged or destroyed bulkheading was $1.62 million (Table 11). No respondent indicated having any insurance on this asset, so the estimated cost of returning over half of the bulkheading to service represents a casualty loss of 47.6 percent. Just 2 percent of damaged bulkhead will be repaired or replaced by August, 2009. Another 500 linear feet (9 percent) should be ready by February, 2010 while repairing and replacing just over 4,000 ft. will not be completed until February, 2011; 28 months since Hurricane Ike made landfall. Owners of 620 linear feet of damaged or destroyed bulkheads (12 percent) cannot state when their repairs or replacements will occur (Table 12).

Table 11. Classification of Damage to Bulkhead System and
the Estimated Cost to Refurbish, Repair, or Replace

Level of Bulkhead Damage	Linear feet	Percent	Dollars	Percent
■ Still Useable – some minor refurbishment is needed	550	10%	$325,000	20%
■ Damaged areas are unuseable until they are repaired	4031	77%	$665,000	41%
■ Severely damaged/destroyed – replacement required	697	13%	$625,000	39%
Total Damages	5,278	100%	$1,615,000	100%

Table 12. Summarizing Bulkhead Damage by Expected Time to
Become Operational and the Estimated Cost to do so

	When Work Will be Completed			Repair / Replacement Expense		
Time Necessary to Repair or Replace	Ft.	Pct.	Cum. %	Dollars	Pct.	Cum. %
■ Ready in 6 mo. (Aug. 09)	97	2%	2%	$25,000	2%	2%
■ Ready in 12 mo. (Feb. 10)	500	9%	11%	$560,000	35%	36%
■ Ready in 24 mo. (Feb. 11)	4,061	77%	88%	$690,000	43%	79%
■ Don't Know	620	12%	100%	$340,000	21%	100%
Totals	5,278			$1,615,000	100%	

Finger piers extend out from bulkheaded areas and increase the number of vessels that can be moored within the confines of a marina. Five respondents owned 835 linear feet of finger piers with an estimated replacement value of $240,000 (Table 13).[24] Roughly 29 percent of total pier footage (240 ft.) sustained some degree of damage. Pier damages classified as *"Damaged and cannot be used until repaired"* accounted for 165 ft. (69 percent) while 75 ft. were severely damaged and warranted replacement. The estimated cost to repair or replace pier damage was $140,000 with 86 percent of the total repair/replacement cost required to repair the 165 ft. while 14 percent of the total cost was needed to replace destroyed piers. No one reported having any insurance on their piers so the estimated cost of restoring 240 linear ft. of piers becomes a casualty loss of 58 percent. Though piers are not too common across the commercial harbors within the Galveston Bay system, it is important to note that those who own most of the linear footage of piers cannot state when repairs or replacements will be made (Table 14).

24. Missing values for (a) complete replacement of finger piers and (b) the linear feet of piers damaged or destroyed results in an understatement of both complete replacement cost for the asset class and the total linear feet of piers that must be repaired or replaced. Not having a complete set of information thus overstates the fraction considered as casualty loss to the industry.

Table 13. Classification of Damage to Pier System and the Estimated Cost to Refurbish, Repair, or Replace

Level of Pier Damage	Linear ft.	Percent	Dollars	Percent
■ Still useable, but some refurbishment is needed	0	0%	$0	0%
■ Damaged areas cannot be used until repaired	165	69%	$120,000	86%
■ Severely damaged/destroyed – replacement required	75	31%	$20,000	14%
Total Damages	240	100%	$140,000	100%

Table 14. Summarizing Pier Damage by Expected Time to Become Operational and the Estimated Cost to do so

	When work will be completed			Repair / Replacement Expense		
Time Necessary to Repair or Replace	Ft.	Percent	Cum. %	Expense	Percent	Cum. %
■ Ready in 6 mo. (Aug. 09)	50	21%	21%	$5,000	4%	4%
■ Ready in 12 mo. (Feb. 10)	NA	NA	NA	$50,000	36%	39%
■ Don't Know	190	79%	100%	$85,000	61%	1000%
Totals	240	100%		$140,000	100%	

Damage to Roads and Parking Areas

Respondents indicated owning 886,590 square feet of improved privately-funded roads and parking areas with a combined replacement cost of $693,500 (Table 15).[25] Respondents estimated repairs at around $90,000 which amounts to a 13 percent casualty loss for the asset class. No one had insurance to cover damage to roads and parking areas. As detailed in Table 16, repairs to 58 percent of roads and parking areas will be completed by February, 2010.

Table 15. Classification of Damage to Roads and Parking Areas Showing the Estimated Cost to Refurbish and Repair Damages

Level of Road and Parking Area Damage	Dollars	Percent
■ Still passable – some minor refurbishment is needed	$65,000	72%
■ Damaged areas cannot be used until repaired	$25,000	28%
■ Severely damaged/destroyed – replacement required	$0	0%
Total Estimated Cost to Repair Damages	$90,000	100%

25. Missing values for (a) complete replacement of roads and parking areas and (b) the square footage of roads and parking areas results in an understatement of both complete replacement cost for the asset class and the total square footage of roads and parking areas that must be repaired or replaced. Not having a complete set of information thus overstates the fraction considered as casualty loss to the industry.

Table 16. Summarizing Damage to Roads and Parking Areas by the Expected Time to Become Operational and the Estimated Cost to do so

Time Necessary to Repair or Replace	Repair / Replacement Expense		
	Ft.	Pct.	Cum. %
▪ Ready in 6 mo. (Aug. 09)	$45,000	50%	50%
▪ Ready in 12 mo. (Feb. 10)	$7,500	8%	58%
▪ Don't Know	$37,500	42%	100%
Total, estimated monetary damages	$90,000		

Damage to Fuel Storage Facilities

Eight firms maintained fuel storage and distribution facilities near their commercial harbors to service their fleets and the vessels of other producers. Each of these eight firms experienced varying levels of damage to this asset class. Almost half the estimated expense was required to replace destroyed facilities (Table 17). Industry members expect to have just over half of their fuel storage and distribution facilities operational by August, 2009 (Table 18), but almost a third of the estimated repair/replacement of such facilities is pending with respondents unsure about when those damaged or lost facilities will return to operational status.

Table 17. Classification of Damage to Fuel Storage and Distribution Facilities Showing the Estimated Cost to Refurbish, Repair, or Replace

Level of Damage to Fuel Storage / Distribution Facilities	Dollars	Percent
▪ Minor damage – a few repairs needed	$37,500	22%
▪ Major damage to the storage facility – repairs needed	$52,050	31%
▪ Destroyed of Lost – replacement required	$80,000	47%
Total Estimated Cost to Repair Damages	$169,550	100%

Table 18. Summarizing Damage to Fuel Storage Facilities by the Expected Time to Become Operational and the Estimated Cost to do so

Time Necessary to Repair or Replace	Repair / Replacement Expense		
	Dollars	Pct.	Cum. %
▪ Already operational – prior to 01/09	$5,500	3%	3%
▪ Ready in 2 mo. (Apr. 09)	$5,000	3%	6%
▪ Ready in 4 mo. (June 09)	$30,000	18%	24%
▪ Ready in 6 mo. (Aug. 09)	$52,050	31%	55%
▪ Ready in 12 mo. (Feb. 10)	$25,000	15%	69%
▪ Don't Know	$52,000	31%	100%
Total dollar value of fuel storage damage	$169,550		

Damage to Processing and Office Facilities

Ten respondents owned buildings used for processing and/or offices.[26] Collectively, the oyster industry within the Galveston Bay system maintained just over 51,000 square feet of buildings with an estimated replacement value of $5.9 million. Estimated damage to processing/office facilities was $1.823 million (Table 19). Processing/office facilities fared badly during the hurricane with $1.28 million (about 70 percent) of the dollar

26. Missing values for (a) complete replacement of offices and processing buildings, (b) square footage of the facilities, and the extent of insurance coverage results in an understatement of complete replacement cost for the asset class and the physical square footage that will need to be refurbished, repaired, or replaced. As well, not having a complete set of information overstates the fraction considered as casualty loss to the industry.

damages falling into the *"Significant – major repairs needed to be operational"* category. Industry-wide, casualty losses amounted to roughly 27.5 percent of total asset class replacement, but the actual value may be lower because half the owners carried insurance policies on their processing/office facilities. Five of ten industry members had insurance coverage on their buildings, but at the time the survey was completed, not every respondent with coverage could cite the approximate fraction covered by his policy. Those with information about the extent of their coverage would collectively have $197,500 covered on an industry-wide estimated loss of $1.823 million (about 11 percent). By the time this survey was distributed, roughly 25 percent of refurbishment, repairs, or replacements had been completed (Table 20). Facility owners estimate that 80 percent of the repair/replacement expenses will have been made by August, 2009.

