Photo Credit: Christine Jensen, TPWD

Management Strategies for Oyster Recovery and Fishery Sustainability in Galveston Bay

Christine C. Jensen

Texas Parks and Wildlife Department

Oyster-Producing Bays in Texas

TPWD Oyster Dredge Sampling

Routine Monitoring

- Monthly random sampling
- 10-30 per bay system
- Not enough to manage by harvest area
- Targets both productive and degraded areas

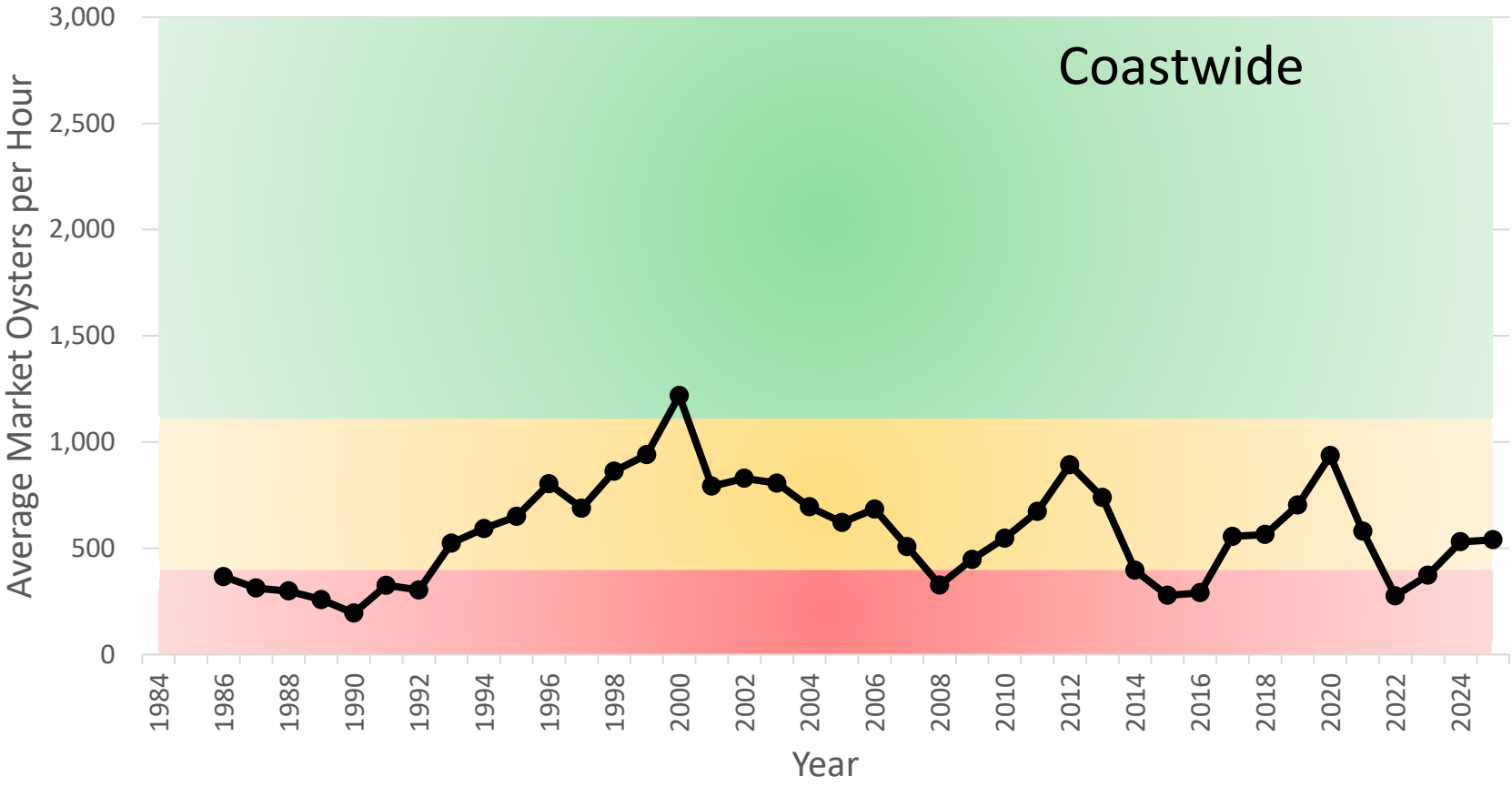
Targeted Oyster Sampling

- More intensive sampling per harvest area

  Up to ~180 per bay system

  Targets more productive, “fishable” reef
- Pre-season and as needed

Market Oyster Abundance ≥ 76 mm (3 in)



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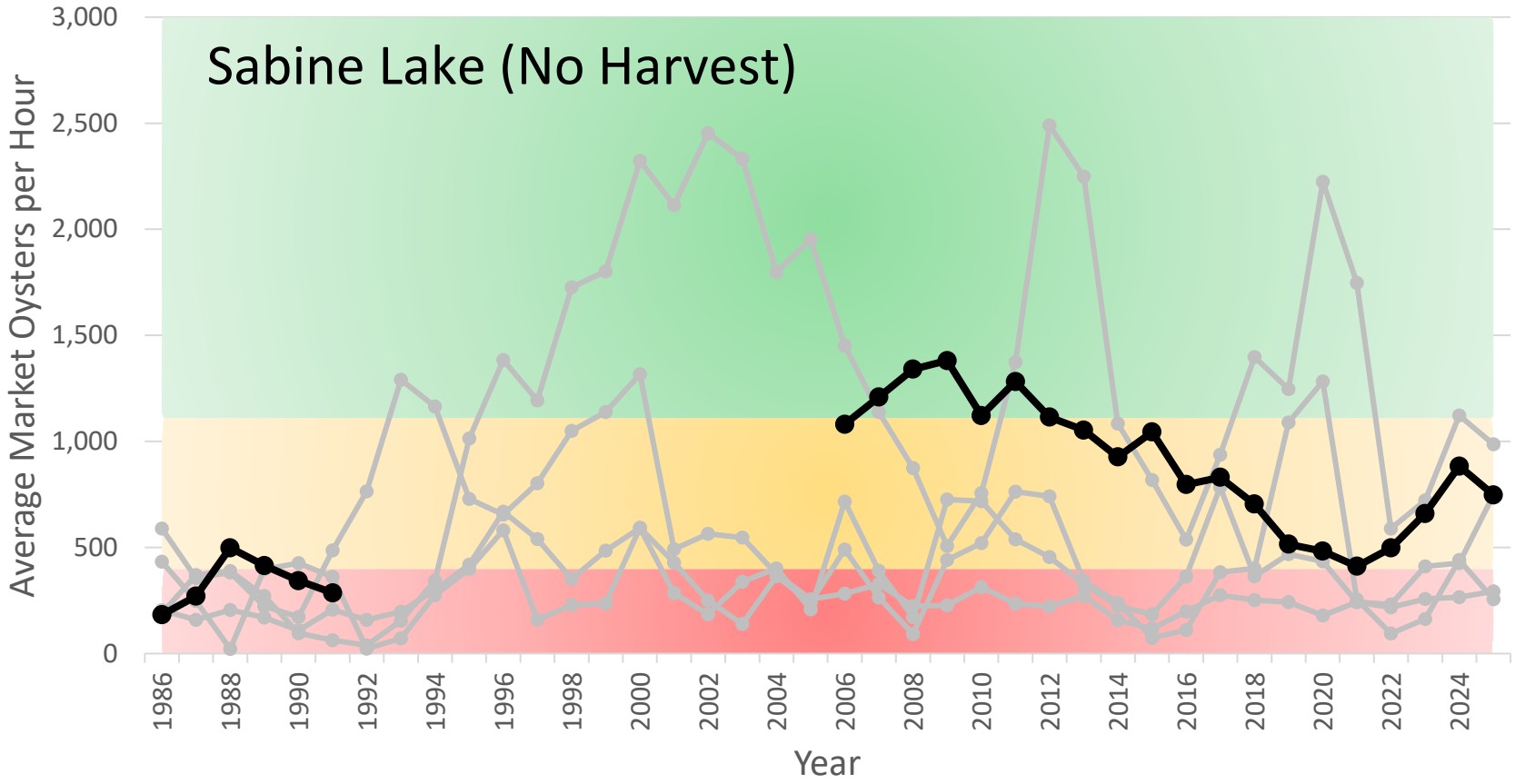

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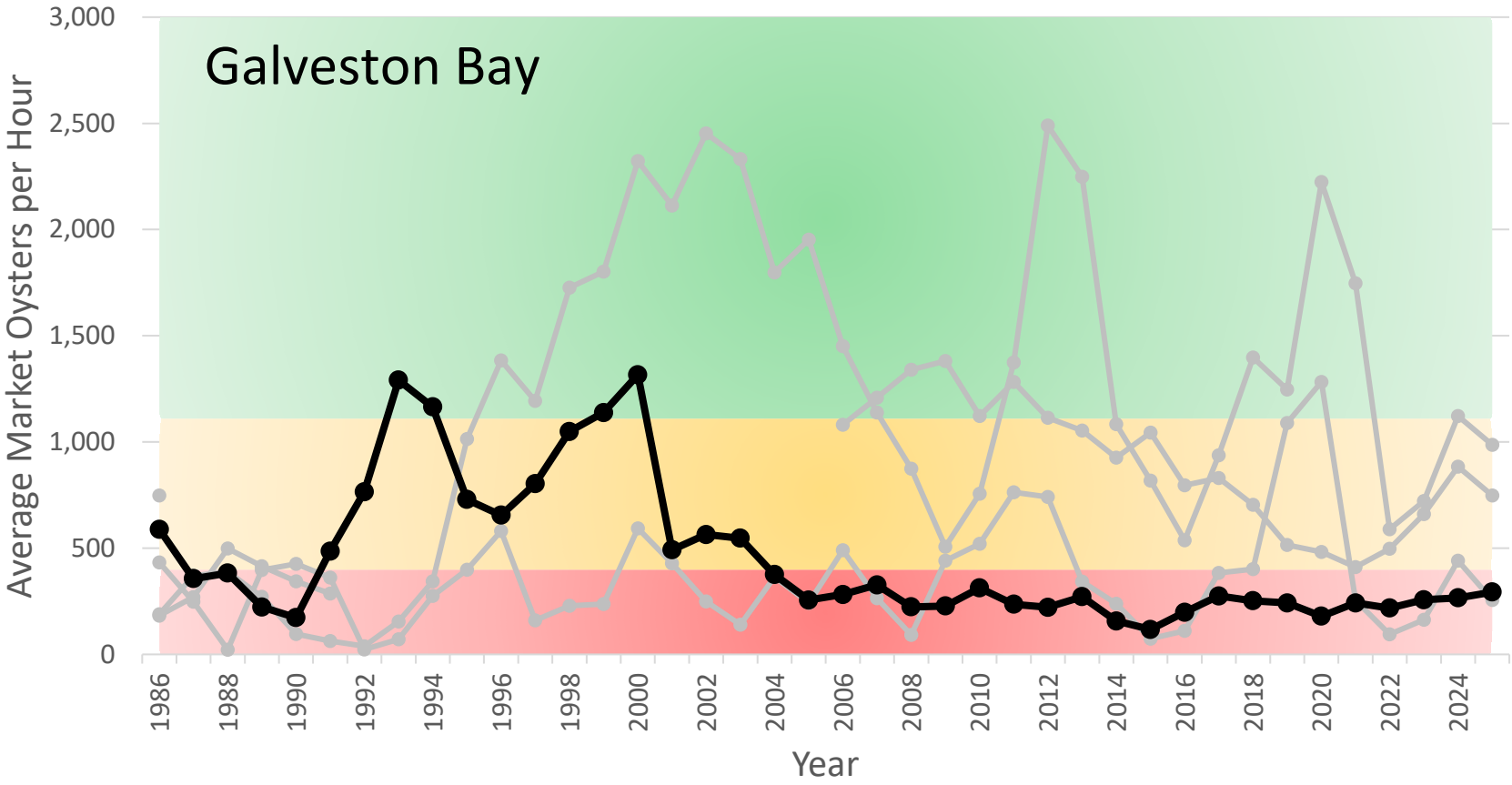

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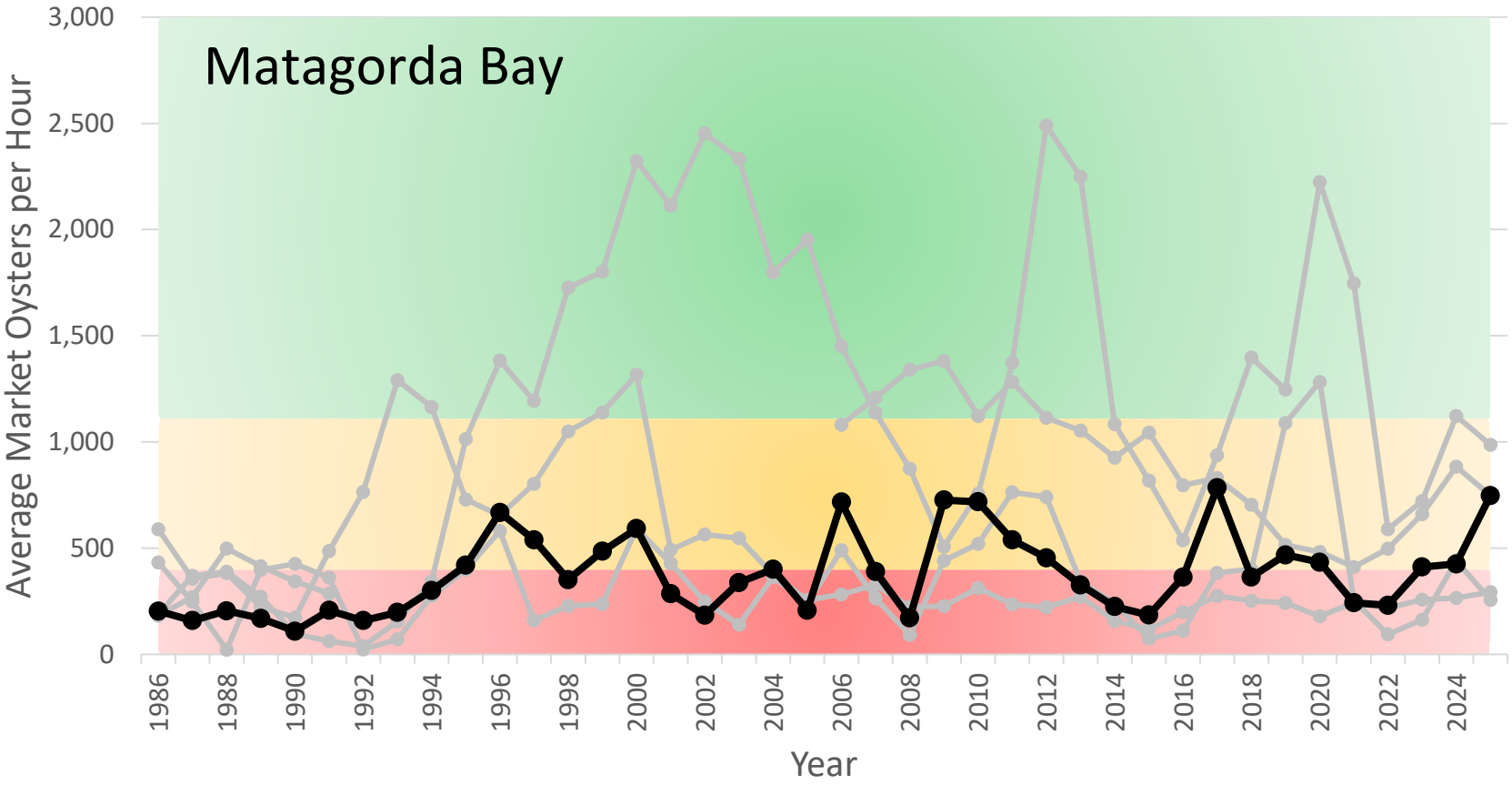

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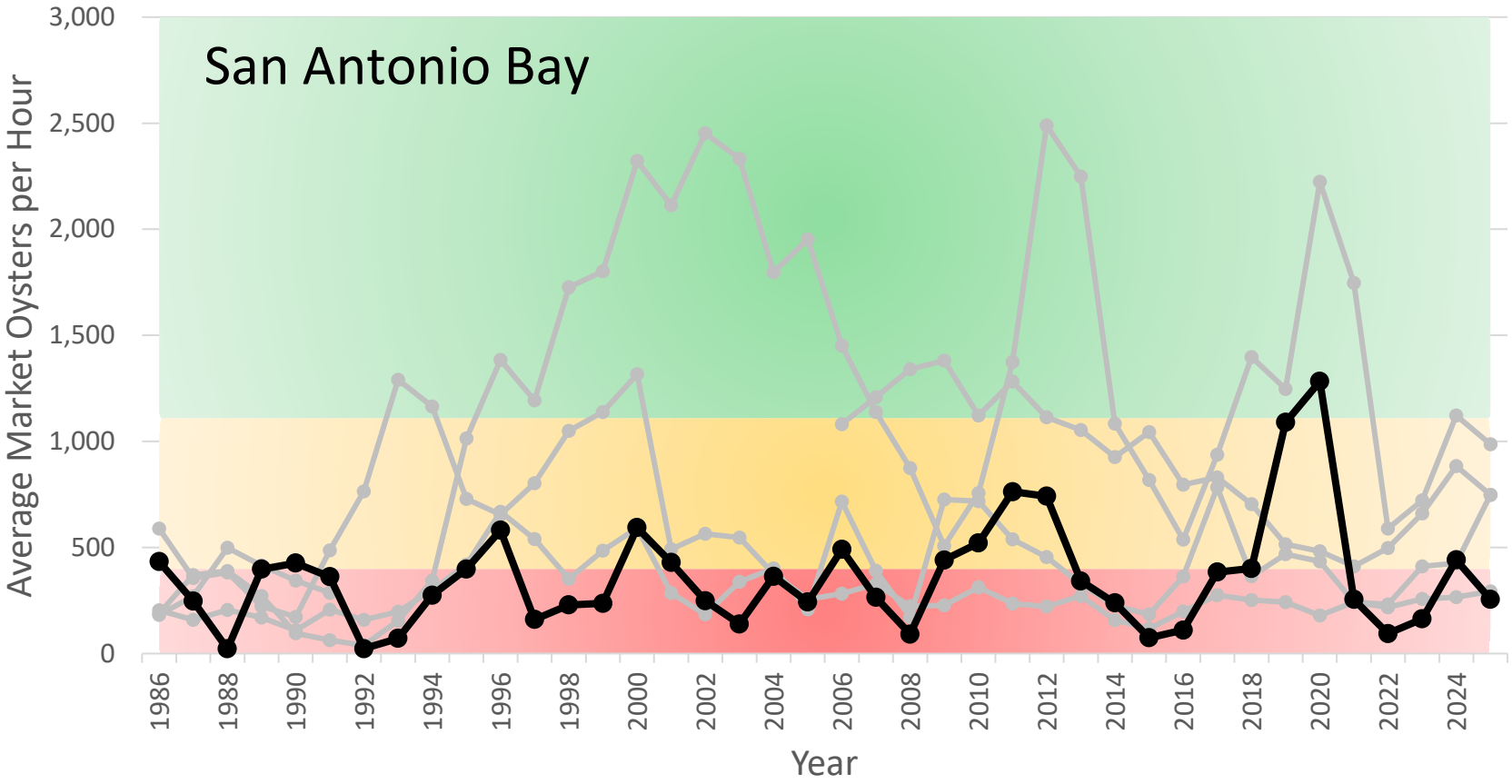

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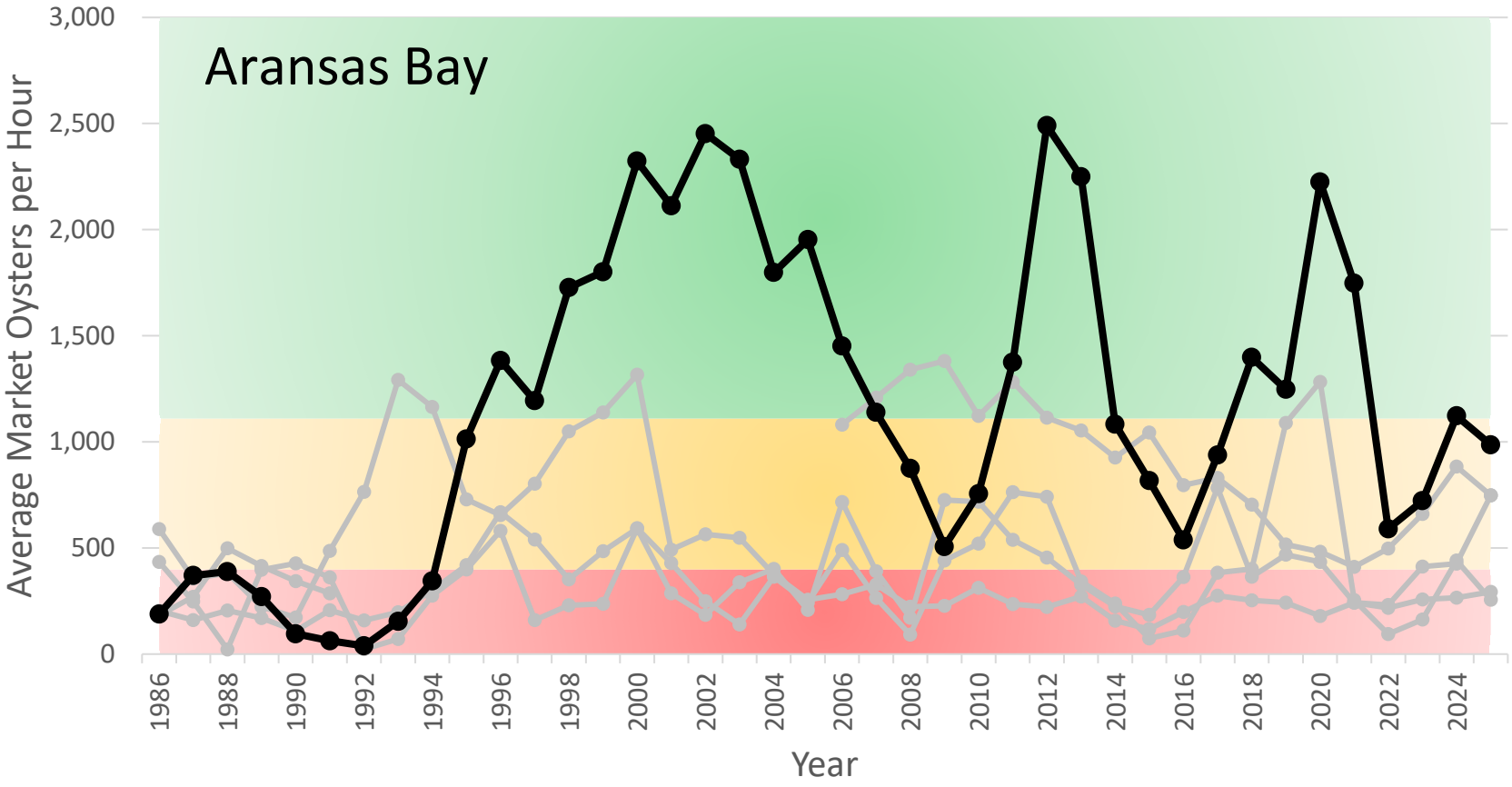
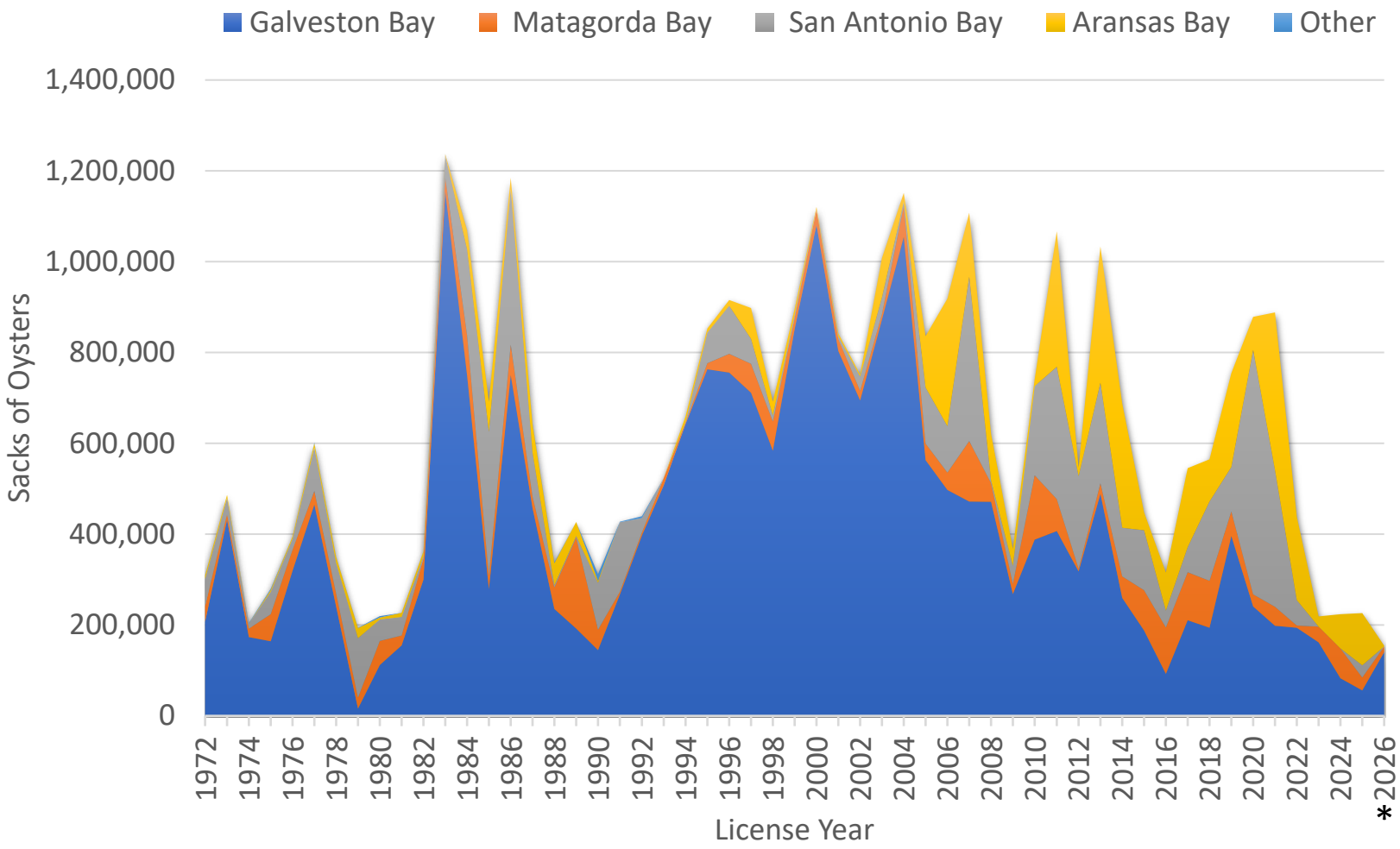


