



SPLASH

STOPPING PLASTICS AND
LITTER ALONG SHORELINES

Connecting Galveston Bay Communities to Conservation Through Birds and Stewardship

Morton Sager

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American Bird Conservancy

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black cat
GIS & Biological





Connecting Galveston Bay Communities to Conservation Through Birds & Stewardship

Trash Monitoring Program

Establish a standardized trash monitoring program to improve understanding of trash movement, accumulation, and composition throughout the LGBW.

- QAPP developed with Black Cat GIS during Year 1 to establish proper data collection, training, and monitoring protocols for volunteers and SPLASH staff.
- Quarterly monitoring at up to four sites extending from north of Houston Ship Channel to the Gulf.
- Host public community cleanups at select monitoring sites in tandem with monitoring efforts.

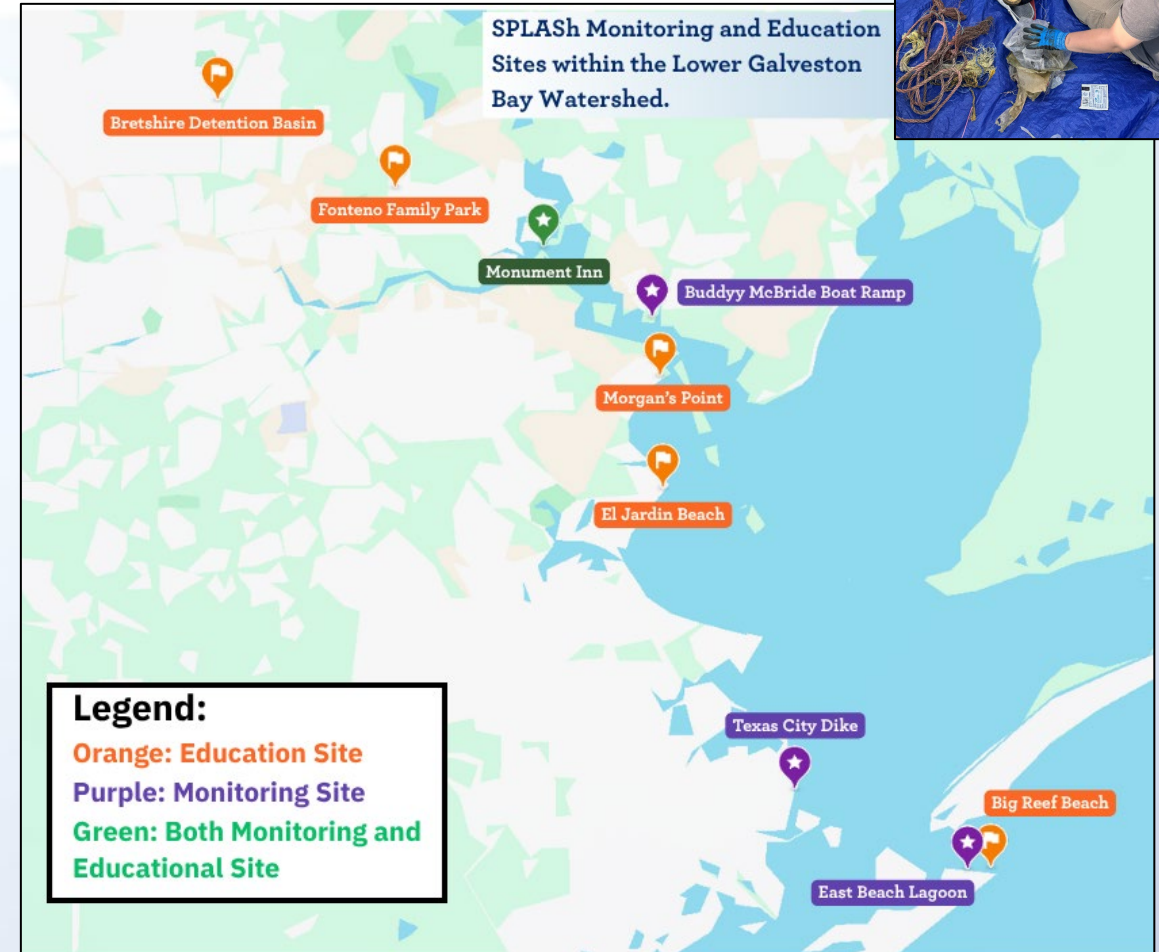
Volunteer Training

KTB will collaborate with ABC to train and certify Houston-Galveston region volunteers in the Texas Litter Database's standardized trash data collection protocol, STOP (Study, Track, Remove, Prevent). Trainings will be conducted at monitoring sites prior to and throughout the monitoring period.

- Volunteers gain practical skills in environmental monitoring and data collection
- Ongoing support from trained volunteers to complete trash monitoring project

Gulf Advocates Program

Implement a year-long education program that introduces students to local conservation issues and solutions. Students build skills and confidence in environmental stewardship and bird conservation.





Project Outcomes and Budget

Outcomes

1. Generate data to identify pollution trends and inform watershed management.
2. Develop environmental stewards within the Houston-Galveston Region.
3. Improve habitat throughout the LGBW for birds and people.

What We Hope to Learn

Composition | What types of debris are present?

Distribution | How does litter variation: upstream vs downstream

Trends | How do patterns change over time, season, etc.

Wider Data Sample | Increased trained volunteers to provide more data sampling

Community Impact | Do students and community members change behavior once working with SPLASh?

Deliverable	Target
Number of Students Reached	120
Number of Schools	6
Number of Teachers who attended Workshop	6
Number of Volunteers at Cleanup Events	250
Number of STOP-Trained Volunteers	50
Number of Community Members Engaged	500
Total Pounds of Trash Removed	9,000
Report Average Pounds of Trash Removed per Site	N/A
Share Responses from Behavior Change Assessments	N/A

Budget Breakdown	
Salary / Wages	\$ 183,072.00
Fringe	\$ 71,123.00
Supplies	\$ 5,085.00
Travel	\$ 5,365.00
Contract	\$ 3,910.00
Other (includes subawards, teacher scholarships, event advertising, other fees)	\$ 92,855.00
Indirect	\$ 84,028.00
Total Request	\$445,438.00
Leverage	\$ 18,070.00

Scalable



A PROGRAM OF TCEQ

Galveston Bay Plan Priorities Alignment



NPS-2: Nonpoint Source Education & Outreach

- TEKS-aligned Gulf Advocates & marine debris curricula (6 schools / 120 students)
- Monthly public cleanups
- Outreach events

HC-2: Habitat Restoration

- Quarterly monitoring cleanups at 4 monitoring sites
- 9,000 pounds of trash removed from habitat

SPO-1 to 3: Stakeholder and Partner Outreach

- 250 volunteers contributing at least 500 hours
- STOP protocol volunteer training with KTB
- 50 volunteers trained in STOP litter data collection protocols to conduct monitoring
- Summer educator trainings with CPE credits

PEA-1 to 3: Support Public Education and Awareness

- 120 students educated through the Gulf Advocates Program
- 500 members of the general public engaged
- Gulf Advocates program targeting 9-12 grade levels

RES-3 & ACS-2: Monitoring & Data Access

- Trash data: Texas Litter Database + SPLASH Story Map
- Conduct quarterly trash monitoring at up to 4 sites in LGBW.