Table 19. Classification of Damage to Processing/Office Facilities
Showing the Estimated Cost to Refurbish, Repair, or Replace

Level of Damage to Processing/Office Facilities	Dollars	Percent
■ Minor – some refurbishment needed to be operational	$302,000	17.0%
■ Significant – major repairs needed to be operational	$1,280,000	70.0%
■ Complete Destruction – reconstruction necessary	$241,000	13.0%
Total	$1,823,000	

Table 20. Summarizing Damage to Processing/Office Facilities by the Expected
Time to Become Operational and the Estimated Cost to do so

Processing/Office Facilities	Dollars	Pct.	Cum. %
■ Already operational – prior to 01/09	$455,000	25%	25%
■ Ready in 6 mo. (Aug. 09)	$1,000,000	55%	80%
■ Ready in 9 mo. (Nov. 09)	$75,000	4%	84%
■ Ready in 12 mo. (Feb. 10)	$150,000	8%	92%
■ Don't Know	$143,000	8%	100%
Total dollar value of processing/office facilities damage	$1,823,000		

Damage to Processing Equipment

While all food processing firms undergo the scrutiny of state and federal regulatory authorities, the oyster industry receives some of the most intensive regulatory oversight across the entire food processing sector. A sophisticated complement of processing equipment is required in today's oyster processing and marketing industry, brought about by the regulatory mandates for post-harvest treatment to ensure public health as well as the desire for convenience among institutional purchasers. Federal post-harvest treatment requirements exist for those firms that market oysters for the half-shell trade throughout the summer months, and these requirements have also contributed to greater convenience for half-shell oyster products than the age-old practice of opening live oysters upon a customer's order. Mandated, post-harvest treatment and the desire for more convenience-oriented half-shell oyster products has necessitated significant investment in continuous, cryogenic freezing equipment along with the material handling systems necessary to generate the volume of throughput needed to justify the investment in such equipment. In addition, ice manufacture, holding coolers and freezers are standard equipment in most processing plants as are the complement of processing tables, packaging systems, material handling assets such as pallet jacks, skate-wheel conveyors, and offloading conveyors which move sacks of shellstock from the vessel to the dock.

Oyster processors and marketers estimate that $1.8 million would be needed to replace all their processing equipment. Roughly 44 percent of processing equipment assets ($813,900) was damaged by Hurricane Ike; much of it from the storm surge which impacted electronic control systems used in continuous-feed equipment like cryogenic freezing tunnels (Table 21). The level of damage sustained across processing equipment was about evenly split between significant damage requiring major repairs ($405,000 or 50 percent) and complete destruction requiring replacement ($388,900 or 48 percent). At the time this survey was administered, only half of respondents with insurance on building contents knew the value covered by insurance ($44,600 or 5.5 percent of reported dollar damage). When asked when repairs or replacement of processing equipment would occur, 32 percent of total damages would be operational by August, 2009 and another 12 percent would be ready by November, 2009; the start of the public oyster season (Table 22). However, over half of the estimated damage to processing equipment has no specific time frame for becoming operational.

Table 21. Classification of Damage to Processing Equipment Showing the Estimated Cost to Refurbish, Repair, or Replace

Level of Damage to Processing/Office Facilities	Dollars	Percent
■ Minor – some servicing is needed to be operational	$20,000	2%
■ Significant – major repairs needed to be operational	$405,000	50%
■ Complete Destruction – replacement is necessary	$388,900	48%
Total dollar value of processing equipment damage/loss	$813,900	

Table 22. Summarizing Damage to Processing Equipment by the Expected Time to Become Operational and the Estimated Cost to do so

Processing Equipment	Dollars	Pct.	Cum. %
■ Already operational – prior to 01/09	$40,000	5%	5%
■ Ready in 6 mo. (Aug. 09)	$220,000	27%	32%
■ Ready in 9 mo. (Nov. 09)	$95,000	12%	44%
■ Don't Know	$458,900	56%	100%
Total dollar value of processing equip. damage	$813,900		

Damage to Inventories

The final section of the damage assessment survey asked about the quantities of various types of inventory on hand just prior to the storm (e.g., raw materials, packaging materials such as boxes, cups, tins, lids, gallon containers, etc., and finished goods). [27] Ten of the respondents held some inventory in their facilities just prior to Hurricane Ike with a value of $388,000.[28] Any type of inventory that was compromised to any degree would typically be discarded, so the value of discarded items would expected to be high relative to the total, estimated replacement value for the asset class. In fact, roughly 91 percent of inventory value was discarded (Table 23). Insurance was minimal for inventories, covering just 0.4 percent of the estimated losses, but two respondents who had coverage did not have definitive information about what fraction of inventory loss would be covered when the survey was distributed.

27. Leaseholders have live inventory held in wet storage on their leases, but this particular asset was covered in the section that dealt with damage to leases and oysters on those leases. In this case, Inventories refer to purchases either awaiting processing (as reflected by raw materials or packaging materials), or distribution (reflected as finished goods).

28. Missing values for the cost to replace all classes of inventory results in an understatement of complete replacement cost for the asset class. A missing value also overstates the fraction considered as casualty loss to the industry.

Table 23. Classification of Damage to Raw Materials, Packaging Materials, and Finished Goods Showing the Estimated Cost to Refurbish, Repair, or Replace

Level of Damage to Inventories	Dollars	Percent
■ Minor – some items had to be discarded	$17,000	5%
■ Significant – most items had to be discarded	$0	0%
■ All classes of inventory were destroyed	$336,000	95%
Total dollar value of damage/loss to inventories	$353,000	100%

Reported Employment and Payroll Impacts From Hurricane Ike

After asking about the physical damages, the survey turned to employment and payroll impacts for the twelve months just prior to the storm and the twelve months after Hurricane Ike. Respondents provided detailed information about number of employees and the associated payroll on a quarterly basis between September, 2007 and August, 2008 (i.e., September – November '07; December '07 – February '08; March – May '08; June – August '08). In the twelve months preceding Hurricane Ike, industry members who provided both employment and payroll information hired 159 individuals who earned an average of $27, 759 over the 12-month interval.[29] Collectively, some $4.4 million was paid out in wages and salaries.

Estimating employment and payroll going forward was difficult for the industry because of several unanswered questions. The first question was the quantity of oysters unaffected by the storm that would be available for the 2008-2009 harvest. The second question that would impact each operator's estimates of employment, and payroll for the twelve months after the storm was uncertainty about when they would be able to support harvest operations and process oysters given the damage sustained to their leaseholds and processing infrastructure. A third source of uncertainty was how long the public reefs could sustain harvests during the public oyster season. While some respondents did complete the actual and projected employment and payroll for the twelve months following Hurricane Ike, the number of complete responses was too low to make any meaningful industry-wide estimates.