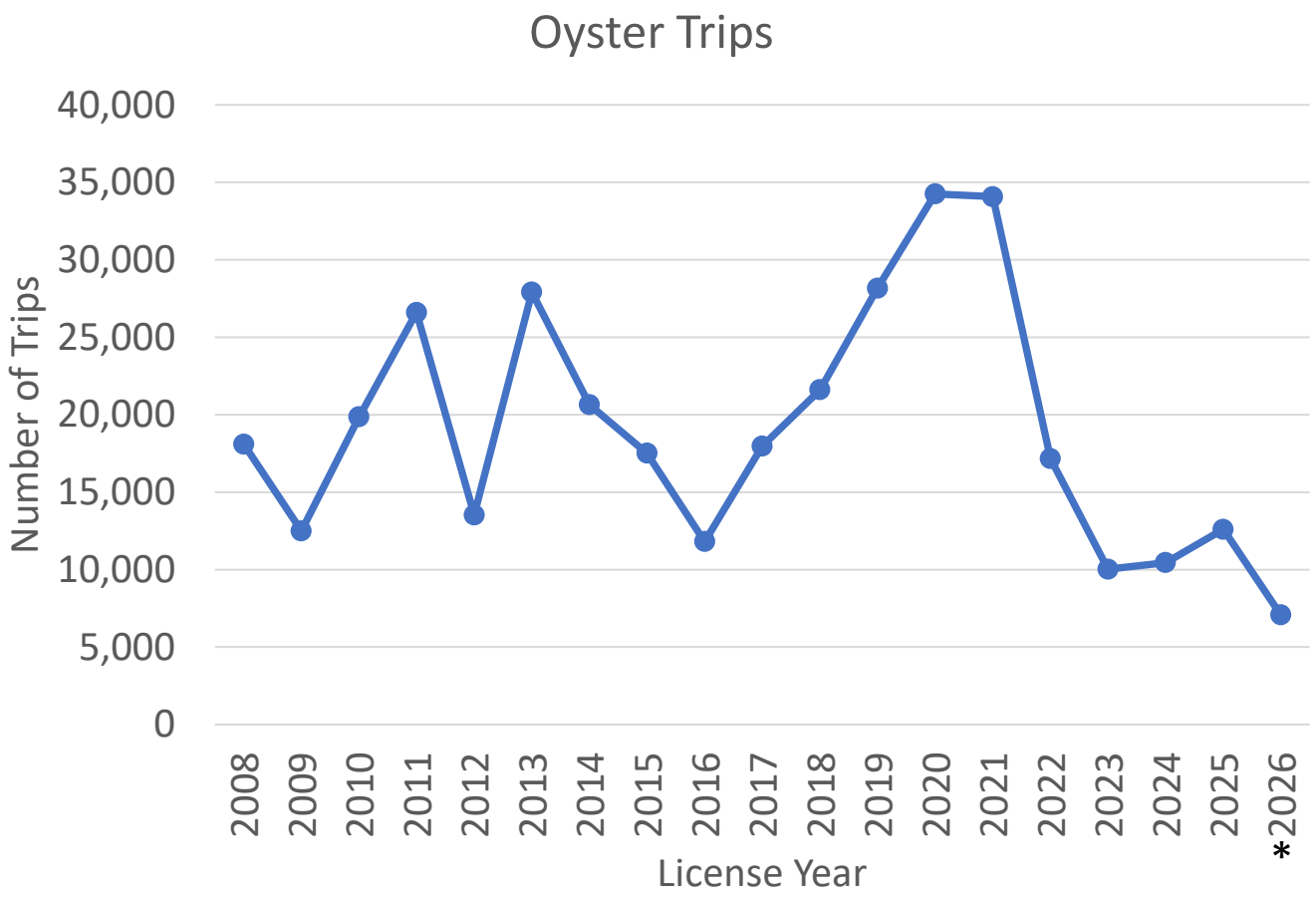
Texas Commercial Oyster Landings



*Season ongoing

- Galveston Bay historically majority of landings
- Increase in harvest from southern bays
- Low harvest since 2022-23 season

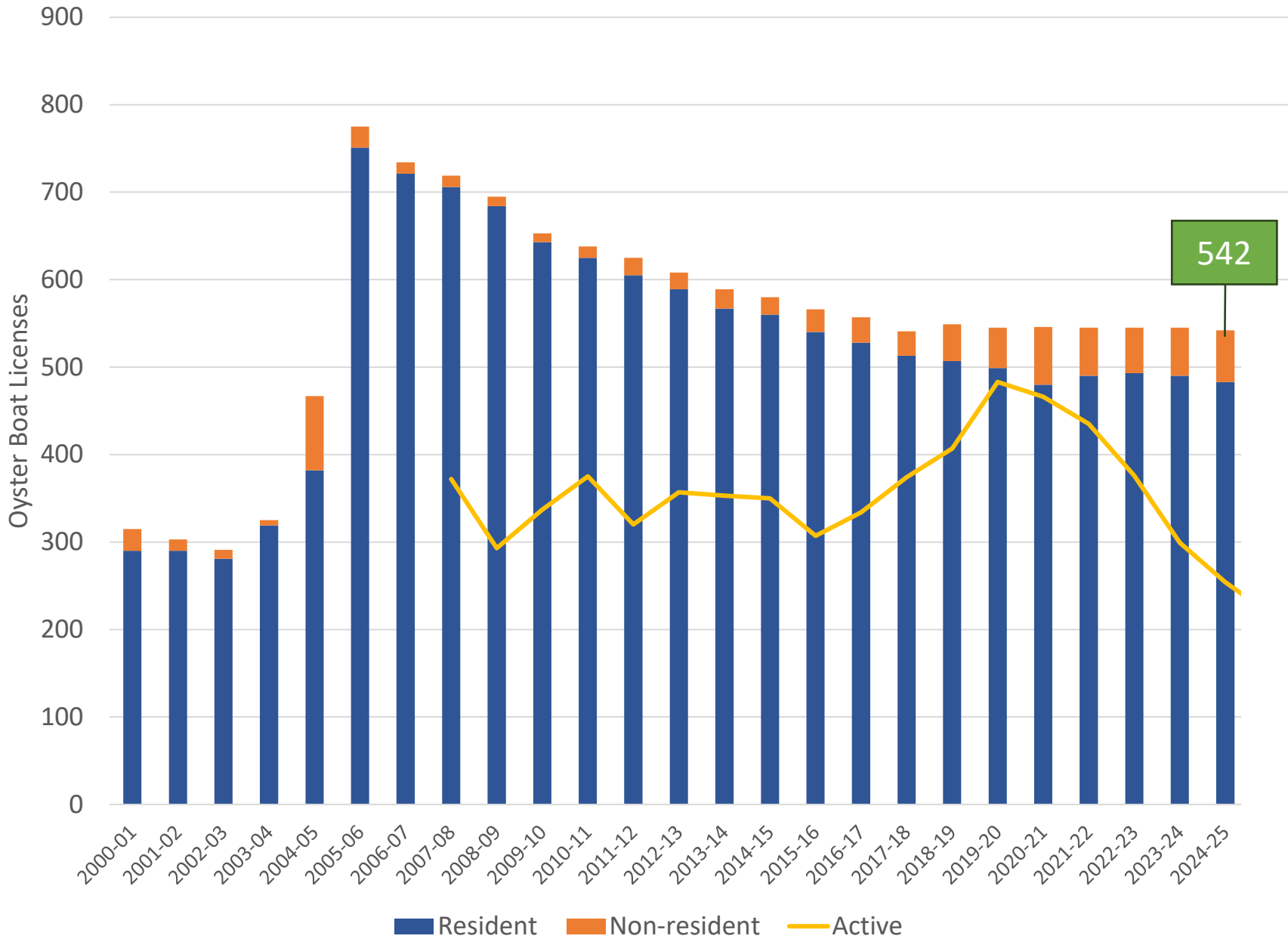
Fishing Effort



*Season Ongoing

Season	Avg # of Vessels per Day	Min Vessels	Max Vessels
2007-08	76	1	211
2008-09	53	1	141
2009-10	87	1	193
2010-11	124	1	241
2011-12	116	7	204
2012-13	133	1	232
2013-14	110	1	203
2014-15	84	2	223
2015-16	61	1	170
2016-17	99	1	195
2017-18	144	1	250
2018-19	194	1	310
2019-20	238	1	379
2020-21	228	1	344
2021-22	130	1	359
2022-23	69	1	263
2023-24	81	2	174
2024-25	85	1	163
*2025-26	93	1	178

Too Much Fishing Pressure



TEXAS COMMERCIAL OYSTER BUYBACK PROGRAM

2017

- Legislation passed to authorize oyster license buybacks

2018–2022

- 6 rounds
- Only 15 bids received
- Only 3 licenses bought back

2023–2024

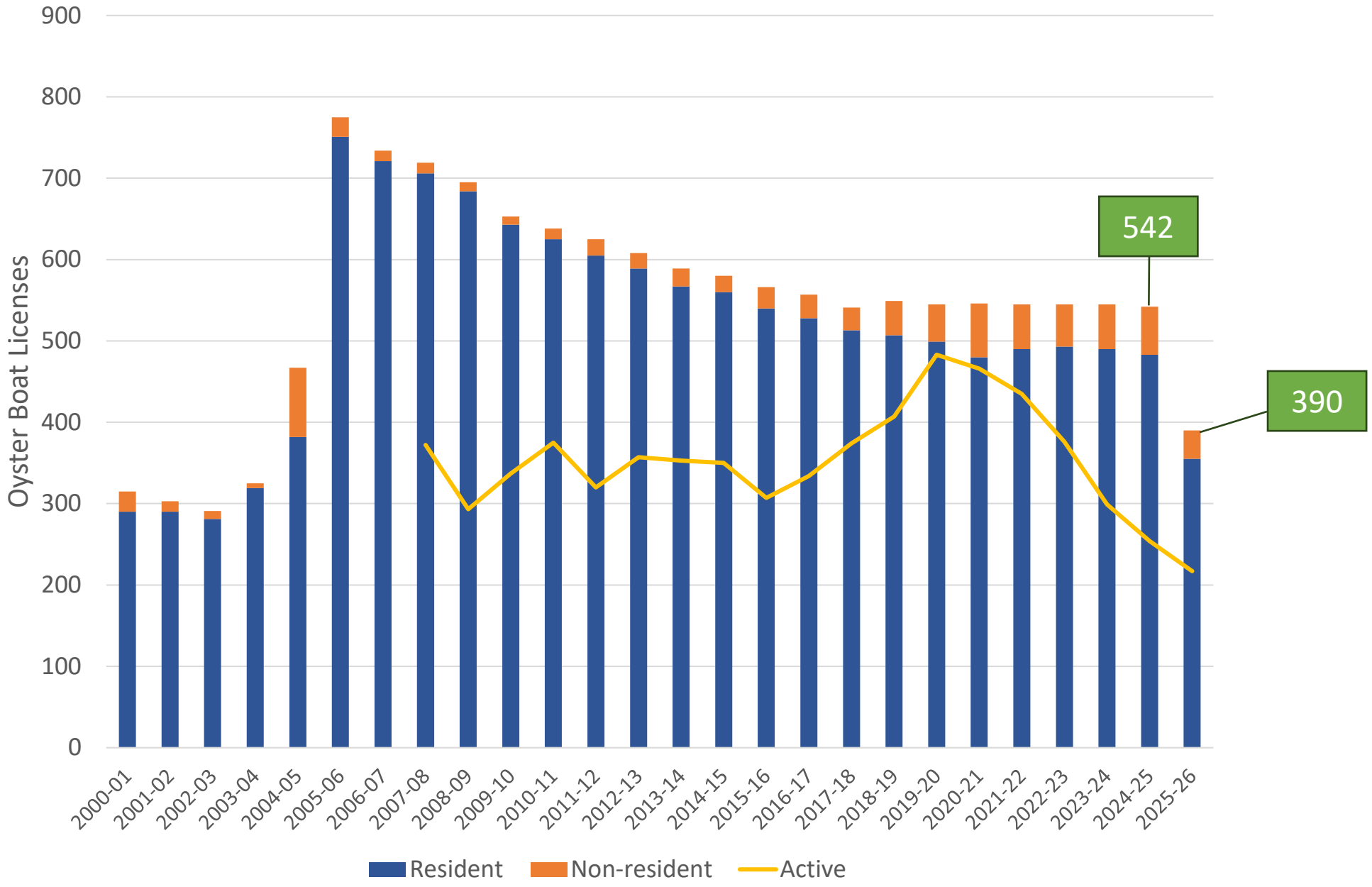
- 2 more rounds
- Held public meetings to publicize program and get more interest
- 63 bids received but much more than TPWD willing to pay
- Bid range:

$18,000 - $500,000

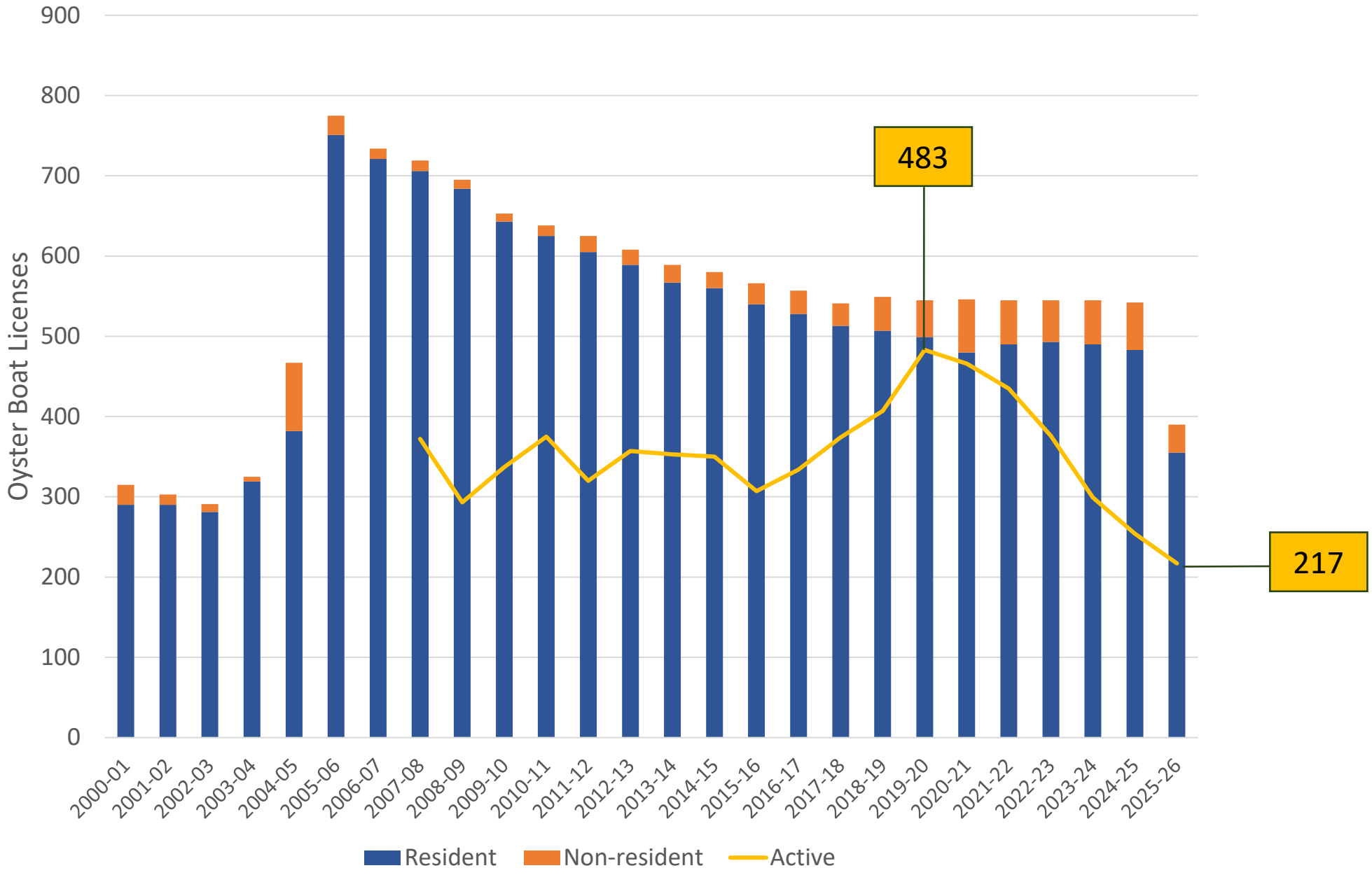
2025

- Private Donor
- Flat rate of $30,000 per license
- Goal of purchasing 150 licenses
- Purchased 112 licenses

Too Much Fishing Pressure



Too Much Fishing Pressure



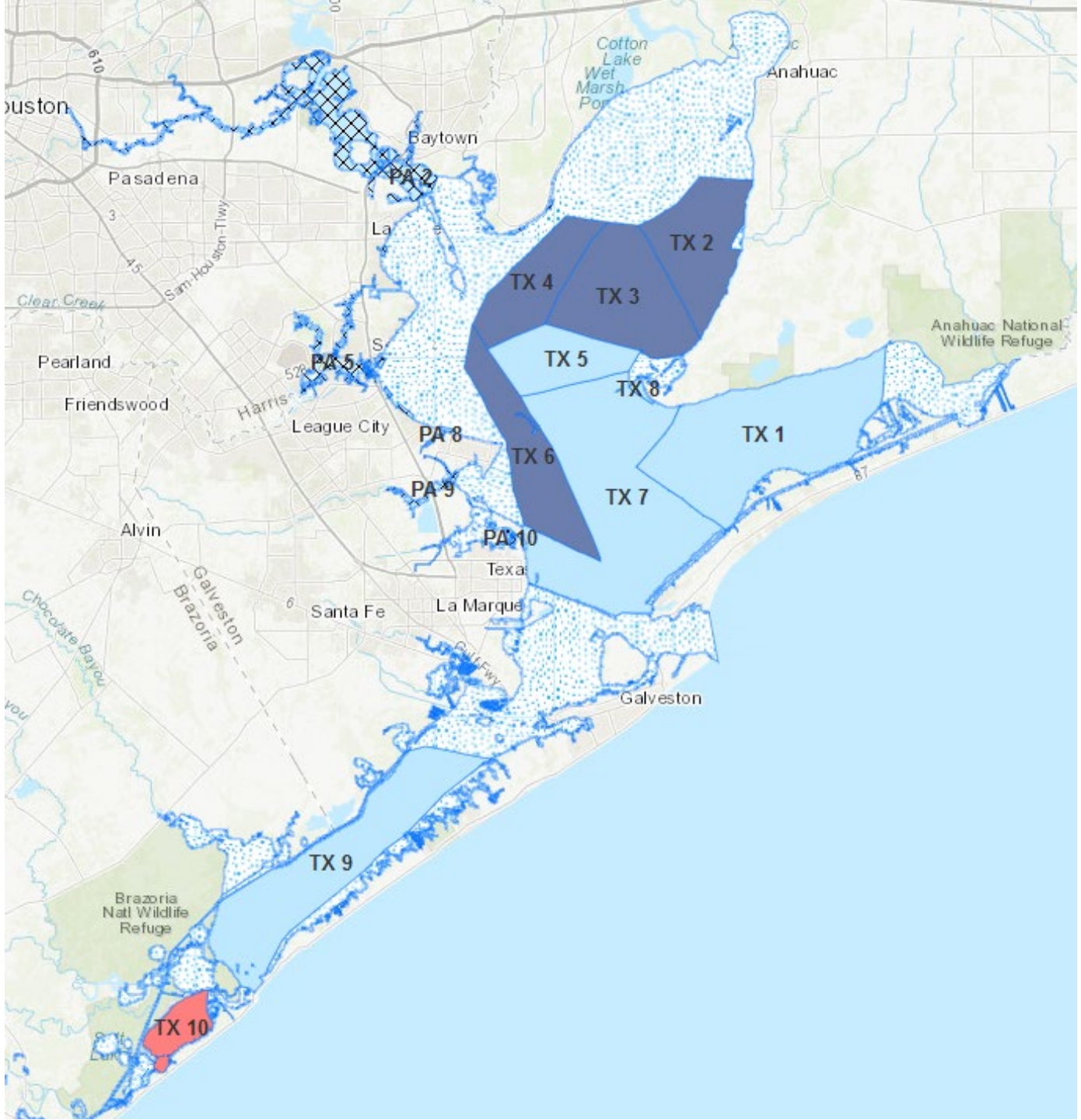
2026 Buybacks

Public Meetings
in April

Area Management

Shellfish Harvest Areas

- TX Dept of State Health Services
  - Closures based on public health
- TPWD
  - Closures based on market oyster abundance



Current Management

- TPWD closures based on abundance of market-size oysters
- Opening Threshold
  Average of **1,110** market oysters/hour
- Closure Threshold
  Average of **399** market oysters/hour

Lights	Rules	
Abundance	Initial Closure	Reopen
	Open	Open
	Open	Closed
	Closed	Closed

What should we open/close?

- TPWD guidelines – open areas above 1,110
- Avoid concentrating boats
- Balance between conservation and the need to provide fishing opportunities
- Distributes the fleet among bay systems

Preseason Targeted Oyster Sampling Results For 2025-2026 Oyster Season		
Harvest Area	Date	Average Market (≥3") CPUE
TX-1	9/4/2025	900
TX-2	9/5/2025	0
TX-3	9/5/2025	0
TX-4	9/5/2025	12
TX-5	9/4/2025	1068
TX-6	9/5/2025	318
TX-7	9/4/2025	804
TX-8	9/9/2025	48
TX-9	9/9/2025	0
TX-11	9/10/2025	0
TX-12	9/10/2025	364
TX13	9/9/2025	1398
TX-14	9/2/2025	684
TX-15	9/2/2025	372
TX-16	9/15/2025	24
TX-18	9/15/2025	284
TX-19	9/3/2025	738
TX-20	9/3/2025	1332
TX-21	9/15/2025	582
TX-24	9/10/2025	804
TX-25	9/10/2025	228
TX-26	9/16/2025	390
TX-27	9/16/2025	372
TX-29	9/9/2025	876
TX-30	9/9/2025	764
TX-32	9/9/2025	437

What should we open/close?