Plan Priority One:
Ensure Safe Human and Aquatic Life Use



Plan Priority Two:
Protect and Sustain Living Resources



Plan Priority Three:
Engage Communities



Plan Priority Four:
Inform Science-Based Decision Making

Action Plan: Improve Water Quality Through Nonpoint Source Pollution Abatement (NPS)

NPS-2	Support Nonpoint Source Education and Outreach Campaigns
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Action Plan: Support Habitat Conservation (HC)

HC-2	Habitat Restoration
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Action Plan: Preserve Galveston Bay Through Stakeholder and Partner Outreach (SPO)

SPO-1	Stewardship Programs and Volunteer Opportunities
SPO-2	Workshops and Events
SPO-3	Support Regional Initiatives

Action Plan: Support Public Education and Awareness Initiatives (PEA)

PEA-1	Key Issue Engagement
PEA-2	Adult Education
PEA-3	Kindergarten to 12th Grade (K-12) Education Efforts

Action Plan: Collaborate with Research Institutions to Support Focus Area Applied Research and Monitoring (RES)

RES-3	Conduct Physical Stressor Monitoring and Research	x
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Action Plan: Increase Access to Galveston Bay Ecosystem Information (ACS)

ACS-2	Access to Monitoring and Research Data	x
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Thank you!

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*Yellow-crowned Night Heron by
Brian Lasenby / Shutterstock
Wilson's Plover Chick with Flower
by Kristina Macaulay*



Black Skimmer by Norman Bateman / Shutterstock



HARC

black cat
GIS & Biological



Galveston Bay Monitoring and Research Project Database: Spatial and Metric Visualization for M&R

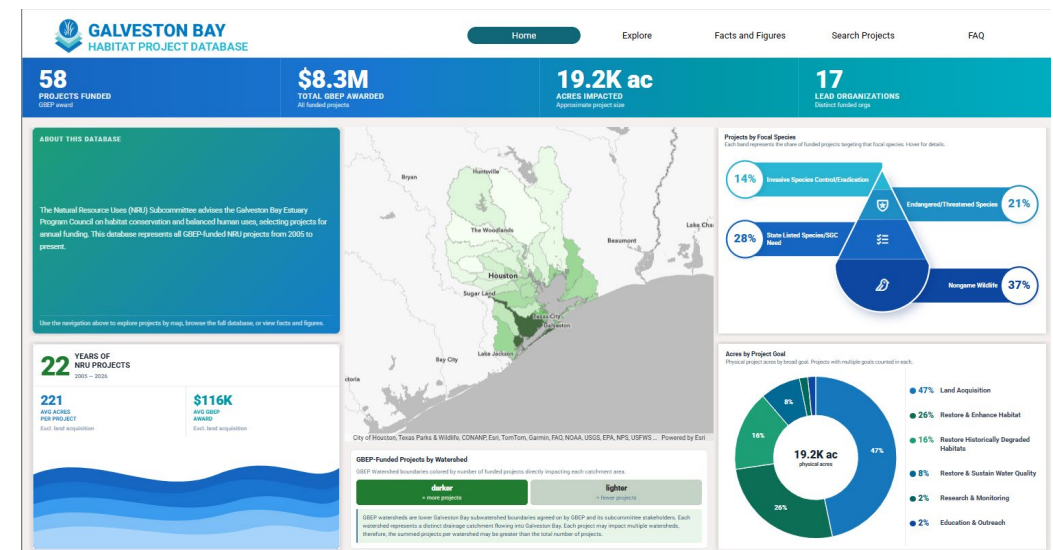
Erin Kinney
Houston Advanced Research Center

Amanda Hackney
Black Cat GIS

Project Timeline

Data Collection

- Obtain, process, and enter M&R Project Data from GBEP through 2005
- Filling-in Data Gaps from Pls
- QA/QC of Project Data
- Obtaining supplemental information
- Building a Survey 123 form that will standardize project details to support the maps and visualizations that address the questions from M&R
- Identify and obtain supporting datasets



Fall 2027

2028

Build Database

- Create optimal interface for M&R
- Troubleshoot Database
- Create Virtual Tours

Planning + QAPP Phase

- QAPP Development
- GBEP M&R Workshop to identify priority metrics

2028

Visualization Development

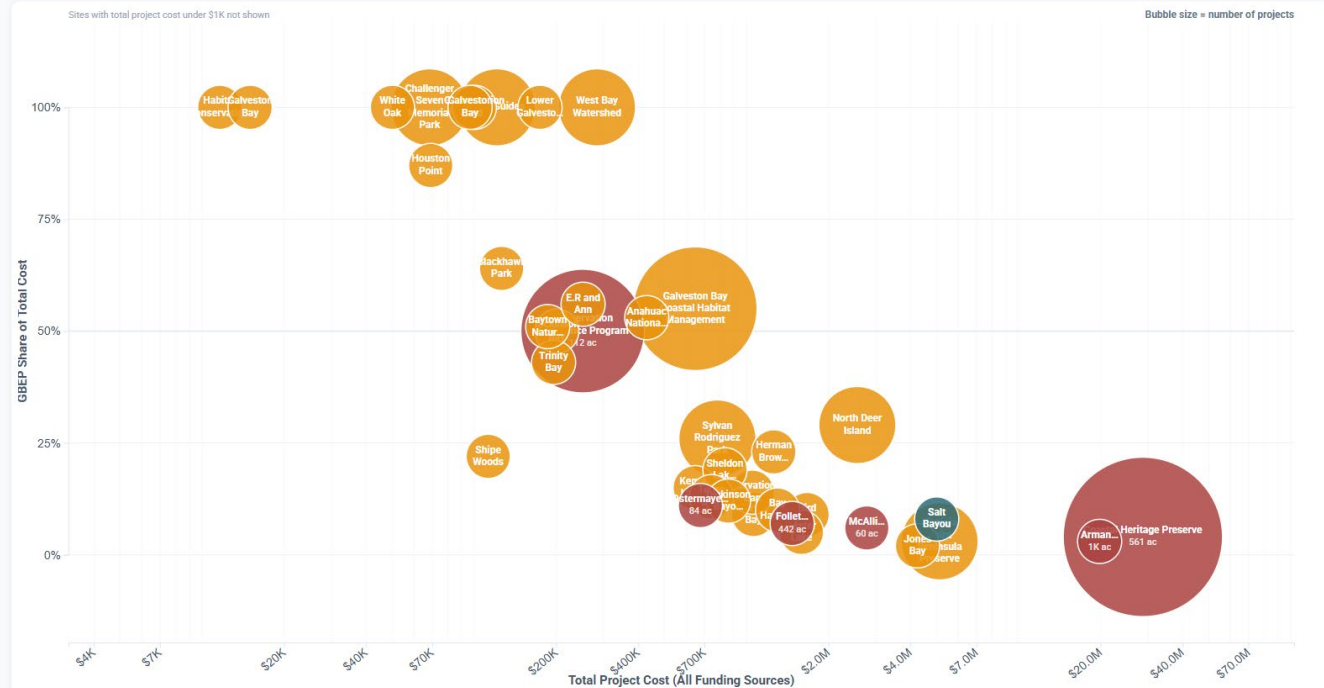
- Identify which graphs to standardize
- Identify which metrics to track and which to pair
- Research and create new visuals
- Integrate into NRU Habitat Database Format
- Periodically test drafts with M&R for feedback

2029

Interactive visualizations of GBEP project funding, habitat types, lead organizations, and conservation outcomes from 2005 to present



GALVESTON BAY
HABITAT PROJECT DATABASE



Explore

Click and drag to pan across the bay, scroll to zoom in and out, and use the layer controls to filter by watershed, project type, or funding status.