Ranking and Specifying Various Public Works Projects

The final question set in the survey presented four potential recovery projects that could be publicly funded. Respondents were asked to rank the importance of each stated project from 1 (most important) to 4 (least important) and were also given the opportunity to describe and rank other public works efforts. Based on reported damage to public oyster reefs and leaseholders' own surveys of their leases, it is no surprise that the two most important recovery projects to oyster-dependent firms are (a) to remove debris from the bottom of the Galveston Bay system and (b) to plant shell on the public reefs that were damaged by Hurricane Ike (Table 24). Respondents felt that the least important publicly-funded recovery project was the removal of debris that was washed onto private upland areas. Two respondents presented three similar recovery suggestions to be funded with public monies, though only one prioritized their suggestions: (a) transplanting oysters onto leases like the state of Louisiana allows, (b) planting shell, river rock, or limestone on private leases, and (c) establishing markings that delineate private leaseholds in the bay.

29. Only responses that included **<u>both</u>** employment and payroll for the quarters where additional people were required were used to prevent over or under-estimating the collective number of jobs and the associated payroll.

Table 24. Respondents' Preferences for Various
Publicly-funded Recovery Projects

Possible publicly-funded recovery projects presented in the survey:	Count	Mean
■ Removal of debris from the bay bottom similar to what was done in after Katrina.	18	1.89
■ Planting shell on public reefs that were damaged or destroyed.	18	2.22
■ Removal of vessels that were washed onto private property.	16	2.25
■ Removal of residential/industrial debris that was washed onto private upland areas.	16	3.69
Respondent-defined, publicly-funded recovery projects:	Count	Score
■ Planting shell, river rock, or limestone on private leases that were damaged.	1	2
■ Transplanting oysters onto leases as done in Louisiana.	1	1
■ Marking leases.	1	3

Summary

Texas and the Galveston Bay System: An Important Supplier of Eastern Oysters

Anchored by the production from the Galveston Bay system, Texas has been the second-most important supplier of Eastern oysters in the country between 1991 and 2007, annually providing 18 percent of the total annual supply (an annual average of 4.78 million meat weight pounds).[30] The opportunity to lease Galveston Bay bottom in for the purpose of creating oyster reefs began in the early years of the last century. Far from converting a public fishery resource to private ownership, leases were only granted in those areas where *"nature failed to produce oyster reefs."* Leaseholders annually make investments to improve the productivity of their leases by (a) planting shell to create substrate upon which oysters settle, attach, and grow and (b) transplanting oysters from closed areas so they can meet food safety standards established by the FDA. As expected, leases are more productive than public reefs. Between 1981 and 2007, publically-managed oyster reefs throughout the Galveston Bay system averaged 132 meat weight pounds per acre while harvests from the 2,321 acres of leased bottom averaged 435 meat weight pounds per acre.

Survey Design and Implementation Procedures

A damage assessment survey was designed and distributed to two types of oyster-dependent firms. The first group includes those firms on the Interstate Shellfish Shippers List, a constantly-updated FDA publication that allows corporate purchasers of oysters to verify the state and federal certification credentials of those who market oysters through interstate commerce. A second group are those individuals who have opted to focus on oyster production from their leases. A list of these firms engaged in just the culture and harvest of oysters was obtained from the Texas Parks and Wildlife Department. Both groups received the same damage-assessment survey.

The questionnaire was mailed on January 9, 2009. Within one week, follow-up surveys were sent to those who had not responded. Three weeks after the original mailing, follow-up surveys were sent to the remainder that had not yet responded. Within the month between original and final mail outs, site visits were also made

30. Between 1968 and 1990 the designation of "second-most important supplier of Eastern oysters" went to Florida 61 percent of the time (14 out of 23 years) and Texas 39 percent of the time (9 out of 23 years). From 1991 to 2007 however, Texas has continuously held the second-place slot behind Louisiana, the nation's top Eastern oyster supplier.

to several facilities to discuss the importance of the survey to the larger industry. A similar message was presented at a mid-January meeting at the Galveston County AgriLife Extension Office in Dickinson attended by some 75 seafood producers and marketers. Twenty-four firms were listed on both information sources. Of those 24 firms, two exited the business, and all mail from another company was returned as undeliverable. A total of 13 firms responded, but the total number of responses received was 26 because one firm had numerous subsidiaries that each responded.

The damage assessment survey collected information from 62 percent of the names on both the FDA and TPWD lists (responses from 13 of 21 firms). Not all respondents are leaseholders, but comparing the total amount of leased bottom in the Galveston Bay system with the acreage reported on the damage assessment survey, respondents maintain 1,713 acres or 74 percent of all oyster leases within Texas. The essential point here is that the survey information covers the majority of operators and three-fourths of the leaseholds. Obviously total dollar damages for the industry are higher than the values reported here, but the results should present an accurate sketch of what the industry faces as it works to return to *"pre-Ike"* conditions.

Every element of the operation was considered in the damage assessment survey, from leases within the Galveston Bay system, the fleet of commercial vessels required to harvest oysters and maintain the leaseholds to inventories held when Hurricane Ike made landfall. This survey sought comparisons of replacement value for an entire asset class vs. the cost of making required repairs and replacements. These two values allowed estimates of the storm's impact on a particular asset class. In addition, operators were also asked to estimate how much time would be required to put a damaged or destroyed asset back on line.

Physical Damages to the Galveston Bay Oyster Industry

The overwhelming dollar damage to industry-controlled assets occurred on the 1,713 acres of leased bottom. Leaseholders reported some 930,000 sacks on the leases prior to the storm, but could account for roughly 305,000 sacks after Hurricane Ike passed across the bay. This amounts to a 67 percent loss of living inventory valued at $13.1 million. In addition, leaseholders estimated that another $18.6 million would be required to rebuild that fraction of the leases torn apart or buried under sediment and debris created by the storm surge. While any substantial casualty loss can be crippling, loss of habitat and the inventory that was in varied stages of growth and time to marketability on those 1,713 acres is a crushing blow to leaseholders.

Of the 79 vessels owned by respondents, only four were untouched by the storm. Thirty-six sustained substantial damage and 6 were destroyed or lost. The reported estimates to repair or replace those vessels is $1.63 million. Industry reports that half of the damaged or destroyed vessels will be operational no later than October, 2009, but this will require only 30 percent of the total estimated repair and replacement cost. The other half of the fleet that was damaged or destroyed is estimated to take 70 percent of the total estimated repair/replacement budget, so bringing these vessels back on line may take much longer.

The docks, piers, roads, and parking areas used by the industry sustained damage too, with about 4,600 linear feet – roughly half of the 9,000 feet of bulkhead owned by respondents – either severely damaged or destroyed. By August, 2009 respondents expect to have just 2 percent (97 ft.) of docks and bulkheads repaired or replaced. Most of the repair or replacement (4,0612 ft.) is expected to be completed by February, 2011; 24 months from the day the survey was distributed. With most of the small-boat harbors privately owned, dock damage could create bottleneck problems for the upcoming 2009-2010 oyster season.

Damage sustained to processing buildings and equipment resulted in two different time tracks for returning to full capability. Twenty-five percent of repairs and replacements to processing and office buildings were completed before the survey was distributed. Another 55 percent (a cumulative 80 percent) of the repairs and replacements will be completed by August, 2009. Processing equipment is another matter. Though the cumulative casualty losses for processing equipment were about 44 percent of dollar losses to office and processing buildings ($813,900 vs. $1.82 million), just one-third of repairs or replacements will be completed by August, 2009, while respondents with almost $500,000 in damages (56 percent) do not have any particular time frame for returning to full operational status. Such damage to equipment with no time expectation for putting more than half of the equipment back to work may well limit overall industry capability to process and hold what oysters may be harvested in excess of fresh-market needs during the 2009 – 2010 season.

