



# Oyster

## AQUACULTURE

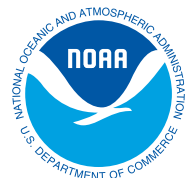
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These fact sheets for the off-bottom oyster aquaculture industry in the Gulf of Mexico provide guidelines and suggested safety procedures in preparing for tropical storms and hurricanes:

- **Introductory Planning Guide**
- **Adjustable Long-Line Farms**
- **Floating Bag Farms**
- **Floating Cage Farms**
- **Land-based Operations**
- **Workboats**

To access all of the fact sheets in this series, visit the National Sea Grant Library at [nsgl.gso.uri.edu](http://nsgl.gso.uri.edu). Using the "search the catalog" function, search "Oyster Aquaculture Hurricane Preparedness Series."

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## Tropical Storm and Hurricane Preparedness for Off-bottom Oyster Aquaculture in the Gulf of Mexico

### Introductory Planning Guide

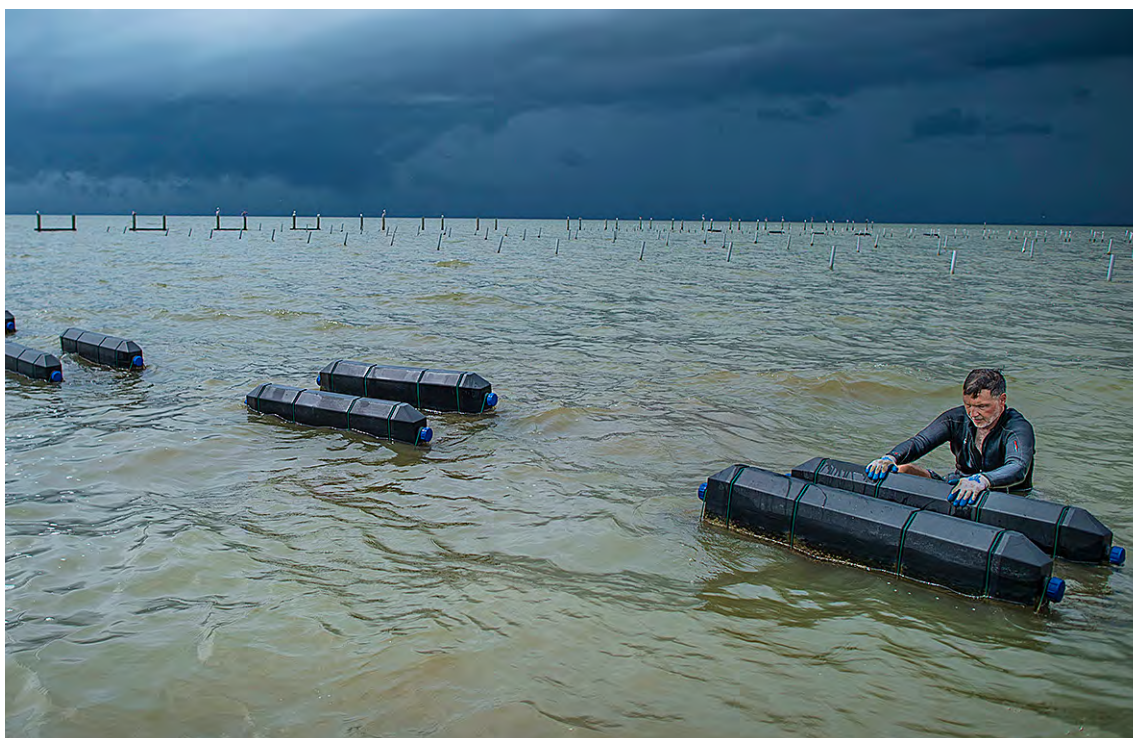
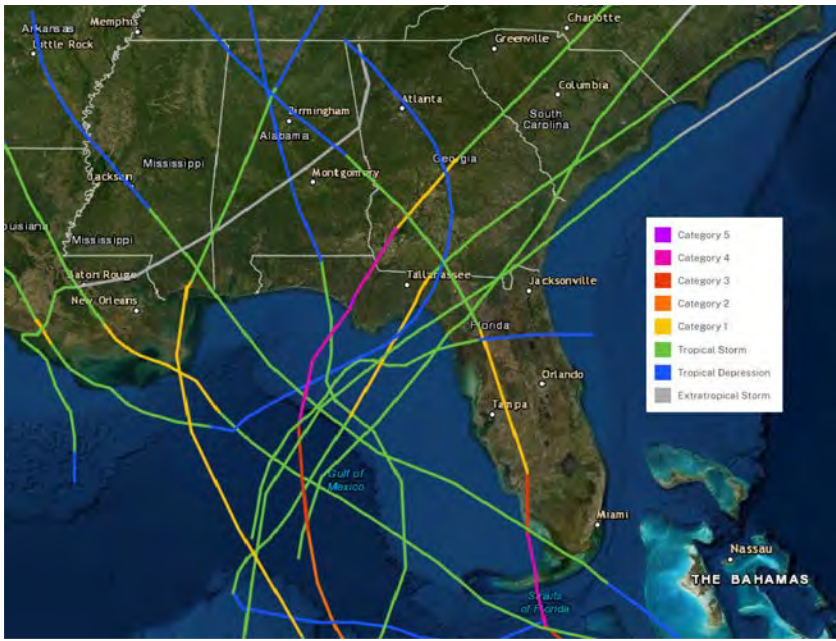


Photo courtesy of USDA Risk Management Agency

#### INTRODUCTION

Off-bottom oyster aquaculture is relatively new in the Gulf of Mexico region. Since 2010, over 200 farms have become established in Alabama, Florida, Louisiana, and Mississippi. Oyster aquaculture, like any agriculture operation, has inherent risks with perils beyond growers' control. However, coastal waters present challenges for oyster farmers, beyond the traditional farm setting, in the form of tropical storms and hurricanes. Extreme conditions associated with these events can result in severe impacts to oyster farms. Damages related to wind, storm surge, and decreased salinity due to flooding include oyster mortality, loss of gear and equipment, and increased labor costs.

The Gulf of Mexico region has a long history of storms that have devastated many coastal communities. The official hurricane season is from June 1 through November 30. As the season progresses, the threat of major hurricanes increases from west to east across the region. As such, Texas and Louisiana are the prime targets for early season hurricanes, while the west coast of Florida is more likely to be impacted in mid-September to October. According to the National Oceanic and Atmospheric Administration (NOAA) National Hurricane Center, the four oyster-producing states (AL, FL, LA, MS) have experienced five hurricanes and seven tropical storms from



**FIGURE 1.** Paths of each tropical storm and hurricane from 2011 to 2019 that made landfall in Florida’s Big Bend and Panhandle, Alabama, Mississippi, and Louisiana since off-bottom oyster culture began in the Gulf of Mexico. Storm tracks were obtained through the NOAA Historical Hurricane Tracks Database ([bit.ly/37Fhc5l](http://bit.ly/37Fhc5l)).

2010 (when off-bottom oyster culture began in the Gulf) to 2019 (Figure 1, Table 1). In 2018, Hurricane Michael made landfall in Florida’s Panhandle as a Category 5 hurricane affecting oyster farms in four coastal counties. The perpetual threat of hurricanes in the Gulf of Mexico emphasizes the importance of business planning and storm preparedness as an essential part of any oyster culture operation, including seed production facilities, farms, and processing plants.

While a hurricane or tropical storm has the potential to inflict damage on oyster farms, growers who have developed storm plans have a better chance of minimizing losses. Planning enables growers to make sound decisions before a storm and increases chances for rapid recovery after the storm. When a storm is approaching, growers need to be able to activate a plan instead of trying to obtain supplies and deciding how to protect their operations. Problems recognized by growers who have not had a plan in place include insufficient training to execute storm preparations, inadequate workforce to prepare for and recover from storms, and lack of proper equipment and supplies on hand.

Information included in this guide was obtained from workshops held in Alabama and Florida, where growers discussed how different preparation strategies and gear types fared during severe weather events. In addition, knowledge on management practices for disaster responses was shared by aquaculture extension specialists at a regional meeting (2018 Oyster South Symposium). This introductory fact sheet focuses on storm plan development, pre-storm preparations, and

post-storm recovery. Additional fact sheets in this series provide specific information pertaining to water-based operations for different oyster culture methods (adjustable long-lines, floating cages, floating bags) and land-based operations (hatchery, nursery, processing facilities). These and other resources listed at the end of this fact sheet can assist oyster growers in developing individualized storm plans to be better prepared for the hurricane season.

	STORM EVENT	LANDFALL	
		DATE	LOCATION
<p><b>TABLE 1.</b> Summary of tropical storms and hurricanes from 2011 to 2019 that have affected Florida’s Big Bend and Panhandle, Alabama, Mississippi, and Louisiana since off-bottom oyster culture began in the Gulf of Mexico. Note there was not a named storm in 2010. Information was obtained through the NOAA National Hurricane Center (NHC), <a href="http://www.nhc.noaa.gov/data/tcr">www.nhc.noaa.gov/data/tcr</a>. Website links for each event provide detailed reports by the NHC.</p>	<a href="#">Tropical Storm Lee</a>	September 4, 2011	Intracoastal City, LA
	<a href="#">Tropical Storm Debby</a>	June 26, 2012	Steinhatchee, FL
	<a href="#">Hurricane Isaac - Cat 1</a>	August 29, 2012	Mississippi River mouth and near Port Fourchon, LA
	<a href="#">Tropical Storm Andrea</a>	June 6, 2013	Steinhatchee, FL
	<a href="#">Tropical Storm Colin</a>	June 7, 2016	Keaton Beach, FL
	<a href="#">Hurricane Hermine - Cat 1</a>	September 2, 2016	East of St. Marks, FL
	<a href="#">Hurricane Irma - Cat 1</a>	September 10, 2017	Multiple FL landfalls: Cudjoe Key, Marco Island, Big Bend/Panhandle
	<a href="#">Tropical Storm Nate</a>	October 8, 2017	Multiple landfalls: Mississippi River mouth and near Biloxi, MS
	<a href="#">Tropical Storm Alberto</a>	May 28, 2018	Bay County/Walton County, FL
	<a href="#">Tropical Storm Gordon</a>	September 3, 2018	Multiple landfalls: Tavernier, FL; Flamingo, FL; AL/MS border
	<a href="#">Hurricane Michael - Cat 5</a>	October 10, 2018	Florida Panhandle near Tyndall Air Force Base
	<a href="#">Hurricane Barry - Cat 1</a>	July 13, 2019	Pecan Island, LA



## DEVELOP A PLAN

To be prepared for hurricanes or tropical storms, oyster growers should develop a comprehensive plan, beginning with site considerations and culture gear installation through post-storm recovery. It is strongly recommended to have a plan developed and in place prior to June of any given year. Both water and land-based operations should be included in the plan. Factors in developing a plan include scale of operation, personnel, equipment, gear type, and other family and personal obligations. Following are some general things to consider in developing a storm plan.