Quick Start Guide

Use navigation elements to zoom, change to satellite views (basemaps), and more.

Click on any map polygon for more information. Pop-ups may take a moment to load. To clear a feature, close the popup.



Clicking on this icon opens a menu to turn layers on/off.

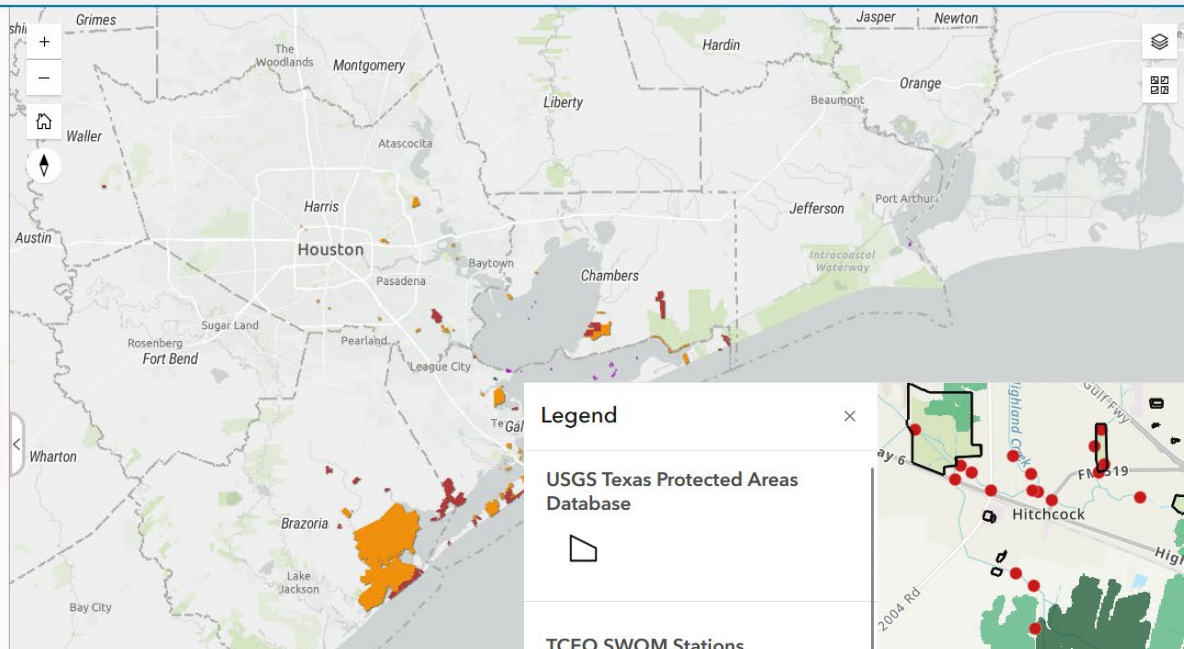


Clicking on this icon allows you to switch the base maps. For example, select 'satellite' to see an aerial view.

MAP LEGEND

NRU PROJECTS

- Restoration, Stewardship & Research
- Land Acquisition and Other Project Goals



Legend

USGS Texas Protected Areas Database



TCEQ SWQM Stations

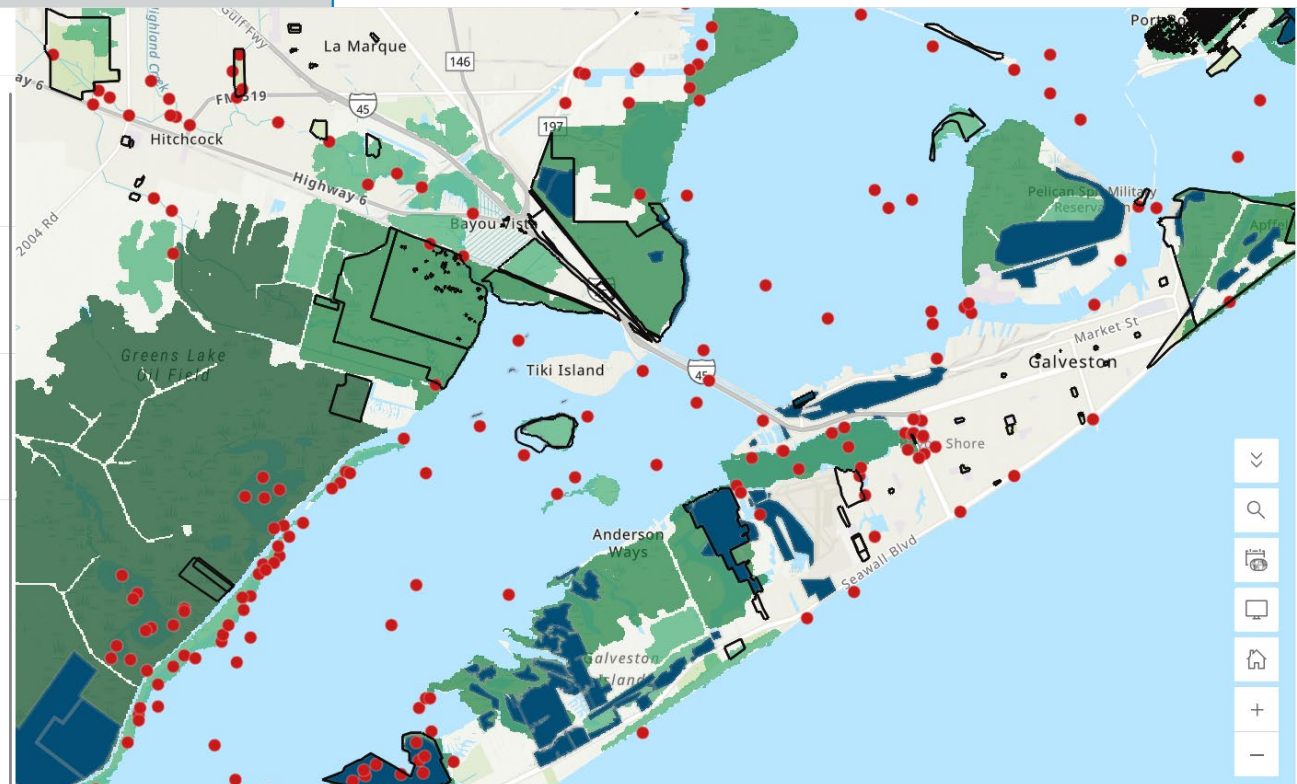


GBEP Projects

- Physical project

Intact Habitat Cores (Southeast Blueprint Indicator)