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- Did this the last 4 seasons

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	TX-30	9/9/2025	764
	TX-32	9/9/2025	437

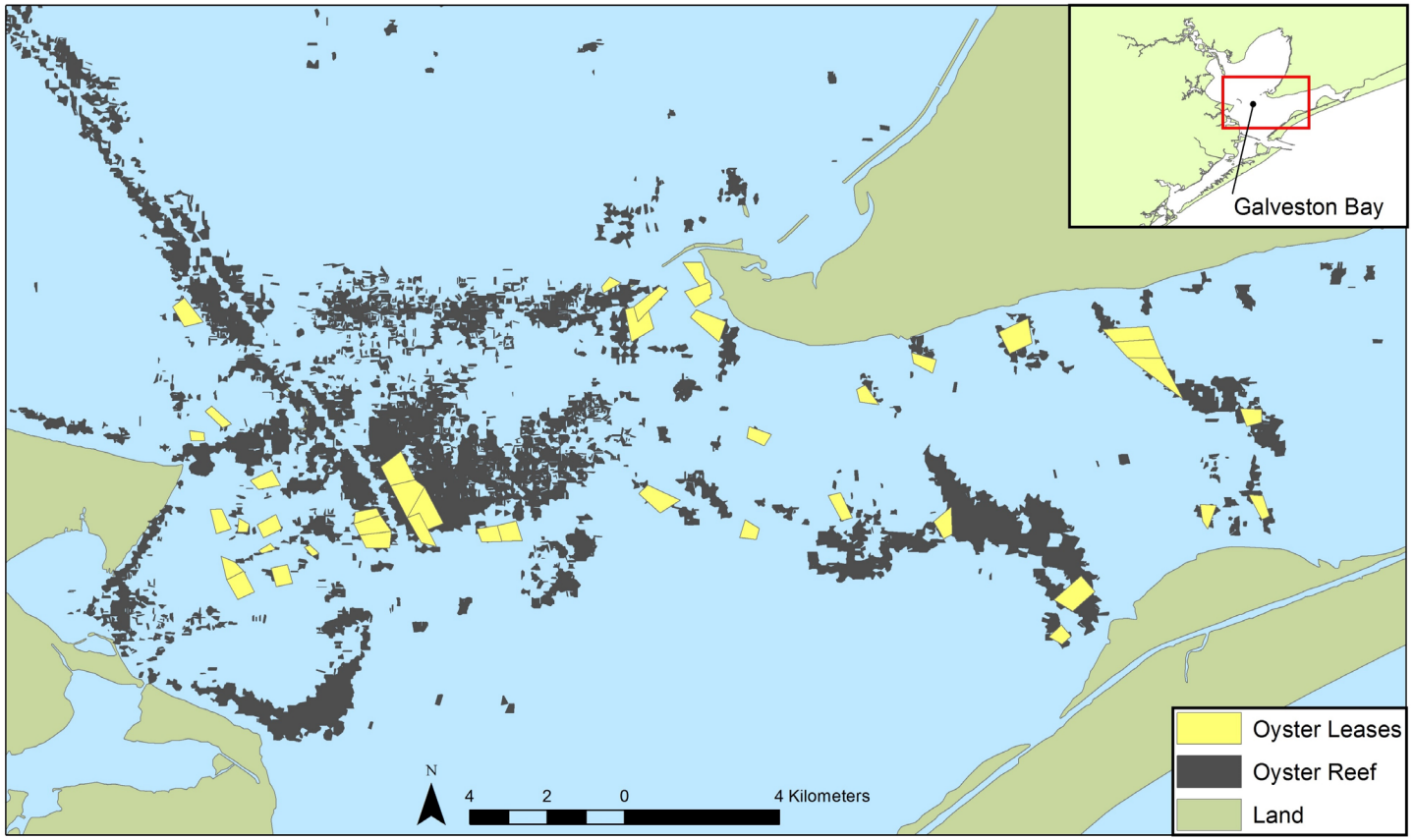
Current Status

- As of today, there are only 7 areas open that have oysters
- TX 33 and 34 don't have many oysters
- Most fishing in Galveston Bay (TX-7)

Galveston Bay

Harvest Area	Public Harvest Area Status	Private Oyster Area Status	Reason for Status
TX 1	Open	Open	n/a
TX 2	Closed	n/a	TPWD Action, Rainfall
TX 3	Closed	n/a	TPWD Action
TX 4	Closed	n/a	TPWD Action
TX 5	Closed	n/a	TPWD Action
TX 6	Closed	Open	TPWD Action
TX 7	Open	Open	n/a
TX 8	Closed	Open	TPWD Action
TX 9	Closed	Open	TPWD Action
TX 11	Closed	n/a	TPWD Action
TX 12	Closed	n/a	TPWD Action
TX 13	Open	n/a	n/a
TX 14	Closed	Open	TPWD Action
TX 15	Closed	Open	TPWD Action
TX 16	Closed	n/a	n/a
TX 18	Closed	Open	TPWD Action
TX 19	Closed	n/a	TPWD Action
TX 20	Open	n/a	n/a
TX 21	Open	n/a	n/a
TX 24	Closed	n/a	TPWD Action
TX 25	Closed	n/a	TPWD Action
TX 26	Closed	n/a	TPWD Action
TX 27	Closed	n/a	TPWD Action
TX 29	Open	Open	n/a
TX 30	Open	Open	n/a
TX 32	Closed	Open	TPWD Action
TX 33	Open	n/a	n/a
TX 34	Open	n/a	n/a

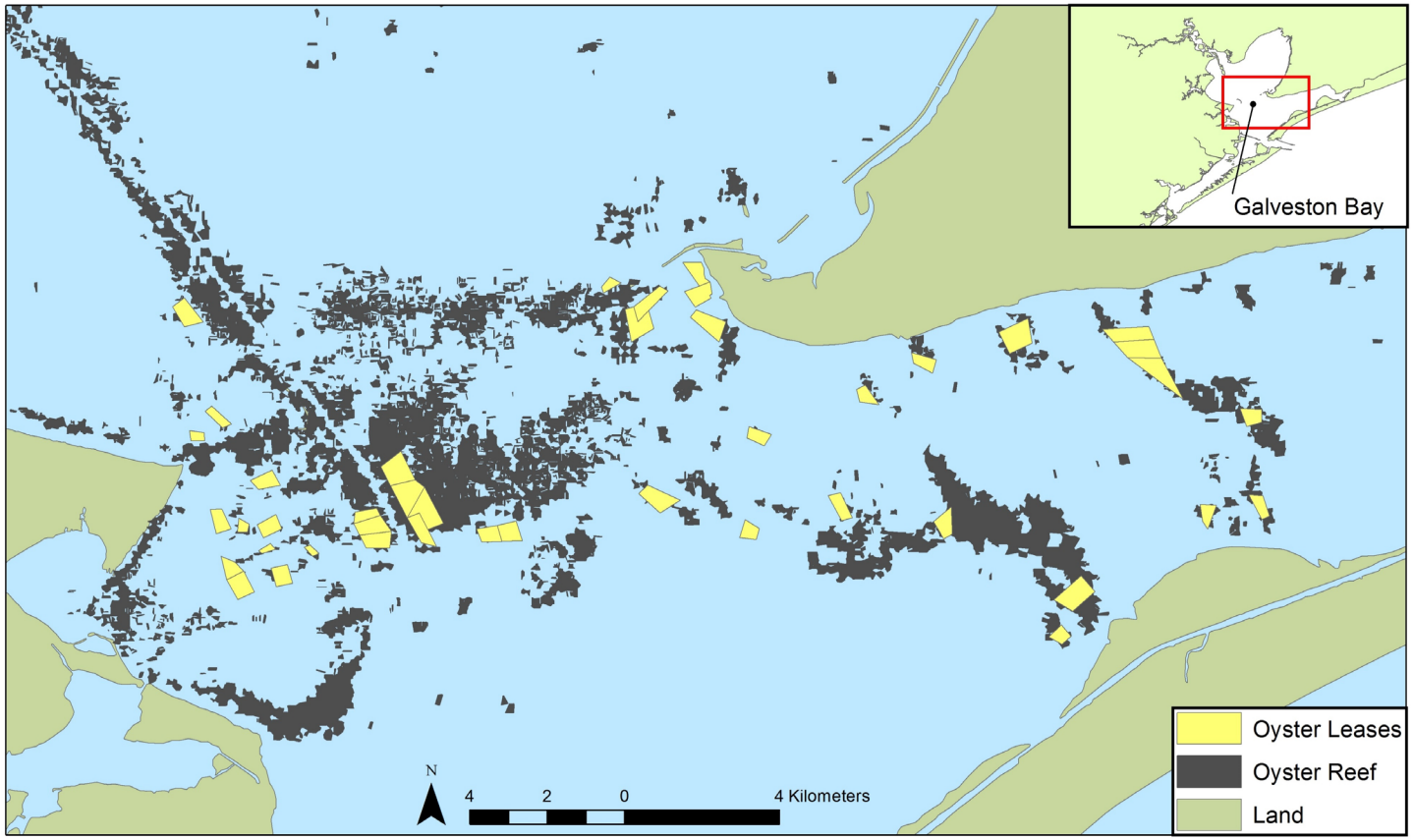
n/a = not applicable



Certificates of Location
(a.k.a. Leases)

- 43 locations
- 2,318 acres
- All in Galveston Bay

- ~20% of coastwide harvest



Certificates of Location
(a.k.a. Leases)

- Expansion of CoL program following SB 1032 in 2023
- Two Types of CoLs:
  - Commercial
    - Harvested
  - Restoration
    - Not harvested (sanctuary)
- Any bay system

Certificates of Location: Applications Received

- Application window Sep 1 – Nov 30, 2025
- Number of completed applications – 152

- Total acreage – 9,244
  - Galveston Bay – 4,075
  - Matagorda Bay – 2,058
  - San Antonio Bay – 1,701
  - Aransas Bay – 1,410

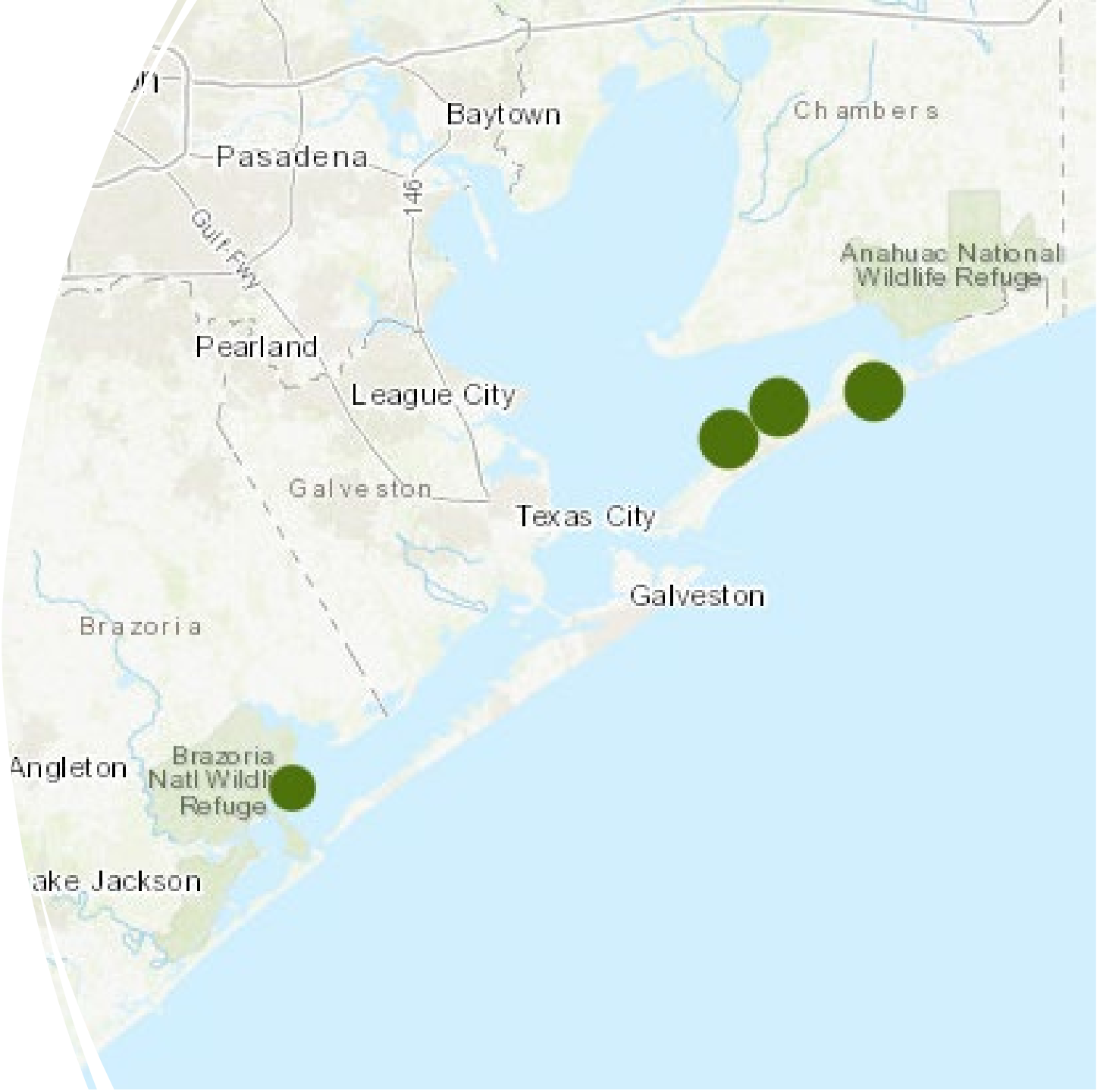
- 149 harvest applications, 3 restoration applications

Certificates of Location: Next Steps

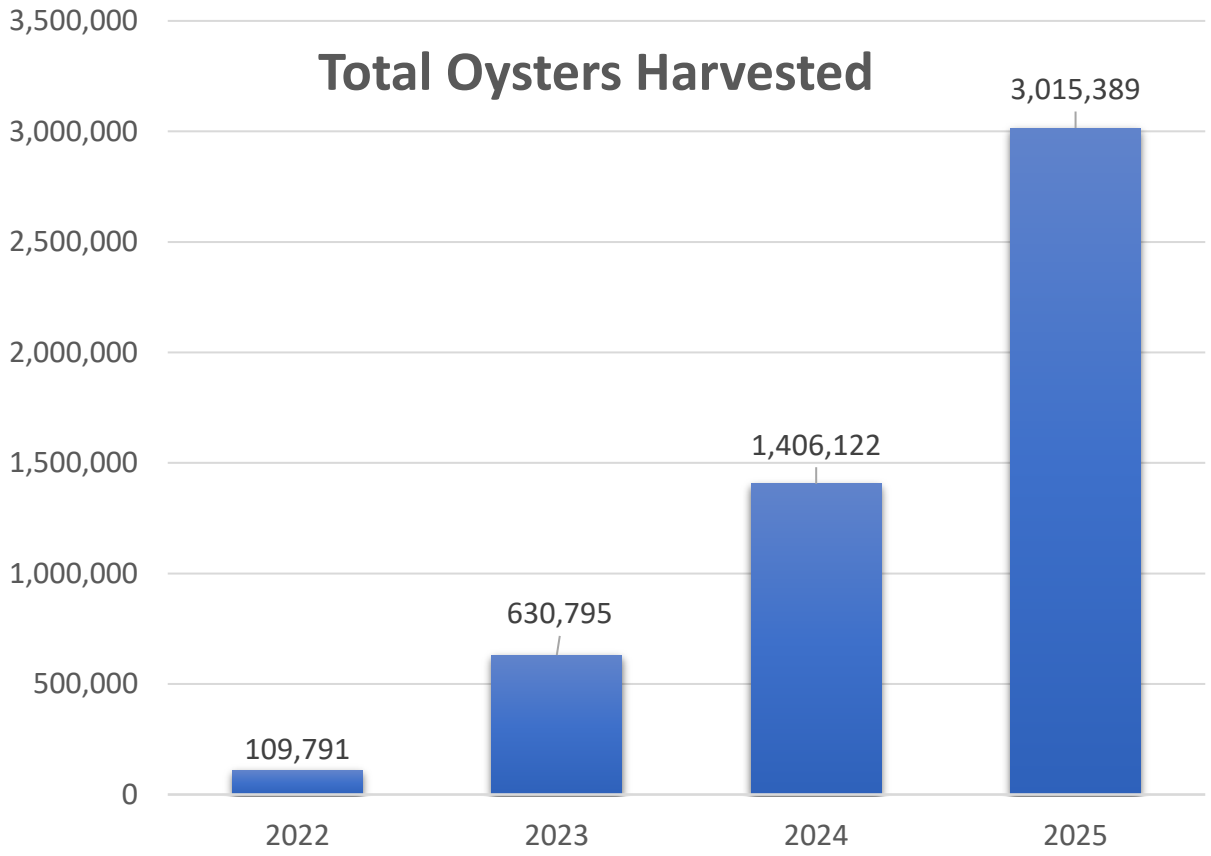
- Complete TPWD application review
- Incorporate GLO review
- Applicants will be notified
- Accepted applications will be able to move forward with the Natural Resources Survey
- Follow-up consultations will be offered for problematic locations

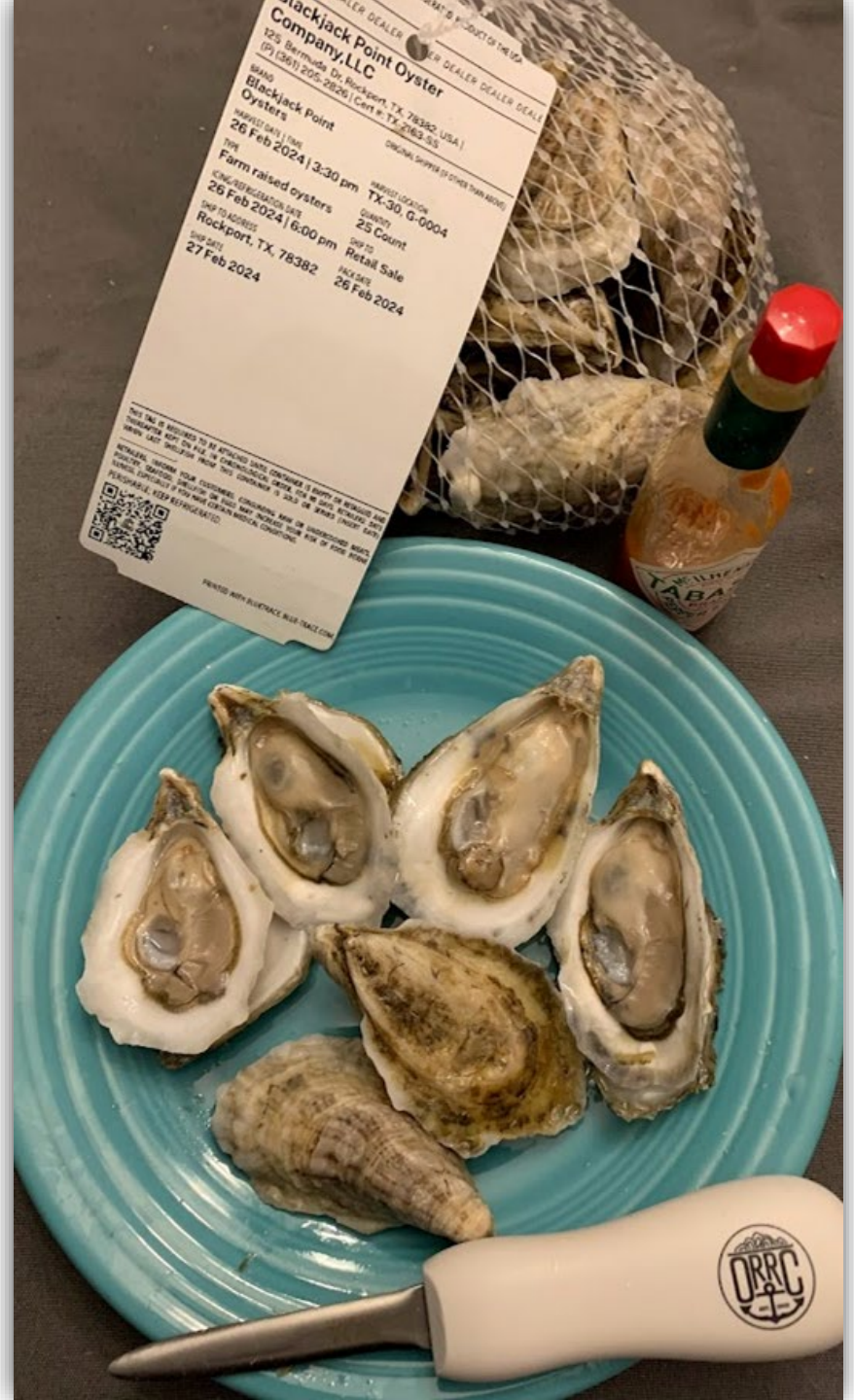
Cultivated Oyster Mariculture Permits

- Coastwide:
  - 17 Grow Out
    - 35 Conditional
  - 8 Nursery Hatchery
- Galveston Bay
  - 3 Grow Out
  - 1 Nursery-Hatchery

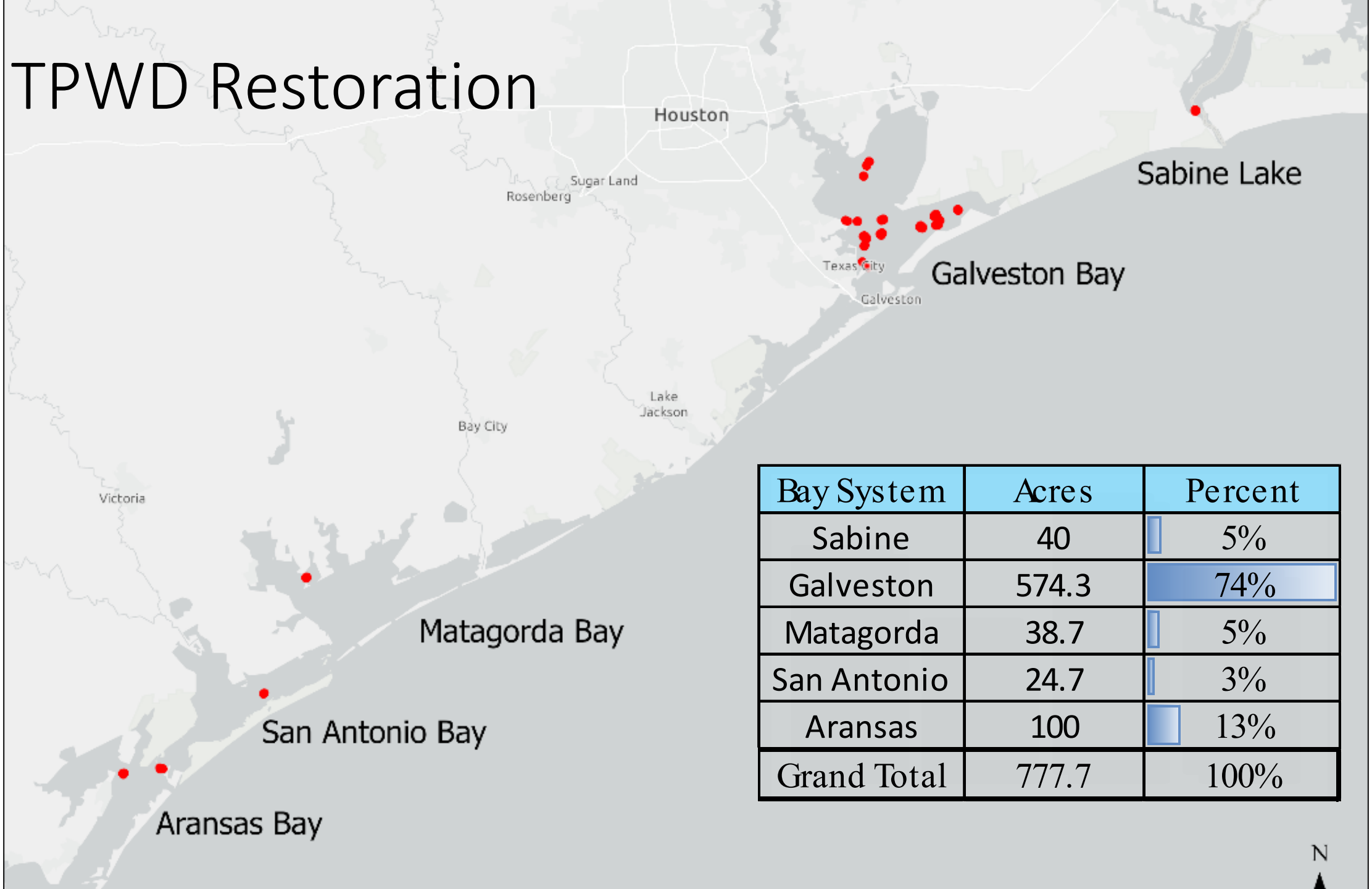


Mariculture Landings





TPWD Restoration



Bay System	Acres	Percent
Sabine	40	5%
Galveston	574.3	74%
Matagorda	38.7	5%
San Antonio	24.7	3%
Aransas	100	13%
Grand Total	777.7	100%

Research Collaboration

- Oyster mortality after Hurricane Harvey (Du et al. 2021)
- Evidence of acidification possibly limiting spat survival after Hurricane Harvey (Hicks et al. 2022)
- Dermo monitoring in Galveston Bay (Gaona-Hernandez et al. 2025, UHCL & TPWD)
- Oyster larval transport – investigating sources and sinks (Liu et al. 2025, TAMUG & TPWD)
- Dredge efficiency (Walsh-Wheat TPWD & TAMU-CC)
- Restoration – mounds vs flats (TPWD & TAMU-CC)
- Oyster stock assessment in Aransas Bay (McCullough & TAMU-CC)

Summary

- ✓ Closely monitor fishery and close as soon as threshold reached

Summary

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- Reduce fleet size – License buybacks

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Summary

- Closely monitor fishery and close as soon as threshold reached
- Reduce fleet size – License buybacks
- Avoid concentration of boats in small areas
- Expand private harvest: Certificate of Location and Mariculture programs
- Restoration
- Research to fill knowledge gaps

Questions?