**Risks** A farm's vulnerability to risks, such as wind, storm surge, and flooding, can be assessed by reviewing previous storm trends near the farm's location. The NOAA National Hurricane Center, [www.nhc.noaa.gov](http://www.nhc.noaa.gov), has storm information (wind speed and direction, pressure, landfall) archived since 1900, which can be used to determine prevailing patterns for different growing locations. By reviewing characteristics of previous storms that have made landfall near the farm, growers can consider what they would have done to prepare and what should be included in their plan.

**Business Information** Important information that must be safeguarded should be identified in the plan. A list of insurance policies and financial documents should be kept current along with locations where these documents are stored. Most of this information can be stored electronically; however, hard copies of important documents may be useful in the event of power outages. It may be prudent to duplicate some documents and keep them in different locations.

**Farm Information** Farm information, such as coordinates, maps, and diagrams of layout and gear, should be included in the plan and available immediately after the storm. Timely inventory records (number of culture units and estimated quantity, age, and sizes of oysters) should also be included. Maintaining a spreadsheet with this information is important for record-keeping required by insurance policies, business loans, or crop disaster assistance programs, such as the U.S. Department of Agriculture (USDA), Farm Service Agency's Noninsured Crop Disaster Assistance Program (NAP). Oyster inventory apps, such as Oyster Tracker or SmartOysters, are available and recommended. Inventory records should also include vehicles, boats, and motors, as well as equipment used on farms (tumblers, pressure washers, cranes or winches, etc.), at shore-based seed facilities (tanks, pumps, filtration systems, etc.), or at shellfish processing plants (forklifts, refrigerated units, etc.). Photographs and videos with time stamps of both water and land-based operations can provide timely and critical documentation.

**Farm Employees** The plan should have information available for farm employees, such as an operational plan identifying essential personnel, services, and equipment, re-opening

protocols, records storage, and agreements with suppliers and contractors. Information on evacuation routes, re-entry requirements, shelter-in-place plans, and alternative reporting locations could be included. It is important to know how many people will be needed to implement the storm plan and who will help as a storm is approaching. Farm employees should be able to implement the storm plan themselves and be cross-trained in tasks outside their normal job duties to assist with securing gear.

**Communication** An emergency contact list (electronic and hard copies) for key personnel and businesses providing services to the farm and its customers should be developed and phone numbers kept current. Phone numbers for employees to call for information should also be included. Another communication component could be developed for the media, customers, or public with predetermined messages and messaging platforms.

**Insurance Policies** The time to review insurance policies for the business is prior to the hurricane season to ensure there is adequate coverage for flood, wind, fire, theft, general liability, catastrophic loss, loss of income, and product liability. Insurance agents should be contacted to review coverage.

## PREPARE A PLAN

Preparation is essential to successful plan implementation. Oyster growers should consider storm preparedness during farm installation, pre-storm season, active season, and post-storm recovery. In this introductory fact sheet, general advice is provided that an oyster farmer can follow to be better prepared in advance of a hurricane, tropical storm, or other severe weather. Advice specific to certain gear types is provided in additional fact sheets found in this series.

**Water-based Preparation** Growers should allow enough time to prepare their water-based operations. The farm's written plan will provide guidelines on how to secure and recover culture gear. Growers may find it helpful to watch videos provided by gear manufacturers as well as seek their recommendations. Storm plans should be practiced so that gear can be secured under a variety of conditions. Likewise, growers and employees must be comfortable with working in and under water during rough sea conditions. Timed practice drills will allow growers to assess what realistically can be accomplished. For example, growers can determine how long it takes to implement the storm plan for one line of gear and then expand based on the entire farm. As storm drills are conducted, plans can be modified. Knowing how long it may take to get back to the boat ramp or dock from the farm may also be helpful as extreme low (blowout) tides can occur when storms approach, resulting in waters too shallow to return.

**Land-based Preparation** Growers should also allow enough time to prepare their land-based operations. Since many growers work in areas that are low lying, equipment and

## Recommended equipment and supplies to implement an oyster farm's hurricane preparation and recovery plan

- NOAA weather radio and extra batteries
- Mobile communications-cell phones, hand-held portable radios, chargers, extra battery packs
- Camera with date and time stamp
- First aid supplies
- Fire extinguisher
- Flashlights and extra batteries
- Spare battery and battery charger for boat
- Fuel and oil properly stored, fuel filters
- Tool kit
- SCUBA gear (keep tanks full)
- Pump with hoses, winch, crane, or hoist
- Extra anchors, ropes, lines
- Spare caps, clips, baskets, bags, bungee cords, cable ties
- Lumber, shutters, tarps, tie-downs for land-based facilities
- Generator of sufficient size for operational needs (serviced and tested)
- Potable water and storage containers as hurricanes come when it is hot

surplus gear will need to be moved to higher ground. Identifying where to relocate items, knowing how much space will be required, and how much time it will take should be determined in advance. Gear that is bulky, such as floats or silos, may require more space and time to relocate than anticipated. Prior to the start of hurricane season (June 1), growers should begin assessing and preparing farms on the water and facilities on land. Farm maintenance should be kept up with, and farm inventory lists (oysters, gear, equipment, machinery, vehicles, etc.) should be updated as needed. Equipment and supplies should be checked and stockpiled. When severe weather approaches, it may be impossible to obtain items needed (fuel, hardware supplies, etc.) from local stores. These businesses may also be closed in the aftermath of a hurricane.

### IMPLEMENT A PLAN

This introductory fact sheet is part of a series with specific fact sheets developed for different types of operations: floating bag farms, floating cage farms, adjustable long-lines, seed production facilities, and processing plants. It is recommended to seek out the relevant fact sheets for specific guidance in implementing a storm plan for these operations.

Broadly, oyster culture gear should be installed with hurricanes and storms in mind. Experienced growers advise overbuilding in setting up a farm. Additionally, routine farm maintenance is key to being prepared in anticipation of hurricane season. Gear (anchors, lines,

bags, baskets, cages, etc.) should be checked regularly and secured, especially areas where culture units are connected to long-lines. Lines should be replaced as soon as chafing is observed. Culture units should be stocked at densities that minimize line chafing; growers may want to maintain oysters at lower densities during hurricane season. Finally, it is recommended that culture units should be marked with business information. Durable, relatively inexpensive tags are available from several commercial suppliers, such as Top-Me Flat Tags, Nelco Products, and Aqua Bag Tags, and can include such information as the grower's name, phone number, lease number, and license or certification number (Figure 2). Lost gear, which typically can be found on adjacent shorelines to the farm, can be more easily identified and returned to the grower after a disaster if it is tagged.

A major part of the plan implementation is ensuring that all employees know their responsibilities prior to, during, and after a storm. Employees should be trained in the safe operation of unfamiliar equipment they may have to use if a storm hits. To have an adequate workforce, volunteers (non-employees) may need to be identified who are willing to work, and they also must be aware of procedures outlined in the plan. Engaging nearby growers who are willing to work together as a team to secure gear is another option to ensure



**FIGURE 2.** Commercially available tags attached to oyster culture bags. Information provided can include grower's name, phone number, lease number, and license or certification number. Photos courtesy of University of Florida/IFAS Shellfish Aquaculture Extension



a farm's storm plan can be implemented in a timely manner.

Determining when to activate a farm's hurricane plan depends on the individual operation and personal evaluation of the farm's exposure. Other factors that must be taken into consideration include farm size, gear type, available personnel, and other obligations. Further, storms can change paths and increase in size and intensity quickly. Various growing areas and even areas within the same waterbody may be affected differently by prevailing winds and currents. Growers should continually check weather reports and websites of local National Weather Service offices and government/emergency management offices. This information will help in deciding when to implement a hurricane plan.

A tiered approach to preparation, which has been adopted in each fact sheet, allows growers to stage tasks based on the storm or hurricane's track forecast. The following color codes developed by the authors of these fact sheets address increasing levels of concern and actions. The first steps of the plan should be initiated when a storm is forming in the Gulf of Mexico or Caribbean Sea or is moving through the Florida straits (Code Yellow). The next steps should be taken when the farm is in the predicted storm path and hurricane/tropical storm watches have been issued for the area (Code Orange). When there is high probability of being in the storm's path and hurricane/tropical storm warnings have been issued for the area, the final preparations should be implemented (Code Red).

## RECOVER AFTER THE STORM

After the storm or hurricane passes, personal obligations may take priority. If a farm has been prepared according to the plan, it may not be necessary to inspect it immediately. Most likely, access to a boat ramp and farm may be blocked with downed trees, electrical lines, boats, or other storm debris. As soon as it is safe to do so, the plan for recovery of oyster crops and gear should be implemented. Adequate help, supplies, surplus gear, and equipment will be needed as discussed in previous sections of this fact sheet.

While assessing impacts to a farm's operations, photos and videos with time stamps can document damages. Insurance agents should be notified of damages. A post-storm inventory of oysters and gear should be completed; however, it may be too soon to assess oyster mortalities. Growers may want to wait several weeks to see if additional losses occur due to lower salinities or other factors. If the grower is enrolled in the USDA Farm Service Agency's Noninsured Crop Disaster Assistance Program, the county office will need to be notified of crop losses within 72 hours of the date that they first become apparent, not necessarily when the event occurs.