Fortunately, casualty losses for inventory – estimated at $351,750 industry-wide – were relatively minor since most operators were working through any frozen, finished goods in preparation for the Fall, 2008 oyster season when Hurricane Ike made landfall. Finally, damage to the asset class fuel storage and distribution systems will require approximately $170,000 for repairs and replacements (Table 25, Figure 8).

Table 25. The Estimated Cost to Repair or Replace All Assets Damaged or Destroyed by Hurricane Ike

Asset class	Dollars	Percent
■ Oyster Leases (1,713 acres)	$31,646,765	83.2%
■ Vessels	$1,630,000	4.3%
■ Docks, Piers, Roads & Parking	$1,845,000	4.9%
■ Fuel Systems	$169,550	0.4%
■ Plant & Equipment	$2,394,800	6.3%
■ Inventories	$351,750	0.9%
Total Cost to Repair or Replace all Damage	$38,037,865	100.0%

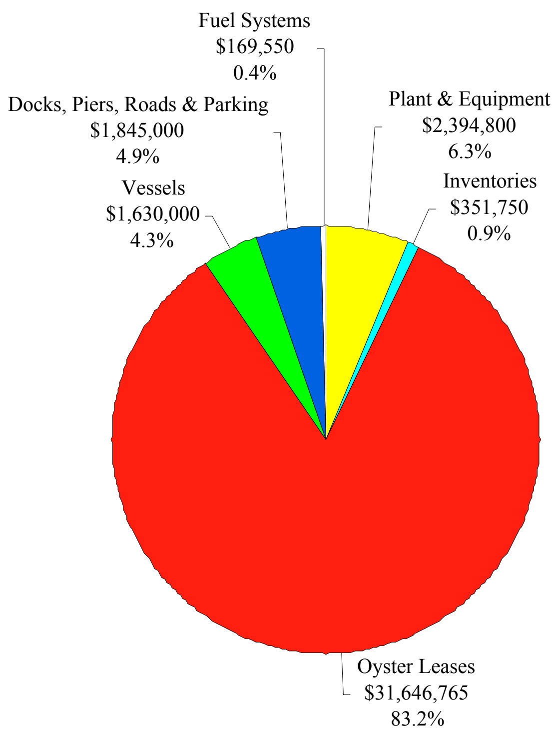

Figure 8. The Estimated Cost to Repair or Replace All Assets Damaged or Destroyed by Hurricane Ike

Firms participating in this survey are quite dependent upon the productivity of both public and private oyster reefs in the Galveston Bay system for a major fraction of their annual revenues. In the 12 months preceding Hurricane Ike, respondents generated 62 percent of their annual revenues from sale of shellstock and shucked meats that originated from the Galveston Bay system (some $18.6 million) and another 4 percent from the sale of other Galveston Bay Seafoods ($1.24 million). One-third of revenues generated in the 12 months prior to Hurricane Ike originated from assorted seafood products that originated outside the Galveston Bay system ($10 million). Sale of ancillary, non-seafood items such as slip rentals and fuel accounted for 1 percent of total annual revenues ($160,000). When asked to report actual and expected revenues for the 12 months after Hurricane Ike (September, 2008 through August, 2009), the collective responses amounted to$6.9 million; just 23 percent of the $30.1 million generated in the previous 12-month interval.

Oyster-dependent firms sustained massive economic damage at the hands of Hurricane Ike. A major source of their revenue-generating capacity – the oyster reef s – have been compromised by the storm surge that (a) covered large portions with silt and debris, (b) scattered living inventory and (c) in some cases broke apart the substrate upon which oyster larvae settles, attaches, and grows.

Environmental Benefits Provided by Oyster Reefs

Aside from their value as an aquatic food, oyster reefs play a major role in ensuring the health of estuarine ecosystems. Experimental manipulation of oysters has documented that environmental water quality is improved when return flows from municipal wastewater treatment systems and stormwater runoff passes across oyster reefs. The pumping and filtering process by which oysters feed reduces (a) phytoplankton biomass generated as a result of nutrient loading and (b) suspended solids in the water column. Oyster reefs also convert various nitrogenous compounds (nitrate, nitrite, and ammonia) back into elemental nitrogen gas which is returned to the atmosphere. Converting nutrients and recycling suspended solids initiates a food web that passes these converted nutrients and metabolites up the food chain; first as nutrients for microphytobenthos (microscopic, unicellular algae) that inhabits bay-bottom surfaces which then becomes forage for bottom-feeding fish and crabs, which then become forage for higher-order predators which are prized by recreational anglers. Because oysters create reefs above the bay bottom, a new, complex habitat is formed that provides both shelter and forage opportunities for juvenile fish and crustaceans. Oyster reefs promote the health and expansion of other preferred estuarine habitats like submerged aquatic vegetation by minimizing the negative effects of eutrophication (through their physiological process of pumping and filtering water). Reefs also reduce the force of wave energy, thus protecting habitats such as fringing salt marsh and submerged aquatic vegetation.

Oyster reefs have quietly ensured the health and productivity of estuarine areas for thousands of years. Today however many estuarine areas are suffering from degraded water quality, loss of important nursery habitats like submerged aquatic vegetation, reduced take of both recreationally- and commercially-important species, and even prohibitions against water-based, contact-recreation.

In summary, most estuarine areas support multiple uses. For example, the Galveston Bay system continuously receives huge volumes of treated municipal wastewater and untreated, storm runoff. Simultaneously, the bay supports several directed, commercial fisheries and a water-based recreational economy built around sportsfishing, boating, and water-contact activities. On the surface these two uses seem at odds, and would be, were it not for the oyster reefs.

Recommended Courses of Action

Both the assessment of damages to oyster-dependent firms and the physical damage assessment of the publicly-managed reefs indicate that a large fraction of the oyster inventory and habitat within the Galveston Bay system was severely damaged by Hurricane Ike. In the firm-level damage assessment, lost oyster inventory and physical damage to reefs on the leases accounted for $31.6 million, 83 percent of total, reported damage to assets controlled by industry. In some cases the oyster reefs and the crop that sat atop them were largely destroyed by the storm surge. This represented oysters for the 2008-2009 season as well as smaller oysters that could be marketed within the next 18 to 24 months. In a few hours, the storm surge literally upended the plans and expectations leaseholders had been working toward for years. Likewise, the SONAR-based assessment of public reefs confirmed silt and debris on 60 percent of the reefs surveyed [1]. Texas Parks and Wildlife Department managers assert that planting cultch on the consolidated reefs within the Galveston Bay system could range from $161 million to $481 million depending upon the level of mortality [24]. Therefore, our recommended courses of action are (a) to restore the reef complex and then (b) to establish some means of economically protecting the value of private reefs. In so doing, the benefits thriving reefs provide to commercial fishermen, recreational anglers, boaters, and swimmers can continue.

Recovery Projects Funded with Public Monies

Survey respondents were queried about their preferences for four potential recovery projects funded from public sources. The most important issue was removal of debris off the bay bottom. This work is underway. The second-most important recovery project was to plant shell on public reefs. Everyone connected with the oyster business or charged with ensuring estuarine water quality would agree on the importance of this activity since restoring suitable substrate is the first step in restoring oyster populations. However, the cost is high, and many not familiar with either the industry or estuarine ecosystems have asserted that investing several hundred million dollars for an industry that generates about $10 million in annual landed value (the amount paid to fishermen) does not represent the best use of public monies. This assertion ignores the fact that oyster reefs ensure a diverse mix of significant, measurable economic benefits in addition to the market value of oysters.

