



# Alabama Oyster Management and Oyster Reef Restoration Strategy



8-9-2023  
Presentation  
GSMFC  
State of the Gulf Oyster Meeting

Image NOAA  
Image © 2016 TerraMetrics

Go

# Goal of Today's Presentation

To provide information about:

- The role of AMRD and the Alabama Department of Public Health (ADPH) in oyster management
- The status of Alabama's Public Oyster Reefs
- How AMRD manages oyster harvest
- Oyster Reef Restoration Techniques Past, Present, Future  
**Implementing the Coastal Alabama Comprehensive Restoration Strategy**
- The Coastal Alabama Comprehensive Oyster Restoration Strategy as it relates to ongoing oyster reef restoration activities by the Alabama Marine Resources Division (AMRD)

# Oysters and Oyster Reefs

## Multiple Levels of Importance



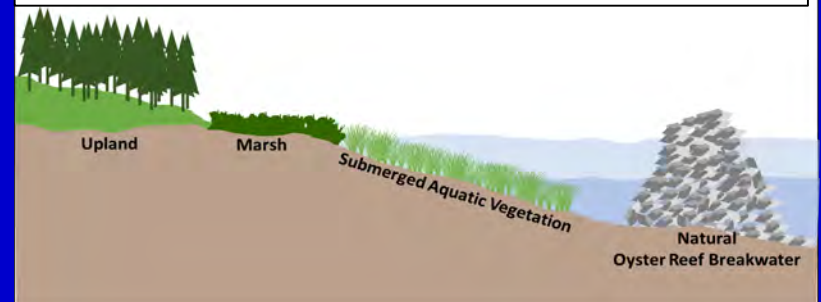
### Finfish and Invertebrate Habitat / Foraging Grounds



### Harvested Commercially and Recreationally



### Filter Water, Shoreline Stabilization, Erosion Control, Support Marsh and Seagrass Habitats



# Oyster Reef Management



## Alabama Marine Resources Division (AMRD)

### AMRD Fisheries

- Collect Fisheries Dependent and Independent Data
- Oyster management includes reef productivity and harvest monitoring
- Planning and Execution of Reef Restoration Projects

### AMRD Enforcement

- Enforce Laws and Regs pertaining to catch and size limits and laws established by the Alabama Department of Public Health (ADPH)
- Oyster management includes patrol of harvest areas, enforcement of sack limits, monitoring no harvest zones, confiscation and handling of oysters harvested/ handled outside of legal compliance



## Alabama Department of Public Health (ADPH)

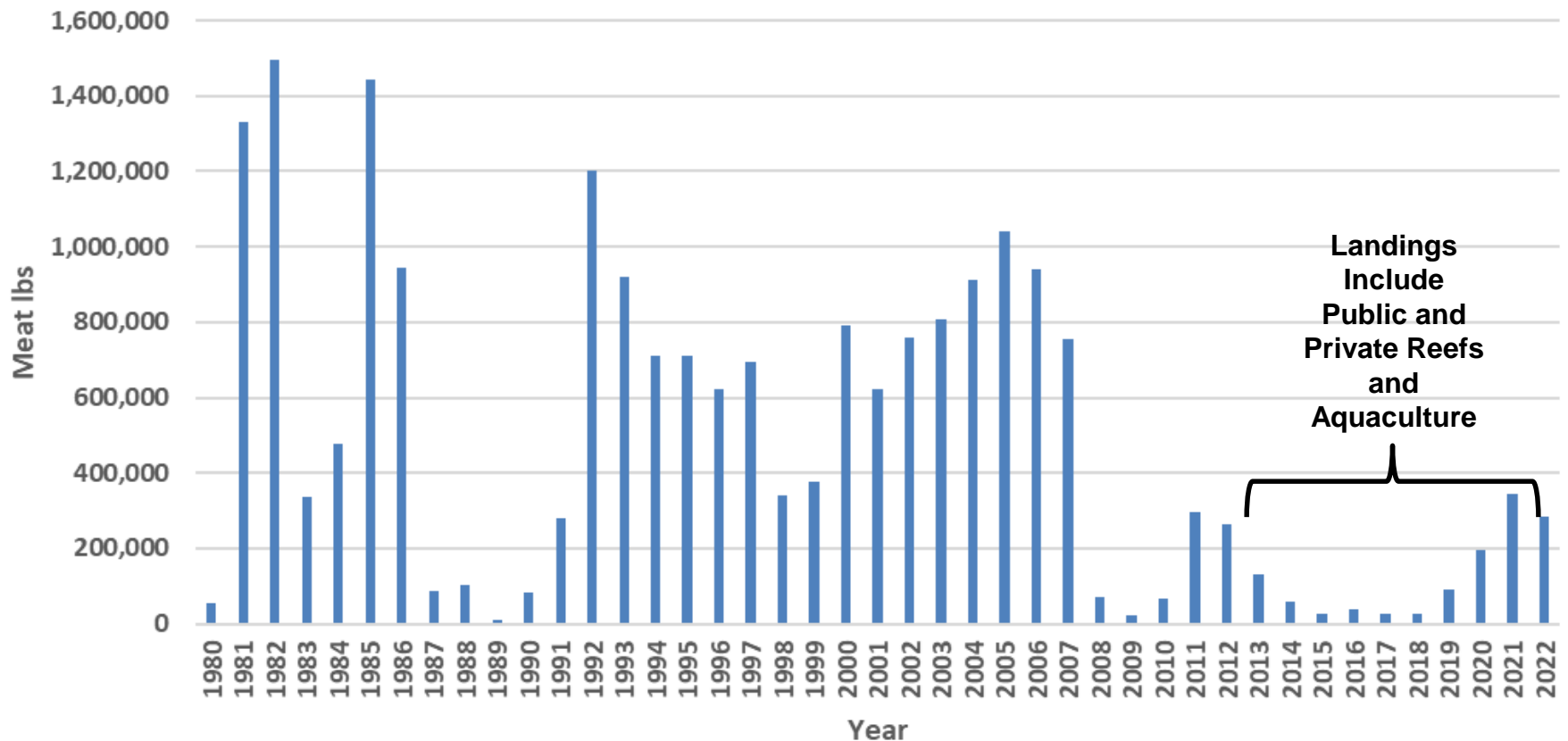
- Setting harvest/landing time limits based on seasonal water and air temperatures (and other parameters)
- Inspection of seafood dealers / processors for compliance in product handling
- Facilitating Shellfish Harvest Area Openings and Closings based on potential health risk criteria

# Alabama's Main Oyster Reefs



# Oyster Landings 1980 – 2022

## Alabama Commerical Oyster Landings in Meat lbs. 1980 - 2022



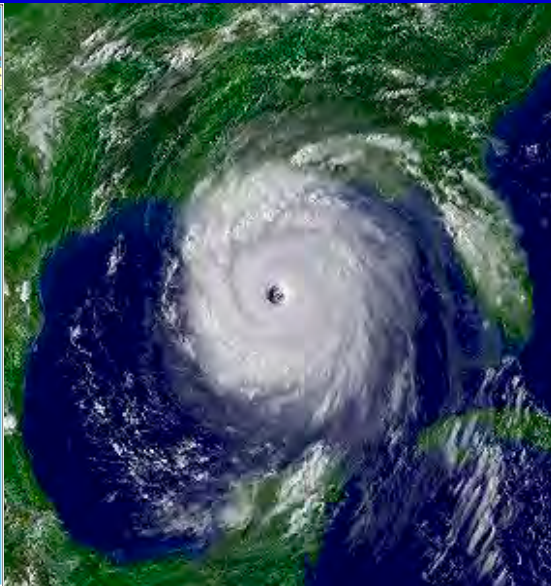
# Status of Alabama Oyster Reefs



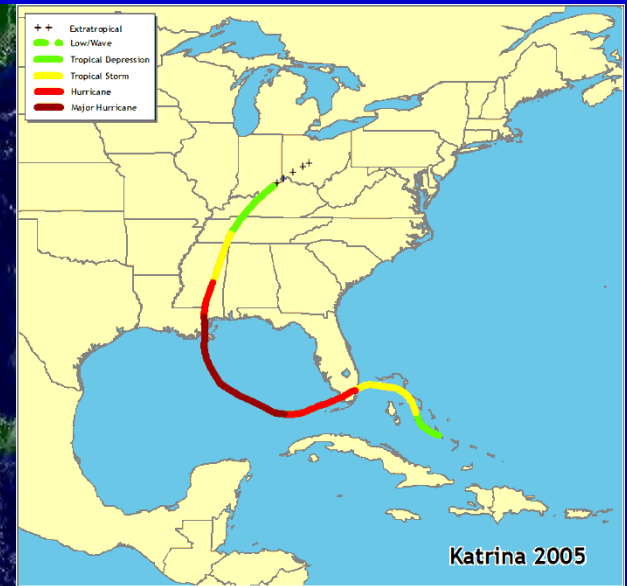
Harvest Season	# Days	# Sacks	Sacks/Day
Fall 2011 - Spring 2012	38	48,581	1,278.4
Fall 2012 - Spring 2013	81	42,047	519.1
Fall 2013 - Spring 2014	63	12,274	194.8
Fall 2014 - Spring 2015	56	7,151	127.7
Fall 2015 - Spring 2016	13	369	28.4
Fall 2016 - Spring 2017	35	1,280	36.6
Fall 2017 - Spring 2018	6	136	22.7
Fall 2018 - Spring 2019	0	0	0.0
Fall 2019 - Spring 2020	36	11,333	314.8
Fall 2020 - Spring 2021	47	22,070	469.6
Fall 2021 - Spring 2022	79	50,020	633.2
Fall 2022 - Spring 2023	61	44,409	732.0

# Hurricanes, Droughts, and Drills

Ivan



Katrina



## Hurricanes Caused:

- Physical Devastation to Oyster Reefs
- Silting to Occur on Many Productive Reefs

## Drought Caused:

- Decreased Fresh Water Flows Over Reefs
- Increased Average Salinity on Alabama's Main Oyster Reefs
- Ideal Conditions for Oyster Drills to Proliferate and Decimate Oyster Reefs