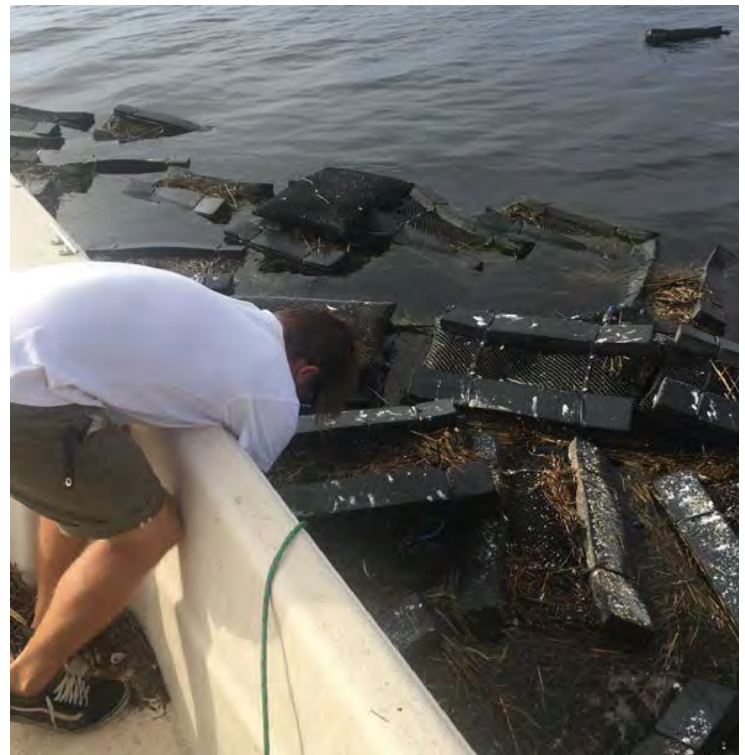
In addition to cleaning up water and land-based operations, areas adjacent to farms should be inspected for lost gear that may have washed ashore (Figure 3). It is important to show the public that growers are responsible by removing derelict gear from the environment. Recovered gear that is tagged could be placed in a central location for growers to retrieve. Growers and employees will need



**FIGURE 3.** Oyster culture gear and dead oysters strewn along shoreline adjacent to oyster aquaculture farms in Franklin County, Florida, after Hurricane Michael. Photo courtesy of Auburn University Shellfish Lab

to dress appropriately (boots, gloves, etc.) to avoid injury from debris, snakes, chainsaws, or other hazards.

In anticipation of storm surge, flooding, and power outages, shellfish areas will be temporarily closed to harvesting. The state regulatory agency responsible for managing these areas should be contacted to find out the status of the harvest areas and if water samples and shellfish meats must be tested in order to reopen. At some point, suppliers and customers should be notified of the farm's status. When waters do reopen for harvesting, a social media



Tangled floating culture bags after Hurricane Michael devastated oyster farms in the Florida Panhandle in October 2018. Photo courtesy of Auburn University Shellfish Lab

campaign could be implemented to inform customers. Local news media could also be contacted as human-interest stories are important for informing the public.

If the county is declared a disaster, the farm may be eligible for certain federal programs. The U.S. Federal Emergency Management Agency (FEMA) should be contacted to find out what programs may be available to help in recovery efforts. Several low-interest loan programs may be offered through the U.S. Small Business Administration and the USDA Farm Service Agency for refinancing, repairs, replacement of damaged property, or production losses. Information in the Resources section of this guide provides website links to these federal and state agencies.

In the aftermath of the storm, growers should take the time to review their farm's plan and determine what went right and what could be done differently in the

future. The plan should be modified based on lessons learned. Growers should also assess their farm's economic situation and recovery options, such as replanting, repairing, and/or replacing gear and equipment.

## FACT SHEETS

FDACS Gear Management: [shellfish.ifas.ufl.edu/wp-content/uploads/Media\\_Files\\_Aquaculture-Files\\_FDACS-P-01914-Aquaculture-Gear-Management\\_2019.pdf](https://shellfish.ifas.ufl.edu/wp-content/uploads/Media_Files_Aquaculture-Files_FDACS-P-01914-Aquaculture-Gear-Management_2019.pdf)

FDACS Preparation and Recovery from Hurricanes: [shellfish.ifas.ufl.edu/wp-content/uploads/FDACS-P-01461-Preparation-and-Recovery-from-Hurricanes\\_2019.pdf](https://shellfish.ifas.ufl.edu/wp-content/uploads/FDACS-P-01461-Preparation-and-Recovery-from-Hurricanes_2019.pdf)

University of Florida/IFAS Hurricane Manual for Marine Interests: [sfyl.ifas.ufl.edu/media/sfylifasufedu/miami-dade/documents/disaster-preparation/hurricane-and-disaster/HurricaneManual1-\(2\).pd](https://sfyl.ifas.ufl.edu/media/sfylifasufedu/miami-dade/documents/disaster-preparation/hurricane-and-disaster/HurricaneManual1-(2).pd)

## RESOURCES

### National Information

American Red Cross: 1-800-RED-CROSS (800-733-2767), [www.redcross.org](http://www.redcross.org)

American Red Cross Food, Shelter, and Financial Assistance: 866-GET-INFO (866-438-4636)

Centers for Disease Control and Prevention (CDC): [www.cdc.gov](http://www.cdc.gov)

Environmental Protection Agency (EPA): [www.epa.gov](http://www.epa.gov)

Federal Emergency Management Agency (FEMA): 800-621-FEMA (3362), [www.fema.gov](http://www.fema.gov)

FEMA Agencia Federal para el Manejo de Emergencias: [www.fema.gov/es](http://www.fema.gov/es)

FEMA Disaster Assistance: [www.DisasterAssistance.gov](http://www.DisasterAssistance.gov)

FEMA Hurricane Ready Business Toolkit: [www.fema.gov/media-library/assets/documents/152381](http://www.fema.gov/media-library/assets/documents/152381)

National Oceanic and Atmospheric Administration (NOAA): [www.noaa.gov](http://www.noaa.gov)

NOAA Extreme Weather Information Sheet (NEWIS) App (only for Apple devices): [apps.apple.com/us/app/newis/id669225819](https://apps.apple.com/us/app/newis/id669225819)

NOAA Gulf of Mexico Disaster Response Center: [oceanservice.noaa.gov/hazards/drc](http://oceanservice.noaa.gov/hazards/drc)

NOAA National Centers for Environmental Information: [www.ncei.noaa.gov](http://www.ncei.noaa.gov)

NOAA National Data Buoy Center: [www.ndbc.noaa.gov](http://www.ndbc.noaa.gov)

NOAA National Environmental Satellite, Data, and Information Service: [www.nhc.noaa.gov/satellite.shtml](http://www.nhc.noaa.gov/satellite.shtml)

NOAA National Hurricane Center: [www.nhc.noaa.gov](http://www.nhc.noaa.gov)

National Weather Service: [www.weather.gov](http://www.weather.gov)

Ready Home and Business Storm Preparation: [www.ready.gov](http://www.ready.gov)

Ready Business: [www.ready.gov/business](http://www.ready.gov/business)

Ready 36-hour pre-landfall timeline for coastal residents: [www.ready.gov/hurricanes](http://www.ready.gov/hurricanes)

Salvation Army (donation hotline): 800-SAL-ARMY (800-725-2769)

US Department of Agriculture, Farm Service Agency (FSA): [www.fsa.usda.gov](http://www.fsa.usda.gov)

USDA FSA state offices: [www.fsa.usda.gov/state-offices/index](http://www.fsa.usda.gov/state-offices/index)

US Department of Homeland Security: [www.dhs.gov](http://www.dhs.gov)

US Small Business Administration: [www.sba.gov](http://www.sba.gov)

### NOAA Extreme Weather Information Sheets

Visit [www.ngdc.noaa.gov/newis](http://www.ngdc.noaa.gov/newis) to download the latest versions of the NOAA Extreme Weather Information Sheets. Fact sheets include pertinent state, county, and national contact information, radio stations, NOAA weather radio, and Department of Transportation information.

### Alabama Information

AL Emergency Management Agency: [ema.alabama.gov](http://ema.alabama.gov)

AL Department of Conservation and Natural Resources (ADCNR): [outdooralabama.com](http://outdooralabama.com)

ADCNR Marine Resources Division: Dauphin Island (251-861-2882) or Gulf Shores (251-968-7576)

AL Department of Environmental Management: 334-271-7700, [www.adem.state.al.us](http://www.adem.state.al.us)

AL Department of Insurance: 334-269-3550, [www.aldoi.gov](http://www.aldoi.gov)

AL Department of Public Health (ADPH)\*: 334-206-5300, [www.alabamapublichealth.gov](http://www.alabamapublichealth.gov)

ADPH Environmental Services\*: 334-206-5373

AL Department of Transportation: 334-353-6554, [www.dot.state.al.us](http://www.dot.state.al.us)

AL Official State Website: [www.alabama.gov](http://www.alabama.gov)

AL Oyster Aquaculture: [alaquaculture.com](http://alaquaculture.com), [info@alaquaculture.com](mailto:info@alaquaculture.com) (email)

Ready Alabama: [www.readyalabama.gov](http://www.readyalabama.gov)

### Florida Information

FL Agency for Workforce Innovation (unemployment claims): 800-204-2418, [www.floridajobs.org/job-seekers](http://www.floridajobs.org/job-seekers)

FL Construction Industry Licensing Board: 850-487-1395, [www.myfloridalicense.com/DBPR](http://www.myfloridalicense.com/DBPR)

FL Department of Agriculture and Consumer Services (FDACS): [www.fdacs.gov](http://www.fdacs.gov)

FDACS Division of Aquaculture\*: [www.fdacs.gov/Divisions-Offices/Aquaculture](http://www.fdacs.gov/Divisions-Offices/Aquaculture)

FDACS Division of Consumer Services (price gouging and fraud): 800-HELP-FLA (800-435-7352), [www.fdacs.gov/Divisions-Offices/Consumer-Services](http://www.fdacs.gov/Divisions-Offices/Consumer-Services)

FDACS Mosquito Control Directory: [www.fdacs.gov/Business-Services/Mosquito-Control](http://www.fdacs.gov/Business-Services/Mosquito-Control)

FL Department of Children and Families (disaster food stamp hotline), 800-342-9274: [www.myflfamilies.com](http://www.myflfamilies.com)

FL Department of Financial Services (insurance complaints and assistance): 800-22-STORM (800-227-8676), [www.myfloridacfo.com](http://www.myfloridacfo.com)

FL Department of Transportation: 866-374-FDOT (3368), [www.fdot.gov](http://www.fdot.gov)

FL Division of Emergency Management: 850-815-4000, [www.FloridaDisaster.org](http://www.FloridaDisaster.org)

FL Emergency Information Hotline: 800-342-3557

FL Official State Website: [www.myflorida.com](http://www.myflorida.com)

FL STORMS App: [floridastorms.org/app](http://floridastorms.org/app)

### Louisiana Information

LA Department of Agriculture and Forestry: 866-927-2476, [www.ldaf.state.la.us](http://www.ldaf.state.la.us)

LA Department of Children and Family Services: 888-LAHELP-U (524-3578), [www.dss.state.la.us](http://www.dss.state.la.us)