A strong, scientifically-based argument has been made for restoring oyster populations within the Galveston Bay system because of the multiple benefits reefs provide. Biofiltration reduces algal blooms and initiates a food-web that results in higher-order predators like red drum. Finally, reefs support other beneficial estuarine habitats that establish the basis for the large economic impacts derived through various uses of the Galveston Bay system. The U.S. Army Corps of Engineers has documented the high marginal environmental benefits of oyster reefs, and has stated that creating these biogenic structures have a relatively low marginal cost when compared against marsh or seagrass restoration efforts. The question remains however about how to fund such a project.

Once source of initial funding may be the NOAA Habitat Program. Two weeks ago we found information about this new program via an internet search. According to the web site, the NOAA Habitat program was seeking "shovel-ready" projects that could restore coastal habitat, stimulate the economy, and create jobs. This program seems “tailor-made” for restoration of oyster reefs within the Galveston Bay system. In the last few days we have learned that Texas Parks and Wildlife has submitted a proposal to this program. The maximum amount of money available for any project is about $10 million; far short of the Texas Parks and Wildlife Department estimates for cultch planting, but it would be a good beginning. Additionally, we would suggest the following course of action.

- Industry, organizations, agencies, and lawmakers need to explore the use of “shovel-ready” efforts established as part of the President’s stimulus package. Because of the Galveston Bay system, Texas is the second-largest supplier of Eastern oysters in the country. The bay also supports other commercial fisheries and a water-based recreation and tourism industry. Each of these uses depends upon oyster habitat. Planting shell on public oyster grounds would restore essential coastal habitat while creating jobs and stimulating the economy.

Recovery Projects Funded by Industry

Rebuilding leases is a process that every leaseholder clearly understands, and implements each year. The difference in per-acre productivity between leased and publicly-managed bottom is standing testimony to the effectiveness of annual shell-planting and oyster transplanting efforts. However, leaseholders are continually plagued by the inability to protect the value of their oyster inventory on private reefs. Hurricane Ike demonstrated that a reef in a shallow bay system is no match for the destructive power of waves created by hurricane-force winds or a storm surge that carries debris and sediment.

- Leaseholders need to explore a Group Risk Plan for oysters offered under the authority of the Federal Crop Insurance Corporation, a USDA-owned corporation. This Spring, such a program was created for leaseholders in Louisiana. While we have no unique recommendations for funding sources that could be used to restore private reefs, financing to support annual reef-improvement work could be easier with a group risk plan in place. Contact has been made with the regional USDA Risk Management Agency Director in Tulsa, and as we receive information about how best to pursue such a program in Texas, that will be passed along to leaseholders.

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Appendix – Damage Assessment Cover Letter and the Accompanying Survey

Sea Grant
Texas Sea Grant Extension

Texas A&M University Sea Grant College Program • Texas AgriLife Extension Service • The Texas A&M University System

Texas AgriLife Research & Extension Center
10345 State Hwy. 44
Corpus Christi, Tx 78406-1412
Tel: 361/265-9203
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January 9, 2009

FIELD(12) FIELD(13) FIELD(14) – FIELD(2)
FIELD(7)
FIELD(8) FIELD(9) FIELD(10)

Dear FIELD(12) FIELD(14),

Twenty-four hours after Ike made landfall, many called for various public projects that could restore the area to *"pre-Ike"* conditions. Creating a list of high-priority recovery projects is an important first step. However, successfully competing for hurricane recovery funds really begins with accurate estimates of storm damage. After Katrina, Sea Grant Extension staff in Louisiana and Mississippi confirmed that public funds were approved for planting shell and removing debris in part because accurate estimates of storm damage sustained by the seafood industry were available. After four months, the total cost of all Ike-related damage has yet to be completely estimated. Even less is known about the damages to the region's seafood industry, so this is why I am asking for your help!

To build an industry-wide damage assessment I need three types of estimates from you. The first estimate is the cost required to repair or replace those parts of your operation that were damaged or lost. Two other estimates are also important. Most likely, your revenues quickly changed after Ike made landfall. The size of this revenue setback and how long you expect it to last must be estimated. Also, you may now be employing fewer people than you did last year. Reductions in both your workforce and payroll must also be estimated.

The enclosed survey built to collect these estimates requests personal economic information. Maintaining your privacy is important, so let me use a past example to show how we protect it. When we measured the performance of offshore shrimp fishing between 1986 and 1997, financial statements from cooperators were the *"heart and soul"* of that study. The cooperators who trusted us with their economic information remain anonymous to this day! Their privacy was preserved by permanently separating their names, addresses, and other contact information from the financial data they provided. I'm the only one who could link a cooperator with his financial information because I created and used a random number that took the place of their contact information. You'll see such a number on the cover of the enclosed survey. Cooperator privacy was also protected because we only reported industry summaries, not individual results. These same protective measures are part of this survey too, so you can be assured that your privacy will be permanently preserved!

Rather than digging through your records to answer the survey questions, we ask for your thoughtful estimates where appropriate. I believe it will take less than an hour to complete this questionnaire. Thanks very much for your assistance. Please contact me with any questions you might have!

All the best to you and yours,

Michael G. Haby
Professor & Extension Economist – Seafood
enclosure: questionnaire & a metered, addressed return envelope

Estimating the Economic Damages Sustained by the Galveston Bay Oyster Industry Which Were Caused by Hurricane Ike

An Anonymous Survey of Oyster Businesses
Across the Galveston Bay System

Firm Number: 521020??

Conducted by

Michael G. Haby – Professor & Extension Economist
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Texas A&M University System
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The information you contribute will be combined with that of others to develop an **industry-wide estimate** of the economic damages created by the storm. An accurate, defensible, industry-wide estimate will be required to compete for various public works projects such as debris removal from the bay, restoration of public oyster reefs, replacement of public bulkheads, docks, and piers, etc.

There is no mention of you or your company anywhere on this questionnaire, only an arbitrary identification number I created. **The information you contribute on these pages will remain permanently separated from your contact information to preserve your privacy. Also, only industry-wide summaries will be released.**

AgriLIFE EXTENSION Texas A&M System — Sea Grant

To estimate the total economic damage caused by Hurricane Ike, three separate impacts must be measured.

- The first is the total estimated cost of repairing or replacing all the physical damage your business sustained. Throughout this section you are asked two questions about replacement cost. First you are asked to estimate the cost of replacing all of a certain asset class that you owned just before the storm, like your Lugger fleet. Next, you are asked to estimate the cost of repairing or replacing just that part of the asset class that was damaged or lost in the storm. These two answers will help us estimate the percentage loss in replacement cost terms.
- The second impact estimates the revenue you expect to lose between the time Ike made landfall and until you return to "full operational status."
- The third impact estimates reductions that may have occurred among both your work force and the payroll your employees earn between the time Hurricane Ike made landfall and your return to "full operational status."

This series of questions asks about physical damage to your oyster leases within the Galveston Bay system.

Q1. Do you hold oyster leases within the Galveston Bay system?

_____ No — If No, please skip to Q2 on page 4.
_____ Yes — If Yes, please answer Q1a through Q1e.

Q1a. How many acres of bay bottom does your business lease?

__________________ acres

Q1b. Did you plant shell on your leases between September 2007 and August 2008?

_____ No — If No, please skip to Q1c on page 2.
_____ Yes — If Yes, please answer Q1ba through Q1bc.

Q1ba. Approximately, what quantity of shell did you plant between September 2007 and August 2008?

____
Please specify the unit of measure you are using.

Q1bb. When you planted this shell, how many acres did you cover?

____
number of acres that received shell

Q1bc. Approximately, what was the total cost of your shell-planting activity between September, 2007 and August, 2008?