*Stramonita haemastoma*

# Drill Predation



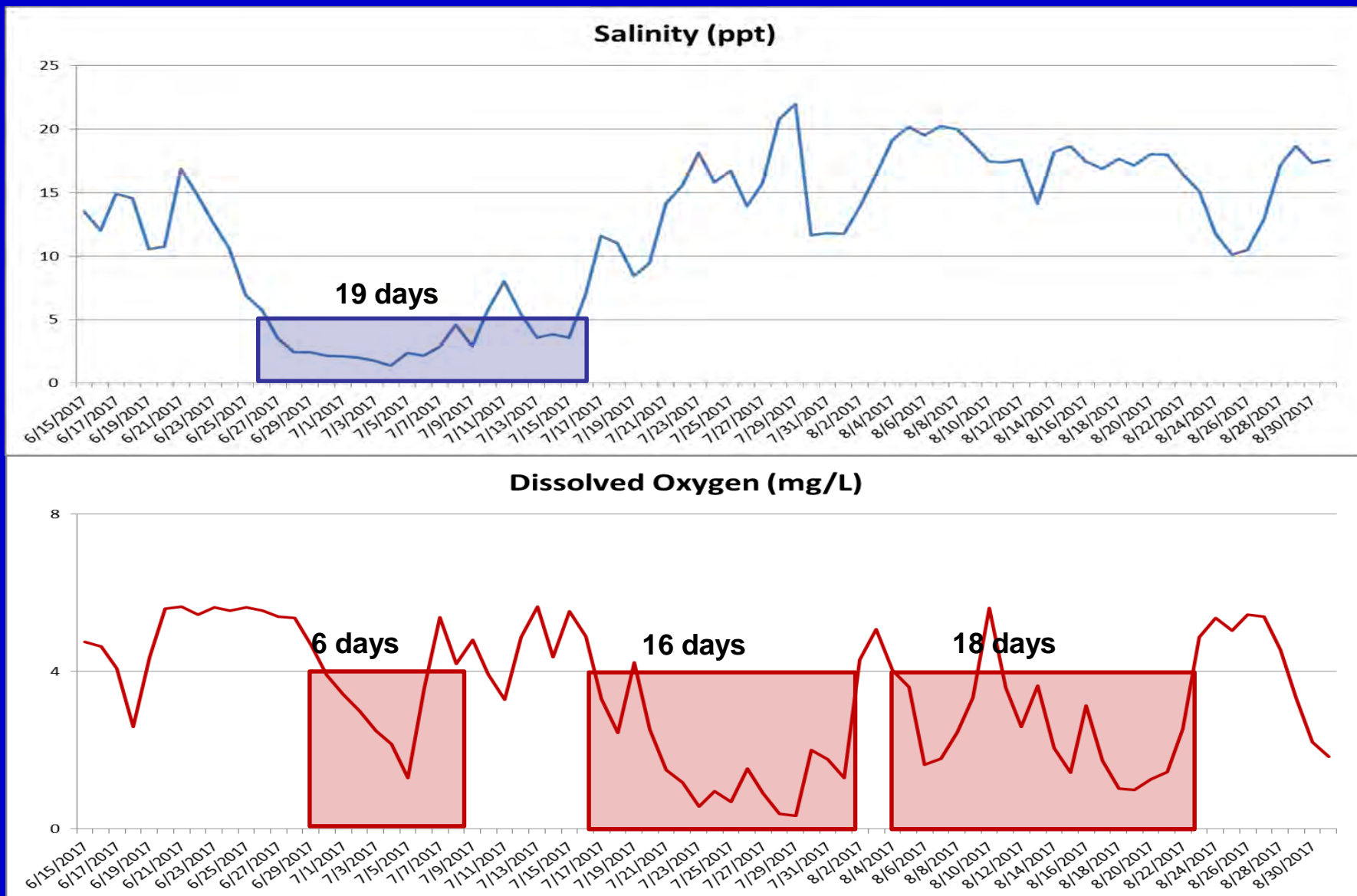
# Deepwater Horizon Oil Spill

## U.S. Coastal Waters Affected by the Gulf Oil Spill



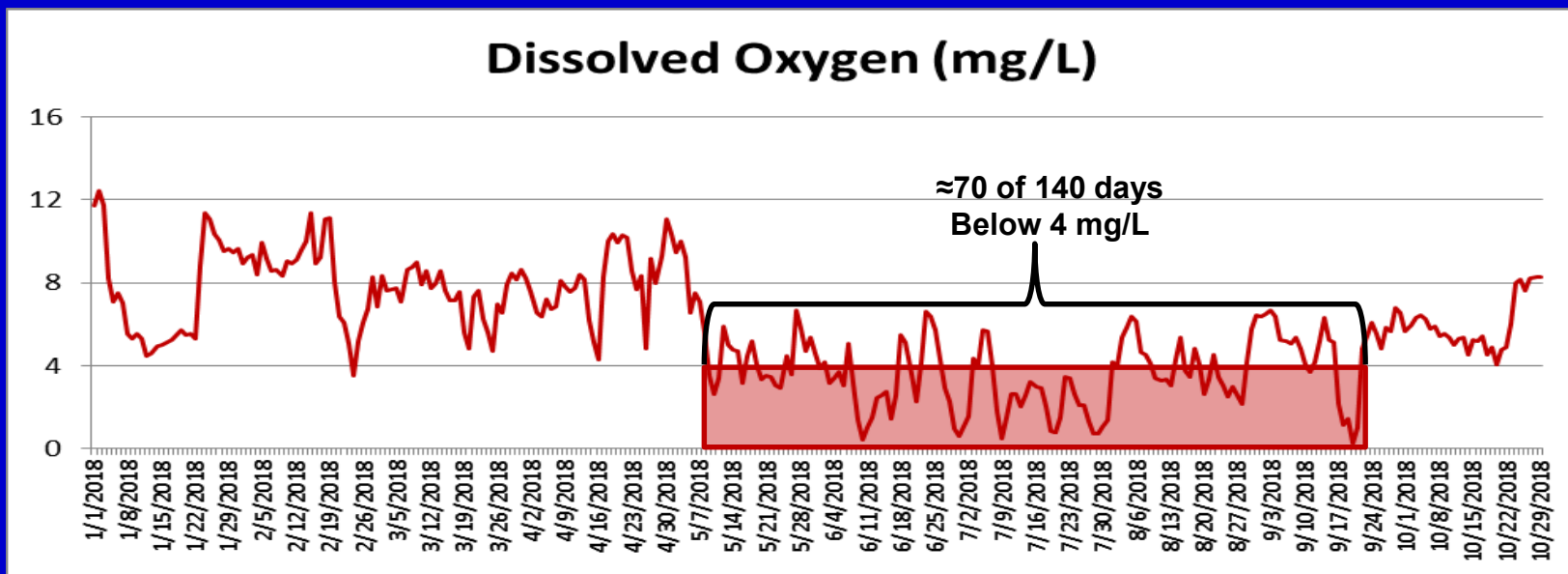
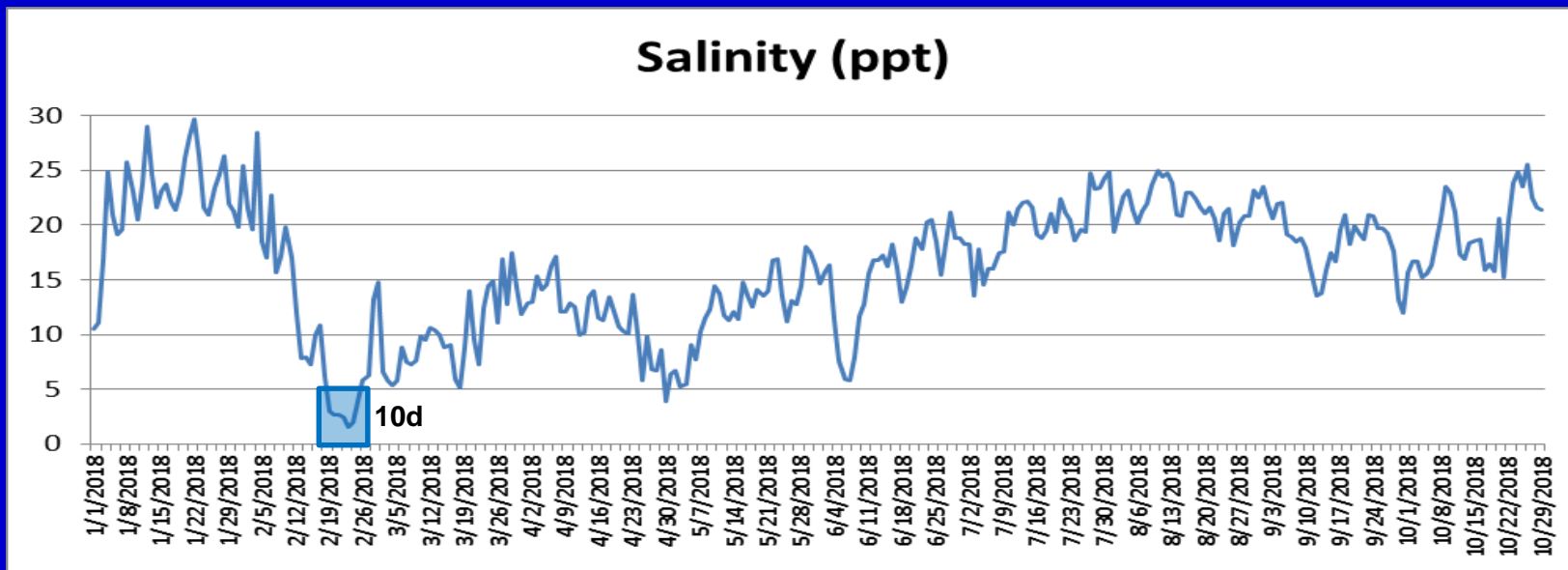
# Salinity and Dissolved Oxygen Levels

## Buoy Reef Jun 15, 2017 – Aug 31, 2017



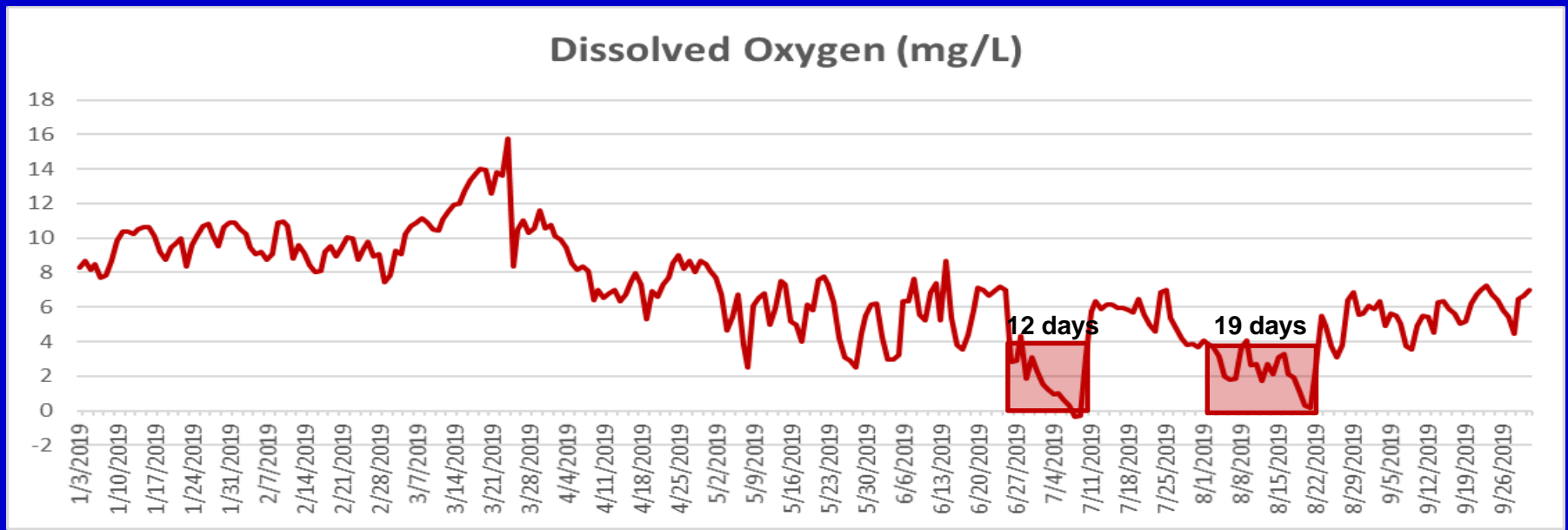
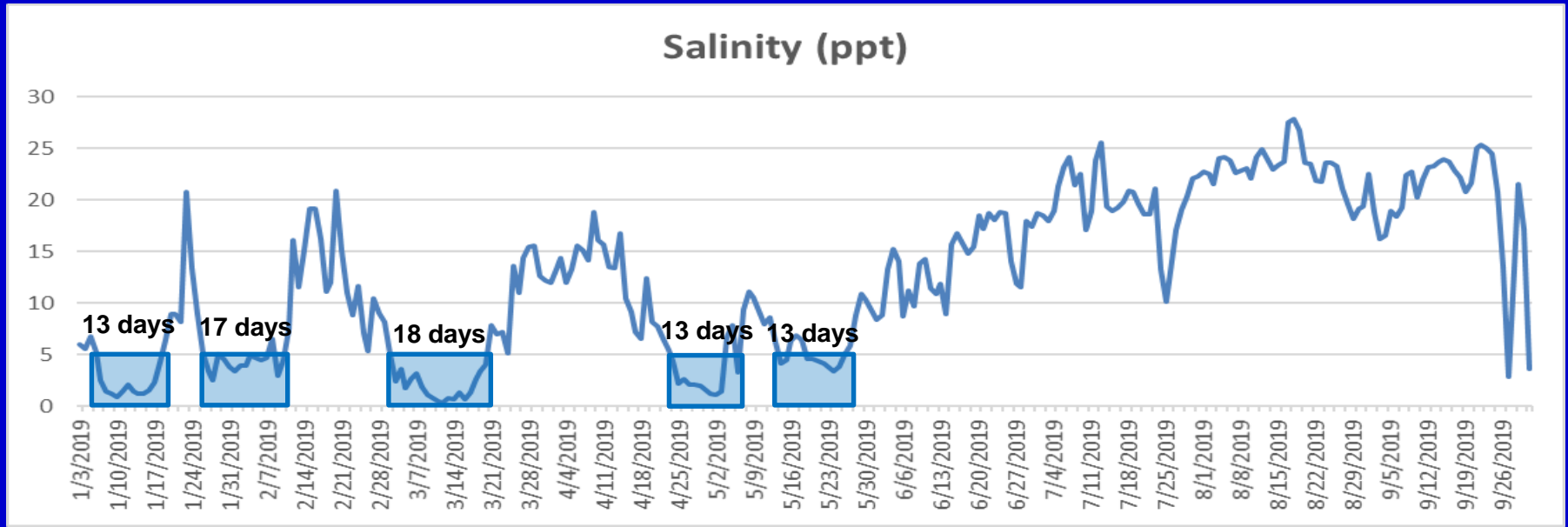
# Salinity and Dissolved Oxygen Levels

## Buoy Reef Jan 1, 2018 – Oct 29, 2018



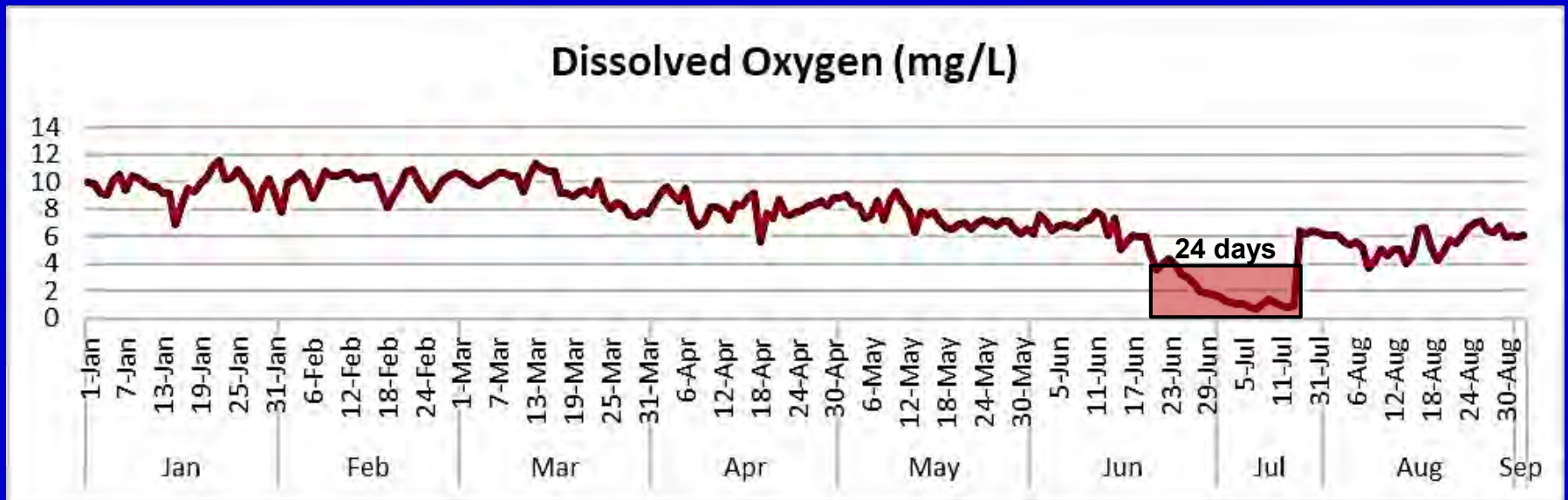
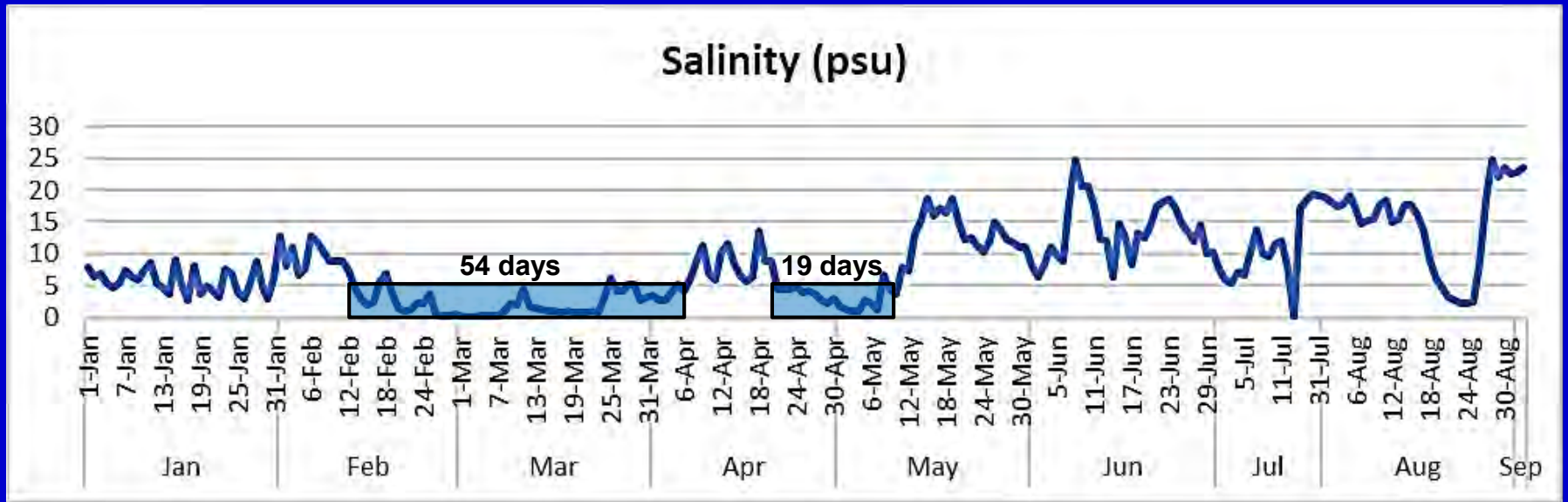
# Salinity and Dissolved Oxygen Levels