LA Department of Environmental Quality: 866-896-LDEQ (5337), [deq.louisiana.gov](http://deq.louisiana.gov)

LA Department of Health (DOH): 225-342-9500, [ldh.la.gov](http://ldh.la.gov)

LA DOH Molluscan Shellfish Central Office\*: 225-342-7653, [ldh.la.gov/index.cfm/page/629](http://ldh.la.gov/index.cfm/page/629)

LA Department of Transportation: 877-4LA-DOT (452-3683), [wwwsp.dot.la.gov](http://wwwsp.dot.la.gov)

LA Department of Wildlife and Fisheries: 225-765-2800, [www.wlf.louisiana.gov](http://www.wlf.louisiana.gov)

LA Get a Game Plan: [www.getagameplan.org](http://www.getagameplan.org)

LA Office of Homeland Security and Emergency Preparedness: 225-925-7500, [www.gohsep.la.gov](http://www.gohsep.la.gov)

LA Official State Website: [www.louisiana.gov](http://www.louisiana.gov)

LA Seafood Marketing and Promotions Board: [www.louisianaseafood.com](http://www.louisianaseafood.com)

LA Workforce Commission (unemployment claims): 225-342-3111, [www.laworks.net](http://www.laworks.net)

LSU Agricultural Research Station: [www.lsuagcenter.com/portals/our\\_offices/research\\_stations/aquaculture](http://www.lsuagcenter.com/portals/our_offices/research_stations/aquaculture)

### Mississippi Information

MS Board of Animal Health: 888-722-3106, [www.mbah.state.ms.us](http://www.mbah.state.ms.us)

MS Department of Environmental Quality: 888-786-0661, [www.mdeq.ms.gov](http://www.mdeq.ms.gov)

MS Department of Marine Resources (MDMR): 800-374-3449, [dmr.ms.gov](http://dmr.ms.gov)

MDMR Shellfish Bureau\*: 228-374-5167 | 800-385-5902, [dmr.ms.gov/shellfish](http://dmr.ms.gov/shellfish)

MS Department of Public Safety: 601-987-1212, [www.dps.ms.gov](http://www.dps.ms.gov)

MS Department of Transportation: 601-359-7001, [mdot.ms.gov](http://mdot.ms.gov)

MS Emergency Management Agency (MEMA): 866-519-6362, [www.msema.org](http://www.msema.org)

MEMA Smart Phone App: [www.msema.org/about/mema-mobile-application](http://www.msema.org/about/mema-mobile-application)

MEMA Hurricane Preparedness: [www.msema.org/preparedness-2/hurricanes](http://www.msema.org/preparedness-2/hurricanes)

MS Official State Website: [www.ms.gov](http://www.ms.gov)

MS Ready.gov: [www.ready.gov/mississippi](http://www.ready.gov/mississippi)

\* These state agencies monitor and manage shellfish harvesting areas and regulate and inspect shellfish processing facilities.

This fact sheet is the result of a collaborative effort among shellfish aquaculture extension specialists in the Sea Grant programs of Florida, Mississippi-Alabama, and Louisiana. For further information, contact:

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# Oyster

## AQUACULTURE

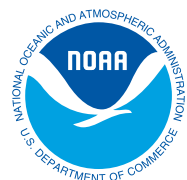
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This publication was supported by Florida Sea Grant, the Mississippi-Alabama Sea Grant Consortium, and Louisiana Sea Grant. GOMSG-H-20-006



## Tropical Storm and Hurricane Preparedness for Off-bottom Oyster Aquaculture in the Gulf of Mexico

### Floating Bag Farms Guide

Many oyster growers in the Gulf of Mexico region use the floating bag system, an off-bottom culture gear. This fact sheet provides guidance related to storm preparation and planning for this gear type. It is part of a series providing an overview of storm preparation and planning for other oyster aquaculture operations, including adjustable long-line farms, floating cage farms, land-based operations, and workboats.

The floating bag system uses a series of bags, typically buoyed by twin floats. The bags are attached to a main line that is anchored at either end, but anchoring configuration can vary by site. The floats may have removable caps, allowing a farmer to fill the floats and sink the bag to the sea bottom, but many float designs do not have this capability. Bags are flipped to allow for partial air drying, which provides some control of biofouling.



Photo courtesy of Orlando Sentinel

#### INSTALLATION

During installation of the floating bag system, there are several important considerations.

- Assess the site’s exposure to storms as a primary factor in site selection.
- Orient main lines parallel to prevailing winds and waves.
- Choose an anchoring system suitable to the bottom type.
- Install substantial, durable anchors (buried to at least 5 feet depth) that will hold in the farm’s bottom substrate in the strongest storms (see Figure 1 for some options).



**FIGURE 1.** Two types of anchors used to secure floating cage main lines: helical screw anchor (left) and arrowhead anchor (right). Photos courtesy of Auburn University Shellfish Lab

- Bury anchors (typically helical metal screw anchors) fully in the sediment to reduce projection above the sea floor, corrosion, and tangling hazard.
- Invest in durable main line that meets the supplier's recommendation with some protection from chafing at friction points (e.g., anchor attachment).
- Allow sufficient spacing between lines to ensure bags do not collide in bad weather.
- Use a system that will reinforce the bag to reduce chafing at friction points (see Figure 2 for one example).
- If floats have removable caps, invest in and practice with a system, such as a mechanical davit or a compressor to fill floats with air (with a back-up system in place), that allows for safe and efficient sinking and re-floating of bags.
- Place identifying tags on each bag.

### PRIOR TO HURRICANE SEASON

Prior to the onset of hurricane season, oyster farmers should take these steps to reduce the risk of losses.

- Check stocking densities and reduce as necessary (though some farmers have had success by overstocking bags to achieve neutral buoyancy just prior to a storm).
- Check biofouling and control on a routine basis.
- Check all lines for chafing (especially near the clips) and repair as needed.
- Check all bag clips are secured and in good condition at attachment points.

- Have crew conduct timed practices to gauge time needed per line to prepare for a storm.
- For shoreside operations, pick up loose pieces of equipment and secure bags to reduce loss from flooding and wind.
- Review storm plan with crew and family so they can account for personal preparations alongside farm preparations.

### DURING HURRICANE SEASON

A tiered approach to preparation, which has been adopted in each fact sheet, allows growers to stage tasks based on the storm or hurricane's track forecast. The authors developed the following color codes to address increasing levels of concern and actions.

#### CODE YELLOW

Once a hurricane or tropical storm has formed in the Gulf of Mexico or has a chance of entering the Gulf, it is time to begin preparations according to the farm's plan. Note that the timeline is fluid and will depend on the storm's speed and track.

- Re-check stocking densities and reduce as necessary. If opting to overstock bags to achieve slightly positive buoyancy, ensure stocking is appropriate.
- Farmers opting to sink their bags below the surface but still float off the bottom by overstocking bags should consider taking this step now.
- Re-check all lines for chafing (especially near the clips) and repair as needed.
- Ensure all bag clips are secured and in good condition.
- Secure any empty bags on shore or on lines.



- Document the condition of the farm with dated photographs and notes.
- Document the numbers of various sizes of oysters.
- Review workboat(s) plan.

### CODE ORANGE

Once a hurricane or tropical storm watch has been issued, final preparations should begin. In the case of a fast-moving storm, proceed with tasks associated with final stages of preparation.

- Sell product as market allows.
- Track the storm's progress frequently and carefully. When assessing whether to sink bags, keep in mind the amount of time necessary to carry out the sinking operation. Farmers should also weigh the risks of bags and oysters being buried in the substrate.
- Remember that the day before the storm is to make landfall, farmers should not plan to be on the water. They will need that day for other preparations and the weather will likely not allow for it.
- If weather conditions do not warrant sinking bags, consider adding slack to anchor lines to allow for storm surge. Alternatively, some farmers opt to tighten their mainlines to pull bags under the water surface.
- If weather conditions warrant sinking bags, remove both floats from bags and allow them to rest on the

bottom or remove one float or alternate floats to partially or completely submerge the bags to keep them just above the bottom. Store floats safely onshore.

- For systems that have floats with caps, remove caps from floats or alternate floats and ensure all air from floats is removed when sinking.
- Some growers suggest replacing caps on floats (once all air is removed) to prevent sediment from filling the floats (though this may depend on sediment type). This adds considerable time to preparations.
- If allowed by state regulations, some farmers opt to tow floating bags to more protected areas.
- Prepare to implement workboat(s) plan.

### CODE RED

When a hurricane or tropical storm warning has been issued and there is a high probability of being in the path of the storm, farmers must conclude final preparations if and only if they can be accomplished safely. Farmers will make a series of personal risk assessments.

- Conduct last check of farm.
- Implement workboat(s) plan.
- Get to safety.

### POST-STORM RECOVERY

Oyster growers and their employees must be ready to take care of the needs of the farm as soon as it is safe and reasonable to do so. After a storm has passed, the following tasks should be considered.

- Assess risk of returning to farm, and proceed only when safe.
- Patrol the area upstream and downstream of the farm for significant debris that could entangle or dislodge gear once it is raised, and remove or secure debris.
- Document the condition of the farm with dated photographs and notes.
- Refloat bags as soon as practically possible by adding flotation and/or reducing stocking densities.
- If caps were removed from floats, use systems designed for this task, with bags lifted from reinforced points, allowing water to drain out the end caps and being careful to work any bags out of the sea floor if necessary.
- If necessary, use an on-board washdown hose to rinse sediment off the bags or out of floats and recap once washed down.



**FIGURE 2.** Use of a PVC pipe bar to reinforce bag and reduce friction where clips attach as one example of a method to reduce chafing. Photo courtesy of Outlaw Oyster Company

- Assess and document oyster survival, gear condition, and losses.
- Once mortality risk has passed, resume normal biofouling regimen.
- Communicate with public agencies about closures and effects of the storm.

- Communicate with buyers and suppliers to provide situation and outlook reports.

### ACKNOWLEDGMENTS

*We are grateful for discussions and input from several commercial growers using floating bags that greatly improved this fact sheet.*



Photo courtesy of Pelican Oyster Company

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# Oyster

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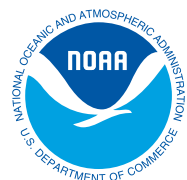
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## Tropical Storm and Hurricane Preparedness for Off-bottom Oyster Aquaculture in the Gulf of Mexico

### Floating Cage Farms Guide

Many oyster growers in the Gulf of Mexico region use the floating cage system, an off-bottom gear. This fact sheet provides guidance related to storm preparation and planning for this gear type. It is part of a series providing an overview of storm preparation and planning for other oyster aquaculture operations, including adjustable long-line farms, floating bag farms, land-based operations, and workboats.