- 0 = Not a core
- 1 = Small core (>100-1,000 acres)
- 2 = Medium core (>1,000-10,000 acres)
- 3 = Large core (>10,000 acres)



Explore Map:

- Project Locations
- Regional vs. Site Specific
- Habitat Type
- Endangered/Species of Concern
- Emerging Contaminants
- Legacy Pollutants

Possible Supporting Datasets:

- Conservation Land
- Legacy Pollutants
- Other Long Term Monitoring Sites
- NRU Project Sites

Project Details

\$195,871
2 Years

Both WSQ and M&R Databases together:
\$320,475 (saving \$71,267) 3 years

Planning + QAPP

- QAPP Development
- GBEP WSQ Workshop to identify priority metrics

Data Collection

- Obtain WSQ Project Data from GBEP through 2005
- Filling-in Data Gaps from PIs
- QA/QC of Project Data
- Obtaining supplemental information
- Building a Survey 123 form that will standardize project details to support the maps and visualizations that address the questions from WSQ
- Identify and obtain supporting datasets

Visualization Development

- Standard Graphs
- Metric Visuals
- Integrate into Standard Format

Build Database

- Create optimal interface for WSQ
- Troubleshoot
- Create Virtual Tours

M&R Goals

Meaningful and effective monitoring of existing, past, and new projects

- ✓ M&R monitoring projects
- ✓ NRU habitat restoration/acquisition projects

→ Existing Data

→ Research and Data Gaps

The database could make the projects visible spatially and add information so that stakeholders can **synthesize the data** more easily and use it to make **informed project-based decisions**.

Assessment, Exposure, and Response to stressors, including but not limited to:

- Species of greatest conservation need
- Contact recreation
- Environmental parameters
- Emerging contaminants
- Legacy contaminants

One example: Legacy contaminants– an interactive map can show where they've been detected, what was measured and monitored, when the monitoring took place, and where those data can be found.

Development of a Comprehensive and Updated Regional Wetlands Database, Economic Valuation of Ecosystem Services, and Wetland Cover Forecasting

OVERVIEW



Wetlands provide critical ecological and community benefits.



Existing wetland datasets are outdated, inconsistent, and limited in detail.



This project integrates imagery, LiDAR, satellite data, and AI to create an updated regional wetland framework.

PRESENTED BY



Thushara Ranatunga, PhD, GISP



Megha Shrestha, PhD



Durga Joshi, PhD



GBEP M&R Subcommittee meeting,
Sept 9, 2026



AI



LiDAR



Aerial Imagery



Satellite Imagery



Prioritization



Forecasting



Ecosystem
Services



Community
Benefits

Why This Project Matters

Current wetland data for Lower Galveston Bay are outdated, inconsistent, and limited in detail.

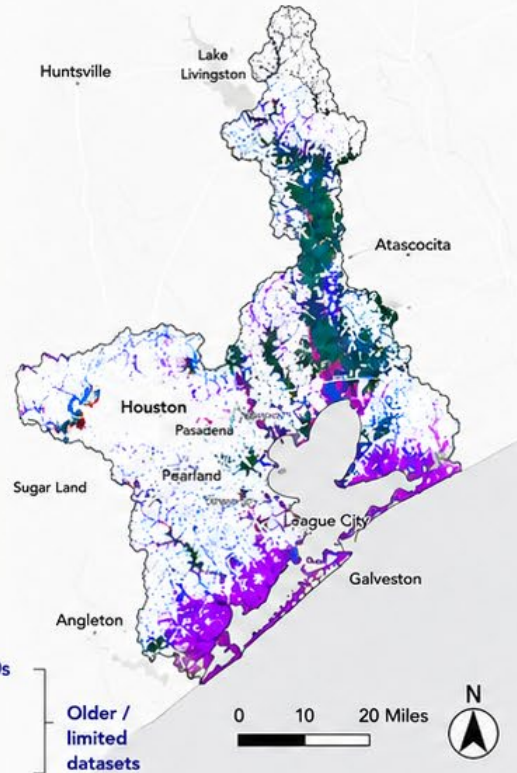
EXISTING WETLANDS FROM DIFFERENT SOURCES

(2016, 2018, 2022, and 2024)

- Lower Galveston Bay Watershed
- Woody Wetlands
- Emergent Herbaceous Wetland
- Freshwater Wetland
- Tidal Wetland
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Palustrine Forested Wetland
- Palustrine Scrub/Shrub Wetland
- Palustrine Emergent Wetland
- Estuarine Forested Wetland
- Estuarine Scrub/Shrub Wetland
- Estuarine Emergent Wetland

DATASETS USED

- NOAA C-CAP – Circa 1990–early 2000s
- NWI – Circa 1990s–early 2000s
- GBEP 2005 delineation – 2005



CURRENT LIMITATIONS



Outdated inventories



Inconsistent classification



Limited resolution



Management gaps

FROM BETTER DATA TO BETTER DECISIONS

OLD / LIMITED DATA



- Coarse boundaries
- Missing features
- Limited context

IMPROVED WETLAND MAPPING



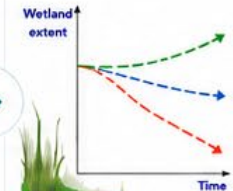
- Finer detail
- More complete
- Actionable insights

ECONOMIC VALUATION



- Measures ecosystem services
- Shows community benefits
- Supports funding decisions

FORECASTING



- Identifies risks
- Tests scenarios
- Guides proactive conservation



Informed Conservation Investments

Quantifies the economic value of wetlands to support smarter, cost-effective prioritization of restoration and conservation efforts.



Plan for the Future

Forecasts wetland change under different scenarios to guide long-term planning and resilience strategies.



Stronger Policy & Stakeholder Support

Provides credible, data-driven evidence to support policy decisions and engage key partners and communities.