## Buoy Reef Jan 3, 2019 – Oct 1, 2019

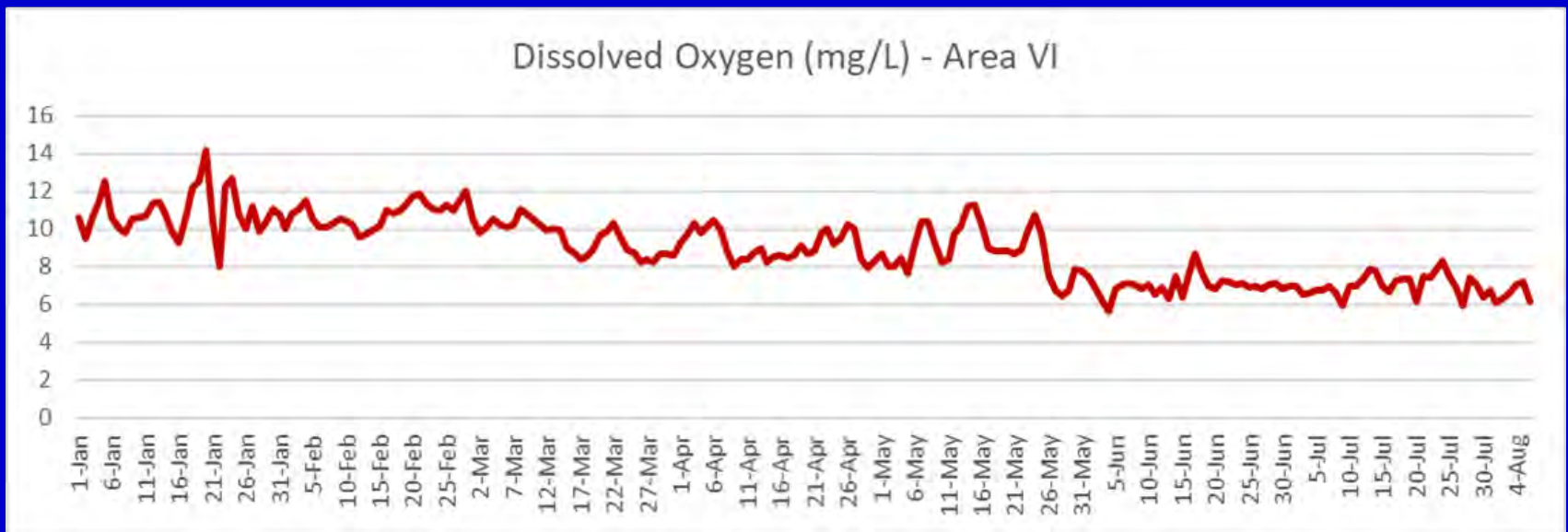
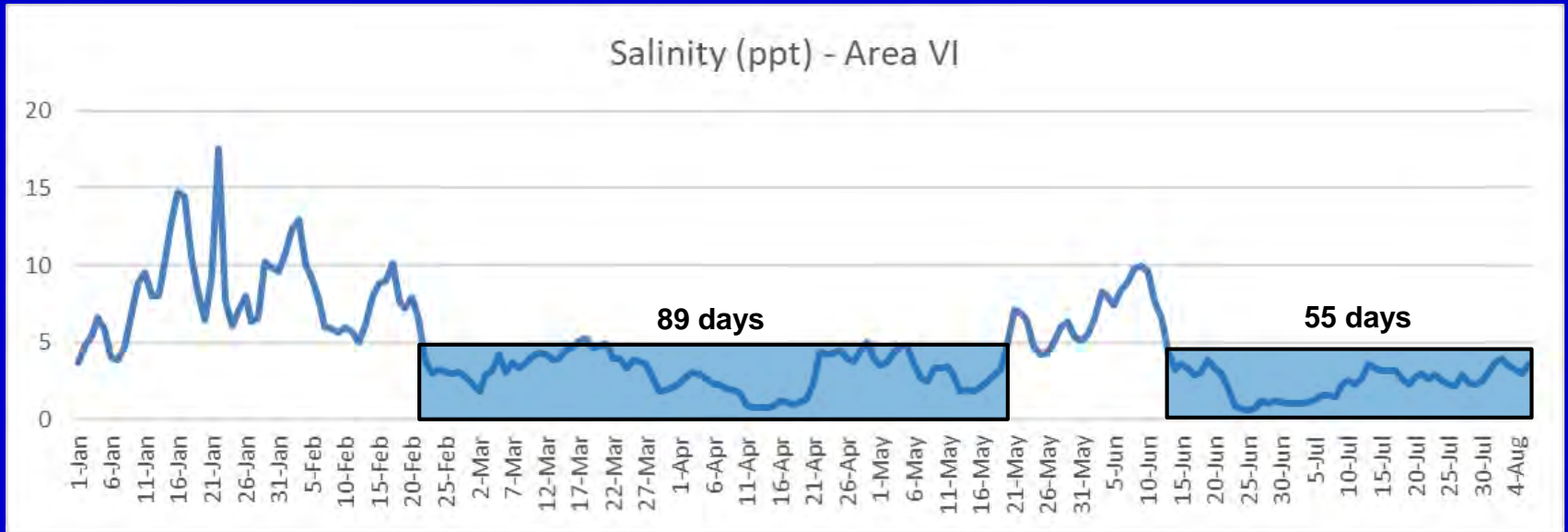


# Salinity and Dissolved Oxygen Levels

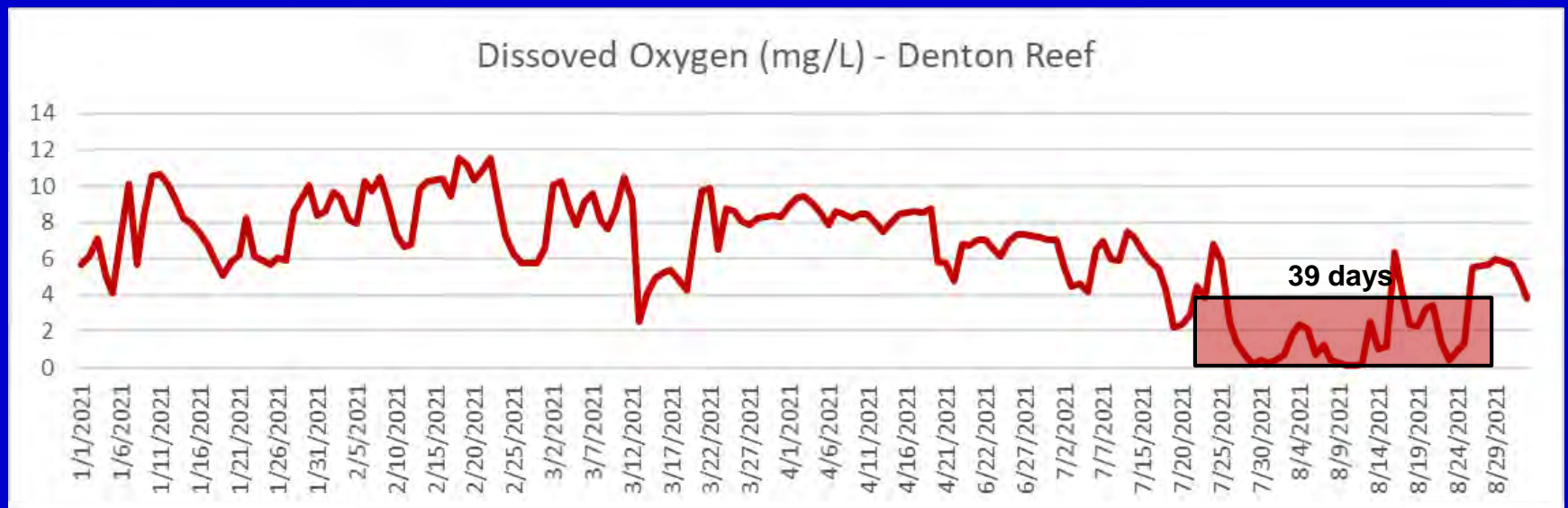
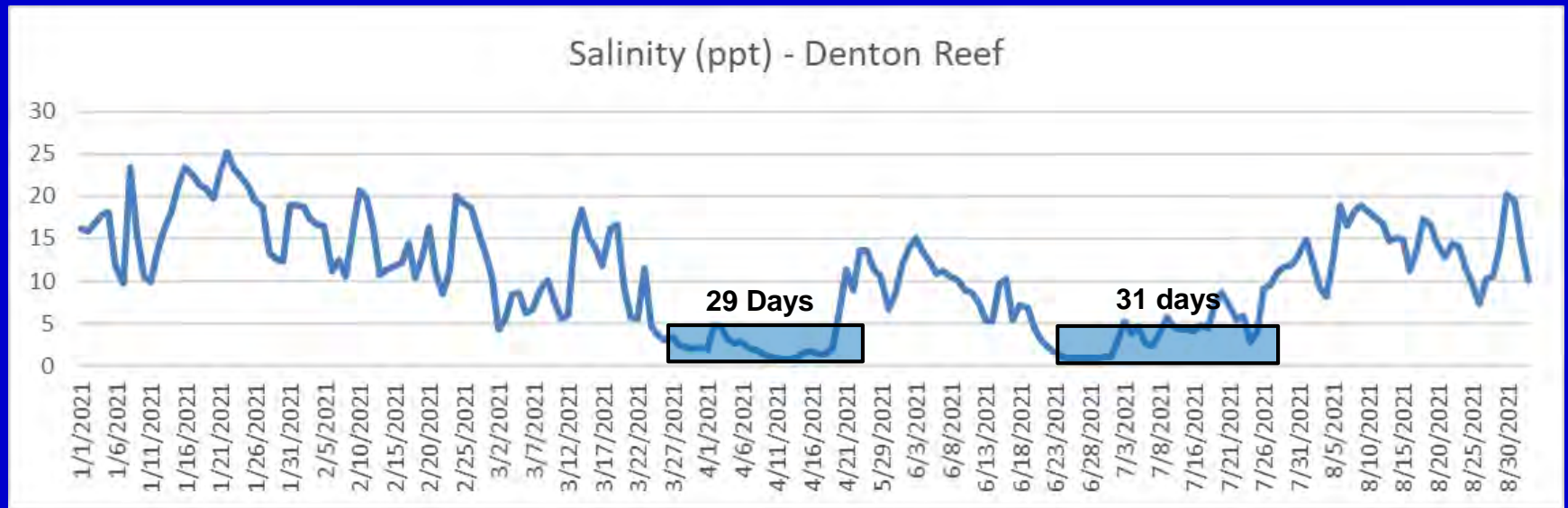
Cedar Point Jan 1, 2020 – Sep 2, 2020



# Salinity and Dissolved Oxygen Levels East Fowl River Jan 1, 2021 – Aug 6, 2021



# Salinity and Dissolved Oxygen Levels Denton Reef Jan 1, 2021 – Sep 2, 2021



# Salinity and Dissolved Oxygen Levels Cedar Point Pier Jan 3, 2022 – Sep 8, 2022

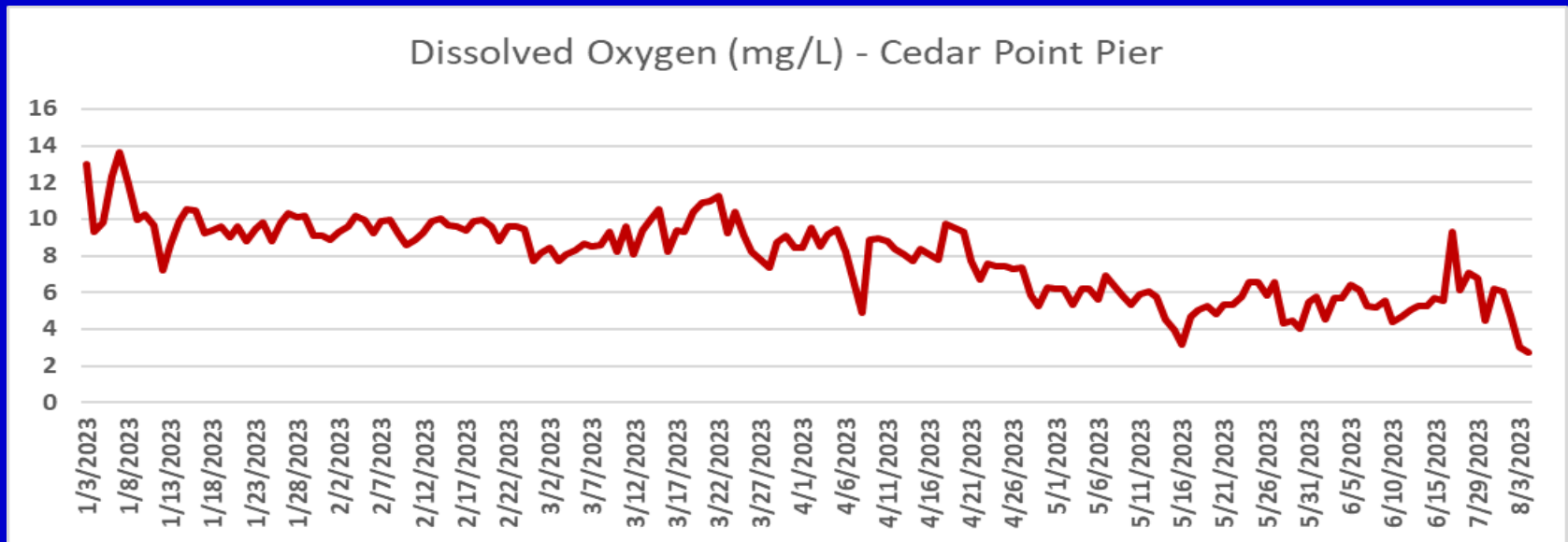
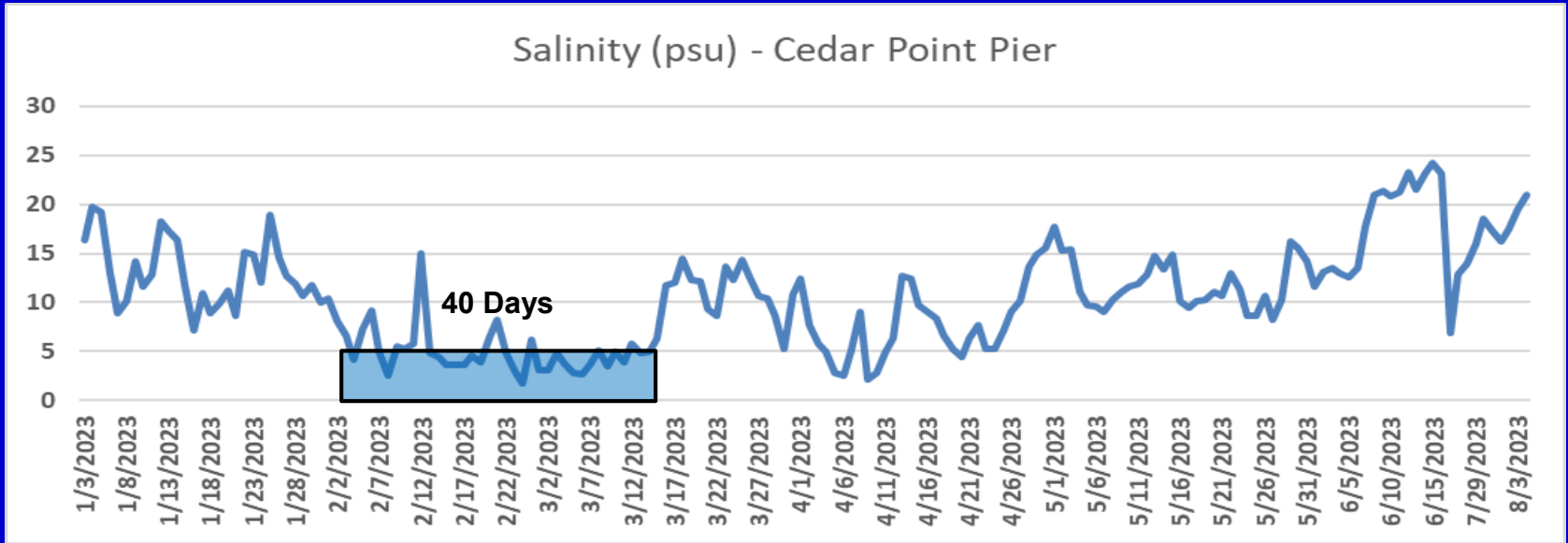
## Salinity (psu) – Cedar Point Pier