The floating cage system uses a series of cages that hold multiple bags of oysters (typically 6), buoyed by twin floats. The cages are typically attached by lateral lines to a main line that is anchored at either end, but anchoring configuration can vary by site. The floats have removable caps, allowing a farmer to fill the floats and sink the cage to the sea bottom. The cage may be raised later, emptying the floats of water to have them floated again. Cages that are flipped on top of the floats allow for air drying, which controls biofouling.

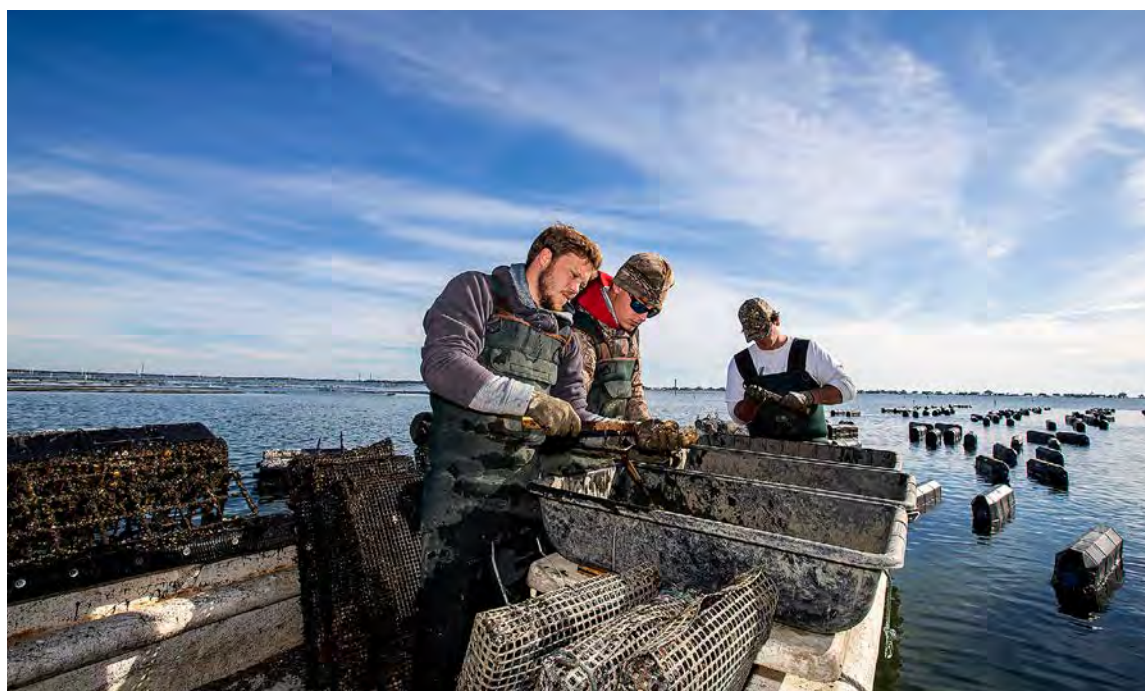


Photo courtesy of Mark Wallheiser

#### INSTALLATION

During installation of the floating cage system, there are several important considerations.

- Assess the site’s exposure to storms as a primary factor in site selection.
- Orient main lines parallel to the prevailing wind and waves.
- Choose an anchoring system suitable to the bottom type
- Install substantial, durable anchors (buried to at least 5 feet depth) that will hold in the farm’s bottom substrate in the strongest storms (see Figure 1 for options).





**FIGURE 1.** Two types of anchors used to anchor the floating cage mainlines: helical screw anchors (top) and arrowhead anchors (bottom). Photos courtesy of Auburn University Shellfish Lab

- Bury anchors (typically helical metal screw anchors) fully in the sediment to reduce projection above the sea floor, corrosion, and tangling hazard.
- Invest in durable anchor line with some protection from chafing at friction points (e.g., anchor attachment).
- Allow sufficient spacing between lines to ensure cages do not collide in bad weather.
- Invest in and practice with a system, such as a mechanical davit or a compressor to fill the floats with

air (with a back-up system in place), that allows for safe and efficient sinking and re-floating of cages. (Figure 2)

- Place identifying tags on each cage or bag.

### PRIOR TO HURRICANE SEASON

Prior to the onset of hurricane season, oyster farmers should take these steps to reduce the risk of losses.

- Maintain appropriate stocking densities so that cages are not crowded and heavy.
- Air dry cages to control biofouling on a routine basis.
- Make it a habit to check bridles and lines when flipping to ensure lines do not get tangled.
- Check all lines for chafing, and repair as needed.
- Check all door closures to ensure that the attachments are secure and not worn.
- Have extra caps on hand in workboat.
- Remove empty cages from the line, as these are prone to come off the line in bad weather.
- Have crew conduct timed sinking practices (including in less than ideal weather conditions) to gauge time needed per line to correctly sink cages.
- For shoreside operations, pick up loose pieces of equipment, and secure cages and bags to reduce loss from flooding and wind.



**FIGURE 2.** A mechanical davit used to raise sunken floating cages from the seafloor after the storm has passed. Photo courtesy of Jason Rider





Photo courtesy of Grand Isle Sea Farms

- Review storm plan with crew and family so they can account for personal preparations alongside farm preparations.

## DURING HURRICANE SEASON

A tiered approach to preparation, which has been adopted in each fact sheet, allows growers to stage tasks based on the storm or hurricane's track forecast. The authors developed the following color codes to address increasing levels of concern and actions.

### CODE YELLOW

Once a hurricane or tropical storm has formed in the Gulf of Mexico or has a chance of entering the Gulf, it is time to begin preparations according to the farm's plan. Note that the timeline is fluid and will depend on the storm's speed and track.

- Re-check stocking densities and reduce as necessary, taking special care with any bags of seed as the smaller mesh can produce more water resistance.
- Re-check all lines for chafing and repair as needed.
- Re-check that all bridles and pucks are in good condition.
- Re-check that all bag and cage closures are in good condition.
- Consider consolidating all small seed (e.g., seed held in 2 mm bags) to one section of cages so that you can re-float those cages first once the threat has passed.

- Secure any empty bags and cages on shore or on lines.
- Document the condition of the farm with dated photographs and notes.
- Document the numbers of various sizes of oysters.
- Review workboat(s) plan.

### CODE ORANGE

Once a hurricane or tropical storm watch has been issued, final preparations should begin. In the case of a fast-moving storm, proceed with tasks associated with final stages of preparation.

- Sell product as market allows.
- Track the storm's progress frequently and carefully. When assessing whether to sink cages, keep in mind the amount of time necessary to carry out the sinking operation.
- Remember that the day before the storm is to make landfall, farmers should not plan to be on the water. They will need that day for other preparations, and the weather will likely not allow it.
- If weather conditions do not warrant sinking cages based on personal judgment, consider adding slack to anchor lines to allow for storm surge.
- If weather conditions warrant sinking cages, ensure that cages sit "float down" on the bottom, with the wire mesh off the bottom (though this may depend on sediment type).

- Ensure all air from floats is removed when sinking, and walk or dive over the cages to be sure the pontoons are down, with adjustments made as needed.
- Some growers suggest replacing caps on floats (once all air is removed) to prevent sediment from filling the floats (though this may depend on sediment type). This adds time to preparations.
- Prepare to implement workboat(s) plan.

### CODE RED

When a hurricane or tropical storm warning has been issued and there is a high probability of being in the path of the storm, farmers must conclude final preparations if and only if they can be accomplished safely. Farmers will make a series of personal risk assessments.

- Conduct last check of farm.
- Implement workboat(s) plan.
- Get to safety.

### POST-STORM RECOVERY

Oyster growers and their employees must be ready to take care of the needs of the farm as soon as it is safe and reasonable to do so. After a storm has passed, the following tasks should be considered.

- Assess risk of returning to farm and proceed only when safe.
- Patrol the area upstream and downstream of the farm for significant debris that could entangle or dislodge gear once it is refloated, and remove or secure debris.
- Document the condition of the farm with dated photographs and notes.
- Refloat cages as soon as practically possible, using the systems designed for this task, with cages lifted from reinforced points, allowing the water to drain out the end caps and being careful to work any cages out of the sea floor if necessary.
- If necessary, use an on-board washdown hose to rinse sediment out of floats, and recap once washed down.
- Assess and document oyster survival, gear condition, and losses.

- Once mortality risk has passed, resume normal biofouling regimen.
- Communicate with public agencies about closures and effects of the storm.
- Communicate with buyers and suppliers to provide situation and outlook reports.

### ACKNOWLEDGMENTS

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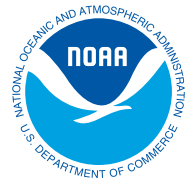
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 GOMSG-H-20-004



## Tropical Storm and Hurricane Preparedness for Off-bottom Oyster Aquaculture in the Gulf of Mexico

### Adjustable Long-Line Farms Guide

Many oyster growers in the Gulf of Mexico region use the adjustable long-line system (ALS), an off-bottom culture gear. This fact sheet provides guidance related to storm preparation and planning for this gear type. It is part of a series providing an overview of storm preparation and planning for other oyster aquaculture operations, including floating cage farms, floating bag farms, land-based operations, and workboats.

The ALS system uses a tensioned monofilament line strung between anchored pilings with riser posts placed at uniform intervals allowing adjustment of the baskets' height in or above the water column. This guidance is primarily for intertidal operations.



Photo courtesy of USDA Risk Management Agency

#### INSTALLATION

During installation of the ALS system, there are several important considerations.

- Assess the site's exposure to storms as a primary factor in site selection.
- Orient lines perpendicular to the prevailing wind and waves, if possible.
- Invest in durable line that meets the supplier's recommendation with some protection from chafing, such as an outer sleeve.
- Invest in basket-to-line clips that secure the baskets in position on the line.



**FIGURE 1.** Two types of tensioning systems that allow adjustment of line tension in the adjustable long-line system: the donut tensioner (left) and the turnbuckle (right). Photos courtesy of Auburn University Shellfish Lab

- Be sure lines are taut. Some growers opt to use a donut tensioner or other system to adjust tautness (Figure 1).
- Install pilings and riser posts and allow to set prior to storm season.
- If using a sliding sleeve with a clip, install a top pin to ensure that the sleeve cannot come off the riser post top (Figure 2).
- Limit distance between riser posts to about 8-9 feet, with enough room for no more than three baskets.
- Bury riser posts at least one-third of their length.
- Bury at least 50% of the end pilings in the sediment, leaving enough length for at least 3-4 feet to extend above mean high water.
- Include one “storm position” clip in the adjustable clip system, where baskets are suspended just above the bottom during storm events, beneath the heavy wave action.
- Place identifying tags on each basket.