$_______________________________________

Q1c. Did you transplant oysters in 2008?

_____ No If No, please skip to Q1d.
_____ Yes If Yes, please answer Q1ca and Q1cb.

Q1ca. Approximately, what quantity of oysters did you transplant in 2008?

____
Please specify the unit of measure you are using.

Q1cb. Approximately, what was the total cost of your transplanting operation?

$____

Q1d. What volume of oysters would you estimate existed on your leases in the Galveston Bay system prior to Ike? Please record the estimated quantity and the estimated value.

Estimated **quantity** before Ike ____________________________________
Please specify the unit of measure you are using.

Estimated **value** before Ike $____________________________________

Q1e. Have you been able to evaluate the condition of your leases and your oyster crop after the storm?

_____ No If No, please skip to Q2 on page 4.
_____ Yes If Yes, please answer Q1ea.

Q1ea. Using the choices below, please record the percentage of the oyster crop on your leases that falls into **each** of the following categories. (Please make sure that your percentages add up to 100.)

_______Oysters seem OK – very similar to *pre-Ike* conditions
_______Oysters appear dead – buried under silt or debris
_______Oysters are missing – apparently swept away
____
= 100 percent

Q1eaa. Approximately what would it cost to restore or rebuild the oyster crop on your leases that was damaged or destroyed by the storm?

$____________________________________

This series of questions asks about physical damage to commercial vessels you use in your oyster business

Q2. Did you own any commercial vessels when Ike made landfall?

_____ No If No, please skip to Q3 on page 7.
_____ Yes If Yes, please answer Q2a, Q2b, and Q2c.

Q2a. Did you own any **Luggers** just before Ike made landfall?

_____ No If No, please skip to Q2b on page 5.
_____ Yes If Yes, please answer Q2aa through Q2ac.

Q2aa. How many **Luggers** did you own just before Ike hit?

__________________number of Luggers

Q2ab. What do you think it would cost to replace **all** the **Luggers** you owned just before Ike hit?

$____
total, estimated replacement cost for all the **Luggers** you owned

Q2ac. Using the choices below, please indicate the number of your **Luggers** that fall into each damage category.
(Please make sure your numbers add up to the total in Q2aa.)

_______No damage
_______Minor damage – a few repairs needed.
_______Substantial damage – hull or engine repairs needed
_______Destroyed or Lost – replacement required.

Q2aca. About how much will it cost to repair or replace all those damaged or lost **Luggers** you identified in Q2ac?

$______________________________________
total cost to repair or replace damaged or lost **Luggers**

Q2acb. How long do you anticipate it will take to repair or replace those **Luggers** that were damaged or destroyed?

____
Please specify days, weeks, or months.

OR, If you have completed repairing/replacing your **Luggers**, please write the date that work was finished.

____

Q2b. Did you own any **bay boats** (such as skiffs, combination shrimp trawlers/oyster dredgers, etc.) when Ike made landfall?

_____ No If No, please skip to Q2c on page 6.
_____ Yes If Yes, please answer Q2ba through Q2bc.

Q2ba. How many **bay boats** did you own just before Ike hit?

__________________number of bay boats

Q2bb. What do you think it would cost to replace **all** the **bay boats** you owned just before Ike hit?

$____
total, estimated replacement cost for all the **bay boats** you owned

Q2bc. Using the choices below, please indicate the number of your **bay boats** that fall into each damage category.
(Please make sure your numbers add up to the total in Q2ba.)

_______No damage
_______Minor damage – a few repairs needed.
_______Substantial damage – hull or engine repairs needed
_______Destroyed or Lost – replacement required.

Q2bca. About how much will it cost to repair or replace all those damaged or lost **bay boats** you identified in Q2bc?

$____
total cost to repair or replace damaged or lost **bay boats**

Q2bcb. How long do you anticipate it will take to repair or replace those **bay boats** that were damaged or destroyed?

____
Please specify days, weeks, or months.

OR, If you have completed repairing/replacing your **bay boats**, please write the date that work was finished.
____

Q2c. Did you own any **shell-planting barges** when Ike made landfall?

_____ No If No, please skip to Q3 on page 7.
_____ Yes If Yes, please answer Q2ca through Q2cc.

Q2ca. How many **shell-planting barges** did you own just before Ike hit?

__________________number of shell-planting barges

Q2cb. What do you think it would cost to replace **all** the **shell-planting barges** you owned just before Ike hit?

$____
total, estimated replacement cost for all the **barges** you owned

Q2cc. Using the choices below, please indicate the number of your **shell-planting barges** that fall into each damage category.

(Please make sure your numbers add up to the total in Q2ca.)

________No damage
________Minor damage – a few repairs needed.
________Substantial damage – structural repairs needed
________Destroyed or Lost – replacement required.

Q2cca. About how much will it cost to repair or replace all those damaged or destroyed **shell-planting barges** you identified in Q2cc?

$____
total cost to repair or replace damaged or lost **barges**

Q2ccb. How long do you anticipate it will take to repair or replace those **barges** that were damaged or destroyed?

____
Please specify days, weeks, or months.

OR, If you have completed repairing/replacing your **barges**, please write the date that work was finished.

____

This series of questions asks about physical damage to your bulkheaded areas, your docks, and your finger piers.

Q3. Did you own any **bulkheaded areas, docks, or finger piers** when Ike made landfall?

_____ No If No, please skip to Q 5 on page 11.
_____ Yes If Yes, please answer Q3a through Q3d.

Q3a. How many linear feet of **bulkheaded areas and docks** do you own?

____
linear feet of bulkheaded area and docks

Q3b. What is the primary material used to construct your **bulkheaded areas and docks**?

____
____

Q3c. What do you think it would it cost to completely replace all of your **bulkheaded areas and docks**?

$____________________________________

Q3d. Were parts of your **bulkheaded areas and docks** damaged or destroyed by Ike?

_____ No If No, please skip to Q4 on page 9.
_____ Yes If Yes, please answer questions Q3da through Q3de.

Q3da. How many linear feet of your **bulkheaded areas and docks** were damaged or destroyed?

____
linear feet of bulkheaded area and docks damaged or destroyed

Q3db. Using the choices below, please select the one phrase that best characterizes the extent of damage to your **bulkheaded areas and docks**. (Please check one.)

_______ Still useable – some minor refurbishment is needed.
_______ Damaged areas unuseable until they are repaired.
_______ Severely damaged/destroyed – replacement required.

Q3dc. About how much do you think it will cost to refurbish, repair, or replace those parts of your **bulkheaded areas and docks** that were damaged or destroyed?

$____
Please specify whether this is a total price or a per-foot estimate.

Q3dd. Did you have insurance that covered damage to your **bulkheaded areas and docks**?

_____ No If No, please skip to Q3de.
_____ Yes If Yes, please answer Q3dda.

Q3dda. What percentage of the total repair or replacement cost you estimated in Q3dc above will be covered by your insurance policy?

_______________________%

Q3de. How long do you anticipate it will take to make major repairs or replace those portions of your **bulkheaded areas and docks** that were damaged or destroyed?

____
Please specify days, weeks, or months.

OR, If you have completed repairing/replacing your **bulkheaded areas and docks**, please write the date that work was finished.

____

Q4. Did your bulkheaded areas and docks also support **finger piers**?

_____ No If No, please skip to Q5 on page 11.
_____ Yes If Yes, please answer Q4a through Q4d.

Q4a. How many linear feet of **finger piers** do you own?

____
linear feet of finger piers

Q4b. What is the primary material used to construct your **finger piers**?

____

____

Q4c. What do you think it would cost to completely replace your **finger piers**?

$__________________________________

Q4d. Were portions of your **finger piers** damaged or destroyed?