## Dissolved Oxygen (mg/L) - Cedar Point Pier



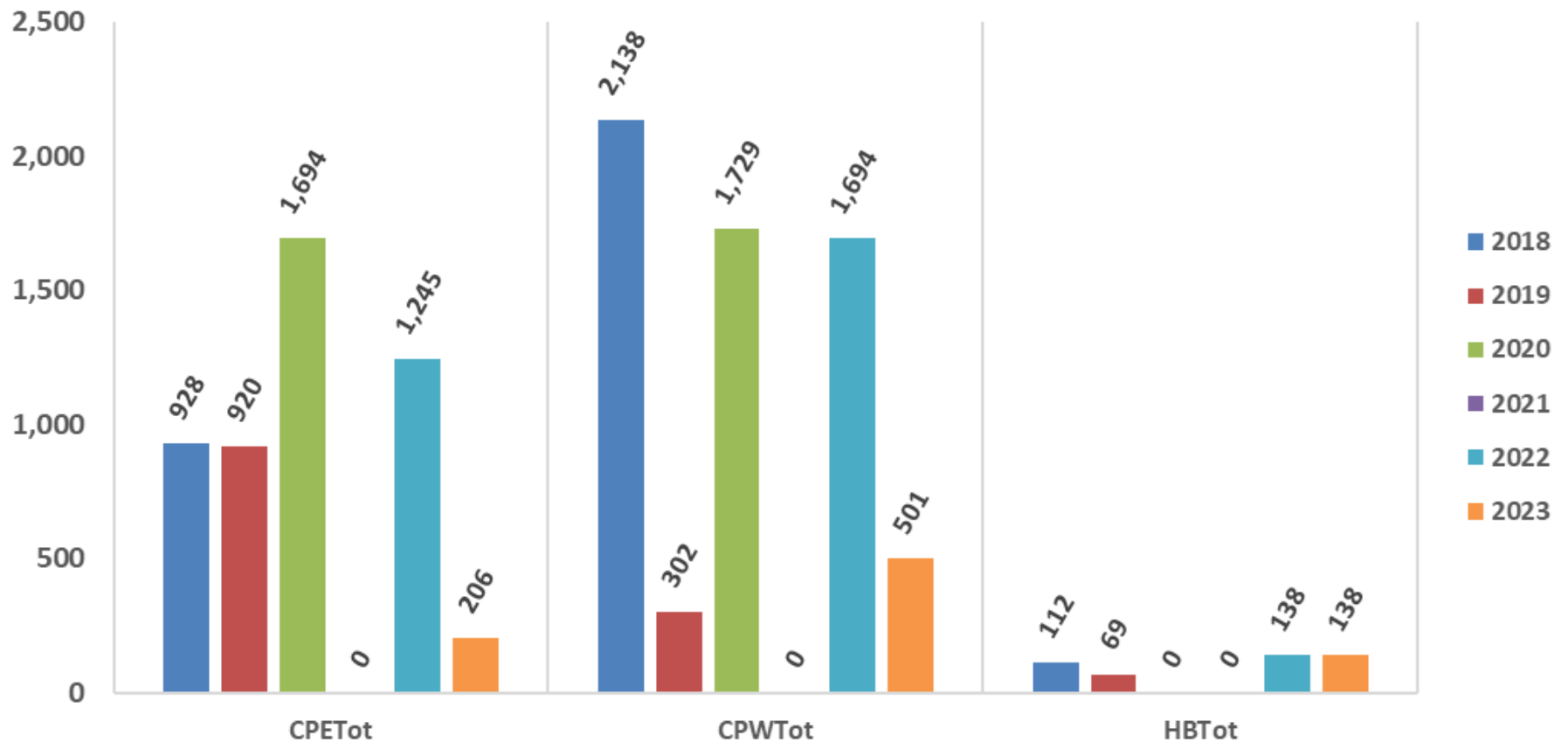
# Salinity and Dissolved Oxygen Levels Cedar Point Pier Jan 3, 2023 – August 4, 2023



# Oyster Drills / Acre

## Quadrat Dives 2018 - 2023

Oyster Drills / Acre  
Cedar Point East, Cedar Point West, Heron Bay  
Quadrat Dives 2018 - 2023



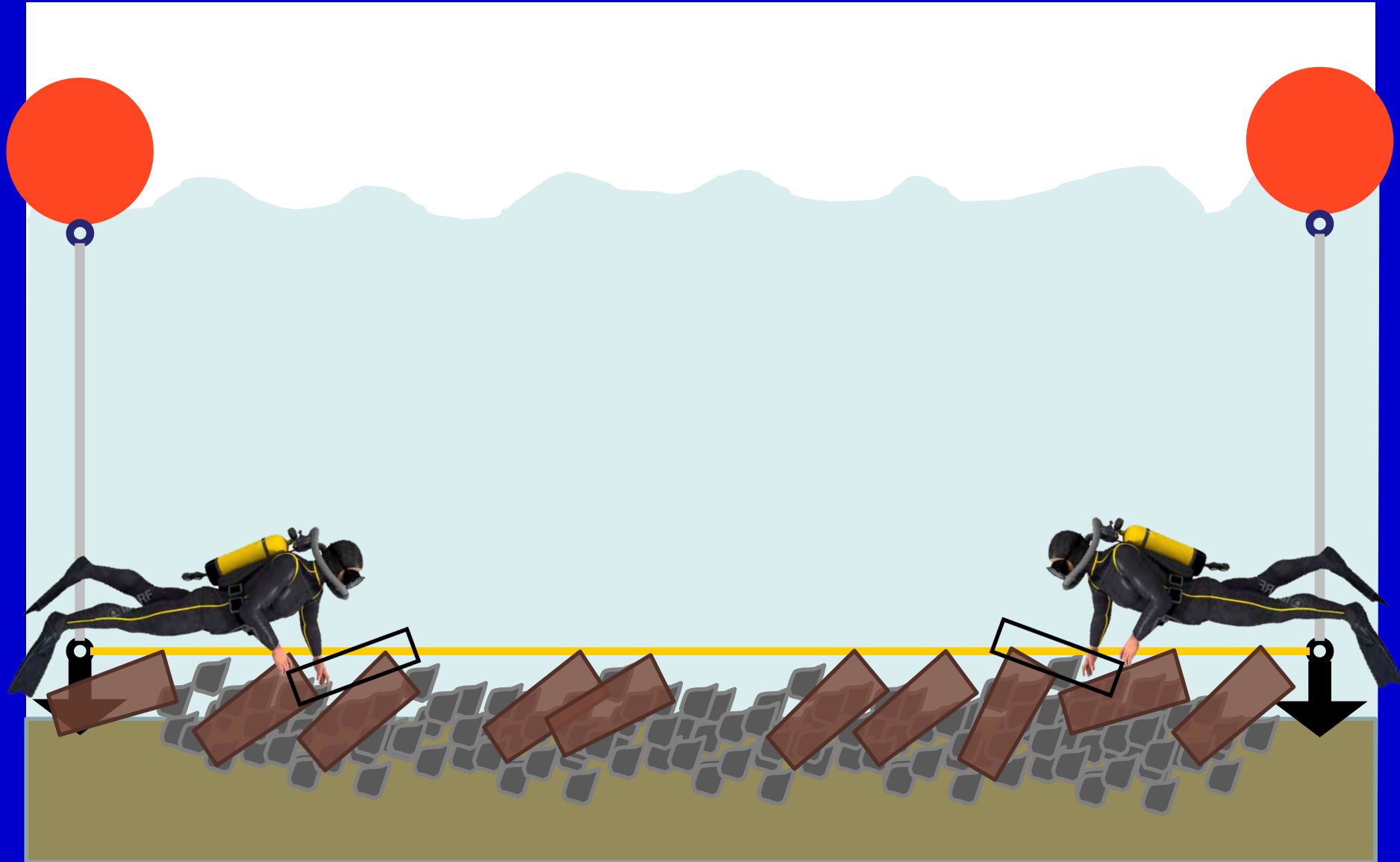
# Oyster Reef Assessment

## Annual SCUBA Quadrat Dives:

- To determine oyster density on public reefs
- To set initial harvest goal for season

# SCUBA Quadrat Sampling

(not to scale, enhanced water clarity)



# SCUBA Quadrat Sampling

(not to scale, water clarity... about right)



# Quadrat Sample Processing



# Additional Oyster Reef Sampling Techniques



**Hand Dredge**



**Hydraulic  
Patent Tongs**



# Harvest Monitoring

**Flexible Harvest Goal utilizing:**

- **Oyster Management Station**
- **Reef Grid System**
- **On-water Harvester Surveys**

# Laws and Regulation Changes Implemented 2011

Public Reef Harvest Season Closed May 1 – Sept 31

Establishment of Oyster Management Stations



# Oyster Management Station



**Alabama Oyster Management Station Card**

DOB: [REDACTED] Seafood ID#: 1234

251-555-1234 Phone #

Herrmann Jason E. Jr.  
Last First MI Suf

\*\* see reverse for instructions regarding the use of this card

**ALABAMA OYSTERS**

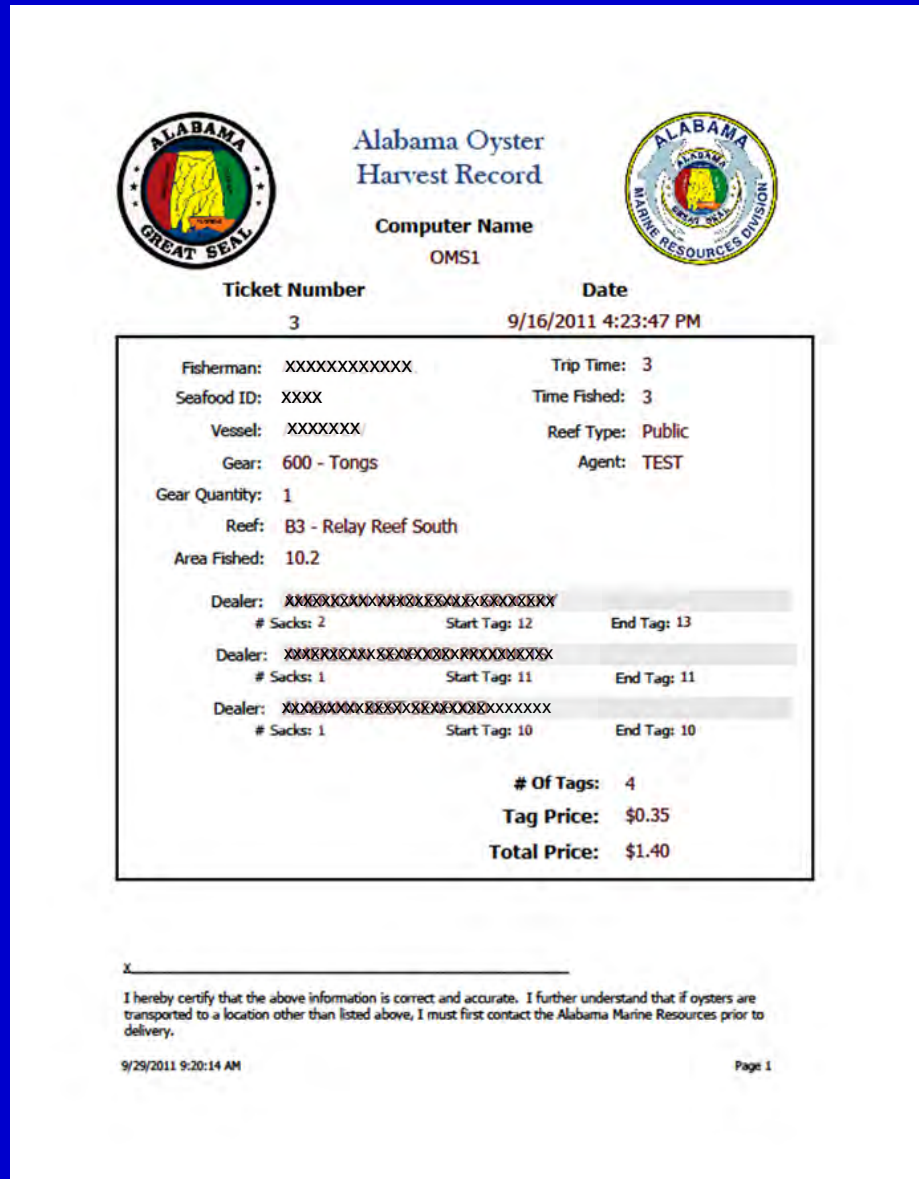
**RESTRICTED USE; FOR SHUCKING BY A CERTIFIED DEALER OR PIP ONLY**

DATE OF HARVEST	HARVESTER ID#	TAG IS REQUIRED TO BE ATTACHED TO EACH SACK OF OYSTERS AT TIME OF LANDING. INFORMATION MUST BE COMPLETE AND LEGIBLE. FAILURE TO PROPERLY COMPLETE EACH TAG CAN RESULT IN CONFISCATION OF OYSTERS AND A FINE UP TO \$500.00
TIME OF LANDING	LOCATION	
DEALER NAME		TAG IS REQUIRED TO BE ATTACHED UNTIL CONTAINER IS EMPTY OR RETAGGED AND THEREAFTER KEPT ON FILE FOR 90 DAYS.
CRASSOSTREA VIRGINICA / ONE SACK		

**ALABAMA OYSTERS**

**TAG IS REQUIRED TO BE ATTACHED UNTIL CONTAINER IS EMPTY OR RETAGGED AND THEREAFTER KEPT ON FILE FOR 90 DAYS.**

DATE OF HARVEST	HARVESTER ID#	TAG IS REQUIRED TO BE ATTACHED TO EACH SACK OF OYSTERS AT TIME OF LANDING. INFORMATION MUST BE COMPLETE AND LEGIBLE. FAILURE TO PROPERLY COMPLETE EACH TAG CAN RESULT IN RESTRICTED USE OR CONFISCATION OF OYSTERS AND A FINE UP TO \$500.00
TIME OF LANDING	LOCATION	
DEALER NAME		TAG IS REQUIRED TO BE ATTACHED UNTIL CONTAINER IS EMPTY OR RETAGGED AND THEREAFTER KEPT ON FILE FOR 90 DAYS.
CRASSOSTREA VIRGINICA / ONE SACK		



**Alabama Oyster Harvest Record**

Computer Name: OMS1

Ticket Number: 3 Date: 9/16/2011 4:23:47 PM

Fisherman: XXXXXXXXXXXX	Trip Time: 3
Seafood ID: XXXX	Time Fished: 3
Vessel: XXXXXXXX	Reef Type: Public
Gear: 600 - Tongs	Agent: TEST
Gear Quantity: 1	
Reef: B3 - Relay Reef South	
Area Fished: 10.2	
Dealer: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	
# Sacks: 2	Start Tag: 12 End Tag: 13
Dealer: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	
# Sacks: 1	Start Tag: 11 End Tag: 11
Dealer: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	
# Sacks: 1	Start Tag: 10 End Tag: 10
<b># Of Tags: 4</b>	
<b>Tag Price: \$0.35</b>	
<b>Total Price: \$1.40</b>	

I hereby certify that the above information is correct and accurate. I further understand that if oysters are transported to a location other than listed above, I must first contact the Alabama Marine Resources prior to delivery.

9/29/2011 9:20:14 AM Page 1

# OMS Overview: Benefits

- To Consumer Safety
- To the Oyster Industry
- To Oyster Reefs

# RECREATIONAL OYSTER HARVEST TAGS

## Implemented 2021

all recreational harvesters must purchase a recreational harvest tag at the Oyster Management Station

**Recreational tags cost \$0.35**

Recreational harvesters may harvest up to 100 legal size oysters per person per day and harvest may only occur during times and in areas open to public harvest.