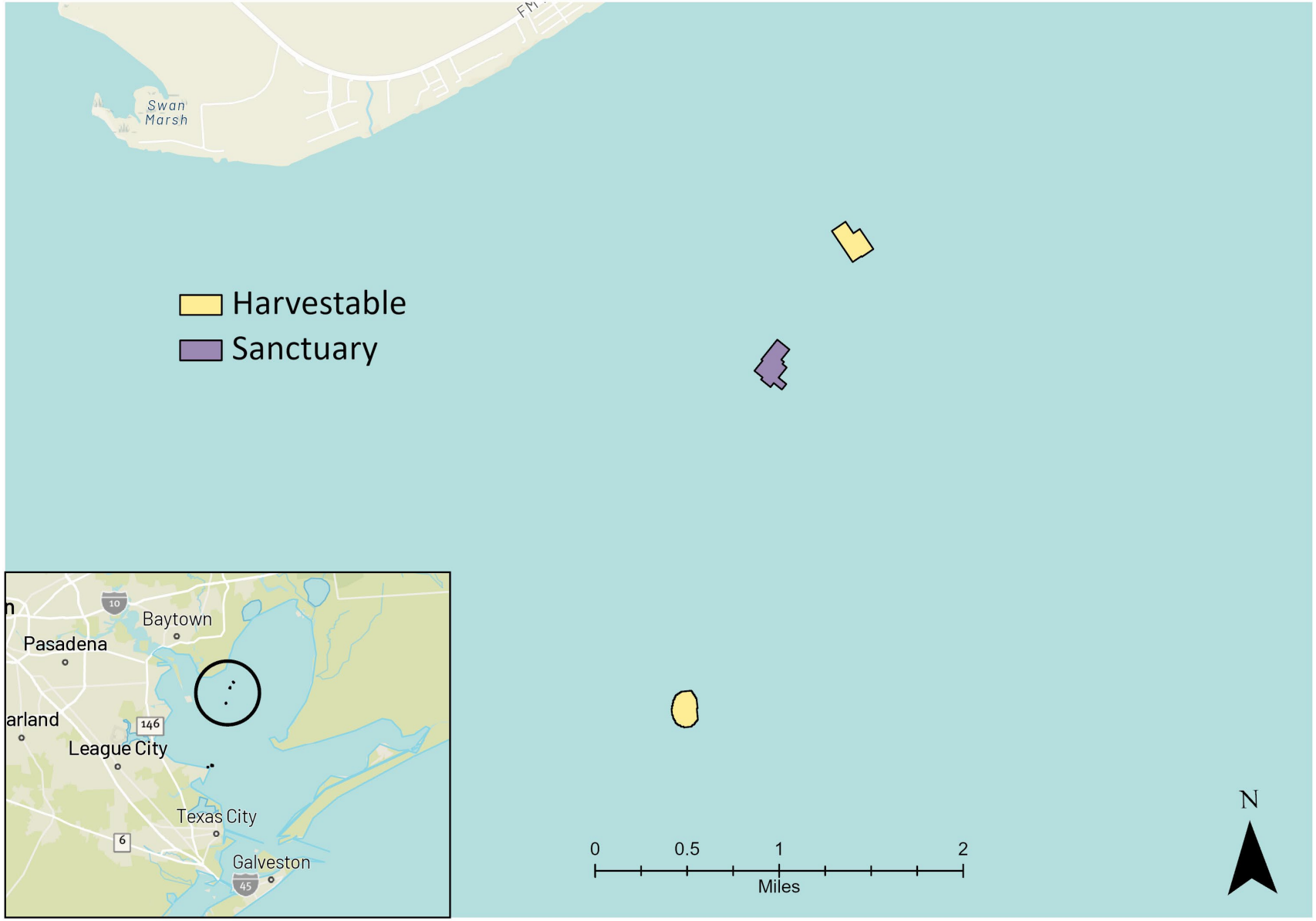
Photo Credit: Christine Jensen, TPWD

Tales from Beezley Reef

Lessons Learned from Adaptively Managing a Restored Oyster Reef Impacted by Sedimentation

Kathy Sweezey, Coastal Restoration Project Director

Image Credits (L to R): Greg Kahn, Kathy Sweezey

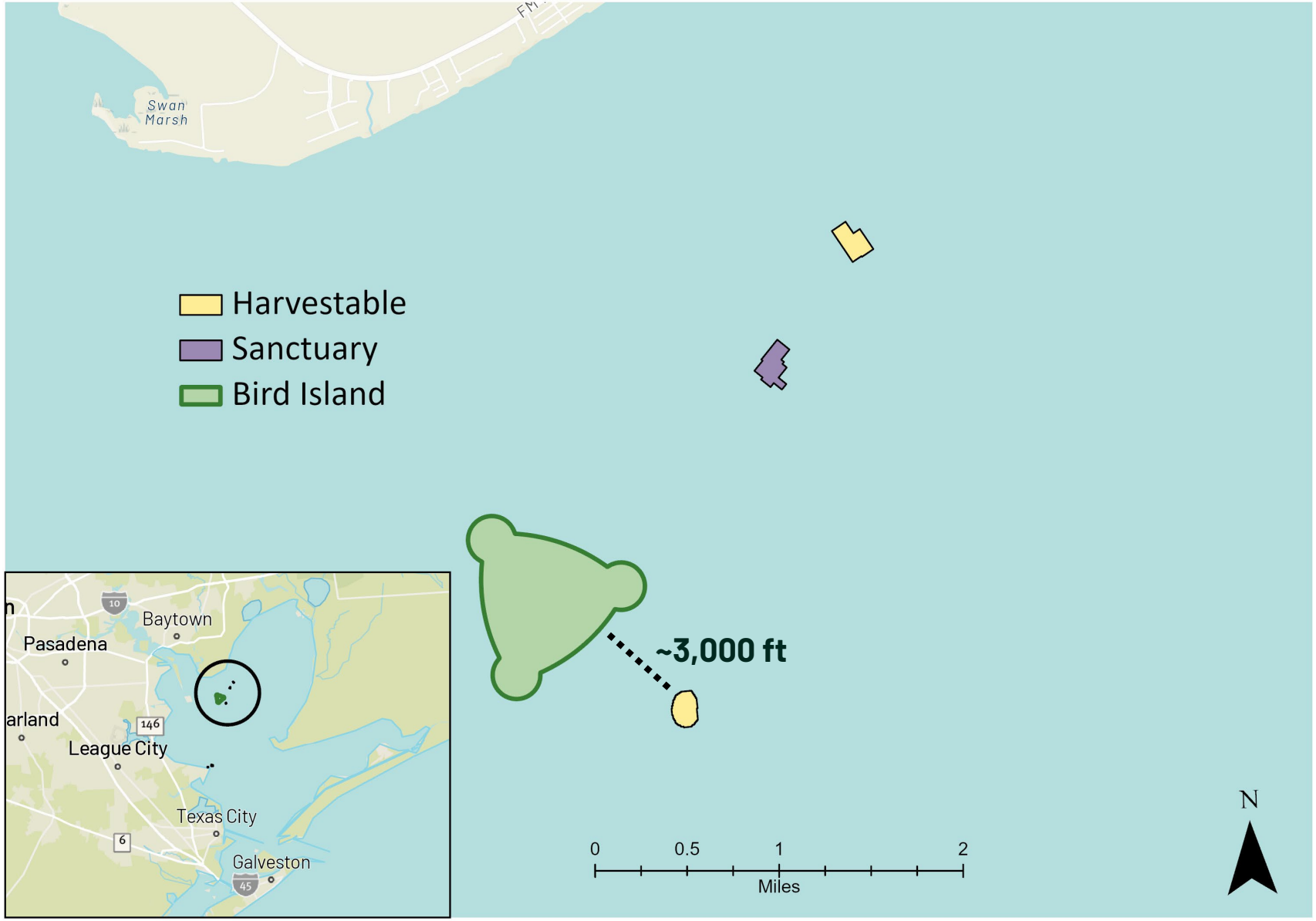


The Nature Conservancy

Beezley Reef

Galveston Bay, Texas

File Name: Galveston Bay Reef.aprx
Created by: Kathy Sweezey
Last updated: 10/22/2025



The Nature Conservancy

Beezley Reef

Galveston Bay, Texas

File Name: Galveston Bay Reef.aprx
Created by: Kathy Sweezey
Last updated: 10/22/2025

Agenda

1. What we saw
2. How we reacted
3. Where we go from here

Beezley Reef Monitoring Events

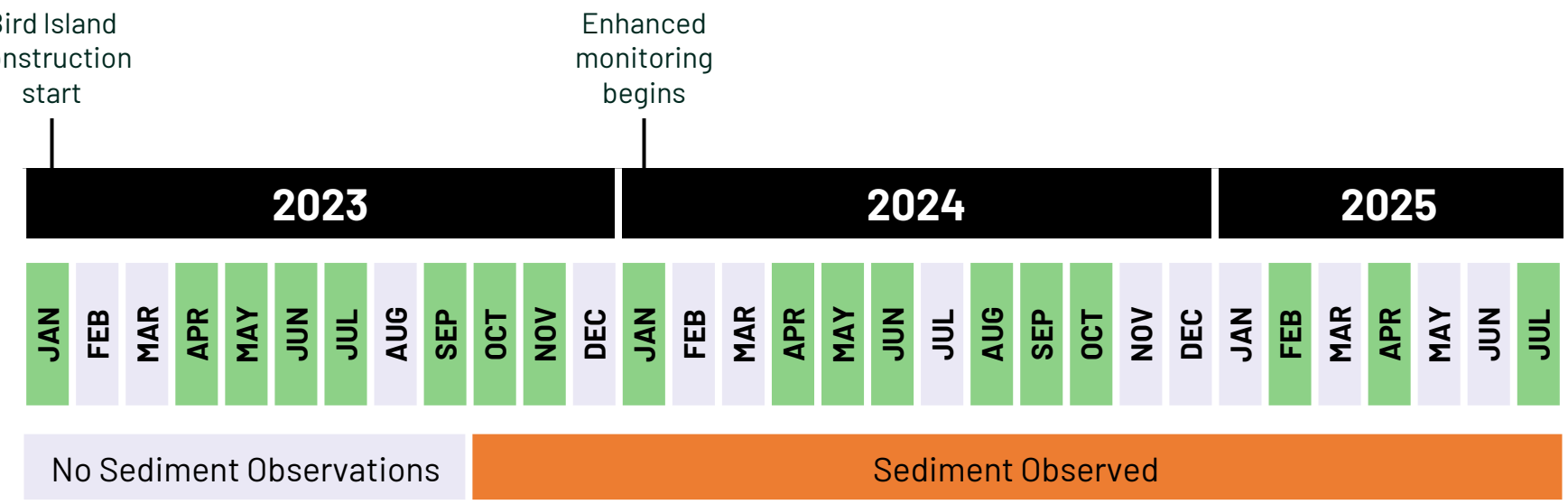
The Nature Conservancy

Regular Monitoring

- Diver Quadrats
- Patent Tongs
- Spat Tiles

Enhanced Monitoring

- Poling
- Ponar Samples
- Turbidity Monitoring
- Sediment Core Samples
- Sidescan Mapping



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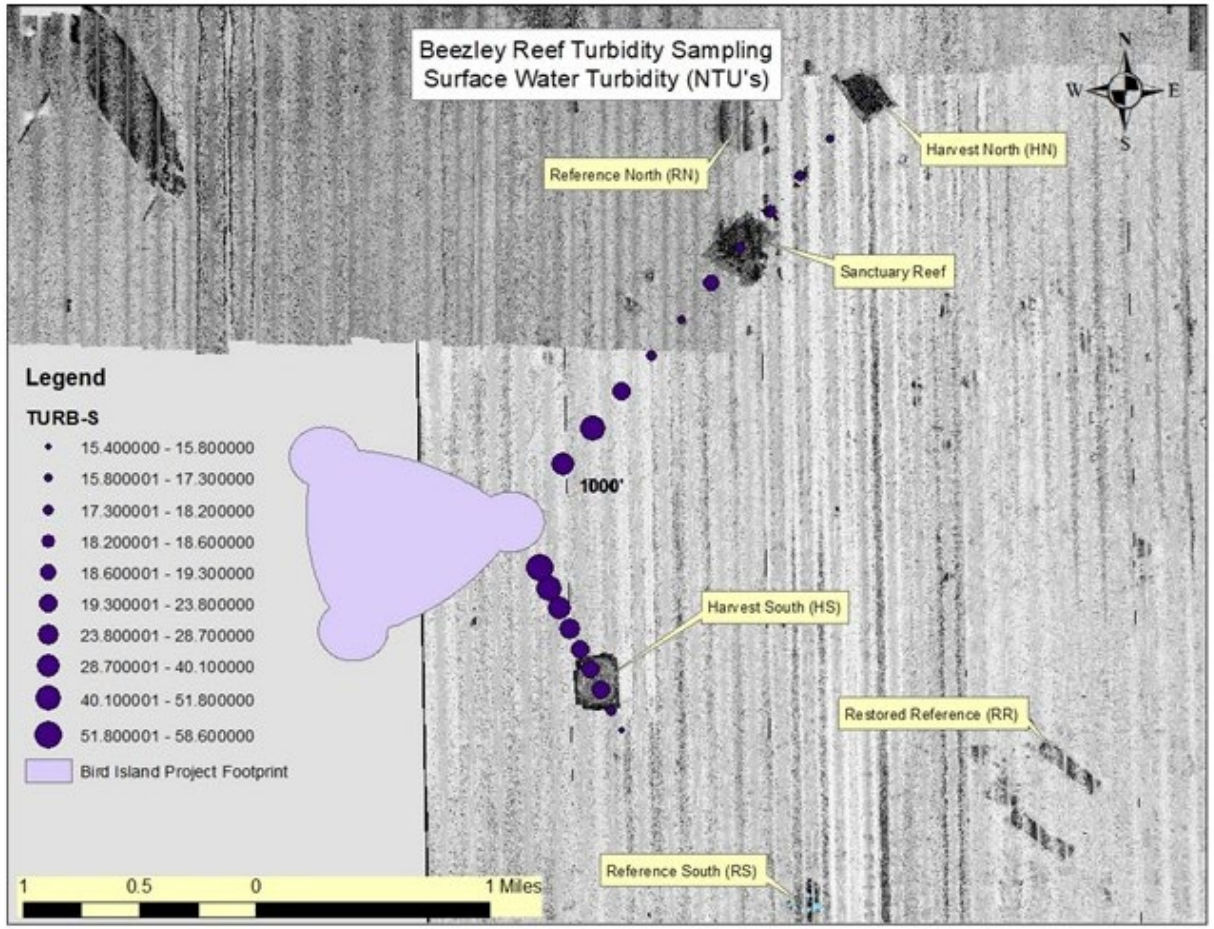
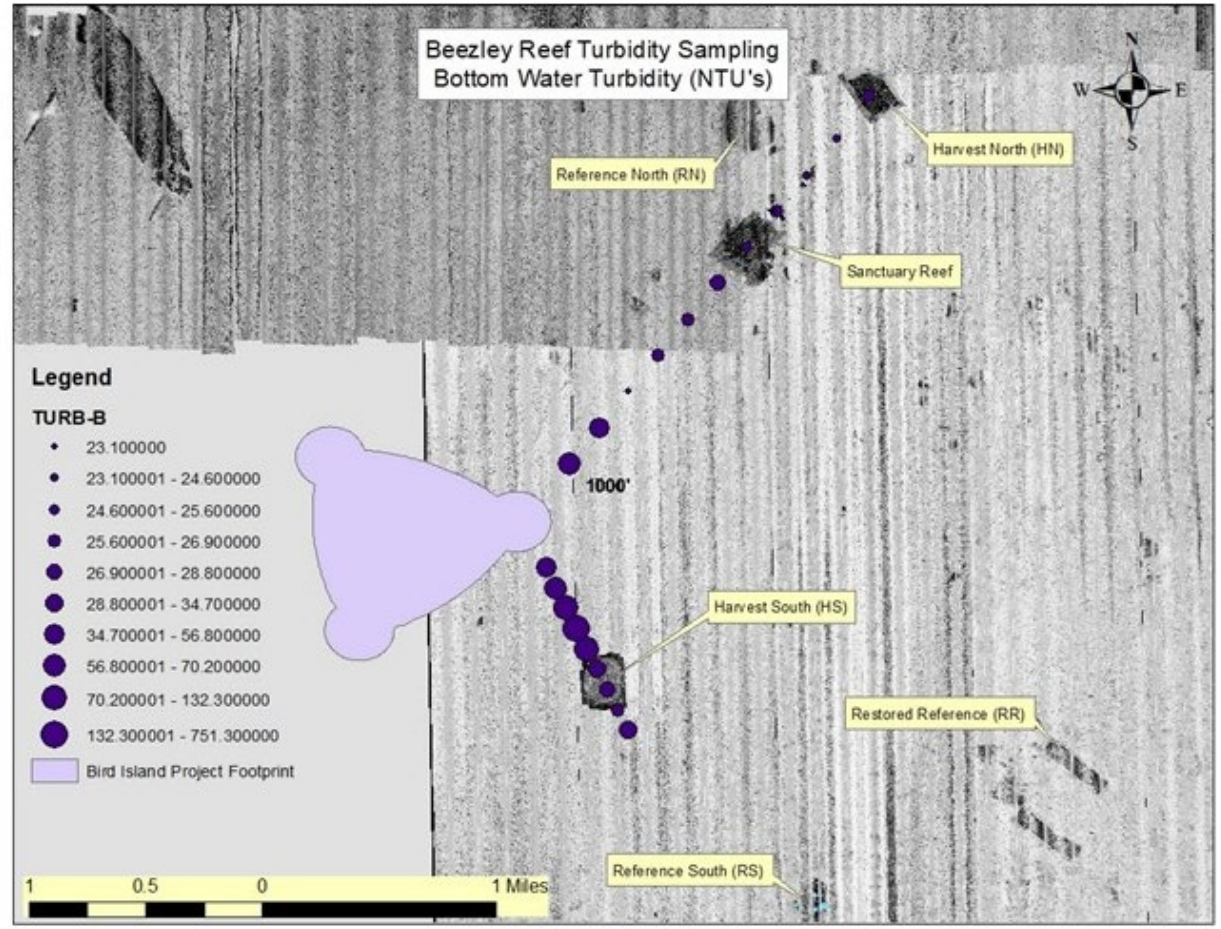
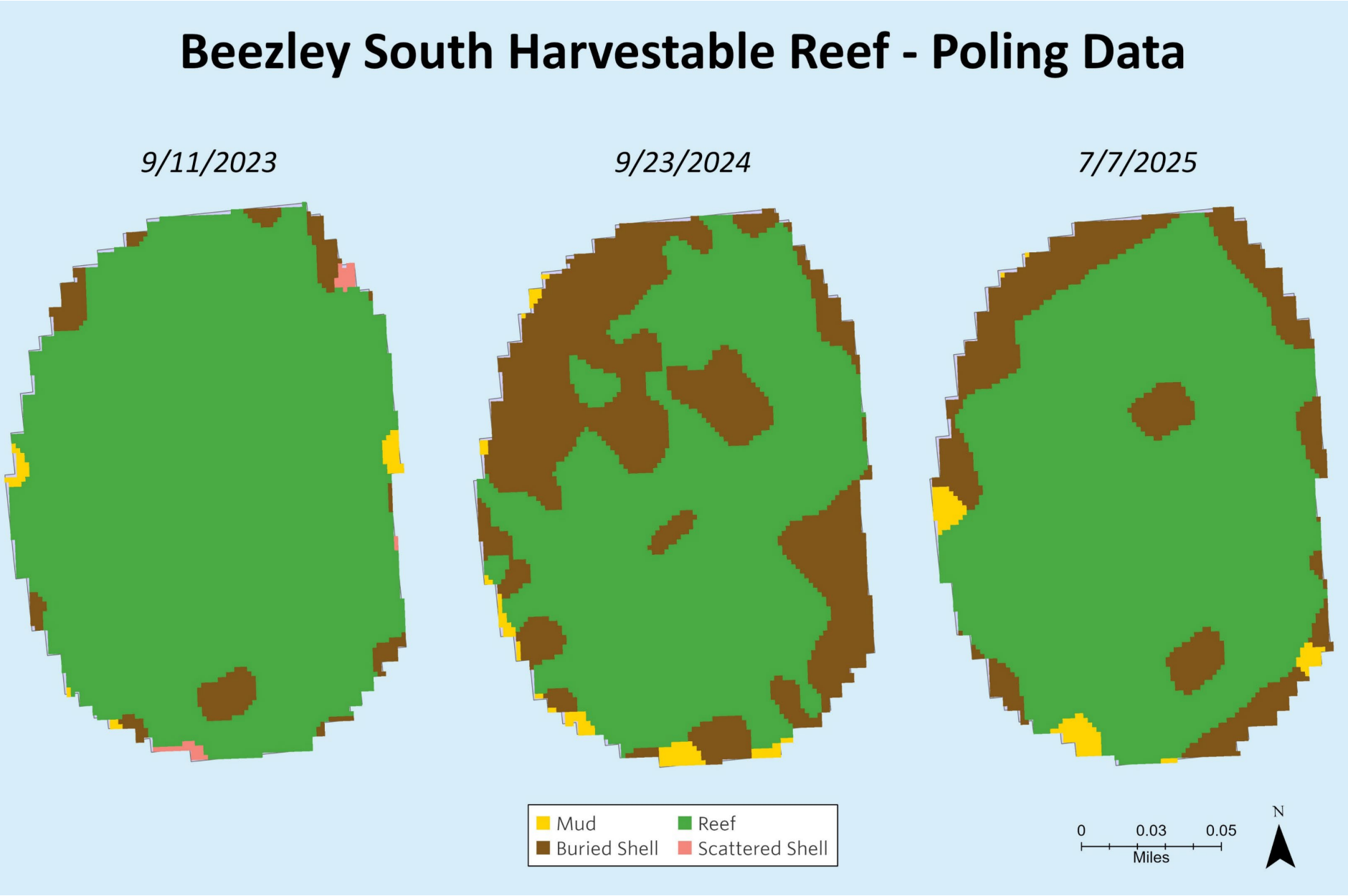

Beezley Reef Turbidity Sampling
Surface Water Turbidity (NTU's)
N
W
E
S
Harvest North (HN)
Reference North (RN)
Sanctuary Reef
1000'
Harvest South (HS)
Restored Reference (RR)
Reference South (RS)
Legend
TURB-S
15.400000 - 15.800000
15.800001 - 17.300000
17.300001 - 18.200000
18.200001 - 18.600000
18.600001 - 19.300000
19.300001 - 23.800000
23.800001 - 28.700000
28.700001 - 40.100000
40.100001 - 51.800000
51.800001 - 58.600000
Bird Island Project Footprint
1
0.5
0
1 Miles

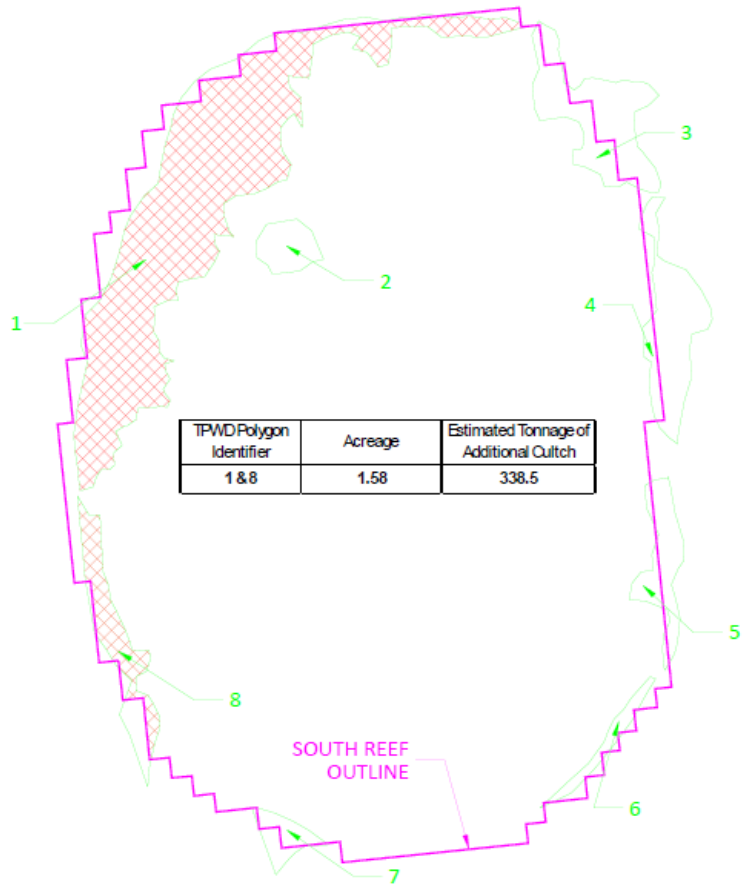
B


Beezley Reef Turbidity Sampling
Bottom Water Turbidity (NTU's)
N
W
E
S
Harvest North (HN)
Reference North (RN)
Sanctuary Reef
1000'
Harvest South (HS)
Restored Reference (RR)
Reference South (RS)
Legend
TURB-B
23.100000
23.100001 - 24.600000
24.600001 - 25.600000
25.600001 - 26.900000
26.900001 - 28.800000
28.800001 - 34.700000
34.700001 - 56.800000
56.800001 - 70.200000
70.200001 - 132.300000
132.300001 - 751.300000
Bird Island Project Footprint
1
0.5
0
1 Miles

Beezley South Harvestable Reef - Poling Data



Sidescan Sonar



TPWD Polygon Identifier	Acreage	Estimated Tonnage of Additional Cultch
1 & 8	1.58	338.5