_____ No If No, please skip to Q5 on page 11.
_____ Yes If Yes, please answer Q4da through Q4de.

Q4da. How many linear feet of your **finger piers** were damaged or destroyed?

____
linear feet of finger piers damaged / destroyed

Q4db. Using the choices below please select the one phrase that best characterizes the extent of damage to your **finger piers**. (Please check one.)

_______Still useable, but some refurbishment is needed.
_______Damaged areas cannot be used until repaired.
_______Severely damaged/destroyed – replacement required.

Q4dc. About how much do you think it will cost refurbish, repair, or replace those parts of your **finger piers** that were damaged or destroyed?

$____
Please specify whether this is a total price or a per-foot estimate.

Q4dd. Did you have insurance that covered damage to your **finger piers**?

_____ No If No, please skip to Q4de.
_____ Yes If Yes, please answer Q4dda.

Q4dda. What percentage of the total repair or replacement cost you estimated in Q4dc above will be covered by your insurance policy?

________________________%

Q4de. How long do you anticipate it will take to make major repairs or replace those portions of your **finger piers** that were damaged or destroyed?

____
Please specify days, weeks, or months.

OR, If you have completed repairing/replacing your **finger piers**, please write the date that work was finished.

____

This series of questions asks about physical damage to your access roads and parking areas.

Q5. Did you own and maintain your **access road(s) and parking area(s)** when Ike made landfall?

_____ No If No, please skip to Q6 on page 13.
_____ Yes If Yes, please answer Q5a through Q5c.

Q5a. What are the characteristics of the **access roads and parking areas** you own?

	Total Square footage (Length x Width)	Surface Type
Roads		
Parking		

Q5b. What do you think it would cost to completely replace your **access roads and parking areas**?

$____

Q5c. Did your **access roads and parking areas** sustain damage from Ike?

_______ No If No, please skip to Q6 on page 13.
_______ Yes If Yes, please answer Q5ca through Q5cd.

Q5ca. Using the choices below, please select the one phrase that best characterizes the extent of damage to your **access roads and parking areas**. (Please check one.)

_______Still passable – some minor refurbishment is needed.
_______Damaged areas cannot be used until repaired.
_______Severely damaged/destroyed – replacement required.

Q5cb. About how much do you think it will cost to refurbish, repair, or replace those parts of your **access roads and parking areas** that were damaged or destroyed?

$____
Please specify whether this is a total price or a per-foot estimate.

Q5cc. Did you have insurance that covered damage to your **access roads and parking areas**?

_____ No If No, please skip to Q5cd.
_____ Yes If Yes, please answer Q5cca.

Q5cca. What percentage of the total repair or replacement cost you estimated in Q5cb above will be covered by your insurance policy?

______________________%

Q5cd. How long do you anticipate it will take to make major repairs or replace those portions of your **access roads and parking areas** that were damaged or destroyed?

____
Please specify days, weeks, or months.

OR, If you have completed repairing/replacing your **access roads and parking areas**, please write the date that work was finished.

____

This series of questions asks about physical damage to your fuel storage facility.

Q6. Did you own a **fuel storage facility** when Ike made landfall?

______ No If No, please skip to Q7 on page 14.
______ Yes If Yes, please answer question Q6a.

Q6a. What do you think it would cost to completely replace your **fuel storage facility**?

$_________________________________

Q6b. Were any parts of your **fuel storage facility** (like the tank itself, the metering and distribution system, and holding berm) damaged or destroyed by Ike?

______ No If No, please skip to Q7 on page 14.
______ Yes If Yes, please answer Q6ba through Q6bd.

Q6ba. Using the choices below, please select the one phrase that best characterizes the extent of damage to your **fuel storage facility**. (Please check one.)

_______Minor damage – a few repairs needed.
_______Major damage to the storage facility – repairs needed
_______Destroyed or Lost – replacement required.

Q6bb. About how much do you think it will cost to repair or replace those portions of your **fuel storage facility** that were damaged or destroyed?

$___________________________

Q6bc. Did you have insurance that covered damages to your **fuel storage facility**?

_____ No If No, please skip to Q6bd.
_____ Yes If Yes, please answer Q6bca.

Q6bca. What percentage of the total repair or replacement cost you estimated in Q6bb above will be covered by your insurance policy?

_______________________%

Q6bd. How long do you anticipate it will take to make major repairs or replace those portions of your **fuel storage facility** that were damaged or destroyed?

____
Please specify days, weeks, or months.

OR, If you have completed repairing/replacing your **fuel storage facility**, please write the date that work was finished.

____

This series of questions asks about physical damage to your office and processing buildings.

Q7. Did you own the **office and processing building(s)** where you conduct business and process oysters when Ike made landfall?

______ No If No, please skip to Q 8 on page 16.
______ Yes If Yes, please answer Q7a through Q7d.

Q7a. What is the approximate total square footage of the **office and processing building(s)** where you conduct business and process oysters?

______________________ square feet

Q7b. What was the primary material used in the construction of your **office and processing building(s)**? (Please check one.)

_______ Masonry (concrete block or brick) building
_______ Pre-engineered metal building
_______ Other types of material (Please list below)
____
____

Q7c. What do you think it would cost to completely replace your **office and processing building(s)**?

$______________________________

Q7d. Did your **office and processing building(s)** sustain any damage from Ike?

______ No If No, please skip to Q8 on page 16.
______ Yes If Yes, please answer Q7da through Q7dd.

Q7da. Using the choices below, how would you assess the damage to your **office and processing building(s)**? (Please check one.)

_______ Minor – some refurbishment needed to be operational
_______ Significant – major repairs needed to be operational
_______ Complete destruction – reconstruction necessary

Q7db. About how much do you think it will cost to refurbish, repair, or rebuild your **office and processing building(s)** that were damaged or destroyed?

$________________________________

Q7dc. Did you have insurance that covered damages to your **office and processing building(s)?**

_____ No If No, please skip to Q8.
_____ Yes If Yes, please answer Q7dca.

→ Q7dca. What percentage of the total repair or replacement cost you estimated in Q7db above will be covered by your insurance policy?

________________________%

Q7dd. How long do you anticipate it will take to make major repairs or replace those portions of your **office and processing building(s)** that were damaged or destroyed?

____
Please specify days, weeks, or months.

OR, If you have completed repairing/replacing your **office and processing building(s),** please write the date that work was finished.

____

This series of questions asks about physical damage to your processing equipment.

Q8. Did you own the **processing equipment** in your facility (like shucking tables, forklifts, pallet jacks, conveyor systems, scales, freezing tunnels, holding freezers, automated packaging equipment, etc.) when Ike made landfall?

______ No If No, please skip to Q9 on page 18.
______ Yes If Yes, please answer questions Q8a and Q8b.

→ Q8a. What do you think it would it cost to completely replace all the **processing equipment** in your plant?

$___________________________________

Q8b. Was any of your **processing equipment** damaged as a result of Ike?

______ No If No, please skip to Q9 on page 18.
______ Yes If Yes, please answer questions Q8ba through Q8bd.

→ Q8ba. Using the choices below, please select the one phrase that best characterizes the extent of damage to your **processing equipment**. (Please check one.)

_______Minor – some servicing is needed to be operational
_______Significant – major repairs needed to be operational
_______Complete destruction – replacement is required

Q8bb. About how much do you think it will cost to repair or replace your **processing equipment** that was damaged or destroyed?

$____
total, estimated cost to repair, or replace processing equipment

Q8bc. Did you have insurance that covered damages to your **processing equipment**?

_____ No If No, please skip to Q8bd.
_____ Yes If Yes, please answer Q8bca.

Q8bca. What percentage of the total repair or replacement cost you estimated in Q8bb above will be covered by your insurance policy?