ALABAMA OYSTERS		XXXXXXX
<b>RECREATIONAL OYSTER HARVEST TAG</b>		<b>NOT FOR SALE, BARTER, OR TRADE</b>
DATE OF HARVEST	HARVESTER NAME	TAG IS REQUIRED TO BE ATTACHED TO EACH CONTAINER OF OYSTERS AT TIME OF LANDING. INFORMATION MUST BE COMPLETE AND LEGIBLE. FAILURE TO PROPERLY COMPLETE EACH TAG CAN RESULT IN CONFISCATION AND A FINE UP TO \$500.00.
TIME OF LANDING	LOCATION	
RECREATIONAL OYSTER HARVESTERS MAY HARVEST UP TO 100 LEGAL SIZE OYSTERS PER PERSON PER DAY FROM PUBLIC OYSTER REEF S. CULLING RULES APPLY AND WILL BE ENFORCED.		RECREATIONAL OYSTER HARVEST MUST ONLY OCCUR DURING TIMES AND IN AREAS THAT ARE OPEN TO COMMERCIAL HARVEST.
CRASSOSTREA VIRGINICA		

**2021 Rec Harvest**  
**1,177 rec sacks**  
(equivalent to 706 com sacks)

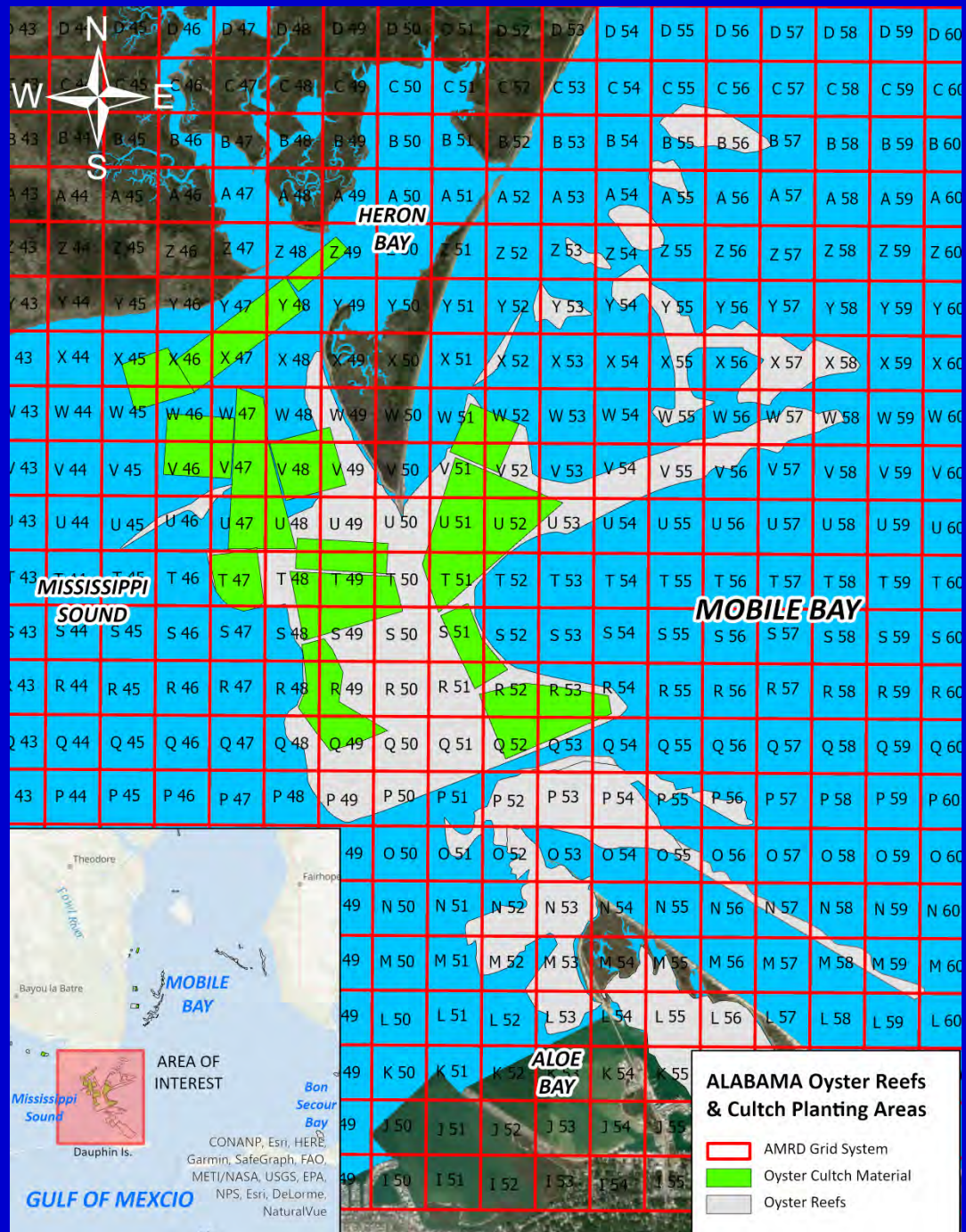
**2022 Rec Harvest**  
**562 rec sacks**  
(equivalent to 337 com sacks)

# Introduced New Reef Grid System in 2020

to help monitor harvest  
and

to reduce  
overharvesting in  
specific areas



with better resolution  
we may be able to  
allow additional  
harvest instead of  
closing large reef  
areas



# AMRD closes blocks of grids when they are harvested sufficiently



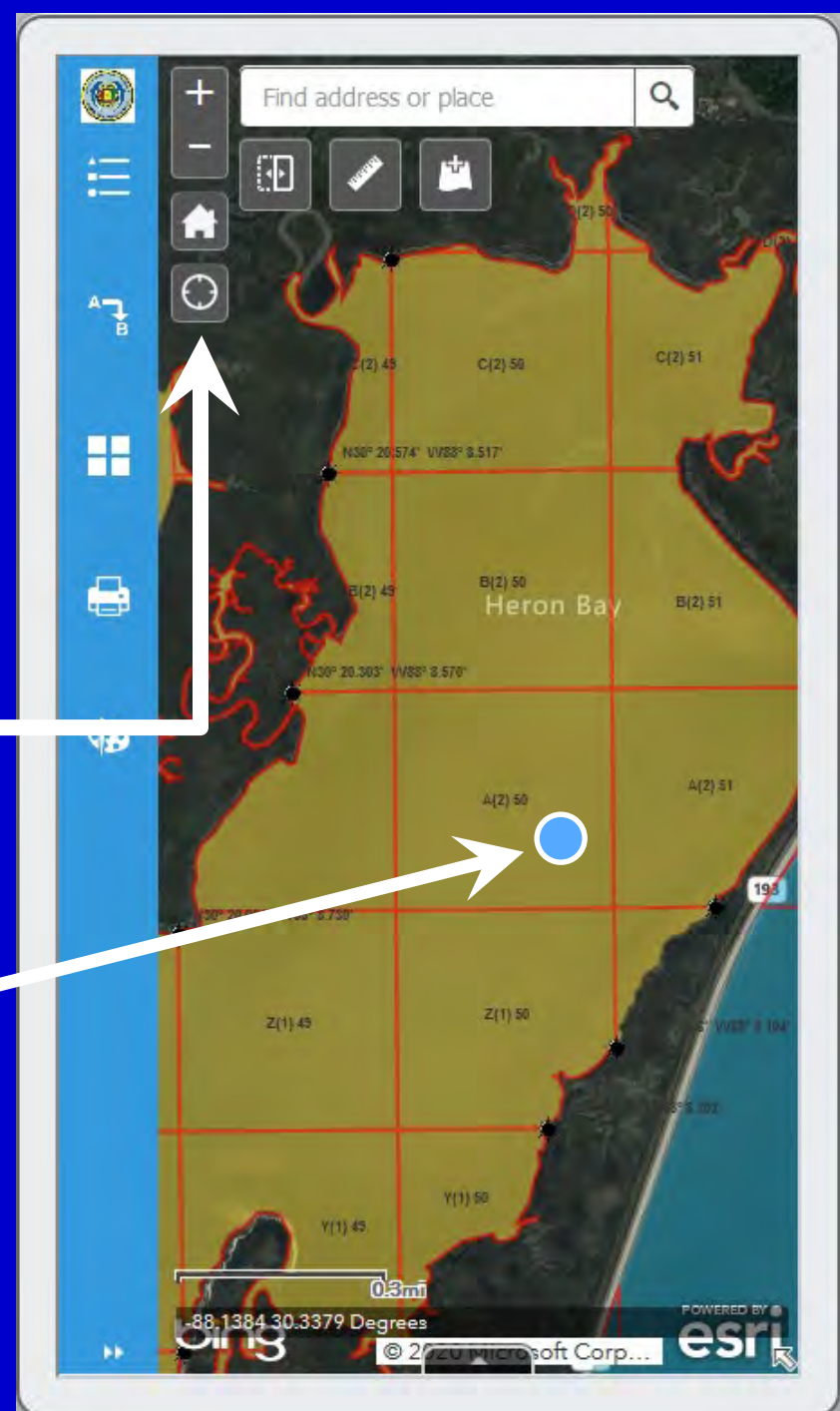
# How do harvesters know they are in the correct grid?

1. Navigate to the following link on your smart phone:  
<https://www.outdooralabama.com/oysterharvest>
2. Push this button at the top of the page  

3. Push the "Target" Button 
4. Follow directions to turn on location
5. Push the "Target" Button again to display position on Map

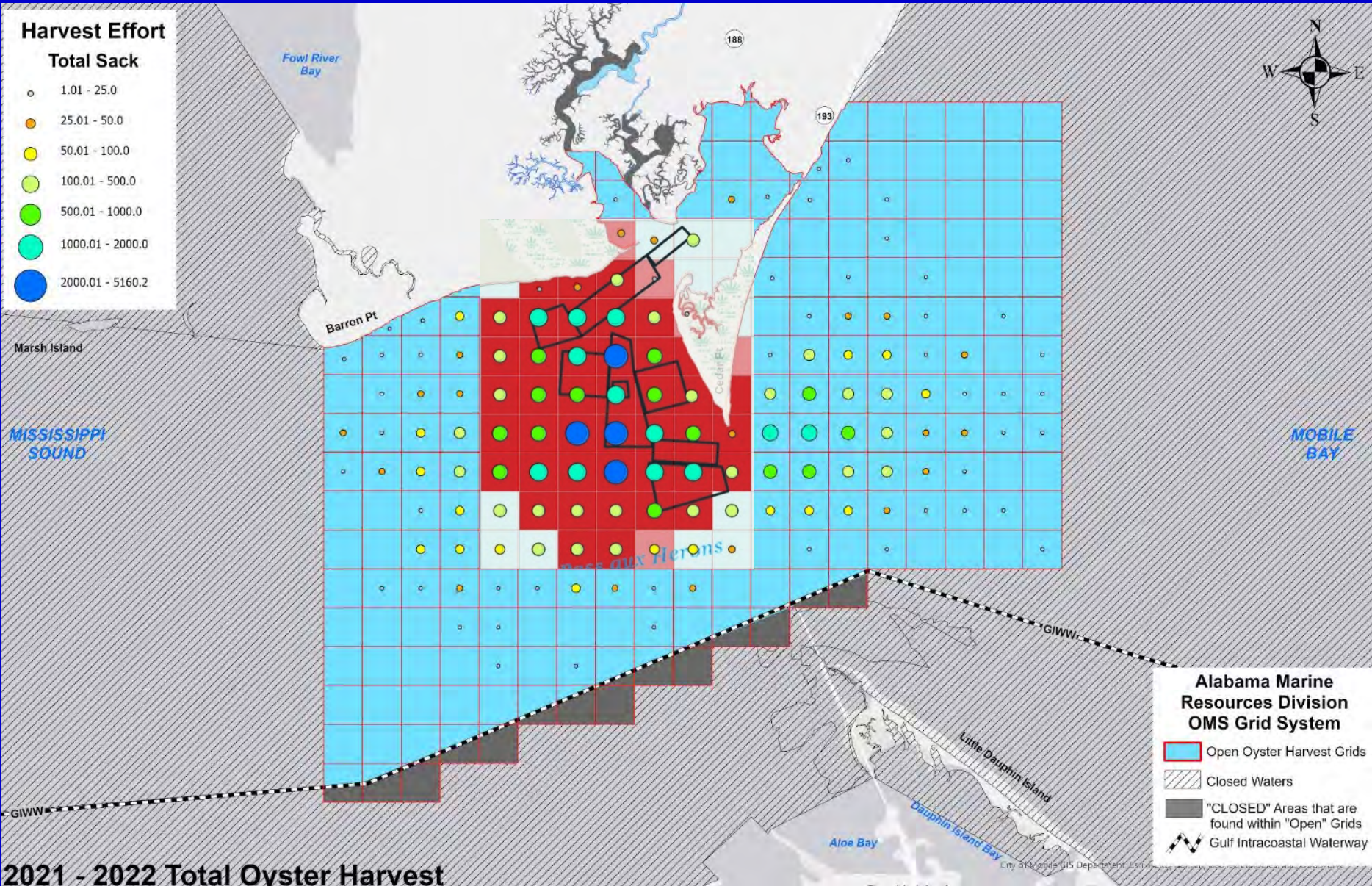
Harvester is the BLUE DOT 

The BLUE DOT  WILL MOVE ON THE MAP WHEN THE HARVESTER MOVES

**Only Open Grids are Displayed**



# Harvester Reports the Grid Harvested



# AMRD Conducts Harvester Surveys

## Purpose of Harvester Surveys:

- Verification of Grids Reported
- Assess harvest status by evaluating oysters and reef material on harvest vessel cull board

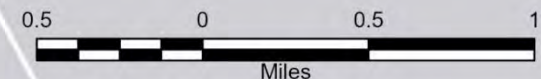
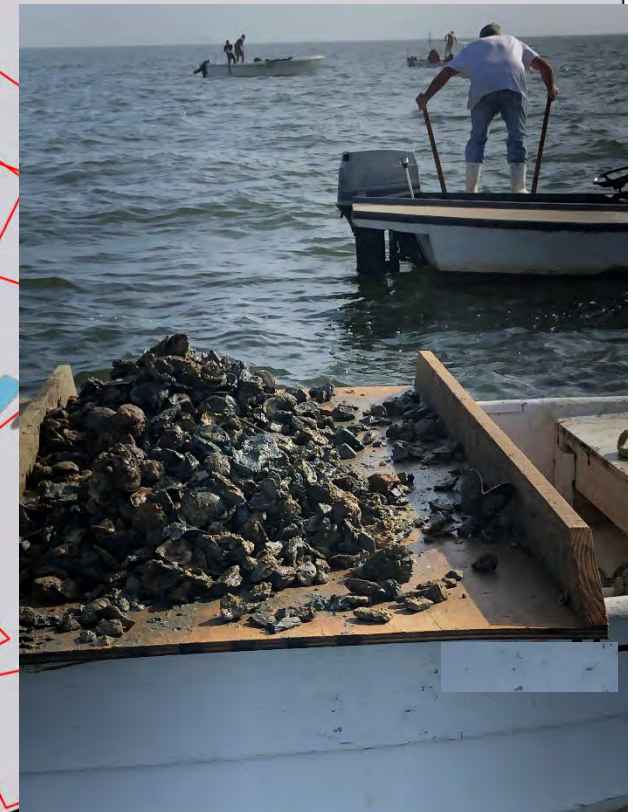