Houston-Galveston Area Council

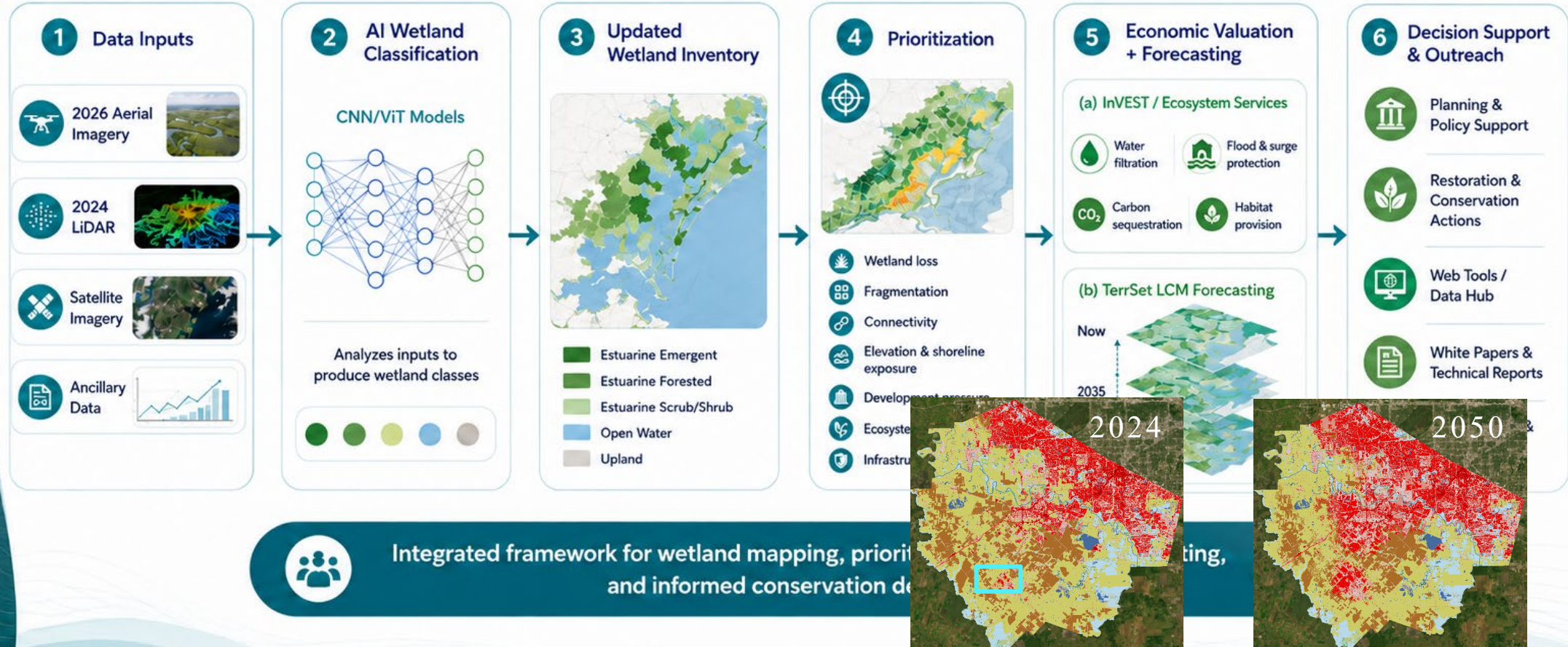
GBEP



Houston-Galveston Area Council

Complete Project Workflow

From multi-source data integration to wetland intelligence and decision support.



Houston-Galveston Area Council

GBEP



Houston-Galveston
Area Council

Expected Outcomes

Five deliverables that move from **raw data to actionable policy** for Lower Galveston Bay wetland protection.

01



Updated Wetland Classification Maps

Accurate, detailed AI-derived wetland inventory.

02



GIS Priority Maps

Spatial maps identifying restoration need, conservation value, and ecological vulnerability.

03



Economic Valuation Report

Comprehensive monetary quantification of key wetland ecosystem services.

04



Future Land-Cover Forecasts

Forecasted scenario outputs showing wetland change under development, conservation, and restoration futures.

05



Public Awareness & Policy Tools

Dissemination via GBEP website, H-GAC Geospatial Hub, interactive web tools, white papers, and public presentations.



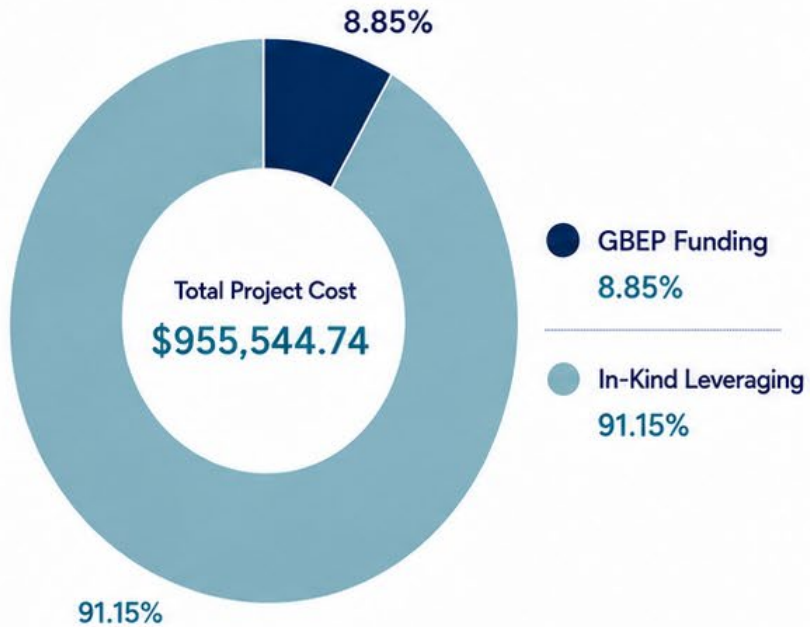


Relation to Action Plan

ACTION PLANS AND CORRESPONDING ACTIONS		PLAN PRIORITIES			
		Ensure Safe Human and Aquatic Life Use	Protect and Sustain Living Resources	Engage Communities	Inform Science-Based Decision Making
Action Plan: Preserve Galveston Bay Through Stakeholder and Partner Outreach (SPO)					
SPO-1	Stewardship Programs and Volunteer Opportunities	x	x	x	
SPO-2	Workshops and Events	x	x	x	
SPO-3	Support Regional Initiatives	x	x	x	x
SPO-4	Local Government Outreach	x	x	x	x
Action Plan: Support Public Education and Awareness Initiatives (PEA)					
PEA-1	Key Issue Engagement	x	x	x	x
PEA-2	Adult Education	x	x	x	
PEA-3	Kindergarten to 12th Grade (K-12) Education Efforts			x	
Action Plan: Collaborate with Research Institutions to Support Focus Area Applied Research and Monitoring (RES)					
RES-1	Conduct Biological Stressor Monitoring and Research	x	x	x	x
RES-2	Conduct Geochemical Stressor Monitoring and Research	x	x	x	x
RES-3	Conduct Physical Stressor Monitoring and Research	x	x	x	x
RES-4	Conduct Monitoring and Research to Address Limits to Contact Recreation	x		x	x
RES-5	Conduct Monitoring and Research to Address Limits to Seafood Consumption	x		x	x
RES-6	Evaluate Best Management Practice (BMP) Projects	x		x	x
RES-7	Conduct Research on Ecosystem Service and Economic Valuation of Bay Resources				x
RES-8	Complete Coastal Resiliency and Acclimation Studies				x
Action Plan: Increase Access to Galveston Bay Ecosystem Information (ACS)					
ACS-1	Tracking Ecosystem Health Indicators	x	x	x	x
ACS-2	Access to Monitoring and Research Data	x	x	x	x
ACS-3	Track Galveston Bay Plan Implementation	x	x	x	x
Action Plan: Improve Water Quality Through Nonpoint Source Pollution Abatement (NPS)					
NPS-1	Support Watershed-Based Plan Development and Implementation	x	x	x	x
NPS-2	Support Nonpoint Source Education and Outreach Campaigns	x	x	x	
NPS-3	Implement NPS Best Management Practices	x	x		x
NPS-4	Host Nonpoint Source Workshops	x		x	x

Budget & Leveraging

Strategic investment with strong in-kind leveraging to maximize impact



FY 2028

\$44,544.74



FY 2029

\$40,000.00



High return on investment: \$87,000 in GBEP funding leverages **\$871,000** in total project resources (10:1 leverage).