________________________%

Q8bd. How long do you anticipate it will take to make major repairs or replace **processing equipment** that was damaged or destroyed?

____
Please specify days, weeks, or months.

OR, If you have completed repairing/replacing your **processing equipment,** please write the date that work was finished.

____

This series of questions asks about physical damage to your inventories.

Q9. Did you have any sort of **inventory** on hand when Hurricane Ike made landfall in mid-September?

______ No If No, please skip to Q10 on page 19.
______ Yes If Yes, please answer Q9a through Q9c.

Q9a. Thinking about your various types of **inventory** on hand when Ike made landfall, please specify whether you had any of the three major classes specified below. (Please check "Yes" or "No" for each of the three types mentioned.)

Did you have any of these three main types if inventory on hand?	Yes	No
• Raw materials		
• Packaging materials (like cups, tubs, tins, lids, boxes, etc.)		
• Finished goods		

Q9b. What do you think it would it cost to completely replace all of the various types of **inventories** in your plant when Ike made landfall?

$____

Q9c. Were any of your **inventories** like raw materials, packaging materials, or finished goods damaged or destroyed because of Ike?

______ No If No, please skip to Q10.
______ Yes If Yes, please answer Q9ca through Q9cc.

Q9ca. Using the choices below, please select the one phrase that best characterizes the extent of damage to your **inventories**. (Please check one.)

_______ Minor – some items had to be discarded
_______ Significant – most items had to be discarded
_______ All classes in inventory were destroyed

Q9cb. What do you think it would cost to replace that portion of your inventory that was unuseable after the storm?

$__________________________ total value of lost inventories

Q9cc. Did you have insurance that covered damages to your **inventories**?

_____ No If No, please skip to Q10**.**
_____ Yes If Yes, please answer Q9cca.

Q9cca. What percentage of the total inventory losses you estimated Q9cb above will be covered by your insurance policy?

______________________%

This question asks about when you expect to return to "full operational status."

Q10. When you expect to have your vessels and all shoreside facilities ready to harvest and process oysters. Please write the approximate date (month & year).

____
When I expect to return to full operational status

Your answers to these next questions allow us to estimate the economic effects of the storm on your expected revenues as well as the number of employees and their payroll through August, 2009.

- Projected losses in revenue, employment, and payroll are only meaningful when compared to a baseline. We have chosen the 12-month time period of September 2007 through August 2008 as that baseline. In these questions that ask about projected losses in revenue, employment and payroll, we first ask about those values in the 12 months **before** Ike made landfall. Rather than asking for monthly information, we hope it is easier for you to express those values by quarters, beginning with Fall '07 (Sept, Oct, Nov) and ending with Summer '08 (June, July, Aug).
- We then ask that you record your **actual values for Fall '08** (Sept, Oct, & Nov) as well as your **estimates** of the revenue, employee numbers and their payroll you expect to generate for the next three quarters – Winter '09 (Dec, Jan, Feb), Spring '09 (Mar, Apr, May), and Summer '09 (June, July, Aug).
- Comparing your actual and estimated revenues, employment, and payroll **since** Ike made landfall to a baseline allows us to quantify the **industry-wide economic impacts** that resulted from (a) the physical damage the oyster industry sustained and (b) the impact of the storm on oyster resources within Galveston Bay.

Q11. In the twelve-months before Hurricane Ike made landfall – that is starting in September 2007 and ending in August 2008 – what was your approximate total gross revenue?

$____ Total gross revenue

Q12. Between September 2007 and August 2008 what percentage of total gross revenue you recorded in Q11 was attributable to the five choices below? (Please make sure that your percentages add up to 100.)

__________ % sale of shellstock from the Galveston Bay system
__________ % sale of shucked oysters from the Galveston Bay system
__________ % sale of other seafoods from the Galveston Bay system
__________ % sale of seafoods from **outside** of the Galveston Bay system
__________ % non-seafood revenue (fuel sales, haul-outs, slip rentals, etc.)

= 100 percent of total gross revenue

Q13. In the 12 months before Ike made landfall – Sept. '07 through Aug. '08 – what percentage of total gross revenue you recorded in Q11 was earned within each three-month time period listed below? (Please make sure that your percentages add up to 100.)

__________ % Fall '07 (September, October, and November)
__________ % Winter '07-'08 (December, January, and February)
__________ % Spring '08 (March, April, and May)
__________ % Summer '08 (June, July, and August)

= 100 percent of total gross revenue

Q14. Since Ike made landfall in mid-September, please record the approximate **gross revenues you have earned for Fall 2008,** and **estimate** those revenues you expect to generate for the next three quarters through August 2009.

$______________________ Fall '08 (Sept, Oct, Nov) – actual
$______________________ Winter '08-'09 (Dec, Jan, Feb) – **estimated**
$______________________ Spring '09 (Mar, April, May) – **estimated**
$______________________ Summer '09 (June, July, Aug) – **estimated**

Your answers to the next two questions will enable us to determine how Hurricane Ike has impacted your employment base and the associated payroll.

Q15. Beginning with **Fall 2007** and working forward to **Summer 2008**, about how many people did you employ during each three-month quarter and what was the approximate payroll for each of those time periods? (Please include all types of employees: clerical staff, processing-plant labor, drivers, dock workers, etc.)

Quarter	Employees **before Ike**	Payroll **before Ike**
Fall '07 (Sept., Oct. Nov.) – actual		
Winter '08 (Dec., Jan. Feb.) – actual		
Spring '08 (Mar., Apr. May) – actual		
Summer '08 (June, July Aug.) – actual		

Q16. **Since Ike made landfall in mid-September**, about how many people did you employ in Fall '08, and what do you anticipate for the next three quarters? Please record **both** expected employee numbers and payroll.

Quarter	Employees **after Ike**	Payroll **after Ike**
Fall '08 (Sept., Oct. Nov.) – actual		
Winter '09 (Dec., Jan. Feb.) – estimated		
Spring '09 (Mar., Apr. May) – estimated		
Summer '09 (June, July Aug.) – estimated		

This final question asks which of several possible public works projects would most benefit the resources of the Galveston Bay system bay and its users.

Q17. Funds from federal or state sources **may be available** for various public works projects. With the widespread damage caused by Hurricane Ike, there will be many demands for whatever monies are available. Please rank the following suggested projects with 1 being the most important project, 2 being next most important, and so on. **If you have other ideas for recovery projects, please list them and rank each one:**

Ranking	Possible Public Works Projects
______	Removal of residential or industrial debris that was washed onto private upland areas.
______	Removal of debris from the bay bottom similar to what was done in Louisiana and Mississippi after Katrina.
______	Removal of vessels that were washed onto private property.
______	Planting shell on public reefs that were damaged or destroyed.
______	______________________________
______	______________________________
______	______________________________

Q18. Would you like to receive the responses you provided in the form of a report?

______ Yes.
______ No Thanks.

This work is conducted and sponsored by the Texas AgriLife Extension Service, the Sea Grant College Program, and the Department of Agricultural Economics at Texas A&M University to help the seafood industry compete for hurricane-recovery funds. No outside funds were requested or used to complete this damage assessment. This study is part of our ongoing outreach and research efforts for the Texas seafood industry.

If there are any comments you have about this survey, the manner in which the information was collected, or any other thoughts you have about the damages created by Hurricane Ike, please use this space for that purpose.

THANK YOU! Your contribution to this effort is certainly appreciated. Please use the pre-addressed, metered envelope to return this questionnaire to Michael G. Haby.

Issued in furtherance of Cooperative Extension Work in Agriculture and Home Economics, Acts of Congress of May 8, 1914, as amended, and June 30, 1914, in cooperation with the United States Department of Agriculture. Edward G. Smith, Director, Texas AgriLife Extension Service, The Texas A&M University System. 06-09