### PRIOR TO HURRICANE SEASON

Prior to the onset of hurricane season, oyster farmers should take steps to reduce the risk of losses.

- Check stocking densities and reduce as necessary.
- Check biofouling and control on a routine basis.
- Check all lines for chafing (especially near the clips) and repair as needed.
- Check for good tension on lines.
- Ensure all basket clips are secured and in good condition.

- Ensure all clips on riser posts are in place, holding the line as intended, and clear of fouling.
- Check for fouling on the riser posts and remove barnacles, oysters, and other hard organisms that could wear the line.
- Have crew conduct timed practices to gauge time needed per line to correctly lower baskets.
- For shoreside operations, pick up loose pieces of equipment and secure baskets to reduce loss from flooding and wind.
- Review storm plan with crew and family so they can account for personal preparations alongside farm preparations.

### DURING HURRICANE SEASON

A tiered approach to preparation, which has been adopted in each fact sheet, allows growers to stage tasks based on the storm or hurricane’s track forecast. The authors developed the following color codes to address increasing levels of concern and actions.

#### CODE YELLOW

Once a hurricane or tropical storm has formed in the Gulf of Mexico or has a chance of entering the Gulf, it is time to begin preparations according to the farm’s plan. Note that the timeline is fluid and will depend on the storm’s speed and track.

- Re-check stocking densities and reduce as necessary, taking special care with any baskets of seed as the smaller mesh can produce more water resistance.
- Re-check all lines for chafing (especially near the clips) and repair as needed.



- Ensure all bag clips are secured and in good condition.
- Ensure all clips on riser posts are in place and holding the line as intended.
- Secure any empty baskets on shore or on lines.
- Document the condition of the farm with photographs and notes.
- Document the numbers of various sizes of oysters.
- Review workboat(s) plan.

### CODE ORANGE

Once a hurricane or tropical storm watch has been issued, final preparations should begin. In the case of a fast-moving storm, proceed with tasks associated with final stages of preparation.

- Sell product as market allows.
- Track the storm's progress frequently and carefully. When assessing whether or not to lower baskets, keep in mind the amount of time necessary to carry out the operation. Remember that the day before the storm is to make landfall, you should not plan to be on the water. You will need that day for other preparations and the weather will likely not allow it.
- If weather conditions warrant lowering baskets based on your judgment, lower all bags to the storm position on the riser clips.

- Prepare to implement workboat(s) plan.

### CODE RED

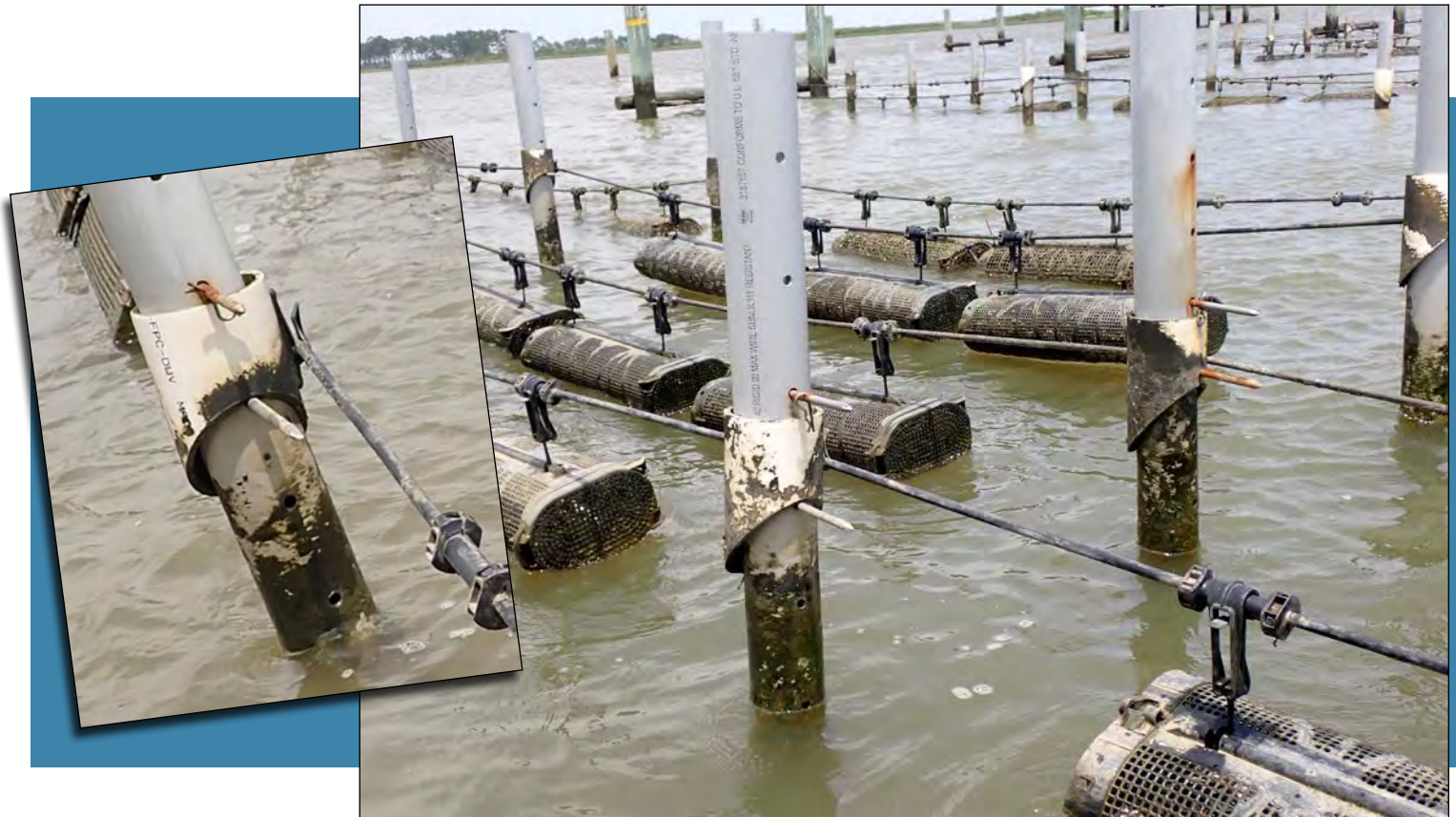
When a hurricane or tropical storm warning has been issued and there is a high probability of being in the path of the storm, farmers must conclude final preparations if and only if they can be accomplished safely. Farmers will make a series of personal risk assessments.

- Conduct last check of farm.
- Implement workboat(s) plan.
- Get to safety.

### POST-STORM RECOVERY

Oyster growers and their employees must be ready to take care of the needs of the farm as soon as it is safe and reasonable to do so. After a storm has passed, the following tasks should be considered.

- Assess risk of returning to farm and proceed only when safe.
- Patrol the area upstream and downstream of your farm for significant debris that could entangle or dislodge your gear once it is raised, and remove or secure debris.
- Document the condition of the farm with photographs and notes.
- Return baskets to customary clip height on riser posts.



**FIGURE 2.** Adjustable long-line sleeve that allows the sleeve (with one clip) to be adjusted up or down the riser pole. Photo courtesy of Auburn University Shellfish Lab

- Assess and document oyster survival, gear condition, and losses.
- Once mortality risk has passed, move lines to high setting to prevent oyster and barnacle set that may occur after storms.
- Communicate with public agencies about closures and effects of the storm.
- Communicate with buyers and suppliers to provide situation and outlook reports.

## ACKNOWLEDGMENTS

*Leon Stott (oyster farm consultant, Australia) and other industry members contributed input for this fact sheet.*



Photo courtesy of Auburn University Shellfish Lab

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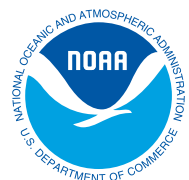
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To access all of the fact sheets in this series, visit the National Sea Grant Library at [nsgl.gso.uri.edu](http://nsgl.gso.uri.edu). Using the "search the catalog" function, search "Oyster Aquaculture Hurricane Preparedness Series."

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## Tropical Storm and Hurricane Preparedness for Off-bottom Oyster Aquaculture in the Gulf of Mexico

### Land-Based Operations Guide



Photo courtesy of Emily Colson, University of Florida/IFAS

Land-based oyster operations that are vulnerable to hurricanes, tropical storms, or severe weather events include seed production facilities and processing plants. This fact sheet provides guidance related to storm planning and preparation, as well as precautionary suggestions, for seed suppliers and wholesale dealers. It is part of a series providing an overview of storm preparation and planning for oyster aquaculture operations in the Gulf of Mexico region.

As the primary source of seed, hatcheries and nurseries are critical components of oyster aquaculture. These facilities are typically located on waterfront property and are at risk to coastal flooding and storm surge. Inside the hatchery, adult oysters (broodstock) are spawned to create oyster larvae that are grown in tanks and fed

cultured microalgae. Oysters complete the larval stages of their lifecycle in the hatchery and are then moved to a nursery setting to be grown large enough for the farm.

Market-size oysters are harvested and delivered by growers to a dealer's processing plant where they are washed, cleaned, sorted, packaged, and stored in a refrigerated cooler prior to distribution. Processing facilities are not necessarily located in flood-prone coastal areas but can be affected by power outages associated with high winds.

#### SITE SELECTION AND FACILITY DESIGN

There are several important considerations in preparing for storms through proper siting, designing, and constructing of land-based facilities. Buildings and structures used in



**FIGURE 1.** Filtration equipment installed on a trailer with quick disconnect and union fittings at the Louisiana Sea Grant Oyster Research Hatchery in Grand Isle, Louisiana. Photo courtesy of University of Florida/IFAS Shellfish Extension

processing shellfish must meet applicable federal and state regulations for sanitary operation; these requirements are not reviewed in this fact sheet.