GBEP Funding Requested

\$87,000 (91% of total cost)



2024 LiDAR Point Cloud

High-density lidar data to capture elevation and vegetation structure.

\$800,000



2026 Natural Color & Color Infrared Aerial Imagery

High-resolution imagery for land cover mapping and change analysis.

\$49,000



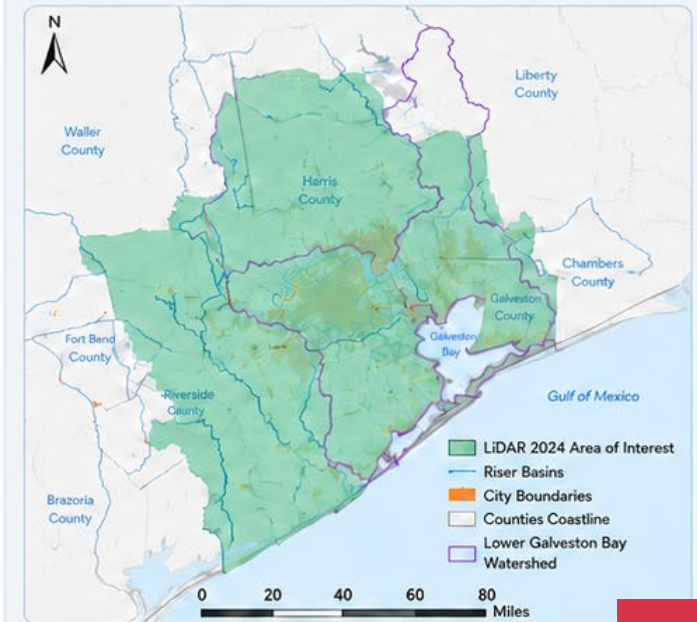
Computing Resources & GIS/Remote Sensing Software

Software licensing, desktop and cloud computing to support analysis.

\$22,000

H-GAC Resources

- ☐ **2024 USGS QL1-density LiDAR Point Cloud and Derivative Products**
 - Cost for the region – \$2.8M
 - L. Galveston Bay Watershed – \$800K
- ☐ **2026 4-Band, 6-inch Resolution Aerial Imagery**
 - Regional cost – \$610K
 - L. Galveston Bay Watershed – \$49K
- ☐ **Computing Resources**
 - Software licensing, desktop and cloud computing – \$22K



Houston-Galveston Area Council

GBEP



Houston-Galveston Area Council



Contact



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Houston-Galveston Area Council

GBEP

Integrated monitoring of oyster larvae and environmental factors in Galveston Bay combining net-tow sampling and eDNA approaches

Hui Liu and Jaime Alvarado
Texas A&M University at Galveston
09/01/2027 to 08/31/2028

Galveston Bay Plan Priorities Addressed:

Plan Priority 2: Protect and Sustain Living Resources, i.e. oysters and zooplankton

Plan Priority 4: Inform Science-based Decision Making, i.e. data collection

Plan Priority 3: Engage Communities,

M&R Subcommittee Priorities

M&R: **Meaningful and effective monitoring of existing, past, and new projects**

- ☒ M&R: Baseline assessments for large-scale, man-made changes to Galveston Bay at an adequate timeline and spatial range to provide useful information.
- ☒ M&R: Assessment, Exposure, and Response to stressors, including but not limited to:
 - ☒ Species of greatest conservation need;
 - ☒ Environmental parameters;

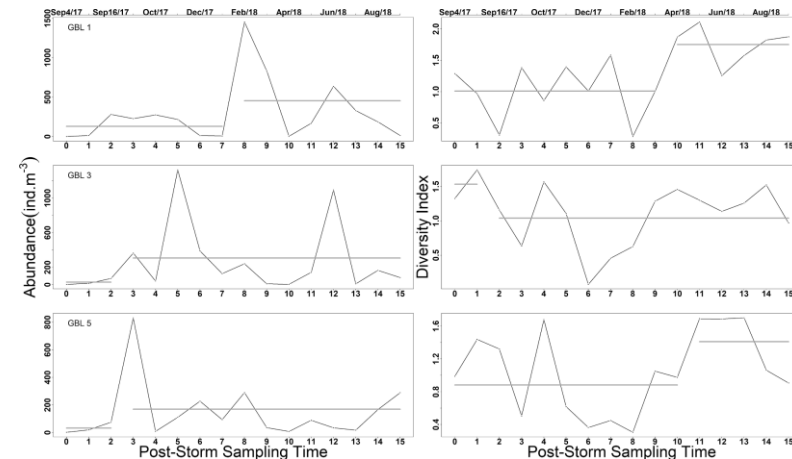


EPA Areas of Special Interest

☒ Make Investments that Address Coastal Resiliency

Knowing the resilience of the bay is prerequisite to perform post-disaster assessments and subsequent restoration actions. All these are relied on the long-term baselines of key ecosystem components for better understanding of the resiliency of Galveston Bay.

Disasters, indicators, Monitoring, Data and Assessment



Liu et al. 2021

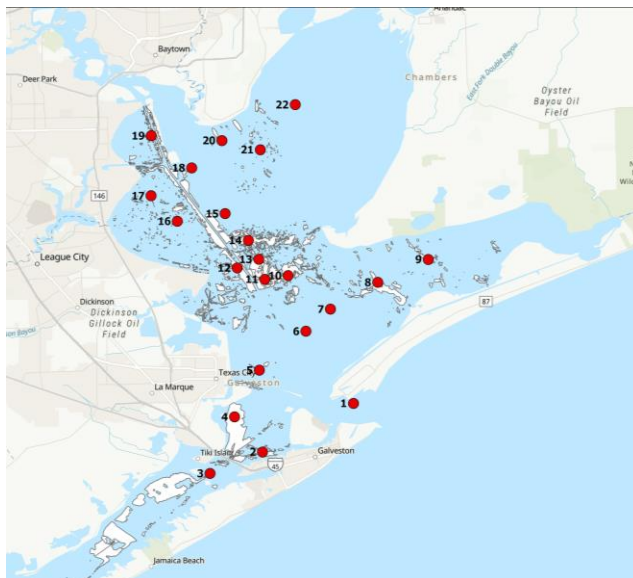
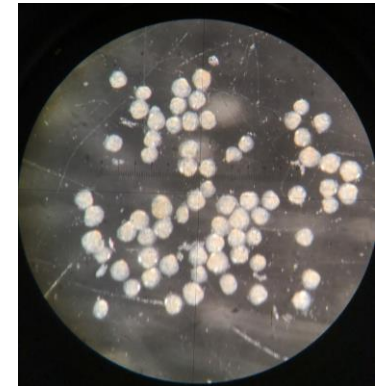
Novel approaches combining net-tow and eDNA with a broad of coverage in time and space