### Harvester\_Surveys\_2021

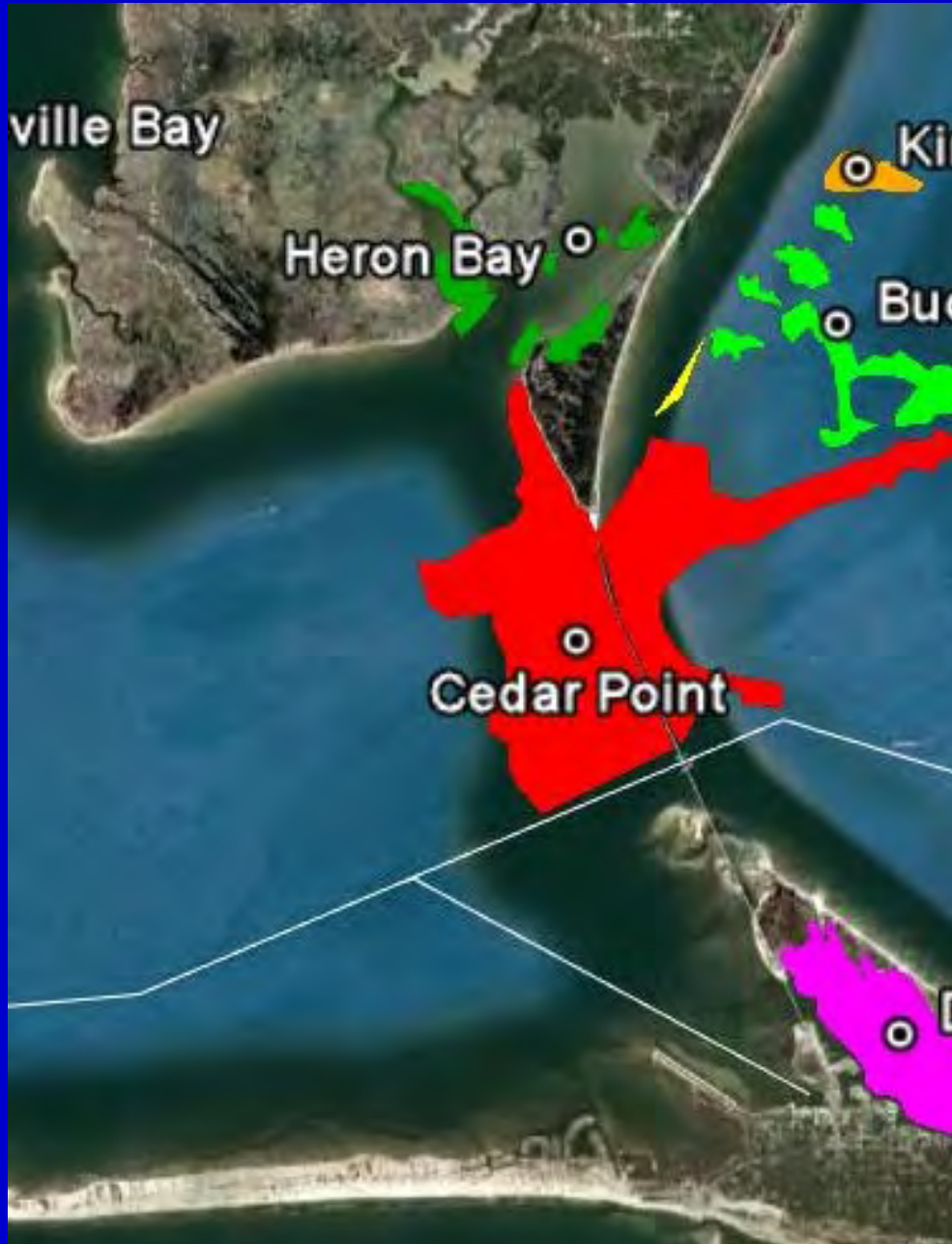
#### Date

- 10/13/2021
- 11/02/2021
- 11/16/2021
- 11/19/2021
- 12/03/2021
- 12/13/2021
- 12/15/2021
- 12/22/2021
- 12/29/2021

- AMRD\_Oyster\_Planting\_Areas
- Intracoastal\_Waterway



# Status of Alabama Oyster Reefs



Harvest Season	# Days	# Sacks	Sacks/Day
Fall 2011 - Spring 2012	38	48,581	1,278.4
Fall 2012 - Spring 2013	81	42,047	519.1
Fall 2013 - Spring 2014	63	12,274	194.8
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# AMRD Oyster Reef Restoration Projects

## Past:

- Cultch Planting
- Oyster Relaying
- Oyster Seed Planting

## Present:

- Cultch Planting
- Oyster Relaying
- Oyster Seed Planting
- Experimental Projects Including:
  - Remote Setting of Oysters
  - Reef Cultivation
  - Reef Cultch Height and Cultch Configuration
- Side Scan Sonar and Multibeam Surveys

## Future:

Implementation of the Coastal Alabama Comprehensive Oyster Restoration Strategy

# Cultch Planting

**782,062 cubic yards of cultch material  
planted between 1972 and 2016**



**Deployment of oyster shell, limestone, or other cultch  
material to provide a substrate for oyster settlement and  
growth**

# Oyster Relay Operations

(Large Scale)



Oyster Harvesters were paid to harvest oysters and cultch and deposit on barge (2010) or transplant to deployment area directly (2011)

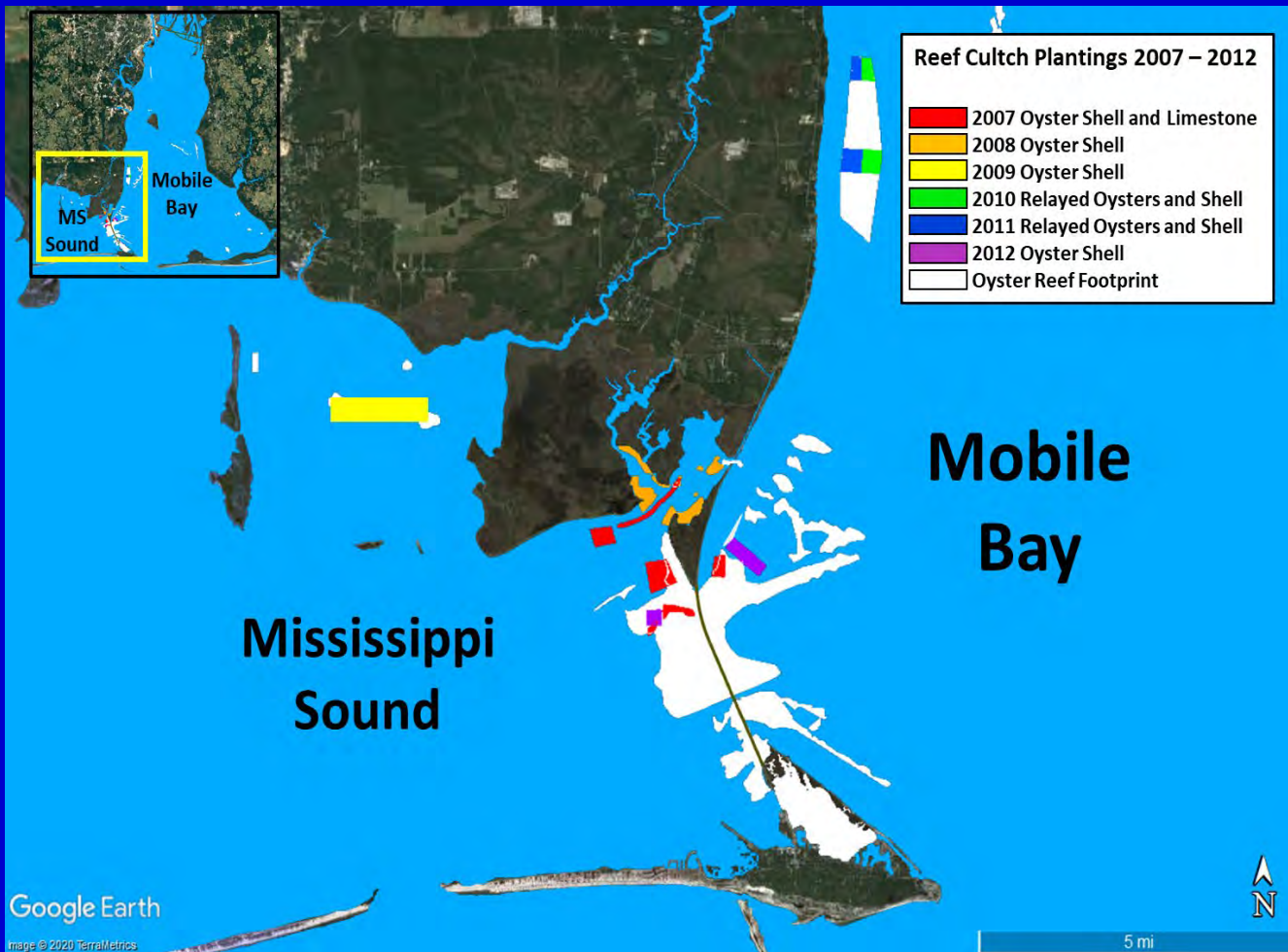


# Oyster Seed Planting



AMRD Staff  
Deploying  
Aquacultured Seed

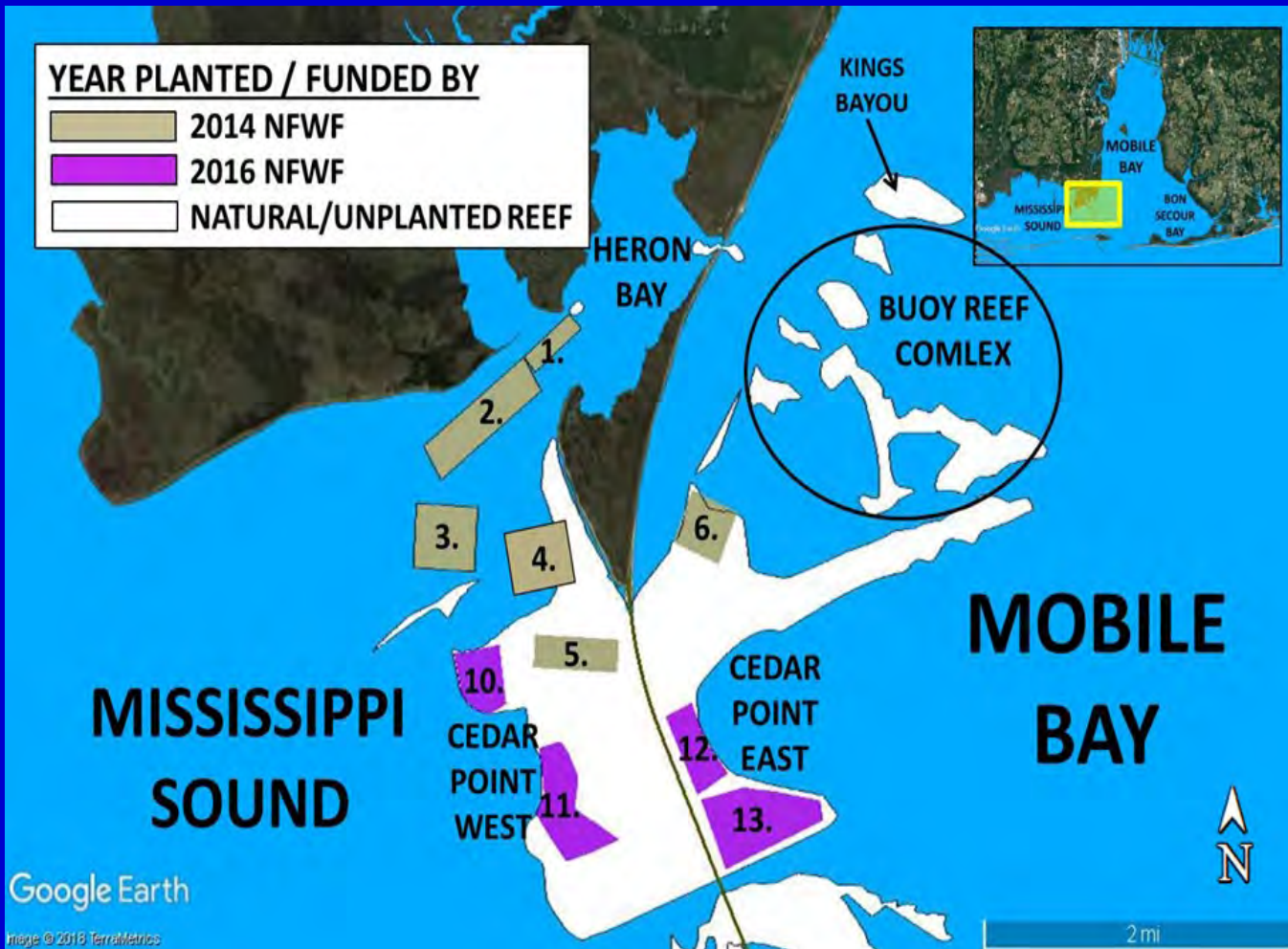
# AMRD Cultch Plantings and Relays 2007 – 2012 (Emergency Disaster Relief Program)



Year	Cultch (c.y.)
2007	31,500
2008	24,000
2009	16,733
2010	4,757 (Relay)
2011	4,457 (Relay)
2012	5,104
<b>Cultch</b>	<b>77,337</b>
<b>Relay</b>	<b>9,214</b>
<b>Total</b>	<b>86,551</b>

# AMRD Cultch Plantings

## Lower Mobile Bay / MS Sound Spring 2014 and 2016 (National Fish and Wildlife Foundation)



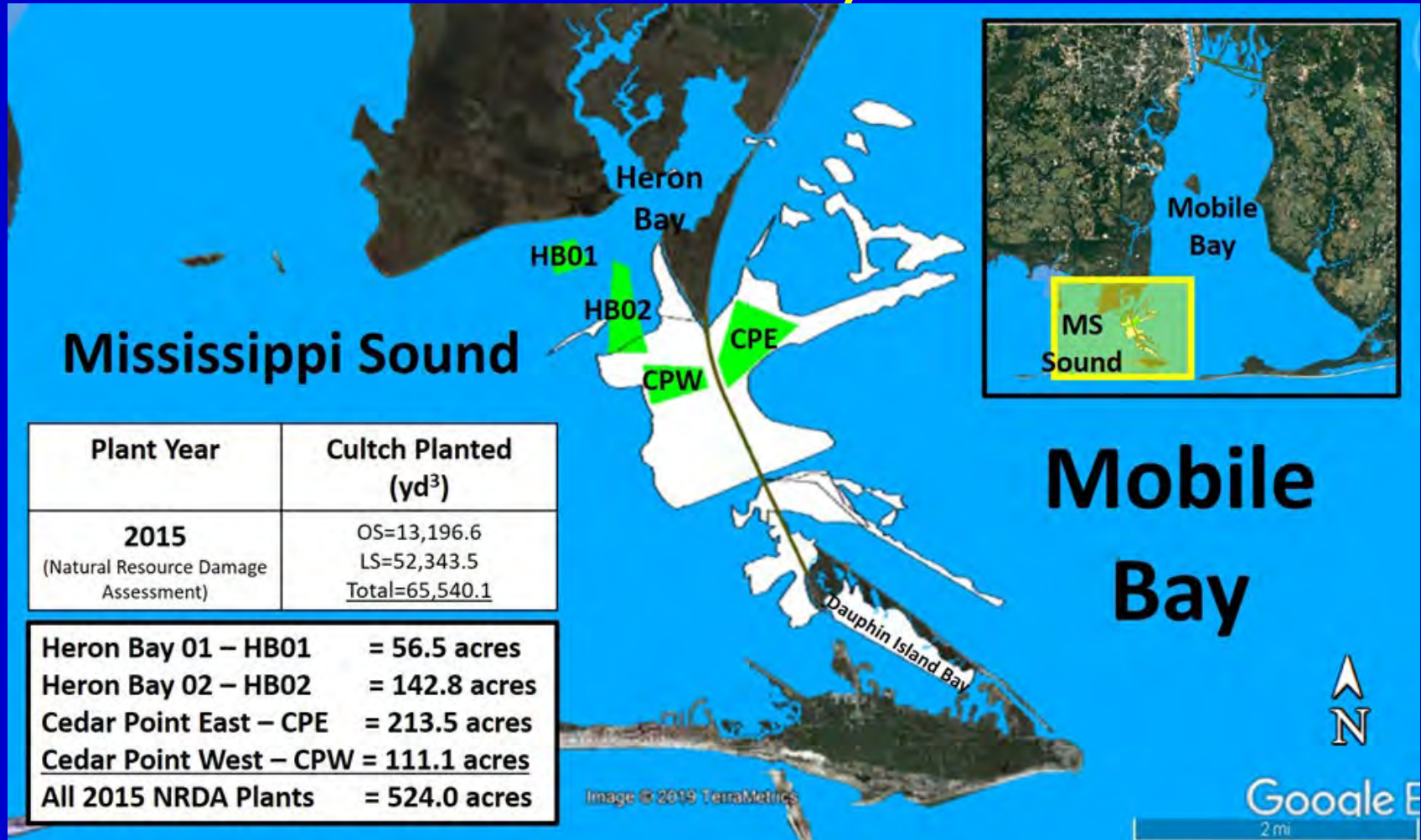
Year	Cultch (c.y.)
2014	27,957
2016	21,554
<b>Total</b>	<b>49,511</b>