Buried Reef Area

Beezley Reef
Next Steps

- GBF to restore 1.5 acres of harvestable reef area
- TPWD to continue monitoring for one additional year
- Share lessons learned to inform future projects

Suggestions for Future Monitoring and Adaptive Management Plans

1 Use multiple monitoring strategies

Assess multiple variables, like low vs high levels of sediment, dredged vs native sediment characteristics, and visual surveys with divers

2 Conduct pre-restoration monitoring

Without a baseline, some observations were difficult to compare

3 Set quantifiable adaptive management triggers

Triggers can be argued without distinct, quantifiable values, like the measured depth of sediment on a reef or square footage of area impacted

Lessons Learned

1. **Adaptive Management is CRUCIAL!!**
2. **Involve stakeholders to build support**
3. **Implement construction BMPs to minimize impacts to adjacent habitats**
4. **Monitor before, during, and after restoration**

Together, we find a way

Kathy Sweezey
k.sweezey@tnc.org

GALVESTON BAY FOUNDATION

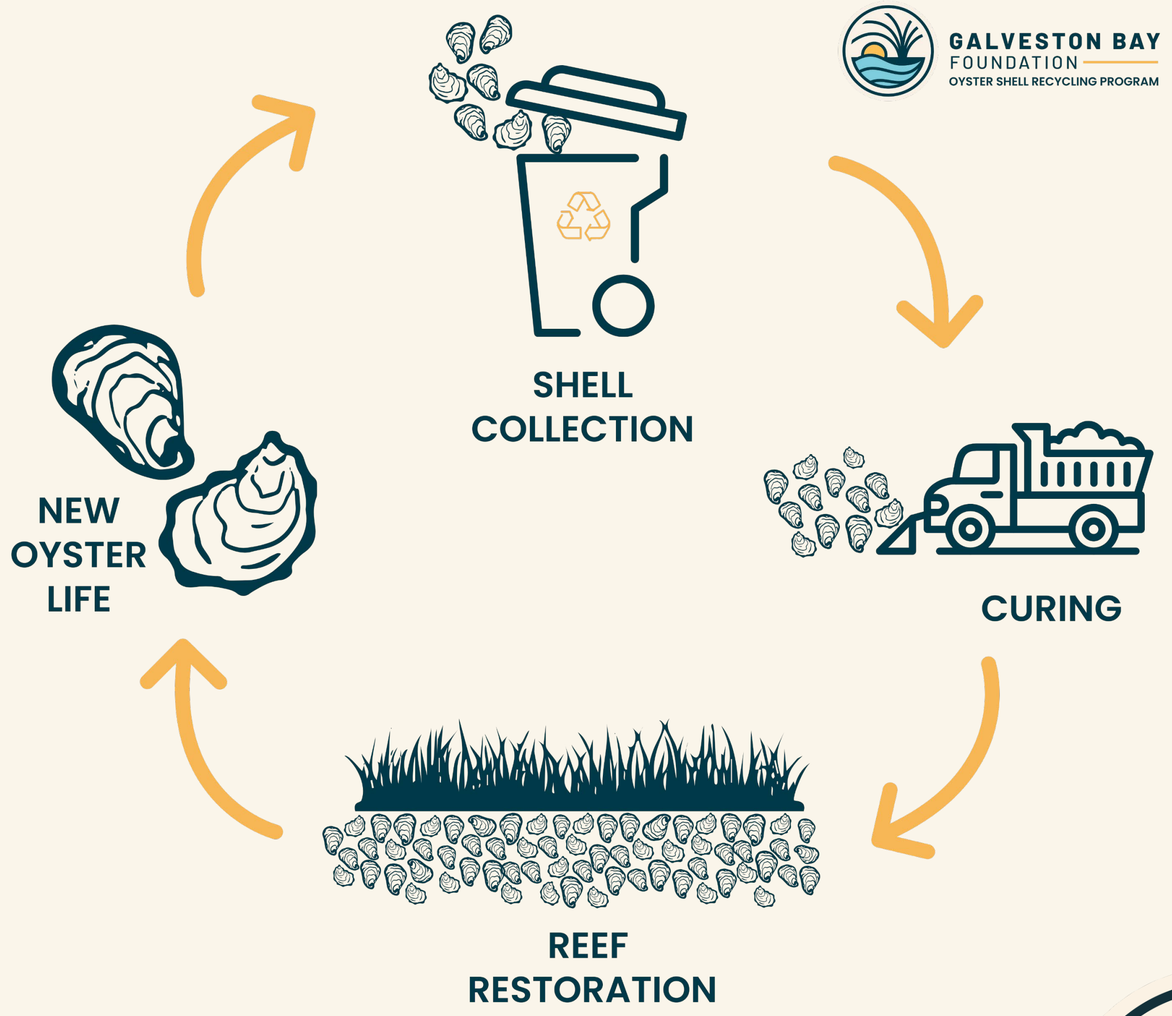
PROTECT TODAY. PRESERVE TOMORROW.

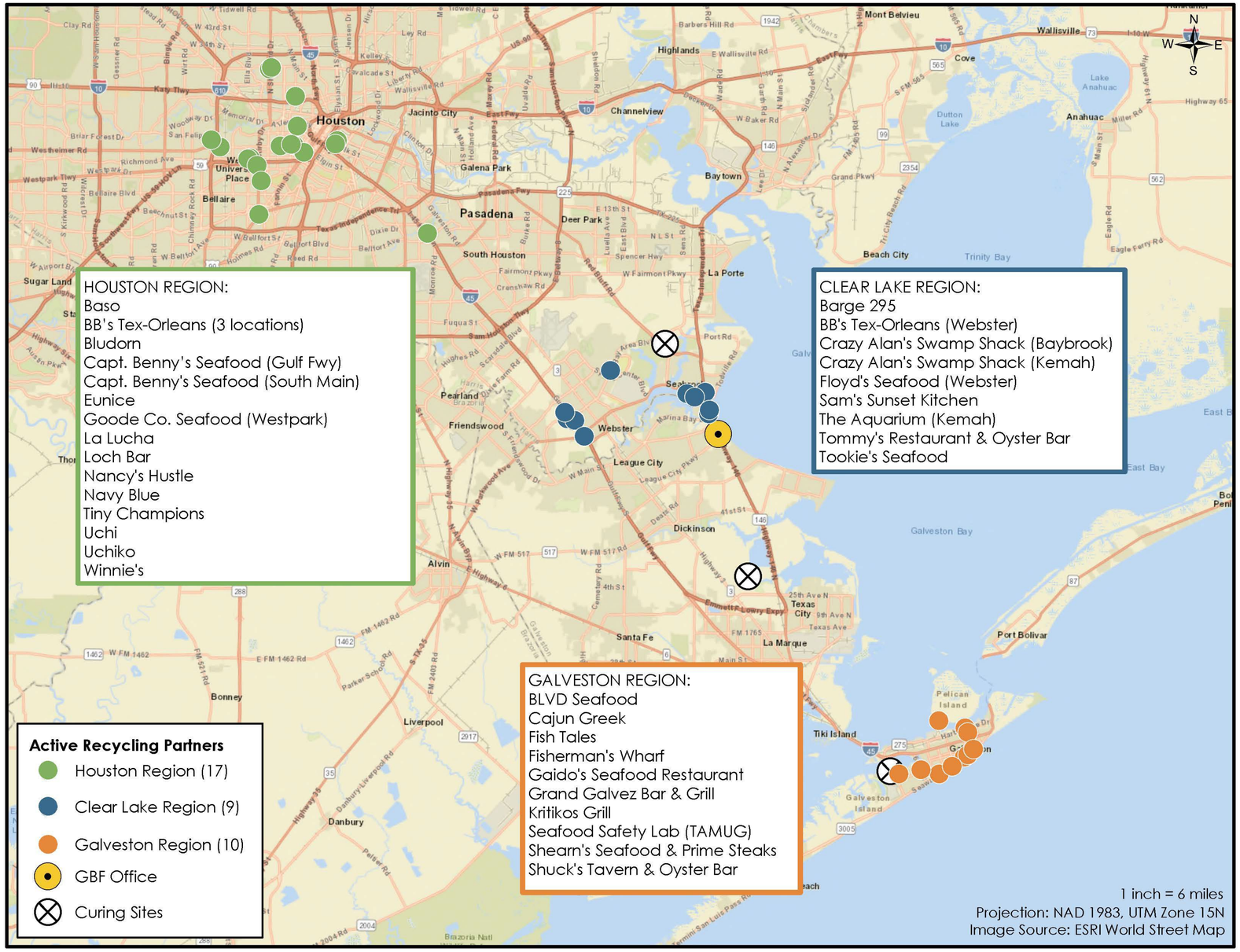
GBF'S OYSTER SHELL RECYCLING PROGRAM, FOURTEEN YEARS OF GROWTH AND FUTURE GOALS

Shannon Batte- Oyster Program Manager

GOAL:

Reclaim oyster shells from local restaurants and return those shells to Galveston Bay to restore native oyster habitat




HOUSTON REGION:
Baso
BB's Tex-Orleans (3 locations)
Bludorn
Capt. Benny's Seafood (Gulf Fwy)
Capt. Benny's Seafood (South Main)
Eunice
Goode Co. Seafood (Westpark)
La Lucha
Loch Bar
Nancy's Hustle
Navy Blue
Tiny Champions
Uchi
Uchiko
Winnie's
CLEAR LAKE REGION:
Barge 295
BB's Tex-Orleans (Webster)
Crazy Alan's Swamp Shack (Baybrook)
Crazy Alan's Swamp Shack (Kemah)
Floyd's Seafood (Webster)
Sam's Sunset Kitchen
The Aquarium (Kemah)
Tommy's Restaurant & Oyster Bar
Tookie's Seafood
GALVESTON REGION:
BLVD Seafood
Cajun Greek
Fish Tales
Fisherman's Wharf
Gaido's Seafood Restaurant
Grand Galvez Bar & Grill
Kritikos Grill
Seafood Safety Lab (TAMUG)
Shearn's Seafood & Prime Steaks
Shuck's Tavern & Oyster Bar
Active Recycling Partners
Houston Region (17)
Clear Lake Region (9)
Galveston Region (10)
GBF Office
Curing Sites
1 inch = 6 miles
Projection: NAD 1983, UTM Zone 15N
Image Source: ESRI World Street Map
N
W
E
S
Houston
Pasadena
Baytown
Channelview
Jacinto City
Galena Park
Deer Park
Bellaire
South Houston
Pearland
Friendswood
Webster
League City
Seabrook
La Porte
Beach City
Trinity Bay
Galveston Bay
Dickinson
Alvin
Santa Fe
La Marque
Texas City
Port Bolivar
Tiki Island
Galveston Island
Pelican Island
Bonney
Liverpool
Danbury
Anahuac
Lake Anahuac
Mont Belvieu
Highlands
Cove
Wallisville
Sugar Land

Piloted program with Tommy's Restaurant and Oyster Bar

Expanded to Galveston Island via partnership with Texas A&M University

Began partnership with Moody Gardens on Galveston Island

Purchased trailer for Moody Gardens

Purchased new landscape trailer

Purchased new EV truck

2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
PHASE I: Pilot		PHASE II: Expansion A						PHASE III: Evaluation A		PHASE IV: Expansion B		Phase V: Evaluation B		
1 Recycling Partner		7 Recycling Partners						10 Recycling Partners		30 Recycling Partners		36 Recycling Partners		

Purchased truck & landscape trailer

Purchased new landscape trailer

Purchased dump truck & expanded to Houston

Shell Collection Routes

Clear Lake Route

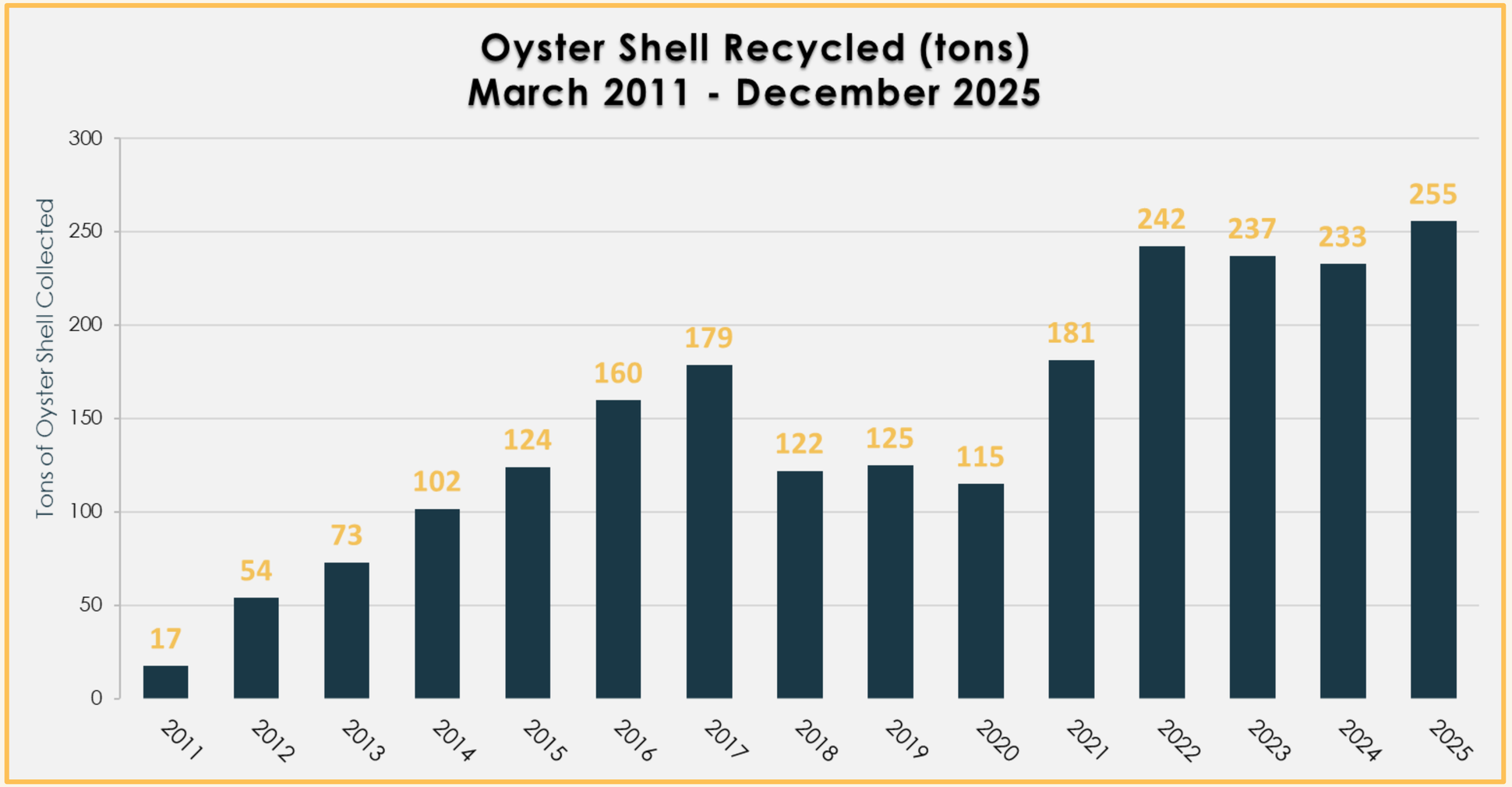
Original shell collection route that began in 2011

Galveston Route

Partnership with Moody Gardens began in 2020

Houston Route

Expanded shell collection to inner loop of Houston in 2021 after purchasing a truck to facilitate the weekly pickups



Total of 2,219 tons!

Sweetwater Lake Preserve

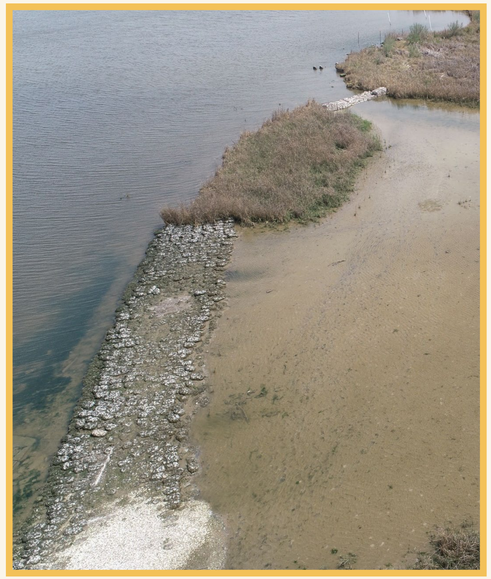
224 tons of shell

1,960 linear feet

Constructed from 2014-2025

Baytown Nature Center

27 tons of shell



105 linear feet

Constructed in 2017 & 2021

Moody Gardens Golf Course

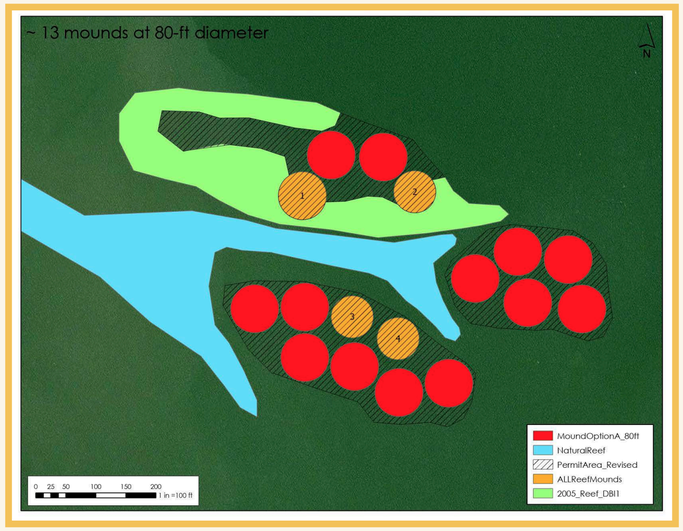
23 tons of shell

158 linear feet

Hole 8: Constructed in 2025
Hole 11: Construction set for 2026

Dickinson Bay Reef

Phase 1: 118 tons of shell
Phase 2: 326 tons of shell
Phase 3: ~470 tons of shell for 3-4 more mounds



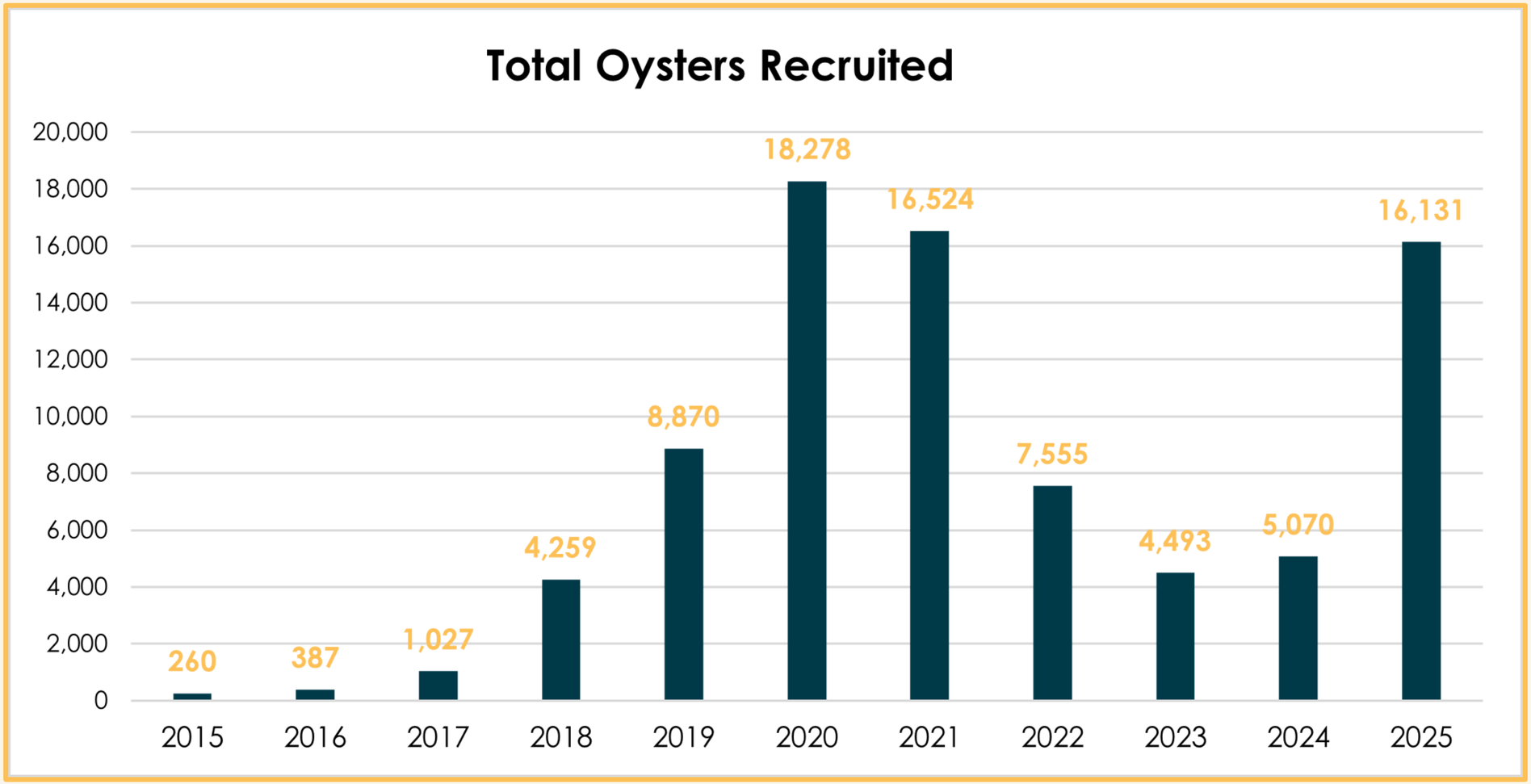
Phase 1:
- *Mound 1- 80 ft. diameter, 1 ft. height*
- *Mound 2- 70 ft. diameter, 1.5 ft. height*

Phase 2:
- *Mound 3- 80 ft. diameter, 2 ft. height*
- *Mound 4- 70 ft. diameter, 1.5 ft. height*

Phase 3:
- *Mounds will be similar size as Phase 1 & 2*

Phase 1: Constructed in 2018
Phase 2: Constructed in 2022
Phase 3: Construction set for 2026

Volunteer Oyster Gardening Program



Total of 82,854 oysters grown!

Types of Gardens

Cage

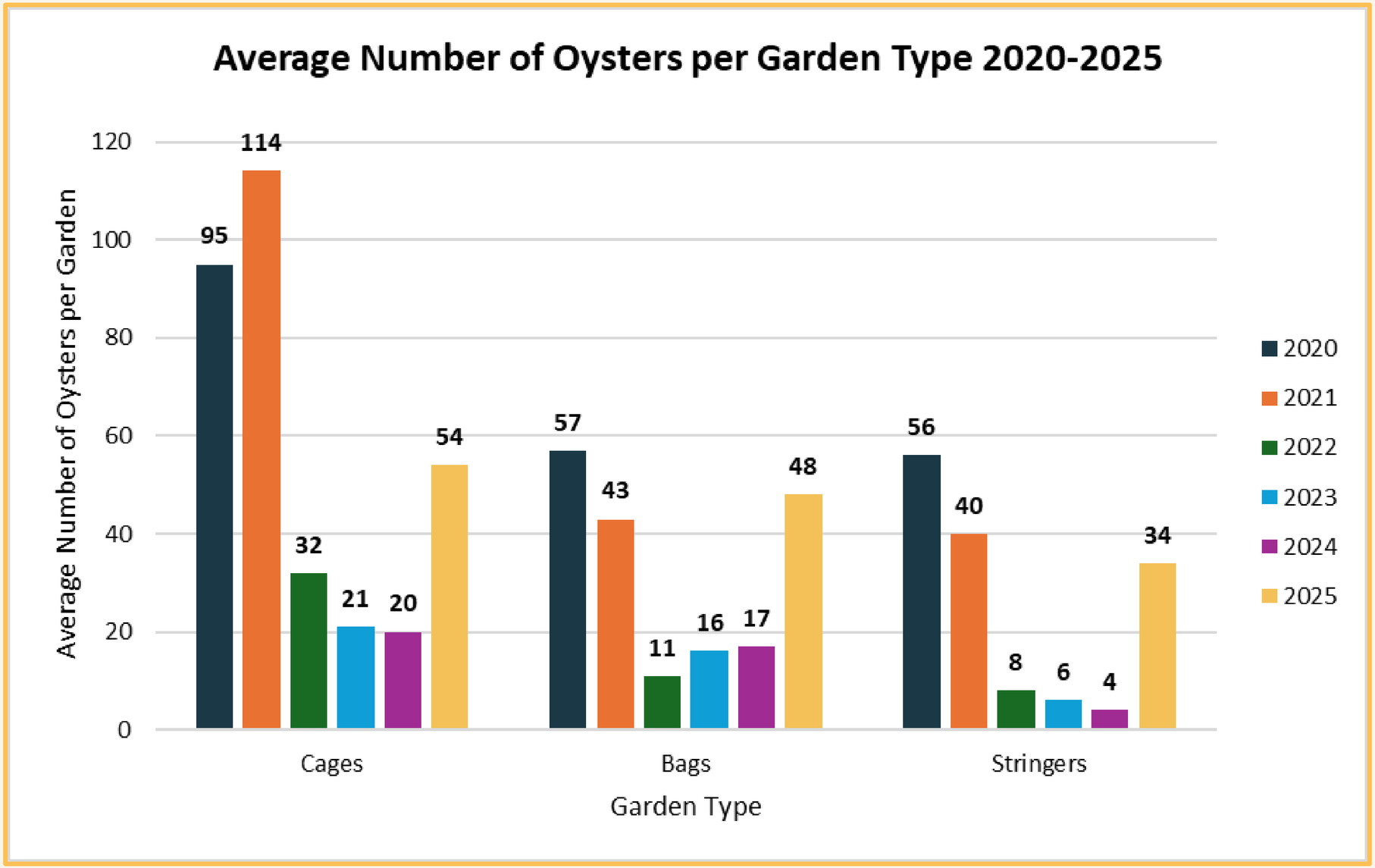
- Most successful
- Material is more costly
- Labor intensive
- Can be used for more than one season

Bag

- Second most successful
- Material is fairly cheap
- Very quick and easy to make
- Can only be used for one season

Stringer

- Least successful
- Material is cheap
- Labor intensive
- Can only be used for one season


Average Number of Oysters per Garden Type 2020-2025
Average Number of Oysters per Garden
120
100
80
60
40
20
0
95
114
32
21
20
54
57
43
11
16
17
48
56
40
8
6
4
34
Cages
Bags
Stringers
Garden Type
2020
2021
2022
2023
2024
2025

Volunteer Reef Monitoring Program

GALVESTON BAY FOUNDATION

Protect Today.