*Traditional monitoring is expensive and inherently faces limitations. Environmental DNA (eDNA) is an emerging method for detecting and identifying species in aquatic environment offering enhanced sensitivity and noninvasive sampling capabilities. **Both methods contain pros and cons, it's better to combine them together.***

Current Status: pelagic larvae remain poorly understood for better restoration of oyster fisheries.

Partners and Their Roles:

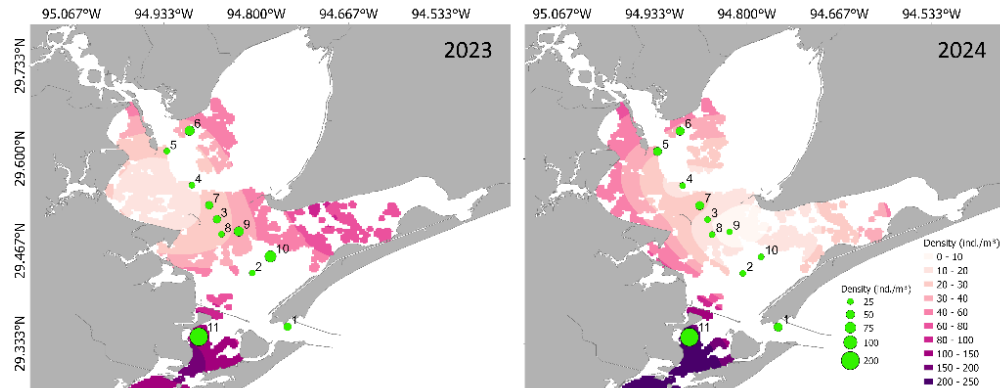
TPWD through ensuring that abundance estimates of pelagic oyster larvae are aligned with their monthly survey of spats for better management and assessment of oyster fisheries.



Objectives:

- (1) to develop a novel technique from combining the traditional sampling and eDNA approaches to generate benchmark data of larval oyster dynamics;
- (2) to provide science-based guidance to agencies and stakeholders in selection of sites as potential oyster sanctuaries that could serve as sources of a reliable and consistent supply of pelagic oyster larvae.

Monitoring and Modeling for Exploration of “Sources” and “Sinks” of Larval Oysters



Liu et al. 2025

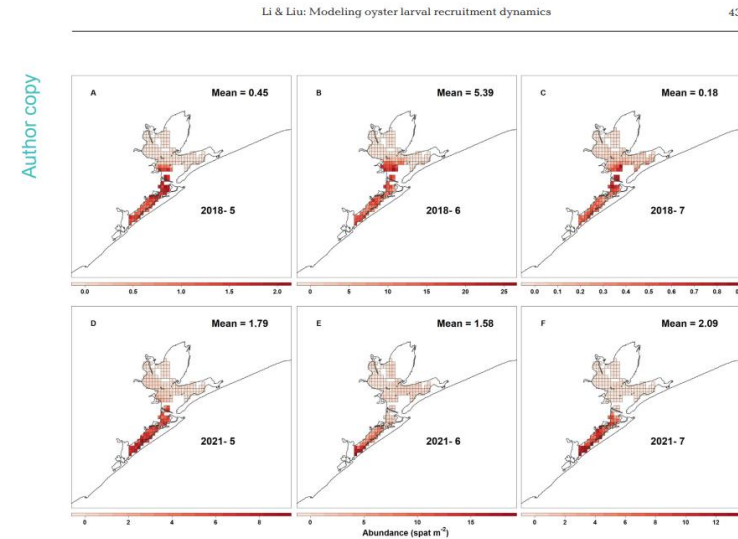
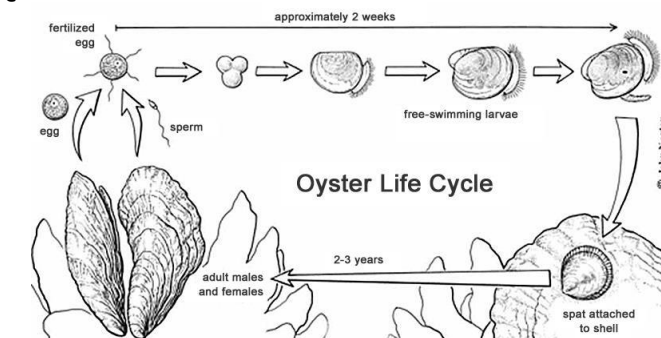


Fig. 6. Simulated oyster larval recruitment (spat m^{-2}) in the Galveston Bay System during the spawning season (May–July; months 5–7) in (A–C) 2018 and (D–F) 2021. The bay-wide mean value is given in each subplot