- ❑ Assess vulnerability of the site to flooding and access to roads during flooding.
- ❑ Evaluate reliability of critical infrastructure (e.g., power, communications, etc.).
- ❑ Construct permanent structures to meet a minimum wind rating of 130 mph (178 km/hr) and comply with Federal Emergency Management Agency (FEMA) regulations pertaining to elevation in flood plain areas.
- ❑ Use concrete walls and metal roofing in your building design as these materials are considered the best construction option for hurricane resistance.
- ❑ Use breakaway walls for temporary structures or below elevated buildings.
- ❑ Use swales and/or berms to direct surface water flow around property and stabilize exposed soils. Criteria for surface water control techniques can be obtained from Soil and Water Conservation district offices.
- ❑ Provide adequate floor drainage in areas where tank drawdowns occur or shellfish are stored, as well as work areas that are routinely rinsed.
- ❑ Install backflow preventers to prevent contamination of potable water supply.
- ❑ Install generators with a capacity to operate critical facility components during power loss for 3 to 5 days (e.g., aerators, pumps, refrigerated coolers, etc.).
- ❑ Set up ground-level components for rapid disconnection to move inland in anticipation of storm surge or coastal flooding. For example, use quick disconnect or union fittings on pumps and filters or permanently install equipment on trailers or pallets (Figures 1 & 2).
- ❑ Maintain grounds around buildings to be free from conditions that may result in shellfish contamination, such as inadequate drainage, or accumulated shell.

- ❑ Identify alternate location(s) where equipment can be easily moved to avoid flooding and wind damage.
- ❑ Maintain access pathways to equipment that may be removed prior to a storm.

## PRIOR TO HURRICANE SEASON

Prior to hurricane season, seed suppliers and wholesalers should take steps to reduce the risk of losses.

- ❑ Develop and review a storm plan detailing personnel responsibilities and chain of command, primary and emergency contact information, and equipment evacuation designations based on storm strength (i.e., what gets removed from the site when a storm gets to a certain strength).
- ❑ Inform employees that if a storm approaches, they will be needed to prepare and implement the storm plan.
- ❑ Have a plan for assessing employees' availability after the storm.
- ❑ Develop and review a post-storm recovery plan including contact information and procedures, relevant local emergency and government contacts, insurance contact information and claim procedures, etc.
- ❑ Obtain civil defense or other identification documents for essential personnel to immediately return after an evacuation.
- ❑ Purchase and maintain a stockpile of storm preparation supplies (e.g., tarps, plywood, sandbags, etc.).
- ❑ Identify an inland off-site storage location that is accessible and able to receive equipment.
- ❑ Make sure generators are in working condition and fuel reserves are adequate.
- ❑ Clean up loose items around buildings and structures to reduce storm preparation workload.
- ❑ Have employees conduct at least one timed run-through of preparation activities to gauge the amount of time needed to implement the storm plan.
- ❑ Maintain inventory of oyster stocks to be able to quickly review needs during hurricane season.

## DURING HURRICANE SEASON

A tiered approach to preparation, which has been adopted in each fact sheet, allows seed suppliers and wholesalers to stage tasks based on the storm or hurricane's track forecast. The authors developed the following color codes to address increasing levels of concern and actions.

### CODE YELLOW

Once a hurricane or tropical storm has formed in the Gulf of Mexico or has a chance of entering the Gulf, it is time to begin preparations according to the facility's plan. Note that the timeline is fluid and will depend on the storm's speed and track.

- ❑ Re-check that all employees have received the storm plan and emergency contact information.



- Check that storm preparation supplies, including generator fuel reserves, are adequate and easily available.
- Document the pre-storm condition of the facility and equipment with dated photographs and notes.
- Make sure the off-site storage location is ready for receiving equipment and remove items that are not necessary for continued operation.

**Hatchery and nursery facilities:**

- Inventory and prioritize in-house larvae, post-set, seed, and broodstock. For example, larvae are the least expensive to produce, so efforts may be minimal in securing these stocks.
- Purchase algal concentrates that can be used to feed oyster stocks if algae cultures crash.
- Keep several bags of synthetic sea salt or rock salt on hand as storms can result in excessive rainfall, lowering salinities of inshore waters.

**Processing plant:**

- Inventory in-house product and pending oyster purchases and sales.
- Prepare to ship out orders sooner than the normal distribution schedule.
- Notify suppliers of the storm plan so shipments do not arrive at your facility.

**CODE ORANGE**

Once a hurricane or tropical storm watch has been issued, final preparations should begin. In the case of a fast-moving



**FIGURE 2.** Filtration equipment installed on a pallet with quick disconnect and union fittings at the Louisiana Sea Grant Oyster Research Hatchery in Grand Isle, Louisiana. Photo courtesy of John Supan

storm, proceed with tasks associated with final stages of preparation.

**Hatchery and nursery facilities:**

- Prepare generator for operation in the event of power loss or evacuation.
- Perform routine cleaning of systems that will be maintained in the hatchery through evacuation (e.g., algal stocks, broodstock holding/conditioning system, etc.).
- Add broodstock not held in conditioning or holding tanks into these systems or return them to the farm.
- Move or prepare to move spare pumps, filters, hoses, and other items to secure storage location (based on predicted storm strength, items may be stored onsite or at an inland location).
- Fill empty tanks onsite at least half full of water to prevent moving from wind or flooding. Place loose gear inside the tanks.
- Secure outdoor raceways and weller tanks with rope, straps, or bungee cords to the tank support system.
- Move nursery drum silos and FLUPSY wellers to higher ground or inland site.

**Processing plant:**

- Locate an alternative storage cooler for remaining inventory or load into a refrigerated truck or trailer if required temperature can be maintained.
- Remove all shell and other materials that may spoil from the facility and grounds to prevent attracting pests and vermin.

**CODE RED**

When a hurricane or tropical storm warning has been issued, final preparations must be concluded if and only if they can be accomplished safely. A series of personal risk assessments must be made.

If the facility is not able to withstand predicted wind speeds or storm surge, vital equipment should be removed and transported to a designated inland location for safeguarding.

**Hatchery and nursery facilities:**

If your hatchery can withstand predicted wind speeds and storm surge, conduct the following activities to reduce losses until employees can return to the facility.

- Feed broodstock oysters heavily, and make sure broodstock sumps are full of seawater.
- Drop the water volume of larval tanks and feed extra algae.
- Swirl any stock algal cultures and transfer darker cultures.
- Drain seawater lines and fill with freshwater if time permits.
- Activate recirculating systems if the facility has the capability to do so.
- Confirm the generator is operating and all critical equipment are connected.

- Hook up a small single-phase blower to the generator to provide aeration to tanks containing oyster larvae, post-set, and broodstock.

If the nursery is vulnerable to storm surge and coastal flooding, conduct the following activities to reduce losses of seed and equipment.

- Shut off electricity to pumps and nursery facility at the breaker box.
- Pull and secure pumps so they do not become submerged.
- Store nursery seed in seawater-dipped towels or drain sock material and place in a cooler to keep damp and cool. Within 2-3 days, seed will need to be placed back into the water.
- Transport nursery seed (if feasible) to another in-state growing area that likely will not be affected by the storm event.
- Stock nursery seed large enough into small mesh (2 mm) bags and secure on farm with other culture gear.

#### **Processing plant:**

- Document storage temperature of cooler (if product remains onsite) with a recording thermometer device, such as Thermapen Blue®.
- Sandbag the cooler and exterior doors to minimize storm surge or flood waters from entering the building.
- Transport inventory via refrigerated truck or temperature-controlled trailer to a predetermined location that is less likely to experience flooding and extended power outages.

### **POST-STORM RECOVERY**

Seed suppliers, wholesalers, and their employees must be ready to take care of the needs of the land-based facilities as soon as it is safe and reasonable to do so. After the storm has passed, the following tasks should be considered.

- Assess risk of returning to the facility and proceed only when safe.
- Notify employees to return to the site for post-storm maintenance and activities.
- If damage occurred, document condition of facility and equipment with dated photographs and notes.

- Return all equipment from alternative off-site storage location.
- Communicate with buyers to provide situation and outlook reports.

#### **Hatchery and nursery facilities:**

- Return water flow to tanks stocked with oysters as quickly as possible.
- Drain, clean, and refeed tanks as soon as clean seawater is obtainable.
- Create a brine with synthetic sea salt or rock salt and add to static tanks to increase salinities if necessary (this is a temporary measure until incoming waters return to normal salinities).
- Assess and document oyster survival and condition.

#### **Processing plant:**

- Take photos to verify the status of the facility in case the local shellfish plant inspector is delayed from visiting the facility.
- If the facility was not flooded, inform the plant inspector and continue with business as usual.
- If the facility was flooded but waters did not reach the cooler and power was not interrupted, clean and sanitize flooded areas and inform the plant inspector. If product is remaining in the cooler, distribute after inspection.
- If flood waters permeated the cooler or power was disrupted and shellstock remaining in cooler exceeded critical temperature limits in the Hazard Analysis Critical Control Point (HACCP) plan, then product is adulterated and must be properly disposed.
- Check with the inspector to find out if potable water at the plant must be tested prior to reopening.

### **ACKNOWLEDGMENTS**

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This fact sheet is the result of a collaborative effort among shellfish aquaculture extension specialists in the Sea Grant programs of Florida, Mississippi-Alabama, and Louisiana. For further information, contact:

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The views expressed herein do not necessarily reflect the views of any of these organizations.

The information and checklists provided in this series of fact sheets are meant as guides only. Following these guidelines and suggested safety procedures does not assure that damages will not occur to oyster crops, gear, or facilities.





# Oyster

## AQUACULTURE

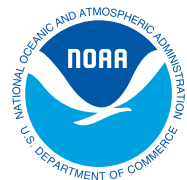
**Rusty Grice**  
**Leslie Sturmer**  
**Bill Walton**  
**Erik Lovstrand**  
**Natalie Simon**  
**Brian Callam**

These fact sheets for the off-bottom oyster aquaculture industry in the Gulf of Mexico provide guidelines and suggested safety procedures in preparing for tropical storms and hurricanes:

- **Introductory Planning Guide**
- **Adjustable Long-Line Farms**
- **Floating Bag Farms**
- **Floating Cage Farms**
- **Land-based Operations**
- **Workboats**

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## Tropical Storm and Hurricane Preparedness for Off-bottom Oyster Aquaculture in the Gulf of Mexico

### Workboats Guide

Boats are one of the most valuable assets belonging to an oyster grower, and protective measures should be taken before, during, and after a hurricane, tropical storm, or severe weather event. This fact sheet provides guidance related to planning and preparation, as well as precautionary suggestions, for boat owners. Following these guidelines does not exempt you from being held responsible should your boat cause damage to another's property. Also, acquisition of safety equipment and following the suggested procedures does not necessarily assure that your boat will not be damaged in a storm. This fact sheet is part of a series, which provides an overview of storm preparation and planning for oyster aquaculture operations in the Gulf of Mexico region.