Preserve Tomorrow.

sbatte@galvbay.org | 1725 Highway 146, Kemah, TX 77565 | 832-536-2265

SENTINEL PROGRAM TO TRACK *PERKINSUS MARINUS* (DERMO) IN OYSTERS OF GALVESTON BAY, TEXAS

George J. Guillen[1,2] Mandi Gordon[1], Kaylei Chau[1], Chelsey Hill [2], Christine Jensen[3], Joel Anderson[4],

State of the Bay Conference

February 24, 2026

Galveston, TX

[1] Environmental Institute of Houston – University of Houston-Clear Lake, Houston, TX.

[2] College of Science and Engineering, University of Houston-Clear Lake, Houston, TX.

[3] Dickinson Marine Lab, Texas Parks and Wildlife Department, Dickinson, Texas

[4] Perry R. Bass Research Station, Texas Parks and Wildlife Department, Palacios, Texas

University of Houston Clear Lake

Environmental Institute of Houston

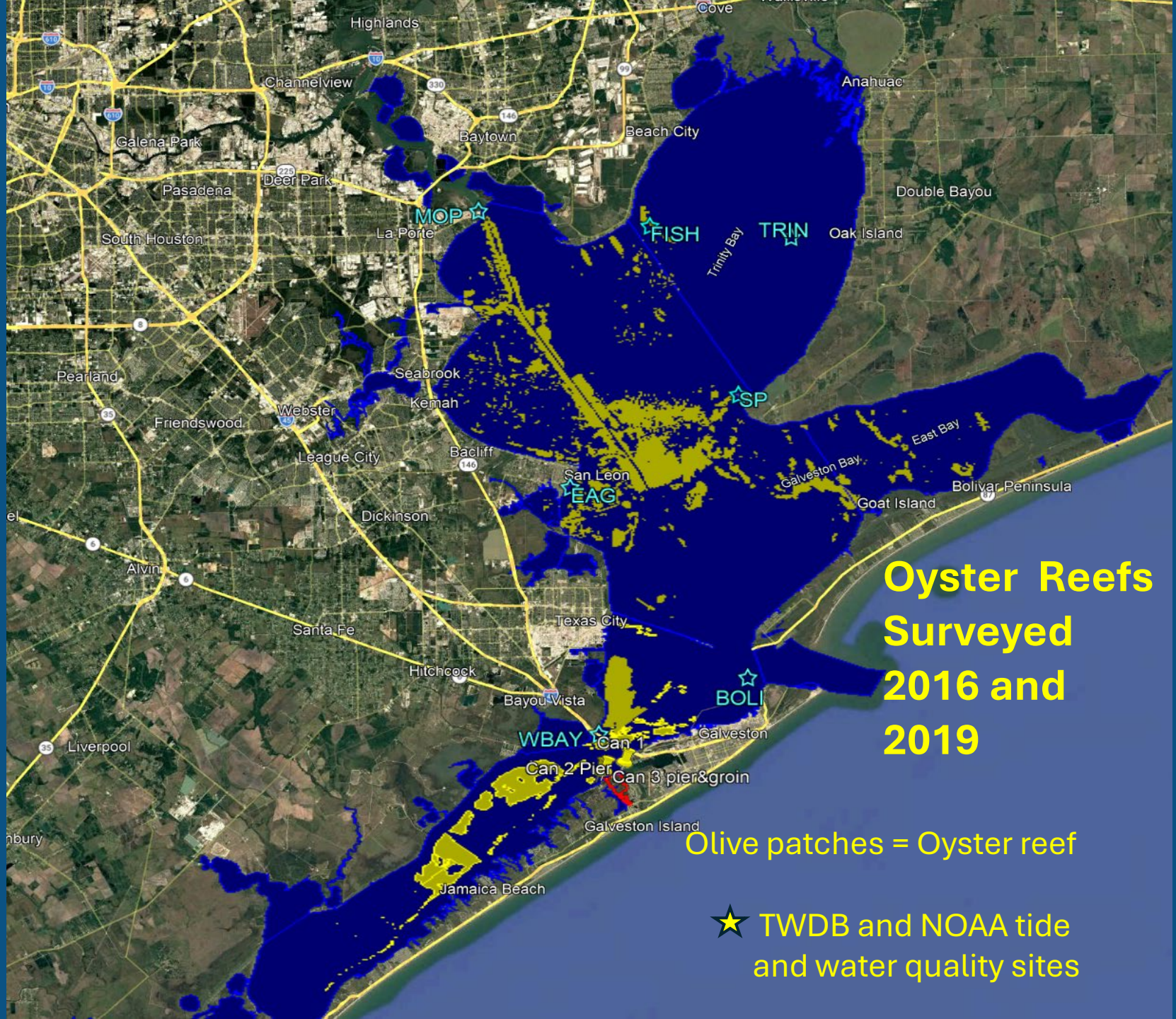
TEXAS PARKS & WILDLIFE

- The Eastern oyster is an **ecosystem engineer** and **keystone species** providing limited hard-bottom habitat and numerous ecosystem services.
- Oysters are considered a reliable **bioindicator** of estuarine ecosystem health since they are impacted and integrate the effects of freshwater inflow, pollutants, climate variability, extreme weather, and habitat destruction and harvesting for food and shell.
- Pathogens and predators that severely reduce their numbers are therefore of concern to fishery managers.
- They provide numerous services to man and the ecosystem

Ecosystem Services Provided by Oysters

Service	Benefit/Value
1. Production of oysters	(↑ market and recreational value)
2. Water filtration & production of pseudofeces	(↓ suspended solids, turbidity, phytoplankton biomass and microbial production; ↑denitrification, SAV, recreational use).
3. Habitat for epibenthic inverts	(↑biodiversity & productivity).
4. Carbon sequestration	(↓greenhouse gas concentrations)
5. Augmented fish production	(↑ market and recreational value)
6. Stabilization of adjacent habitats and shoreline	(↑ SAV and salt marsh habitat; ↓ effects of storm surge and sea-level rise [SLR])
7. Diversification of the landscape & ecosystem	(↑ synergies among habitats); provides one of the few natural hard-bottom habitats in nGOM estuaries.

Grabowski and Peterson (2007)

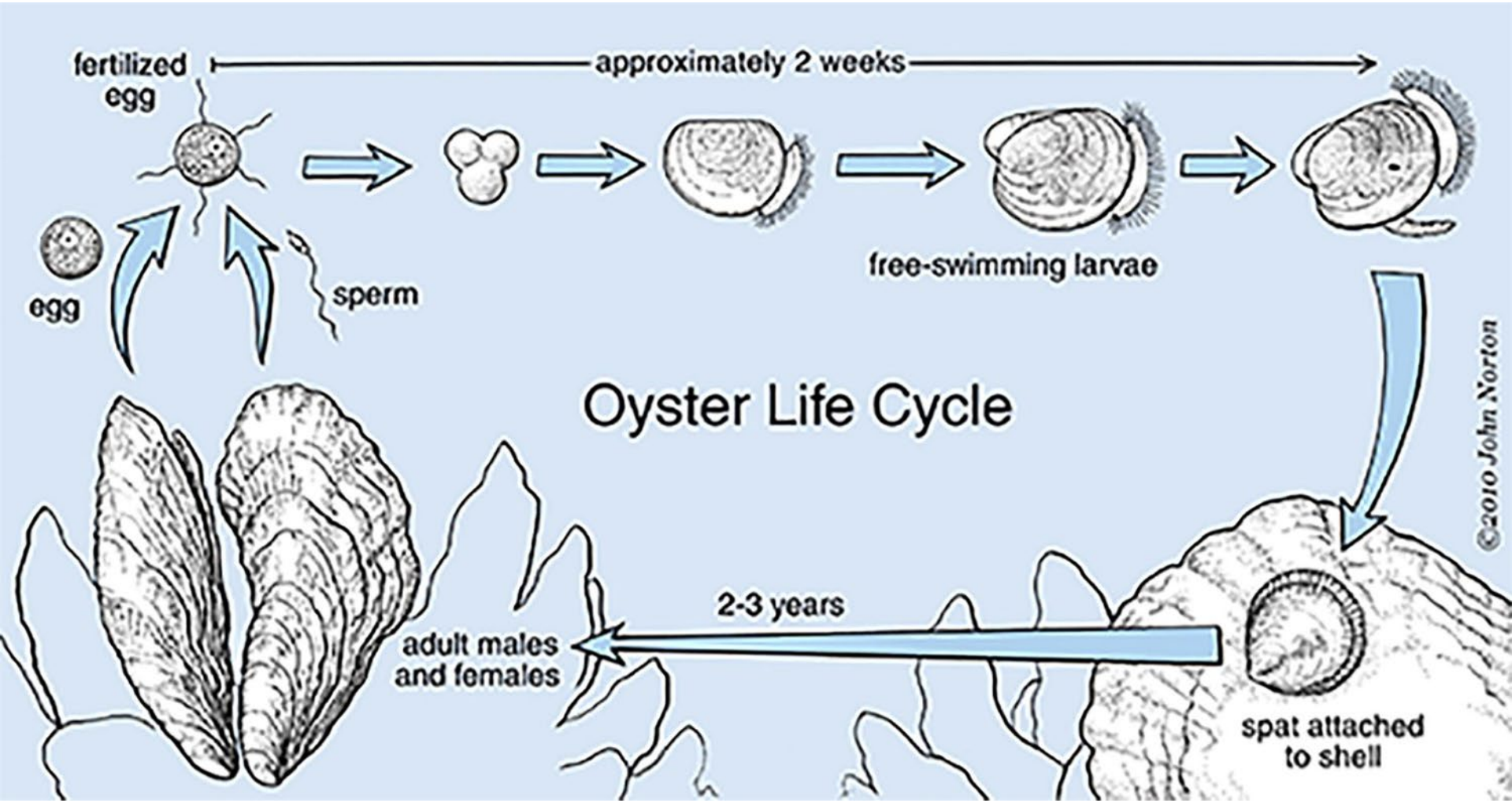

Highlands
Cove
Channelview
Anahuac
Galena Park
Baytown
Beach City
Pasadena
Deer Park
Double Bayou
MOP
La Porte
FISH
TRIN
Oak Island
South Houston
Trinity Bay
Pearland
Seabrook
Kemah
SP
Webster
Friendswood
East Bay
League City
Bacliff
Galveston Bay
San Leon
EAG
Bolivar Peninsula
Goat Island
Dickinson
Alvin
Texas City
Santa Fe
Hitchcock
BOLI
Bayou Vista
WBAY
Can 1
Galveston
Liverpool
Can 2 Pier
Can 3 pier&groin
Galveston Island
Jamaica Beach
Oyster Reefs Surveyed 2016 and 2019
Olive patches = Oyster reef
TWDB and NOAA tide and water quality sites

Oyster Reef Habitat

Major Bay System	Oyster Habitat (Acres)	Major Bay Area (Acres)	Percentage of Major Bay Covered by Oysters
Sabine Lake	38	72,241	0.1%
Galveston	37,247	388,233	9.6%
Matagorda	27,557	285,910	9.6%
San Antonio	7,545	129,005	5.8%
Aransas	12,010	152,828	7.9%
Corpus Christi	2,402	122,152	2.0%
Upper Laguna	25	138,827	0.0%
Lower Laguna	116	173,802	0.1%
Undefined	1,139		
TOTAL	**88,080**	**1,462,997**	

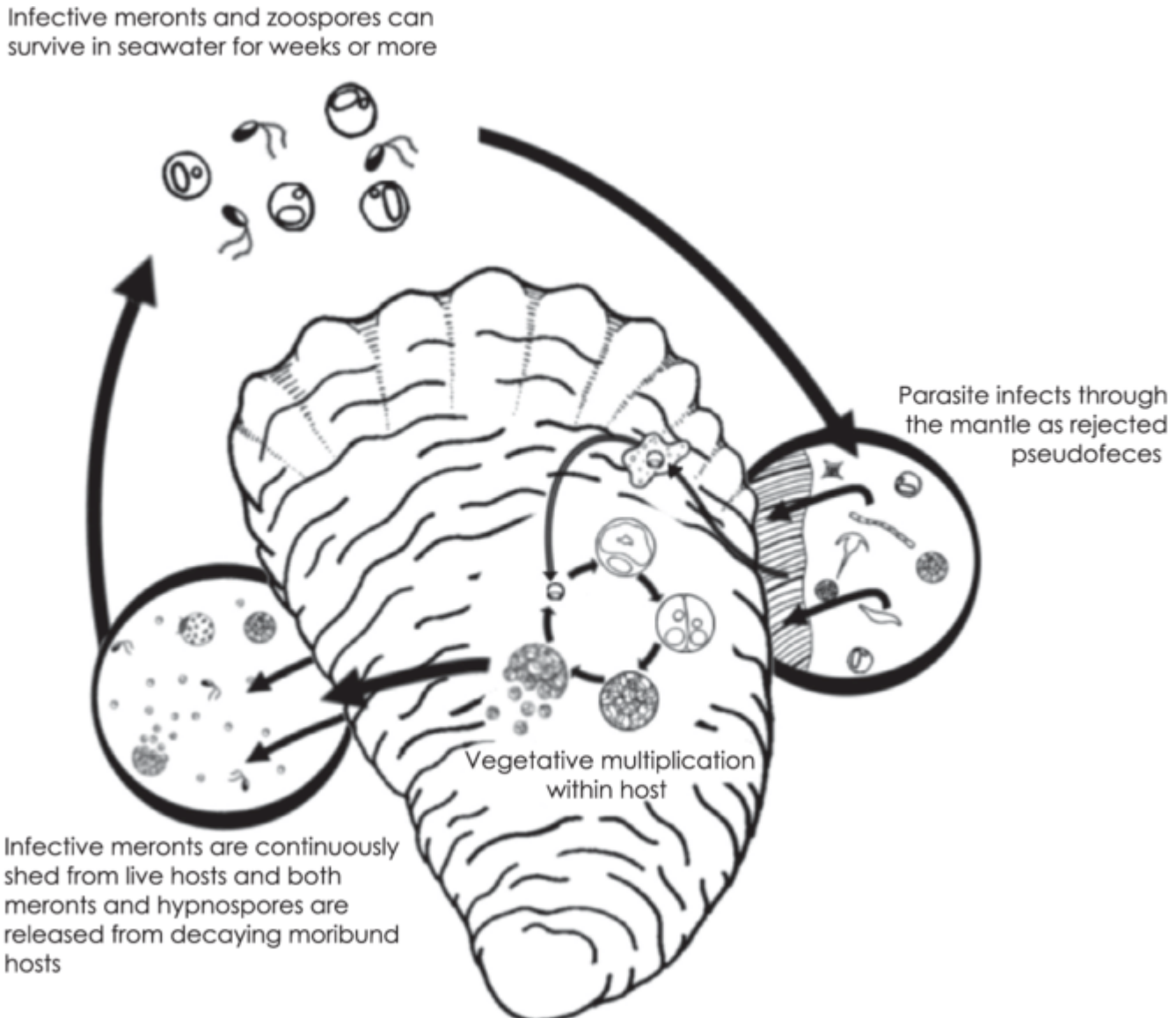
Source: TPWD Coastal Fisheries (https://tpwd.texas.gov/landwater/water/habitats/coastal-fisheries-habitat-assessment-team/).

Life Cycle of Oyster



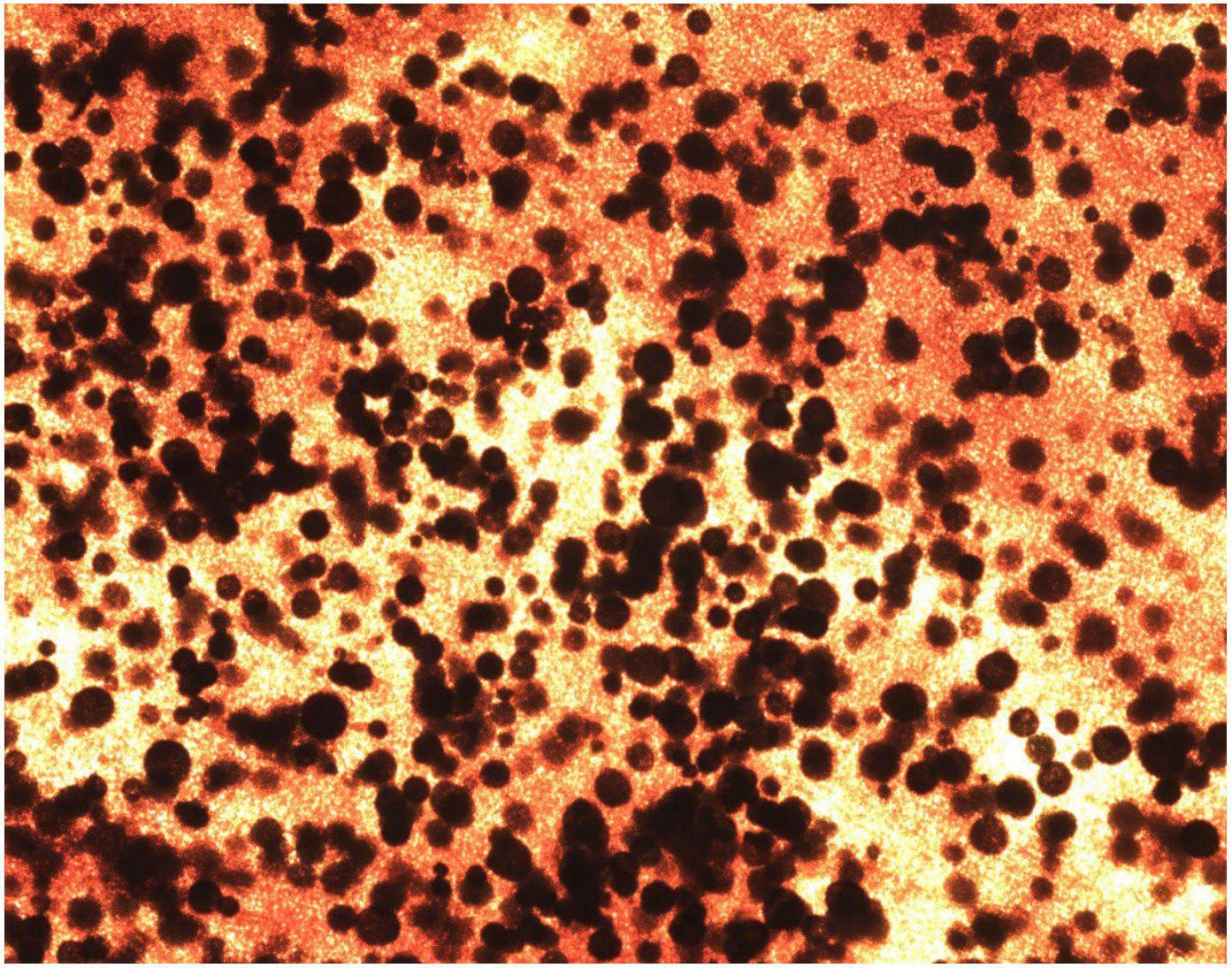
https://extension.umd.edu/resource/oyster-hatchery-0/

Life Cycle of parasite *P. marinus*



Non-specific general signs of *P. marinus* infection

Perkinsus marinus



Thresholds – salinity and temp vs. P. marinus prevalence and intensity.

- Past research suggests the parasite increases significant mortality risk increases at salinity (12-15 ppt) and > 25C temperature. >20% prevalence common.
- In Texas, oysters typically thrive in salinities of and water temperatures between and
- While they can tolerate extreme ranges XXX salinity and XXX to
-), prolonged low salinity (
-) or high temperatures (
-) combined with high salinity significantly increase mortality.

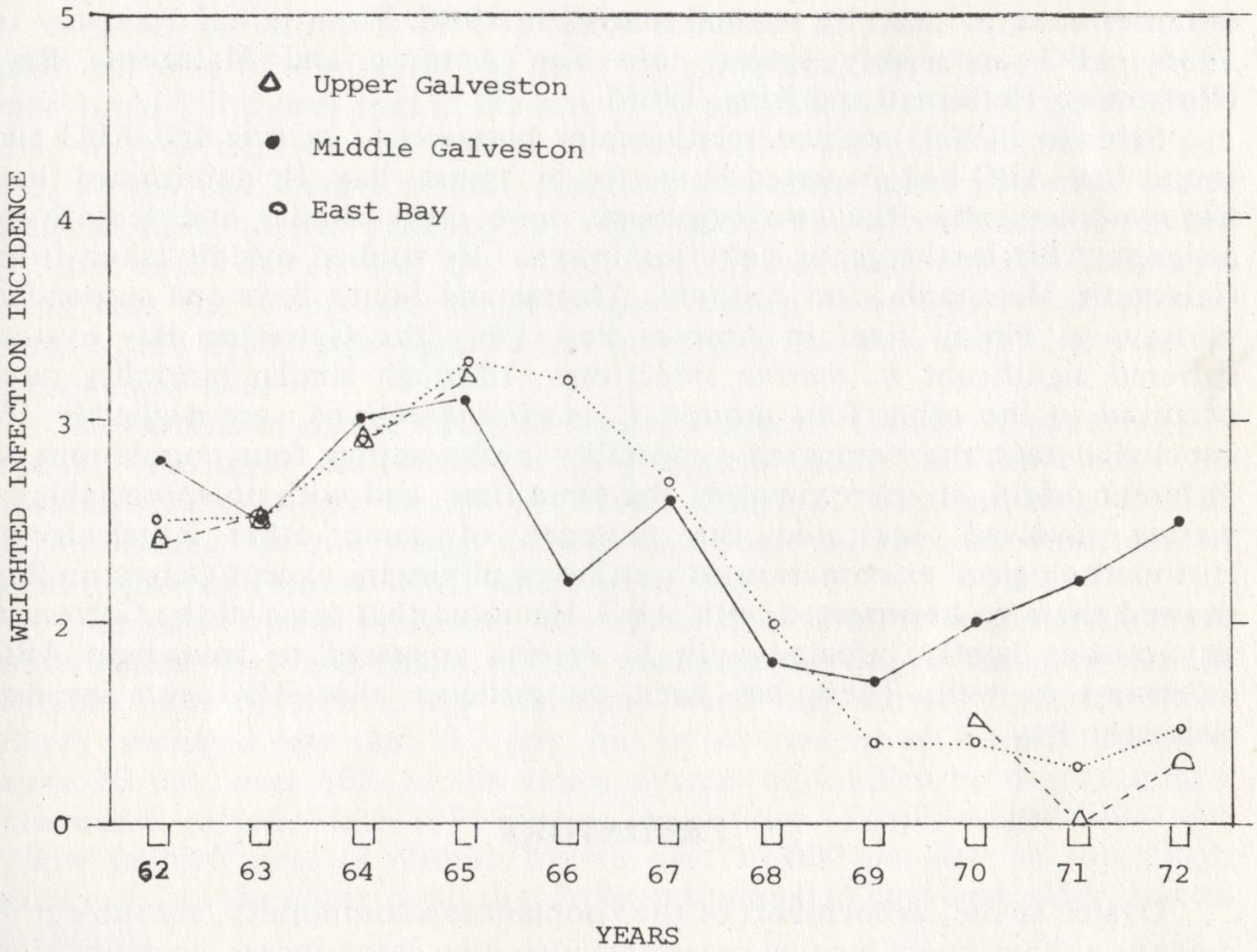


Figure 22: Annual incidence of *L. marina* infection among market oysters from Upper Galveston, Middle Galveston and East Bay stations during 1962-72.