# AMRD Cultch Plantings Mid - Mobile Bay Fall 2014 (National Fish and Wildlife Foundation)



Year	Cultch (c.y.)
2014	10,990
<b>Total</b>	<b>10,990</b>

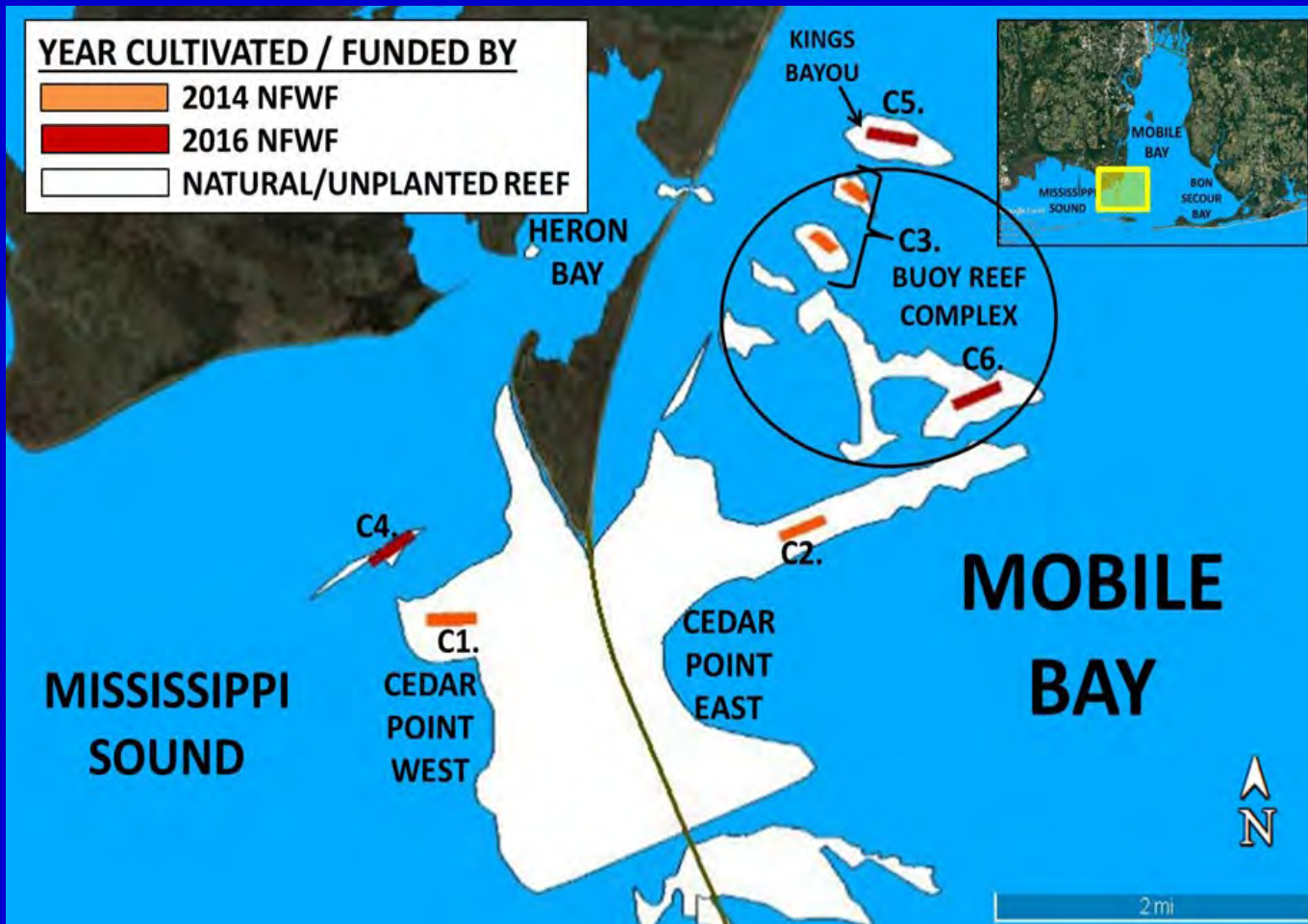
# AMRD Cultch Planting Lower Mobile Bay / MS Sound 2015 (National Oceanic and Atmospheric Administration, Deepwater Horizon National Resource Damage Assessment)



Plant Year	Cultch Planted (yd <sup>3</sup> )
<b>2015</b> (Natural Resource Damage Assessment)	OS=13,196.6 LS=52,343.5 <u>Total=65,540.1</u>

Heron Bay 01 – HB01	= 56.5 acres
Heron Bay 02 – HB02	= 142.8 acres
Cedar Point East – CPE	= 213.5 acres
Cedar Point West – CPW	= 111.1 acres
<b>All 2015 NRDA Plants</b>	<b>= 524.0 acres</b>

# AMRD Experimental Reef Cultivation Lower Mobile Bay / MS Sound 2014 and 2016 (National Fish and Wildlife Foundation)



Year	Area (Acres)
2014	18
2016	18
<b>Total</b>	<b>36</b>

# AMRD Experimental Remote Setting Lower Mobile Bay / MS Sound 2016 and 2017 (National Fish and Wildlife Foundation)



Year	Deployment Events
2016	2
2017	10
<b>Total</b>	<b>12</b>

# AMRD Seed Planting

## Lower Mobile Bay / MS Sound 2013 – 2015

(for the NFWF made possible by the generous seed donations from the Auburn Shellfish Laboratory, Dauphin Island, AL)



### NFWF Grant

Year	Individual Oysters (<0 mm – 50 mm)
Total 2013 - 2015	41,069,890

### Additional AUSL Donations

Year	Individual Oysters (<0 mm – 50 mm)
Total 2018 - 2023	>5,000,000

# Remote Setting of Oysters



Funded by the  
National Fish and Wildlife Foundation

in collaboration with the  
Auburn University Shellfish Laboratory

## Purpose of Study:

To determine if there is a significant difference  
in final oyster density of remote set oysters  
when compared to natural oyster recruitment  
on cultch material.



# DWH NRDA Restore Act Funds

## Experimental Restoration Strategies

- Evaluating New Areas to Plant
- Evaluating New Techniques to Plant Cultch
- Reducing Mortality Through Remote Setting of Oysters

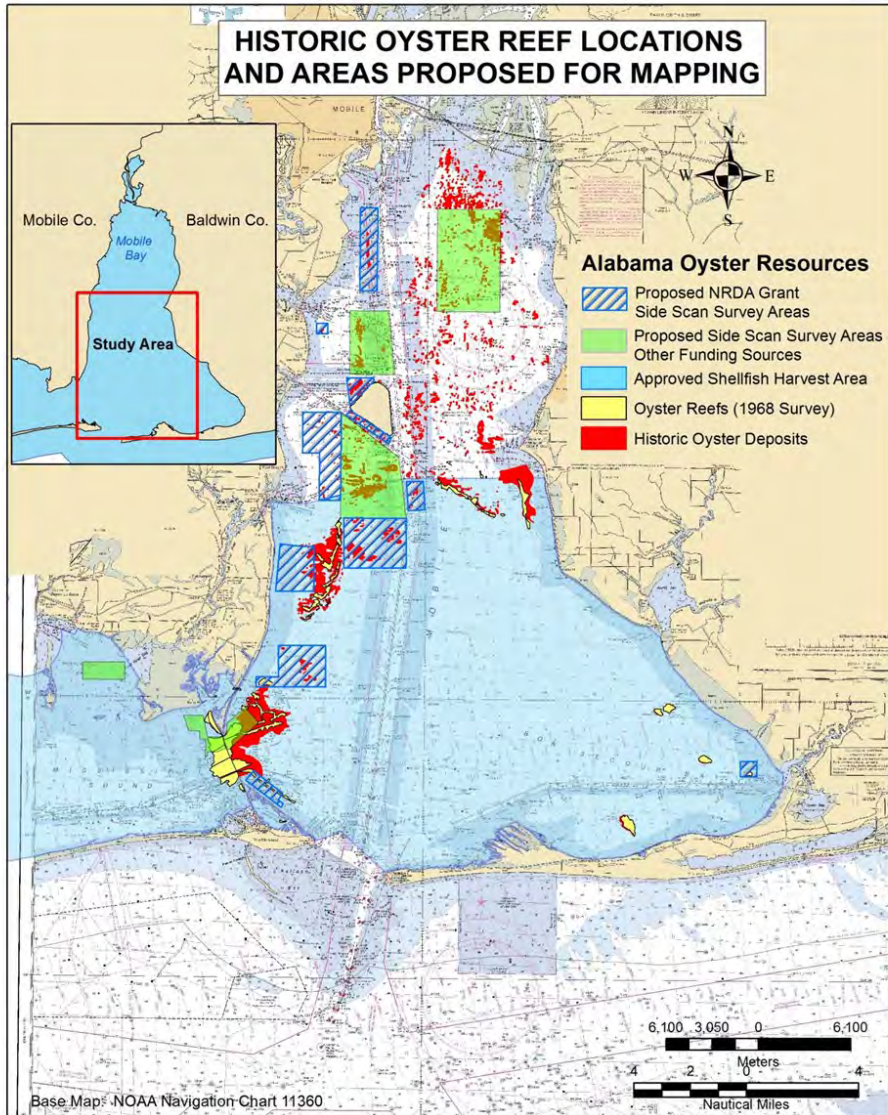
# Projects Through DWH NRDA Restore Act

## Oyster Reef Mapping

AMRD is using side scan sonar to survey recent and historical oyster reef footprints.

This data will be used to find suitable bottoms for reef restoration and update oyster reef maps by determining the area of known oyster reefs.

This will aid in planning future oyster restoration projects.

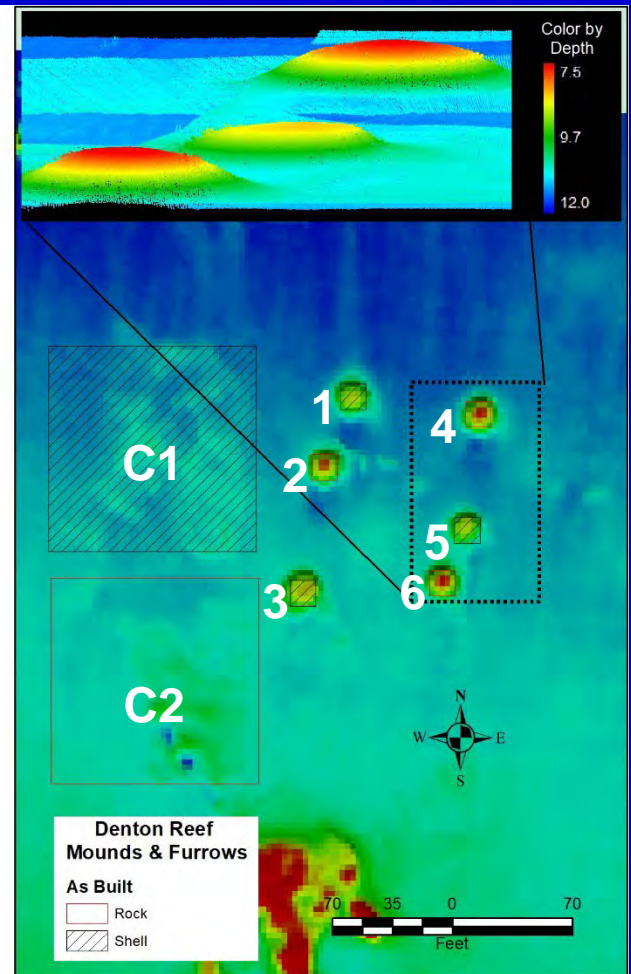
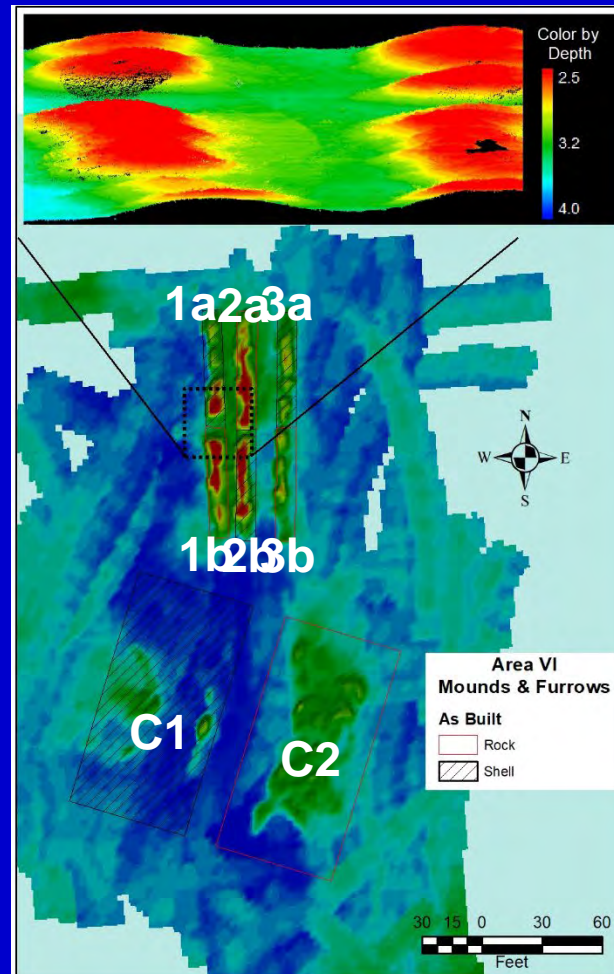


# Reef Height and Configuration Experiments

Small scale experimental projects to look at alternate methods of planting cultch including:

- Planting Cultch in Mounds
- Planting Cultch in Lines to Create Furrows

Post Construction Results	
Denton Reef and Area VI of Oyster Shell (OS) and #4 Limestone (LS) Mounds	
<b>Denton Mounds</b>	
1.	OS (45 c.y.)
2.	LS (45 c.y.)
3.	OS (45 c.y.)
4.	LS (45 c.y.)
5.	OS (45 c.y.)
6.	LS (45 c.y.)
Control 1. OS (45 c.y.)	
Control 2. LS(45 c.y.)	
<b>Area VI Mounds</b>	
1a.	LS (15 c.y.)/1b. OS (15 c.y.)
2a.	LS (15 c.y.)/2b. OS (15 c.y.)
3a.	LS (15 c.y.)/3b. OS (15 c.y.)
Control 1. OS (22.55 c.y.)	
Control 2. LS (22.55 c.y.)	



# Future Projects Through DWH NRDA Restore Act



**Deploying Remote Set Oysters Strategically**  
in certain areas and in conjunction with certain projects such as living shorelines and marsh restoration.