Photo courtesy of Boonedocks Oyster Company

#### PRIOR TO HURRICANE SEASON

Develop a plan of action to secure your boat by trailering it from the threatened area. If your boat cannot be trailered, determine in advance whether to secure at a marina, dry storage facility, mooring, or hurricane refuge in a protected cove or upriver. A checklist of equipment and supplies needed for any of these options should be prepared in advance. Following are important considerations.

- Maintain an inventory list of all boat equipment. Note items you will remove from the boat and those you will leave on board. Items of value should be marked so that they can be readily identified.
- Take photographs or video with a time stamp of your boat and its associated gear.
- Consolidate all documents including

insurance policies, boat registration, engine numbers, equipment inventory, lease agreement with marina or storage area, photographs, and telephone numbers of appropriate authorities, such as the harbor master, U.S. Coast Guard, National Weather Service, insurance agent, etc. Keep these documents in your possession in a locked waterproof box.

- Check with marine and law enforcement organizations for local plans.
- Make sure your insurance policy is current. Your policy may contain helpful information relative to what you should and should not do if there is loss or damage to your boat. Understand coverages, exclusions, and your duties as a boat owner.
- Keep your boat in sound condition. This includes the hull, motor, hardware, and electronics.
- Check that lifesaving and firefighting equipment are in good condition and readily accessible.
- Check that radio equipment for receiving weather information is in working order.
- Plan how to remove and/or secure all boat gear, including radios, antennas, deck boxes, bimini tops, davits, booms, winches, tumblers, etc.
- Purchase necessary supplies ahead of time, such as additional mooring lines (preferably nylon for strength and stretch, and minimum size of 5/8”), additional anchors (should be oversize, 25 pounds or heavier), fenders, fender boards, chafing gear, and screw anchors. These items may not be readily available during hurricane season.

- Make sure that fuel tanks are full, fuel filters are clean, batteries are charged, and bilges are clean throughout the season.
- Determine how long it will take to implement your plan so you will have an accurate estimate of time and work involved.

#### **Non-trailerable Boats:**

- Check your lease or rental agreement with the marina or dry storage area. Know your responsibilities and liabilities, as well as those of the marina or dry storage area.
- Locate hurricane moorings in advance and obtain permission from appropriate persons.
- Inspect your boat’s deck hardware and assess the size and structural attachment of the primary cleats and other hardware. These high load/high stress points should have substantial backing plates and be secured with bolts of adequate size.

### **DURING HURRICANE SEASON**

A tiered approach to preparation, which has been adopted in each fact sheet, allows growers to stage tasks based on the storm or hurricane’s track forecast. The authors developed the following color codes to address increasing levels of concern and action.

#### **CODE YELLOW**

Once a hurricane or tropical storm has formed in the Gulf of Mexico or has a chance of entering the Gulf, it is time to begin preparations for securing your boat. Note that the timeline is fluid and will depend on the storm’s speed



Photo courtesy of Alan Youngblood, Gainesville Sun



and track. Because your boat will be needed to implement the storm plan for your oyster farm, it is important to address as many of these activities in advance.

**Trailerable Boats:**

- Determine the requirements to load and haul your boat to a safe area.
- Make sure your tow vehicle is capable of properly moving the boat.
- Check the condition of your trailer, tires, bearings, and axle. Too often a flat tire, frozen bearings, or broken axle can prevent an owner from moving a boat.

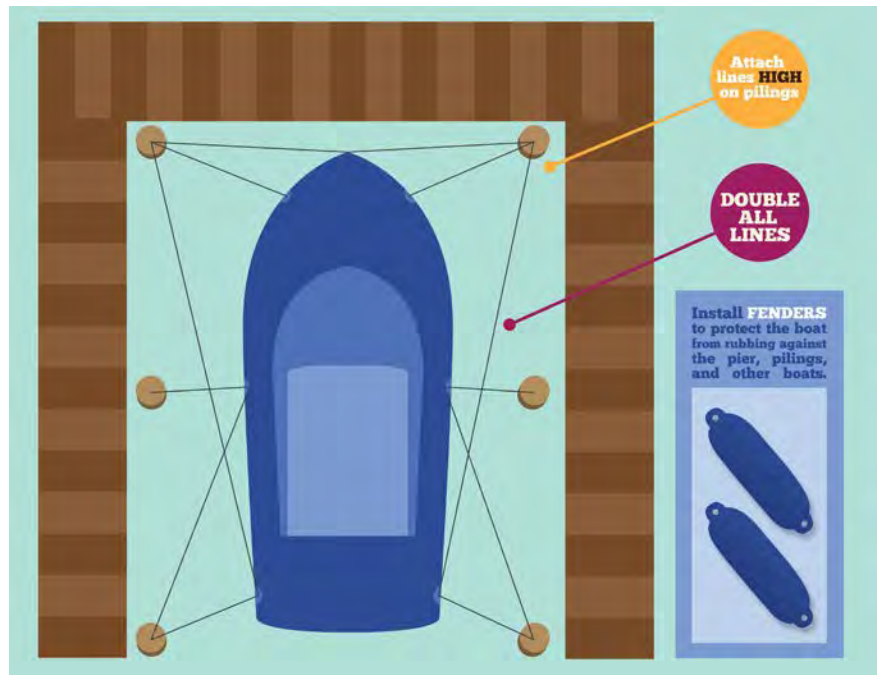
**Non-trailerable Boats:**

If your boat will be moored at a dock or in a marina, a storm surge could cause your boat to bang against the dock or become impaled on the pilings.

- Install heavy-duty fender boards (2"x6") on a bare wood center piling to prevent damage if your boat must remain dockside at a private dock or marina. In addition, acquire fenders of adequate size and strength (for example, old tires are good) to secure to your boat for protection.
- Put some type of preventer at the top of pilings so lines cannot slip off; for example, attach a 2" by 4" wooden board perpendicularly to the piling.
- Have adequate rope available for storm moorings, whether at dock or otherwise. Use double lines. The second set of lines should be at least one size larger than the normal lines, including spring lines at a dock. Note that nylon line will stretch 5-10% of its length.
- Have adequate materials on hand, such as tape, rags, rubber or vinyl hoses, to cover all lines at rough points and prevent chafing of mooring lines.
- Check bilge pumps to be sure they are in working order.

**CODE ORANGE**

Once a hurricane or tropical storm watch has been issued and gear on your oyster farm has been secured, it is time to implement your plan to secure your boat. If your plan calls for trailering your boat, move it at least 36 hours before the hurricane is estimated to strike the area as there may be possible road closures. In the case of a fast-moving storm, it is recommended that you proceed with tasks associated with final stages of preparation.



**FIGURE 1.** Diagrams illustrating how to secure a boat and trailer on land (top) and a non-trailerable boat at a marina or dock (bottom). Images courtesy of Florida Sea Grant.

**Trailerable Boats:**

- Store your boat in a garage or building if you can. If not, place your boat in a location away from power lines, trees, or other objects that can fall on it.
- Lash your boat to the trailer, and place blocks between the frame members and the axle inside each wheel (Figure 1).
- Secure your boat with heavy lines to fixed objects. Because hurricane winds rotate and change direction, try to pick a location that allows you to secure the boat from four directions. It can be tied down to screw anchors secured in the ground (Figure 1).

- Remove the battery to eliminate the risk of fire or other damage.
- Consider letting out about half the air in the tires for lightweight boats and fill your boat one-third full of water to help hold it down. You may also install drain plugs so rainwater can accumulate in the boat.

**Non-trailerable Boats:**

- Secure your boat at a marina by doubling all lines and rig spring lines to cross fore and aft (Figure 1).
- Attach lines high on pilings to allow for tidal rise or surge, and make sure lines will not slip off pilings. Inspect pilings, and choose those that seem strongest and tallest and are properly installed.
- Provide chafing protection for all lines to protect them from wear at contact points.
- Check that batteries are fully charged and can run automatic bilge pumps for the duration of the storm. Consider backup batteries, and turn off all other devices consuming electricity.
- Remove all movable equipment, and lash down everything that cannot be removed.
- Do not raft boats together at moorings or docks, especially if larger and smaller boats are involved. The probability of damage to boats is greater if they are rafted together.
- If placing your boat in dry storage, lash your boat to its cradle with heavy lines. Remove drain plugs so accumulated water will drain and prevent the lift from collapsing. Never leave a boat in davits or on a hydro-lift.

**CODE RED**

When a hurricane or tropical storm warning has been issued, you must finalize your preparations if, and only if, you can accomplish them safely. Growers and employees must make a series of personal risk assessments. If a final inspection of your oyster farm is necessary, there will be limited time to secure your boat.

- Make sure all preparations are in place, and immediately take measures to secure your boat after checking the farm.

This information was modified from *The Disaster Handbook* published by the University of Florida/ Institute of Food and Agricultural Sciences, IFAS publications DPR-0718, DPR-0719, and DPR-0726, August 2005. To learn more about how to secure your boat during a hurricane, browse the following resources used in this fact sheet:

- **The BoatU.S. Guide to Preparing Boats & Marinas for Hurricanes**  
[www.boatus.com/hurricanes/HurricaneWarning.pdf](http://www.boatus.com/hurricanes/HurricaneWarning.pdf)
- **Hurricane Preparedness for Boat Owners, University of Florida/IFAS**  
[www.flseagrant.org/wp-content/uploads/DPR-0718-web.pdf](http://www.flseagrant.org/wp-content/uploads/DPR-0718-web.pdf)

- Do not stay aboard any boat during a hurricane or tropical storm. If you have taken all the precautions previously outlined, you have done all that can be done in anticipation of the storm.
- Stay in a protected and safe place. Stay tuned to news broadcasts and weather advisories concerning the storm so that you will know when the danger has passed.

**POST-STORM RECOVERY**

Oyster growers must be ready to take care of their farms as soon as it is safe and reasonable to do so. After a storm has passed, the following tasks should be considered.

- Check the condition and security of your boat before attempting to move, start, or operate it. If damage has occurred, document with photographs and contact your insurance agent.
- Check with local information sources regarding access to boat ramps in the vicinity of your farm. Authorities may limit access in heavily damaged areas.
- Assess the risks of inspecting your oyster farm, and proceed when safe. Watch carefully for obstructions and loose debris in the water. Markers and other aids to navigation may be missing.

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