TCEQ adopted – environmental flow standards 2011 using processes outlined in SB3

- Texas Legislature passed SB3 in 2007 establishing environmental flows standards adoption program.
- TCEQ adopted **environmental flow standards** for the Trinity and San Jacinto Rivers and Galveston Bay on April 20, 2011, establishing specific, seasonally varying freshwater inflow requirements.
- These standards, codified in 30 TAC, 298(B), are **designed to maintain a sound ecological environment** in the bay by regulating new water right permits.
- In TCEQ Chapter 298 (2011) **a sound ecological environment** is defined as:
- ***"a resilient, functioning ecosystem characterized by intact, natural processes, and a balanced, integrated, and adaptive community of organisms comparable to that of the natural habitat of a region"***

https://www.twdb.texas.gov/surfacewater/flows/environmental/index.asp

Key Aspects of Galveston Bay Flow Standards

- **Purpose:** To protect the ecological health of the Galveston Bay estuary by ensuring adequate freshwater inflow during critical times of the year.
- **Components**: The standards include seasonal, monthly, and pulse flow targets that mimic natural flow regimes.
- **Application**: These rules apply to new water right permits, *not existing, older water rights*.
- **Regulatory Mechanism**: If voluntary, proactive strategies (like purchasing water rights) fail to meet these standards, the rules allow for adjustments to permit conditions.

Study Objectives

- Develop standard protocols for long-term monitoring of Dermo and host including compiling supporting datasets from earlier studies
- Compare primary methods – e.g. qPCR vs. RFTM
- Gather additional data sets to develop better predictions of likelihood of Dermo related infection and mortality under at given:
  - Freshwater Inflow
  - Salinity
  - Thermal regime & season
  - Spatial coverage - extent

RFTM – Rays Fluid Thioglycollate Method
qPCR – quantitative polymerase chain reaction

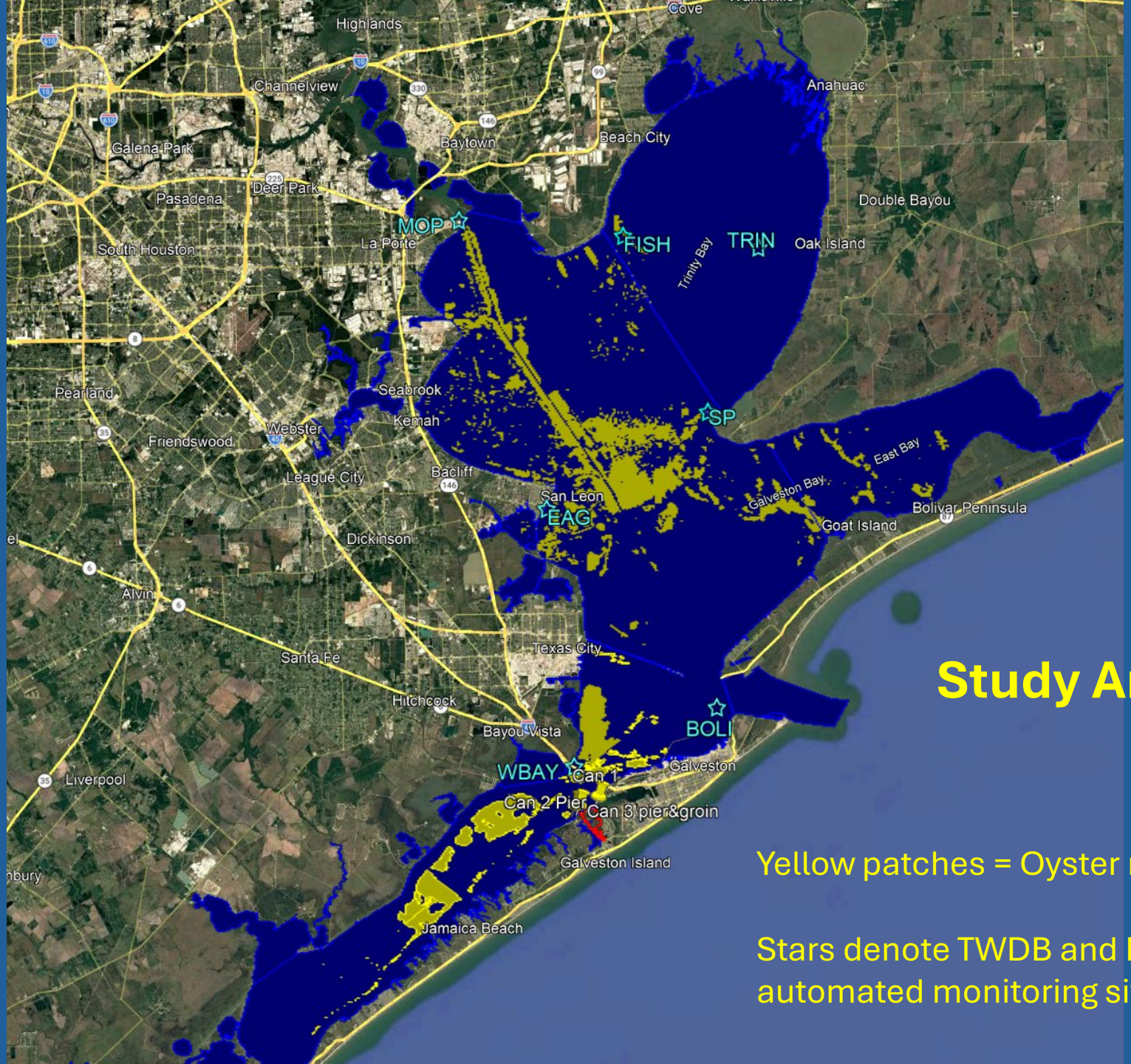
Past Dermo Monitoring

- RFTM – 1952-53; 1958-1961 – Reported on by Hoffstetter 1977, but used different antibiotic reagents compared to later attempts
- Incidences ranged 1.5-2.3 annual and seasonal, n-unknown.
- RFTM – 1962-1972 (Hofstetter, R.P. 1977). Monthly *n-unknown*.
- RFTM – 1998-2010 S.M. Ray data (Quigg and Steichen)
- RFTM & qPCR – 2009-2010 (Hensley et al. 2012)
- RFTM -2014 to 2015 (Silvy et al. 2020).
- RFTM – 2022-23 (Goaona-Hernandez et al. 2025)

Goaona-Hernandez et al. 2025. Impact of *P. marinus* on oyster health (2022-23).

Based on past studies

- *P. marinus* causes significant mortality (up to 50% in adults); less in juveniles and often negligible in early juveniles
- Epizootics can cause 5-30% annual mortality in the first year rising to 60-80% by 2nd year. In extreme cases this can rise to 50% annual mortality.
- Mortality thresholds is associated with heavy infection intensity. Light infections reduces growth.



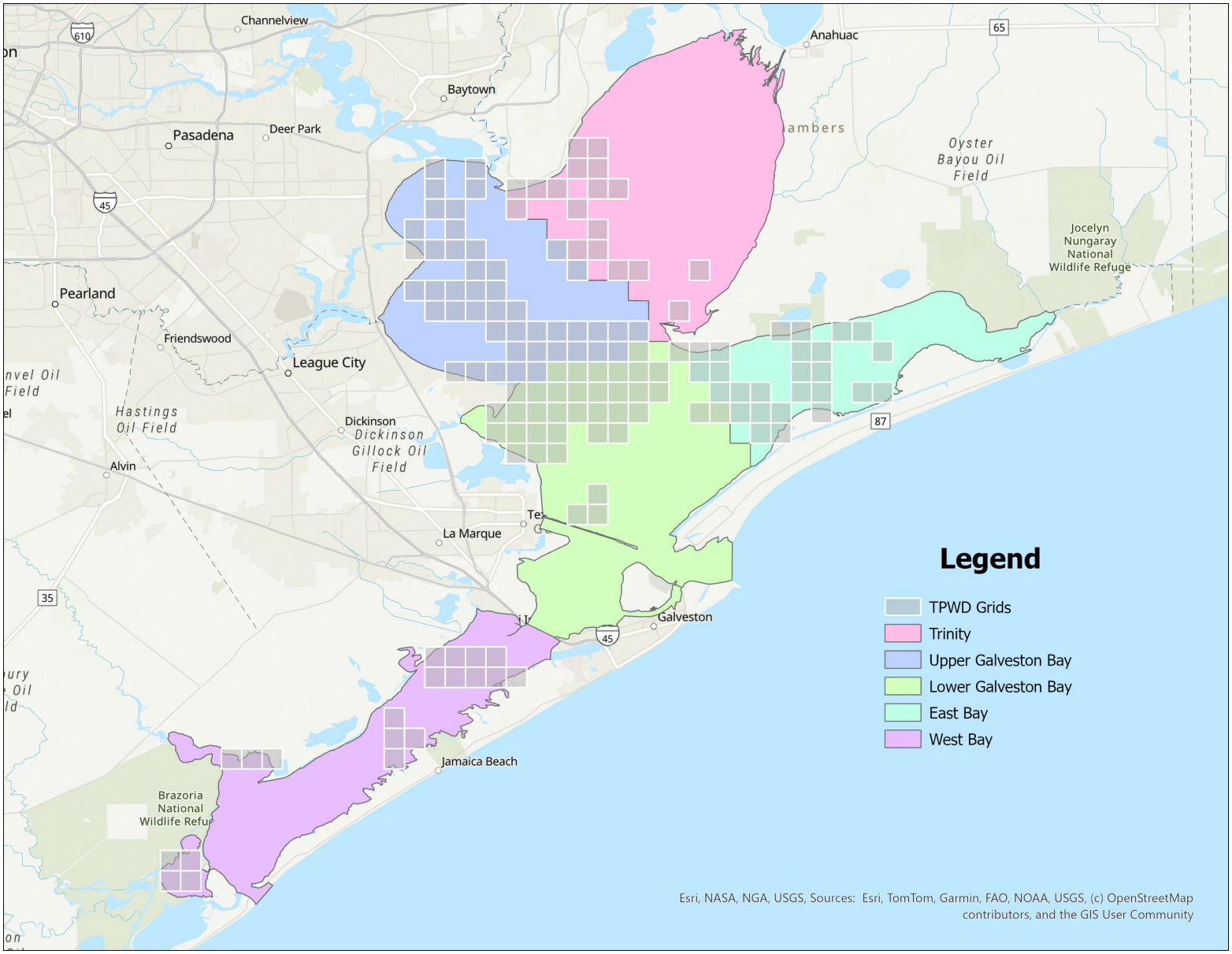
Study Area

Yellow patches = Oyster reefs

Stars denote TWDB and NOAA automated monitoring sites

Current Study Design

- Sampling period – Nov 2025- 2027 (2-month time step)
- Galveston Bay system (Trinity, East, West, Upper and Lower Galveston Bay)
- Sampling associated with TPWD random oyster sampling method using grid system
- Combination of index sites and random sites
- Surveillance of incidence, weighted incidence, and concentration of Perkinsus levels in live oysters.
- Compare traditional RFTM vs. qPCR. qPCR considered standard.



Galveston Bay with **TPWD** Segments and random grids used to select sites

Methodology – field and lab

- TPWD Methodology – randomized grid system used.
- Additional sampling conducted at at Oyster Sentinel Reference Sites = index sites; long term monitoring

- Historical Dermo Data Sets:
- 1962-1972 (Hoffstetter 1977)
- 1998-2010 (Quigg and Steichen 1998)
- 2014-2015 (Silvy et al. 2020)
- 2022-2023 (Gaona-Hernandez et al. 2025)

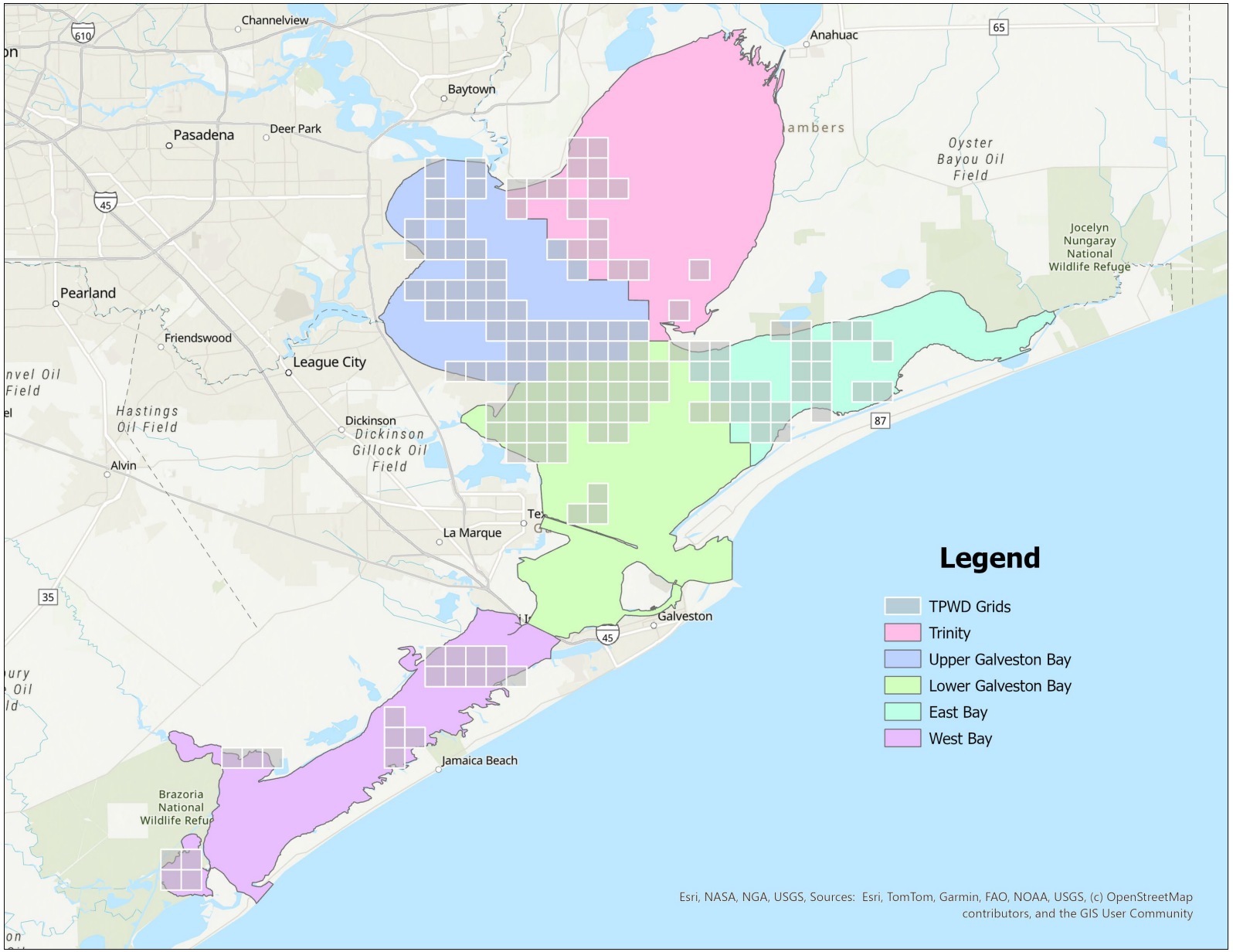
- 2025-2027 (current effort)

Methodology – TPWD grid system

- Oysters will be collected from fixed index sites and randomly selected reef sites using TPWD protocol.
- Historical data will be retrieved from the Oyster Sentinel web site and GRIDII web sites; studies by (B. Silvy et al. 2020) (Hernandez et al 2025).
- Oyster mantle samples taken to lab and processed in within 24 hours. Mantle tissue split and incubated a room temperature in dark for 1 week for examination using RFTM approach.
- 2) The other split tissue sample is preserved in alcohol for qPCR genetic identification by the TPWD genetics lab.

Index Reefs Monitored

Galveston Bay depicting TPWD bay segments and sampling grid.



Field Collection – Oyster Dredge and Water Quality

Chase Nimee (TPWD Biologist) collecting a water sample – 11/18/2025

Confederate Reef (West Bay Index Site) – 11/18/2025

Oyster Dredge from Confederate Reef (West Bay Index Site) – 11/18/2025

Drew Eisenbach at Sweetwater monitoring site using sonde to collect environmental data – 12/22/2025

Kaylei Chau at Sweetwater monitoring site measuring water level using staff gage – 11/24/2025

Establishment of nearby automated monitoring sites (SCT and water level)

Lab Procedures

Shell Shucking
Physical Condition
Inoculation into culture tube
Split sample between RFTM and qPCR
Inoculation into culture tube
1 week of incubation prior to reading
RFTM samples

Preparing Dermo tubes:

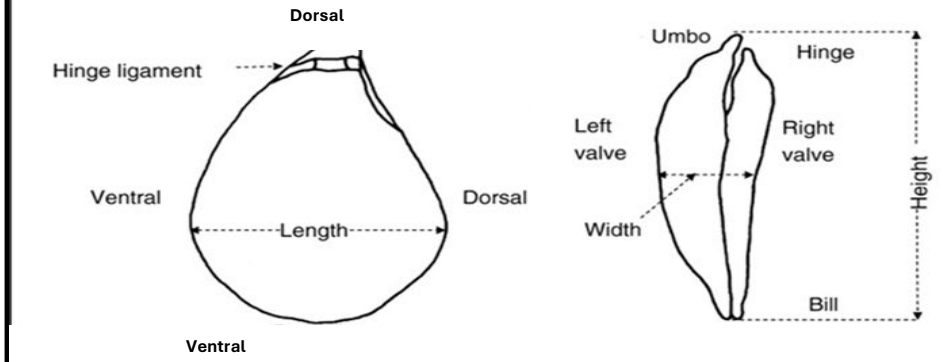
1. Add 20 gm NaCl[a] to 1L of deionized (DI) water.
2. Add 29.0 gm of thioglycollate[b] to the water, heat on low temperature and mix to dissolve.
3. Dispense 10 ml of medium into screw cap culture tubes. (Have caps on loosely for autoclaving.)
4. Autoclave for 15 min.
5. Allow the tubes to cool then tighten the caps.
6. Store the tubes in the dark at room temperature until needed.

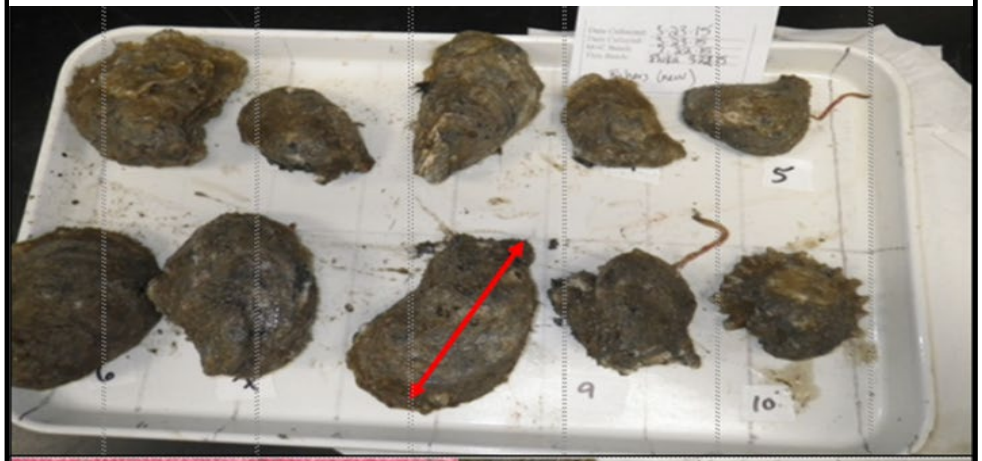
Suggested Vendors:

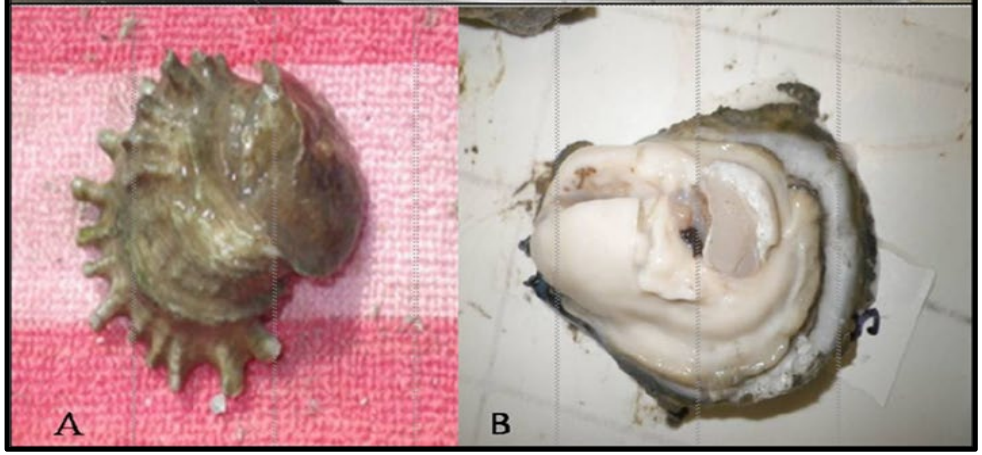
a. Sigma 55886-500G, 500 grams of sodium chloride

b. Fluka 70157 – 500G, 500 grams of

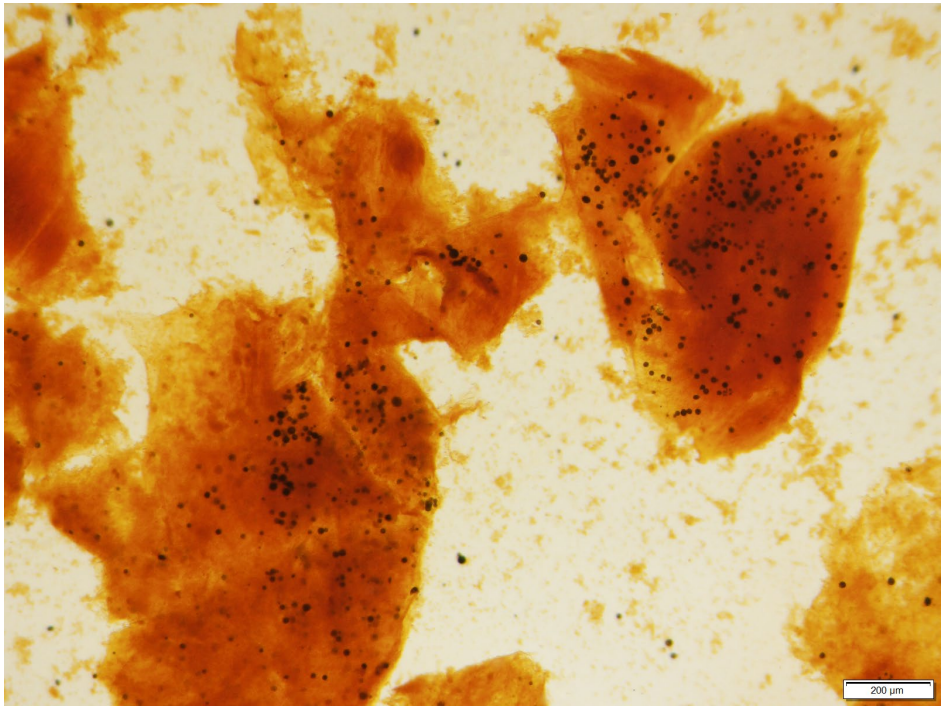
Basic Oyster Anatomy: Dorsal/Ventral







Week 2 post incubation - macerate and stain



Highest Mackin-Score thus far (2.33) – Confederate Reef 11/26/2025

Macerating oyster tissue – Kaylei Chau

Reading of samples:

1. Determine level of parasitism using the Mackin (1962) 0-5 scale, as modified by Craig et al. (1989). Scan the slide under low magnification (e.g., 40x) then switch to 100x magnification if necessary.
2. Use the following photomicrographs as standards as needed. Note that the field of view shown in the following slides is intended to represent the entire sample.

References:

Craig, A., E. N. Powell, R. R. Fay & J. M. Brooks. 1989. Distribution of *Perkinsus marinus* in gulf coast oyster populations. *Estuaries*. 12:82-91.

Mackin, J. G. 1961. Oyster disease caused by *Dermocystidium marinum* and other microorganisms in Louisiana. *Publ. Inst. Mar. Sci.* 7:132-299.