# AMRD Oyster Reef Restoration Projects

## Future:

### Implementation of the Coastal Alabama Comprehensive Oyster Restoration Strategy

- Cultch Planting various planting techniques
- Oyster Relaying
- Oyster Seed Planting
- Remote Set of oysters on Half Shell
- Side Scan Sonar and Multibeam Surveys to identify additional suitable bottoms for oyster reefs
- Surveys of intertidal oyster populations
- Larval Transport Modeling
- Seasonal flow and hydrology modeling

# Oyster Reef Restoration Guidance Document

- Co-Written by AMRD and NOAA
- Defines Oyster Reef Restoration Goals in Alabama and
- Aligns Alabama's Oyster Reef Restoration Goals to the Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement (PDARP/PEIS)

## Coastal Alabama Comprehensive Oyster Restoration Strategy

2021 REVISION

Alabama Department of Conservation and Natural Resources, Marine Resources Division and the National Oceanic and Atmospheric Administration



# Goals of the PDARP/PEIS

## Restore Abundance, Resilience, Diversity

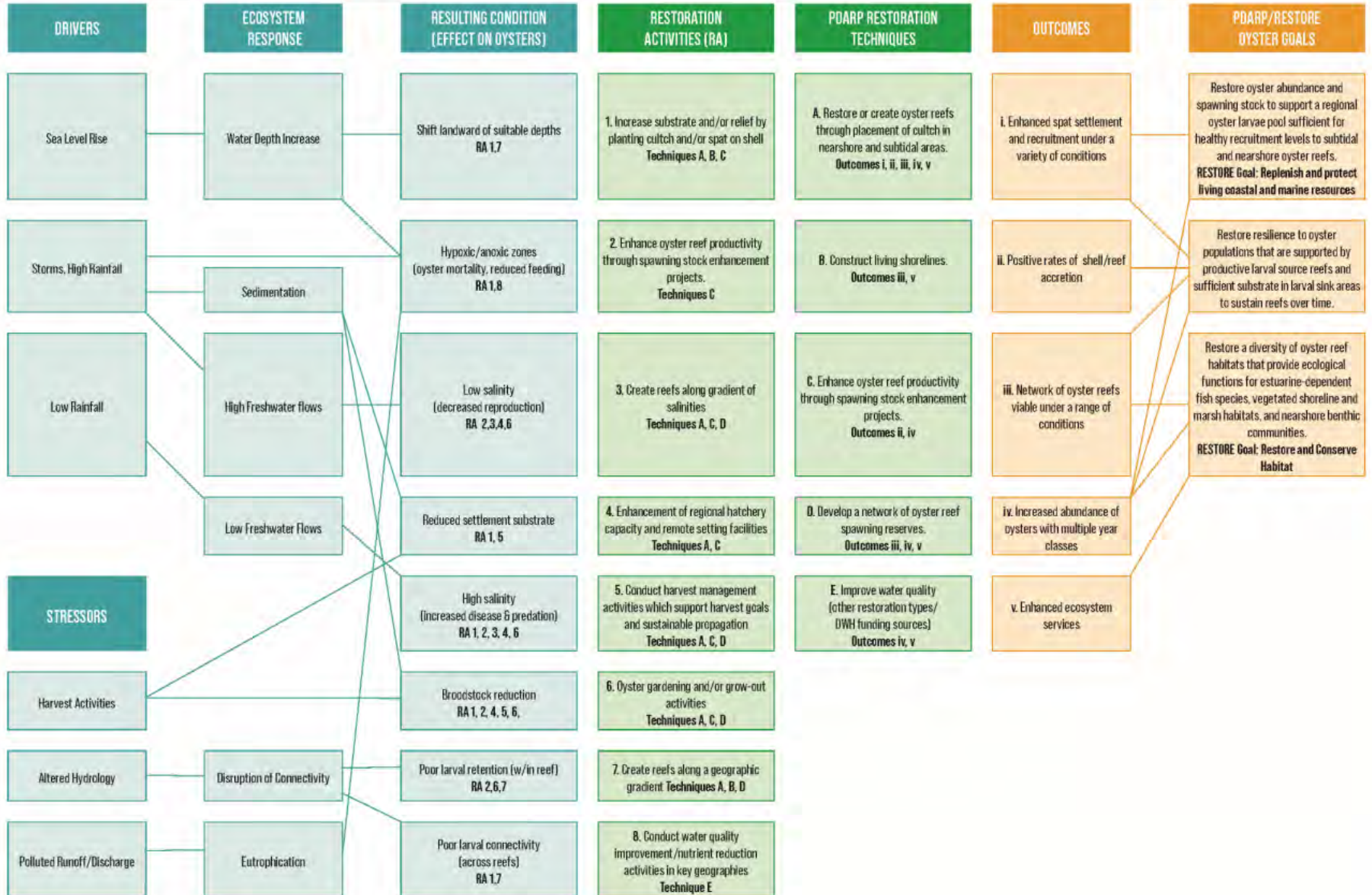
- “Restore oyster abundance and spawning stock to support a regional oyster larvae pool sufficient for healthy recruitment levels to subtidal and nearshore oyster reefs.”
- “Restore resilience to oyster populations that are supported by productive larval source reefs and sufficient substrate in larval sink areas to sustain reefs over time.”
- “Restore diversity of oyster reef habitats that provide ecological functions for estuarine-dependent fish species, vegetated shoreline and marsh habitat, and nearshore benthic communities.”

## The specific goals of this Oyster Strategy Document are to:

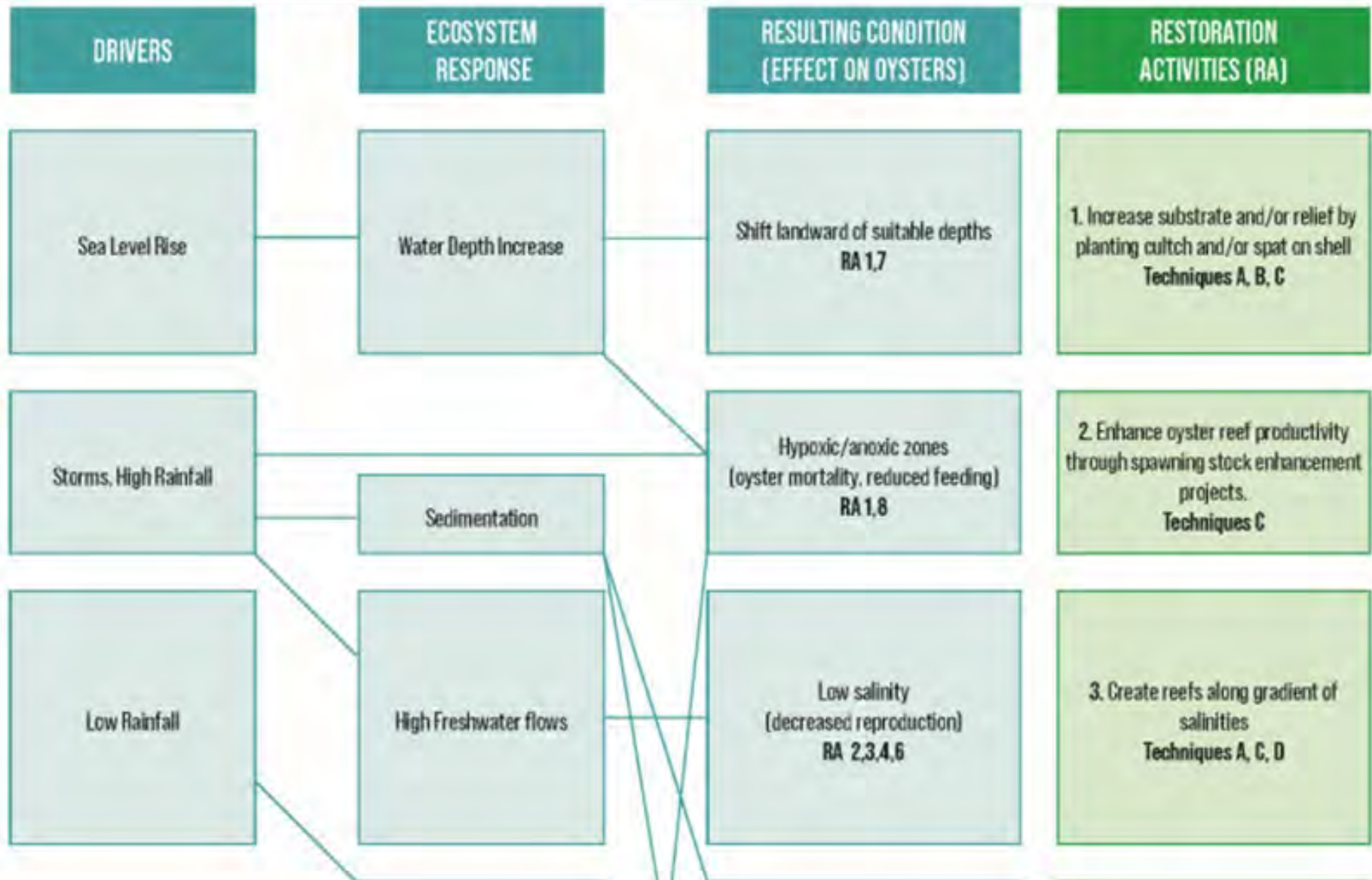
### Identify and Prioritize Restoration Strategies, Identify Data Gaps, Identify Adaptive Management Strategies

- Identify strategies to yield sustainable and resilient oyster populations in coastal Alabama;
- Prioritize potential restoration and enhancement strategies for implementation in the next 3-5 years;
- Identify science and/or data gaps that could help inform future restoration efforts; and
- Identify adaptive management strategies to address uncertainties associated with changing environmental conditions and/or project implementation.

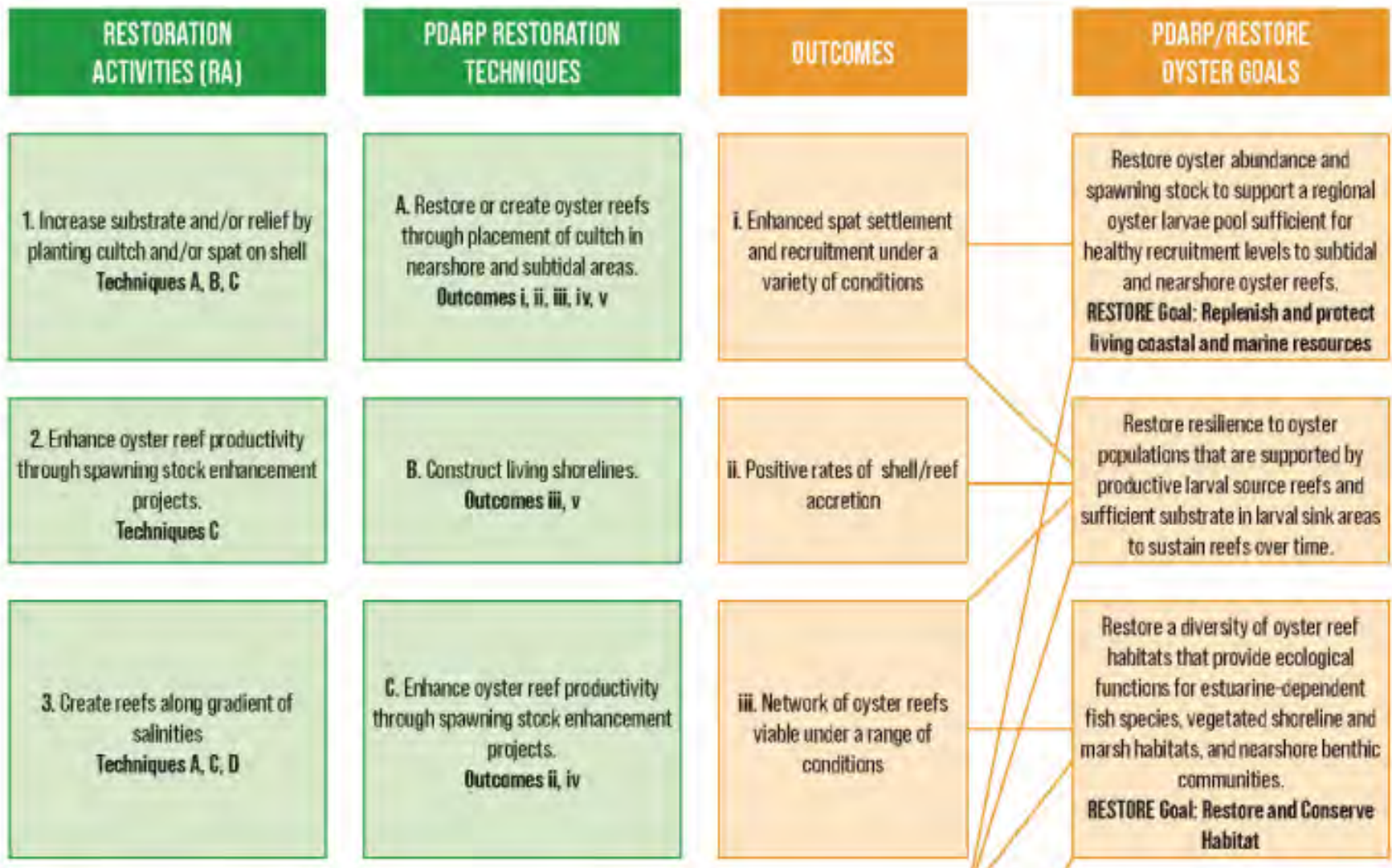
# The Conceptual Model



# The Conceptual Model



# The Conceptual Model



# AMRD Oyster Reef Restoration Projects

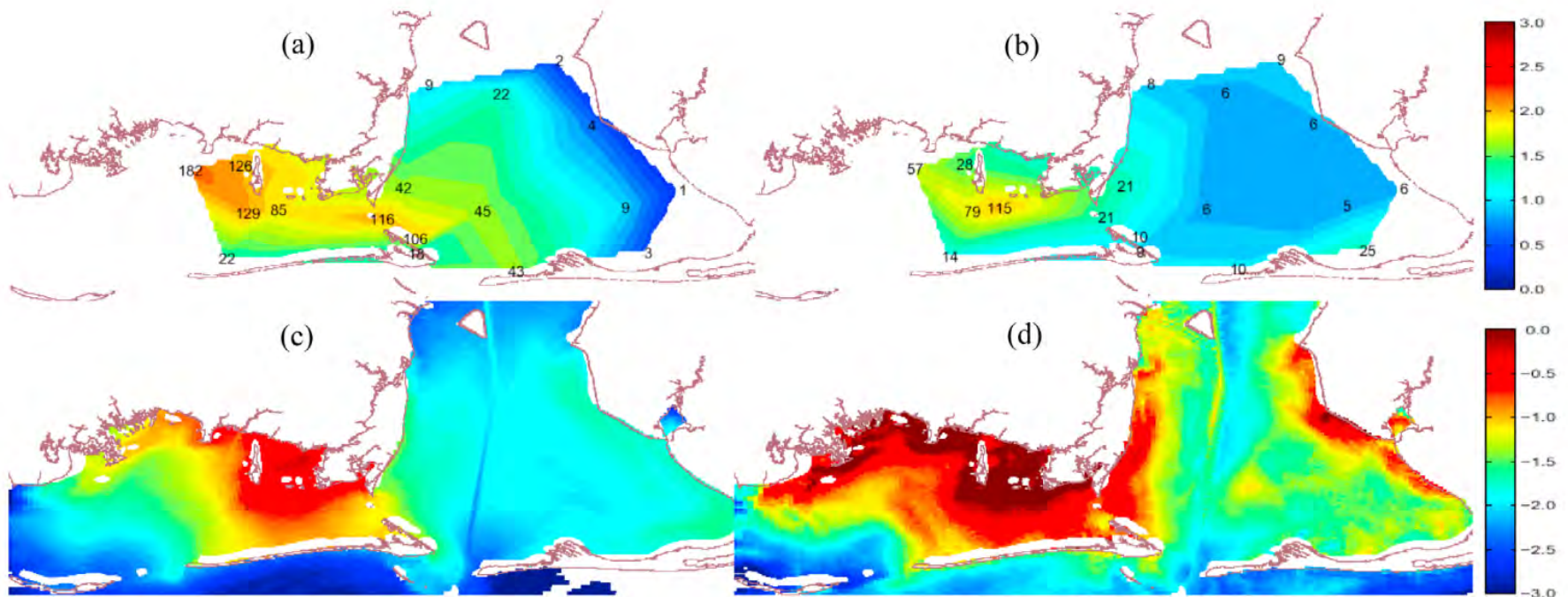
## Future:

### Implementation of the Coastal Alabama Comprehensive Oyster Restoration Strategy

- Cultch Planting various planting techniques
- Oyster Relaying
- Oyster Seed Planting
- Remote Set of oysters on Half Shell
- Side Scan Sonar and Multibeam Surveys to identify additional suitable bottoms for oyster reefs
- Surveys of intertidal oyster populations
- Larval Transport Modeling
- Seasonal flow and hydrology modeling

# Larval Transport and Flow Modeling

Kim, C.K., Park, K., Powers, S.P., Graham, W.M. and Bayha, K.M., 2010. Oyster larval transport in coastal Alabama: Dominance of physical transport over biological behavior in a shallow estuary. *Journal of Geophysical Research: Oceans*, 115(C10).



**Figure 5.** Observed (a) oyster spat settlement (spats m<sup>-2</sup> d<sup>-1</sup>) and (b) bivalve larval concentration (larvae per 10 L) compared with the model results (c) by physical transport only and (d) by physical transport and biological movement, averaged over surveys 11 to 19. Color bars indicate log<sub>10</sub>-transformed data and model results.

Image from Kim et al., 2010



**Questions?**