Dermo Code:

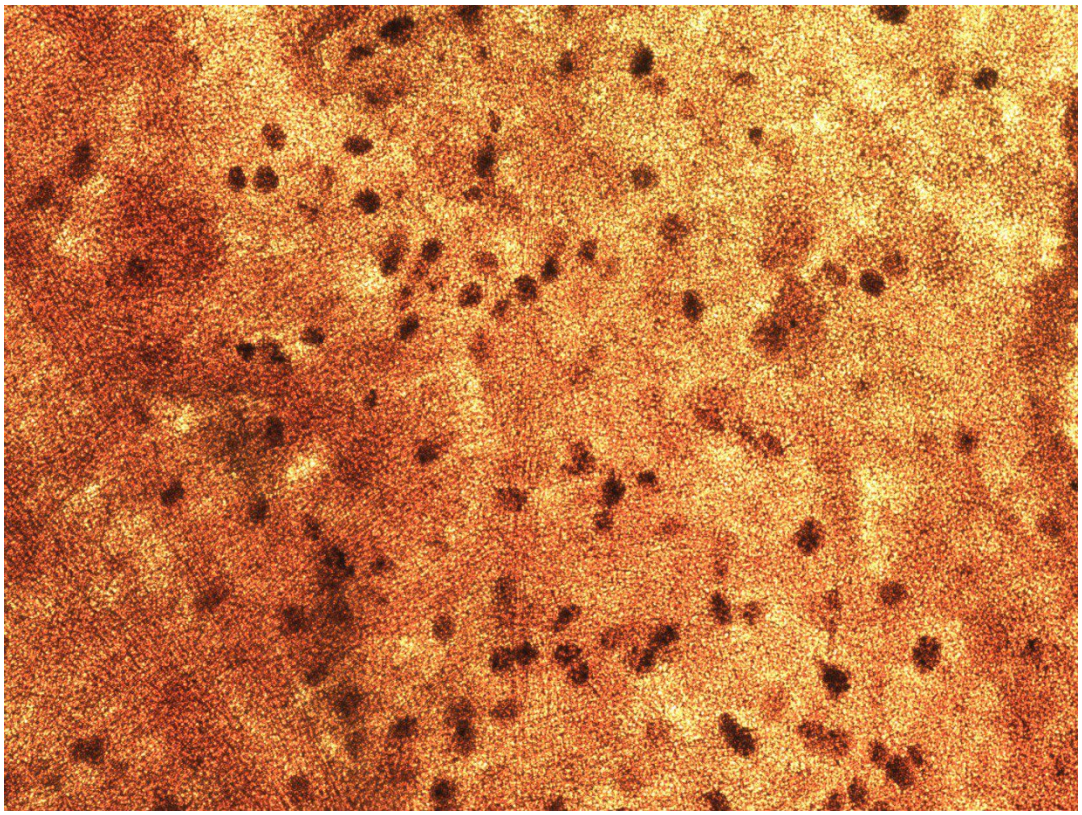
0.00

Description:

No hypnospores present

Comment:

Note the numerous Brown Cells , which are NOT Dermo

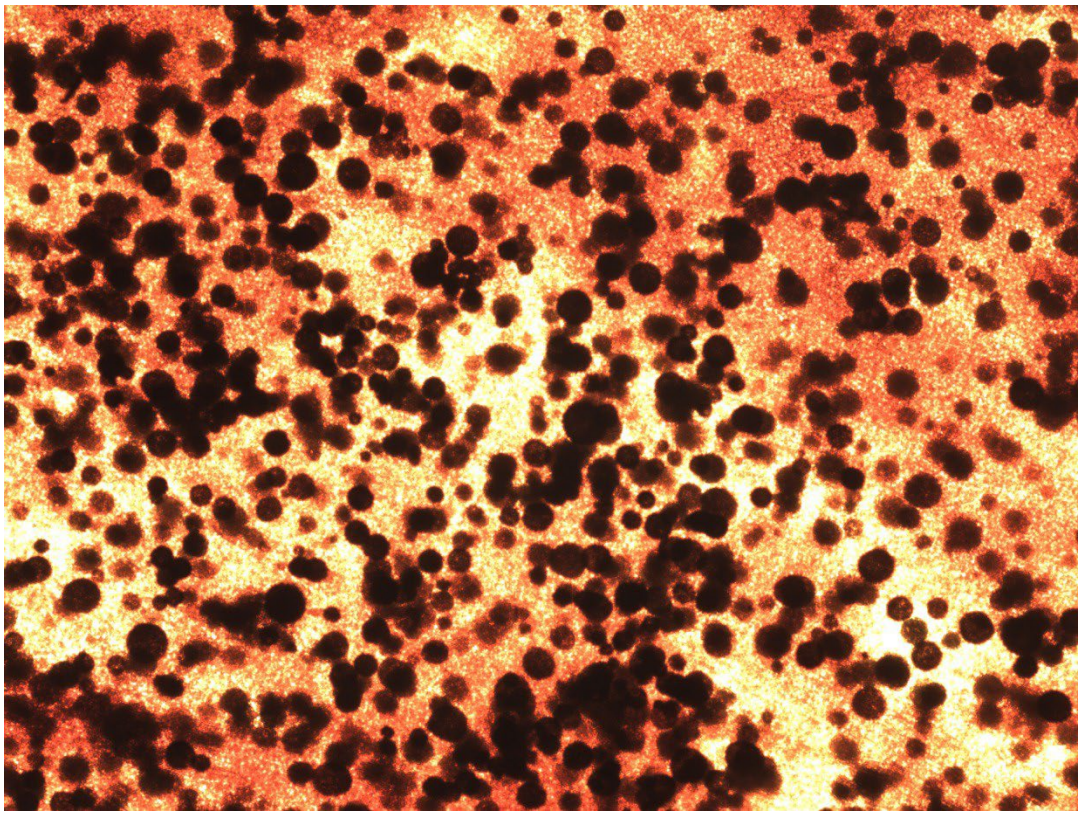


Dermo Code:

3.00

Description:

50% of tissue is hypnospores



Comment:

It is difficult to judge an exact percent coverage such as this.

It helps to judge the sample in relationship to the codes below and above.

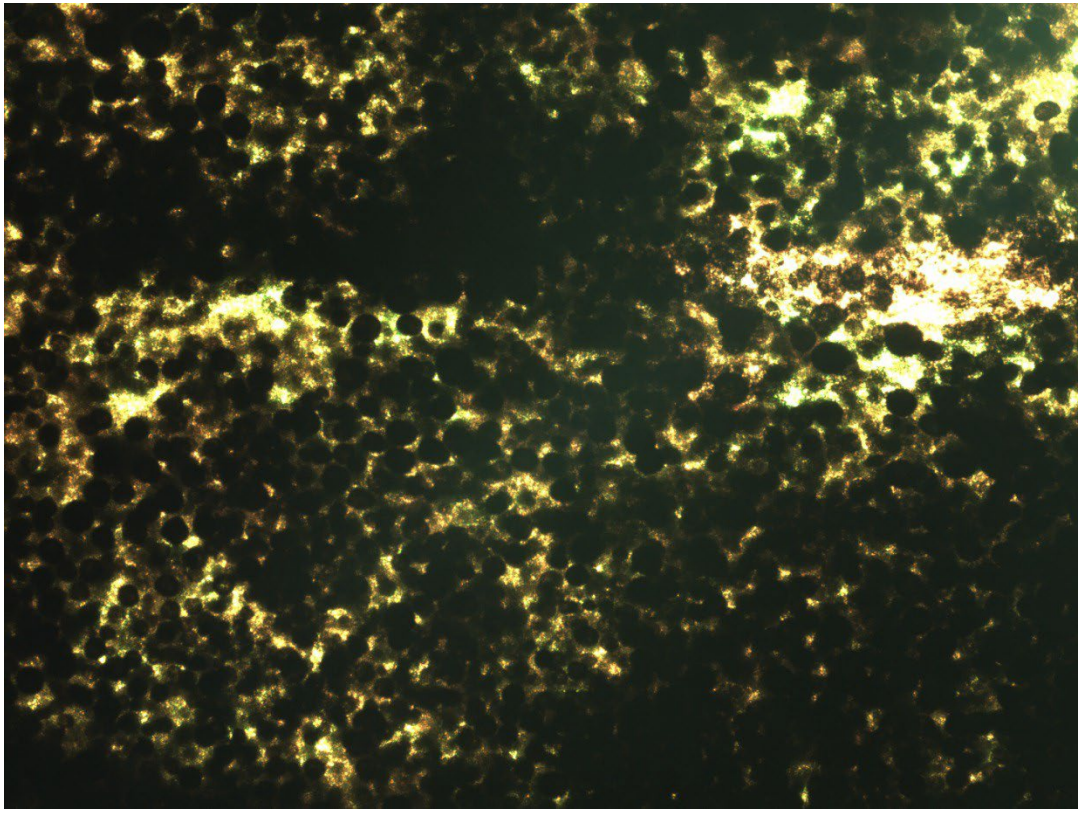
Note also the variation in hypnospore size which affects percent coverage.

Dermo Code:

5.00

Description:

Nearly 100% of tissue is hypnospores



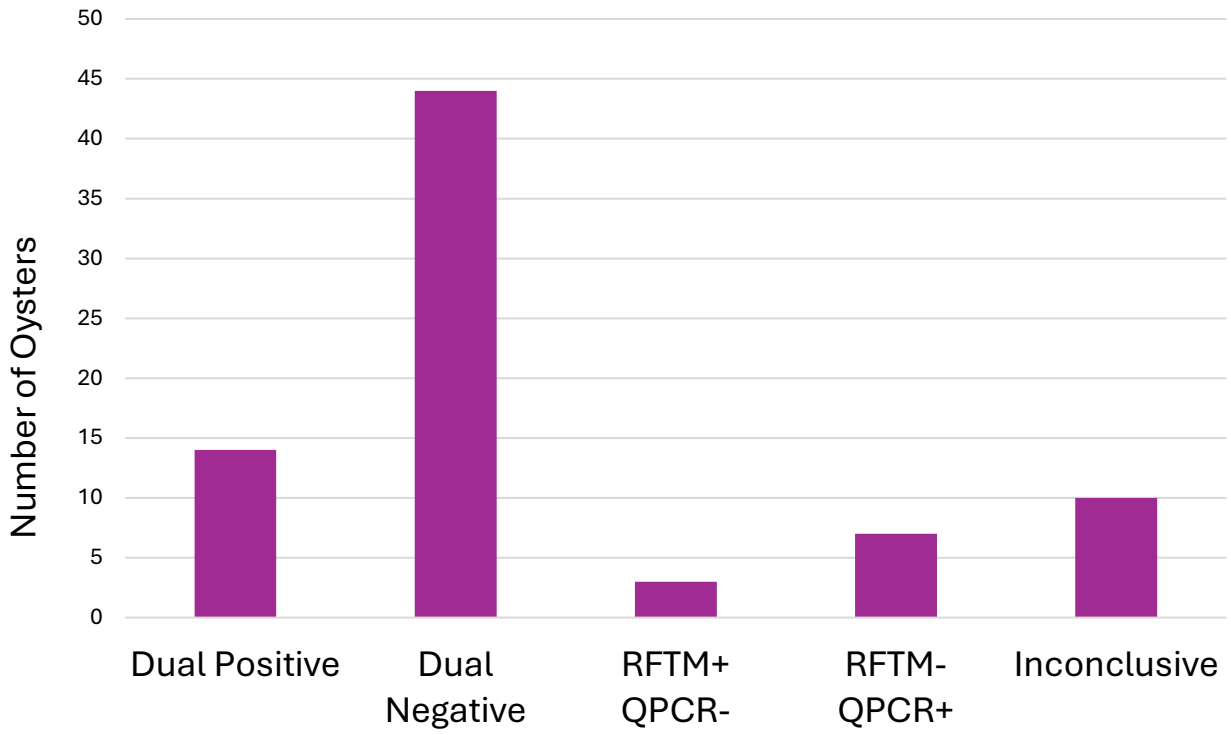
Comment:

Note that the oyster tissue is nearly totally obscured by hypnospores

Preliminary Findings

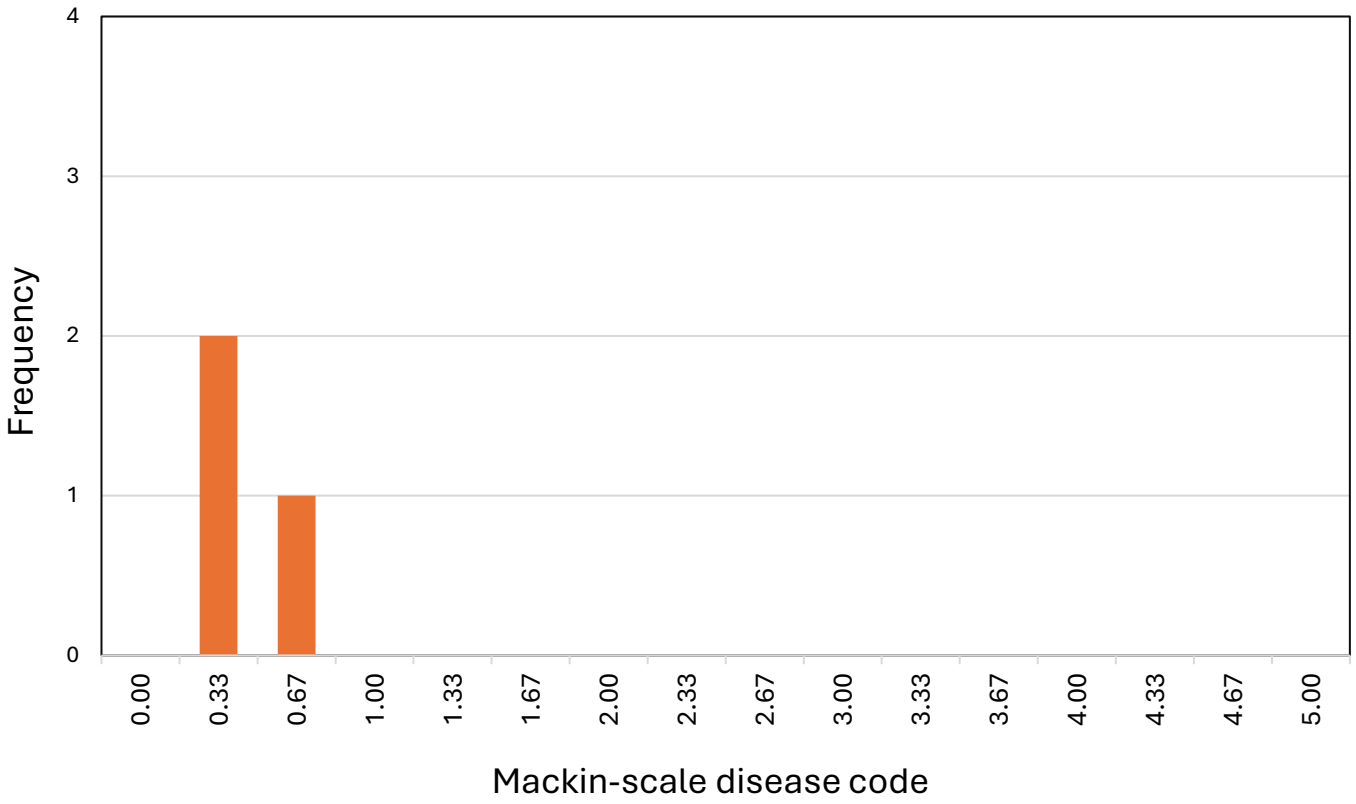
November 2025- Today

Agreement between both methods of monitoring Dermo.

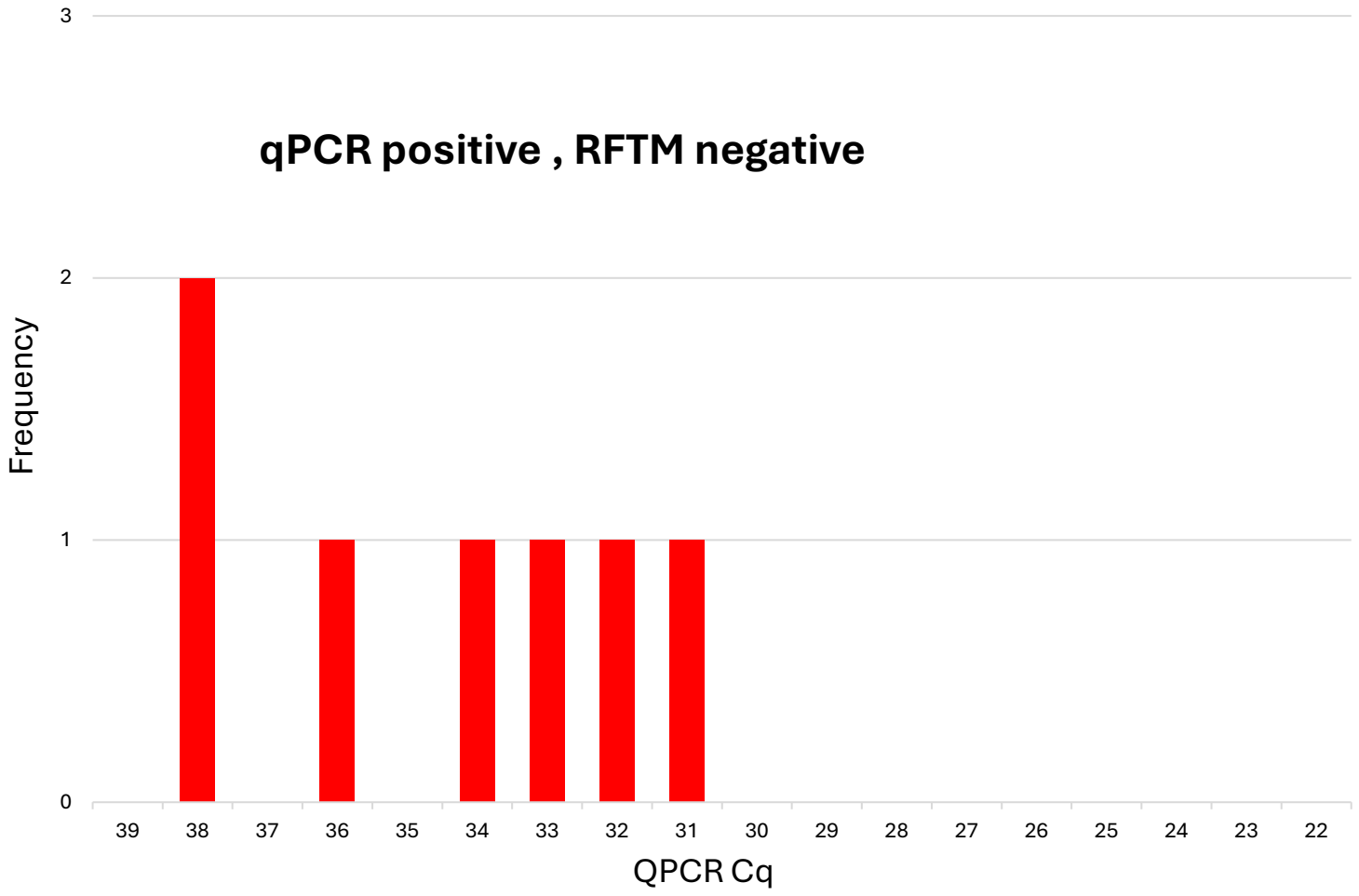


Frequency of dual positive, dual negative, false positive, and inconclusive dermo diagnoses using two different detection methods (RFTM and QPCR)

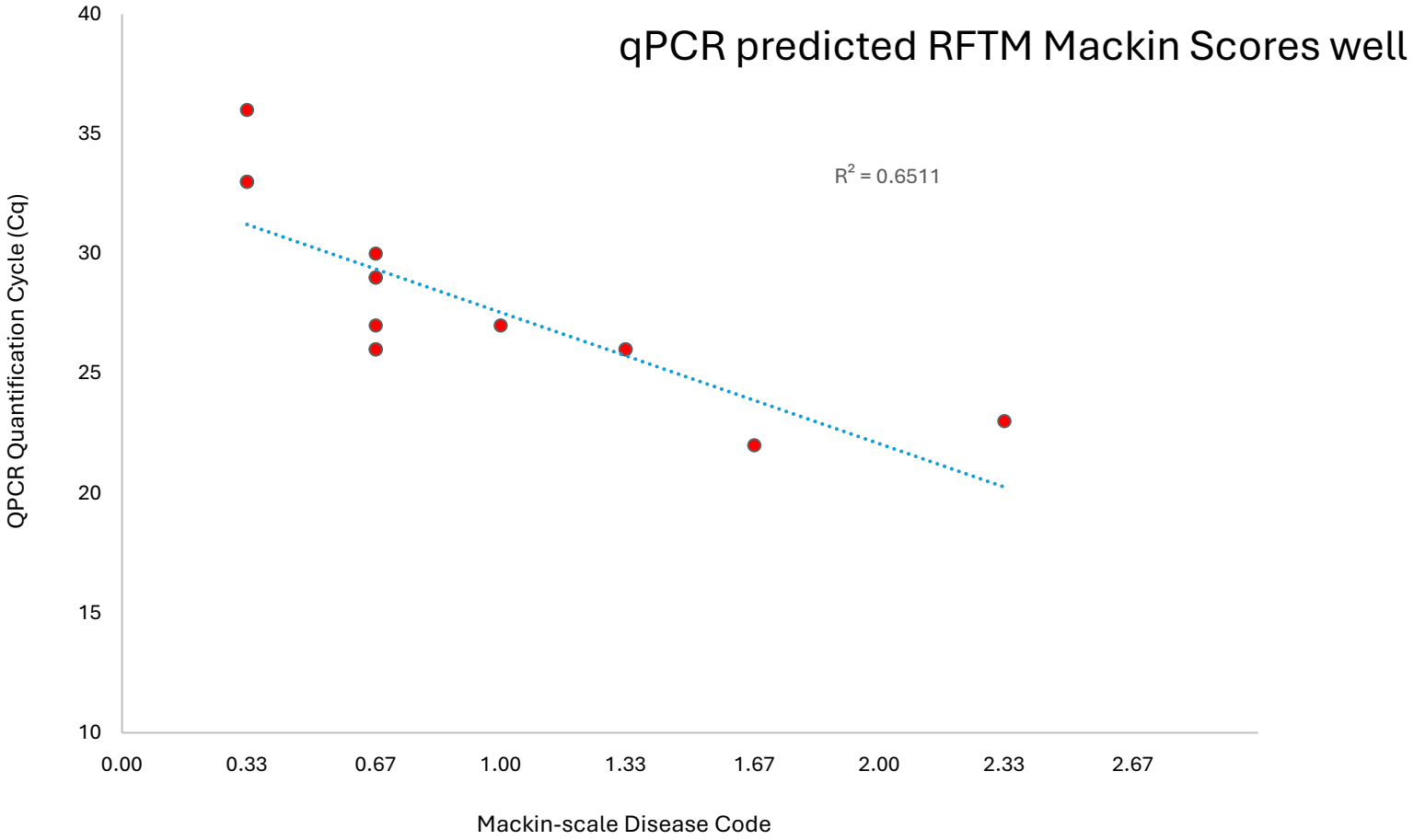
Oysters that were detected with Dermo using RFTM but negative by qPCR



Frequency of RFTM Mackin scores in samples diagnosed as dermo-positive using RFTM, but dermo negative using QPCR

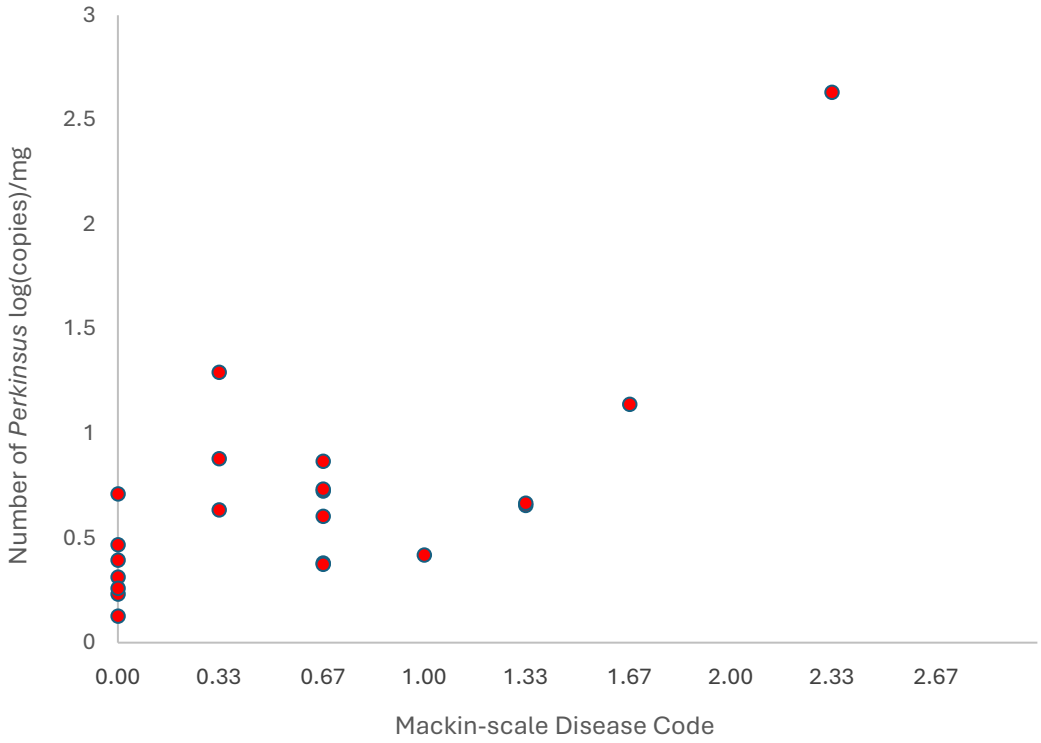


Frequency of QPCR Cq values in samples that were diagnosed as **dermo-positive** in QPCR but dermo-negative using RFTM.



Regression of QPCR quantification cycle (Cq) against observed Mackin scores from RFTM, **using only dermo-positive samples.** qPCR highly predicted RFTM scores.

qPCR



RFTM

Comparison of *Perkinsus* infection load (log(copies)/mg) across Mackin-scale Disease codes. Data includes all detected infection ranges with Mackin scores ranging from 0.00-2.67

Flows & Salinity Analysis

1. Historical data analysis is ongoing.
2. Data mining of old reports and studies
3. Merging of current data with past studies.
4. Automated salinity and temperature data and major environmental monitoring data (e.g. TCEQ, USGS; TWDB) will be queried to match up with Dermo infection data and TPWD CPUE and box count data.
5. Also discussing potential to utilize TWDB modeling simulations to query what if scenarios.

FIN

Triassic Oysters