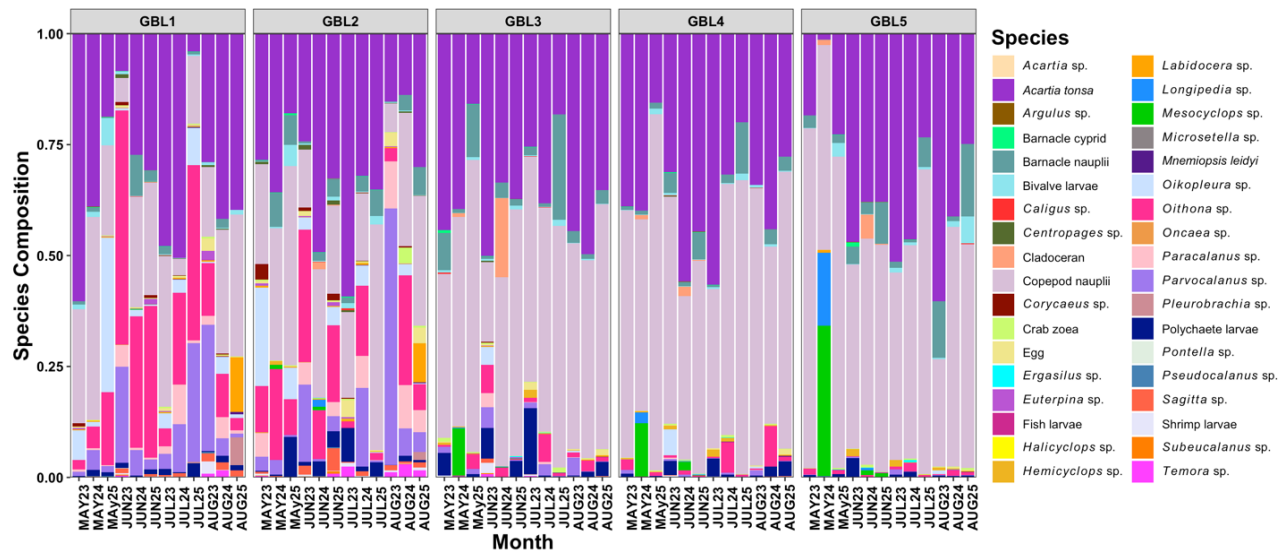
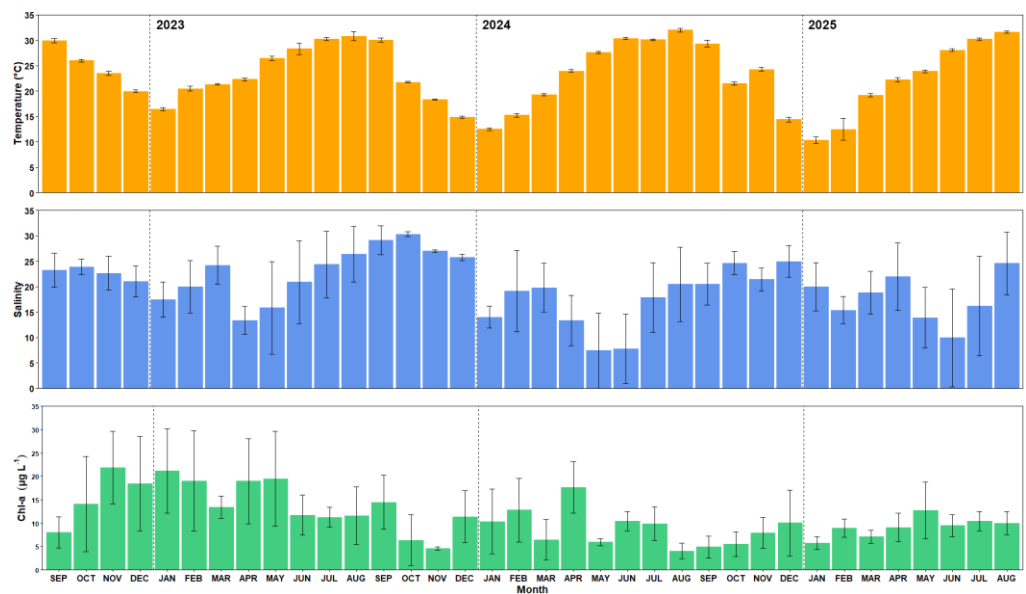
Li & Liu 2025

Useful to Agencies and Stakeholders

1. **When** larvae reach their highest density and **How** their densities are related to specific sites and environmental conditions.
2. **Where** potential oyster sanctuaries could serve as sources of a reliable and consistent supply of pelagic larvae.
3. **What** the success of restoration projects would allow for greater confidence in selecting restoration locations.



Outcome from a recent project contributed to the updated Status of the Bay and more



Monitoring Ecosystem Indicators for
Science-Based Restoration and
Enhancement of Pelagic Habitats of
Galveston Bay

Final Report



By Hui Liu
Texas A&M University at Galveston
Submitted to Texas Commission on Environmental Quality
January 2026
Contract No. 582-23-40251

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Design and Performance Metrics Decision Support for Green Infrastructure and Living Shorelines for Coastal Resilience



Hanadi S. Rifai and Abigail L. Beck
University of Houston

Partner: Galveston Bay Foundation



***Best
Management
Practices***



***Living Shorelines
&
Nature Based
Solutions***

What is the project about?

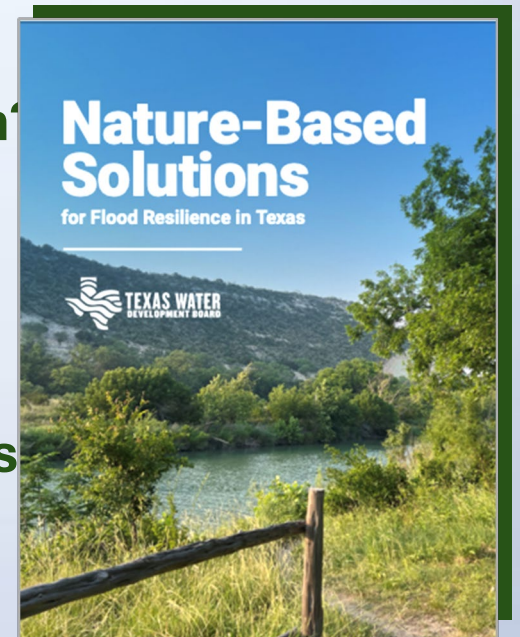
The Need

A comprehensive framework to identify, classify, and rank potential GI implementations to reduce risks and increase resilience to **multiple stressors** (*flooding, extreme heat, drought, and environmental quality*)

Closing the Gap: Project Goal

A risk-based decision support framework for GI with design and performance metrics

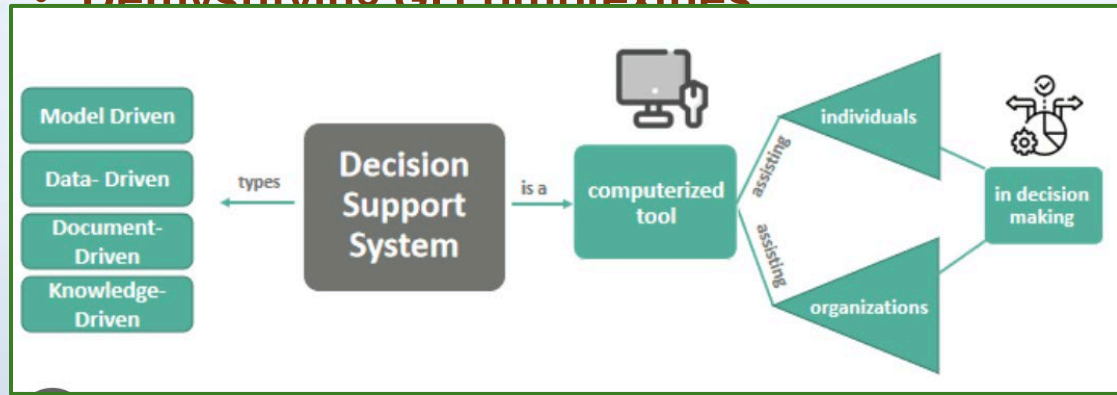
- Green Infrastructure (GI) of interest for mitigation and adaptation, exemplified by:
 - Implementations Under Way
 - Guidance Manuals
 - Training Programs
 - Advocacy Efforts
- Community Perception
- Always considered?
- Hard infrastructure long timelines
- At scale considerations
- O&M challenges



Project Scope and Novelty: *urban, rural, coastal, at scale*

Prioritization and ranking Decision-Support System

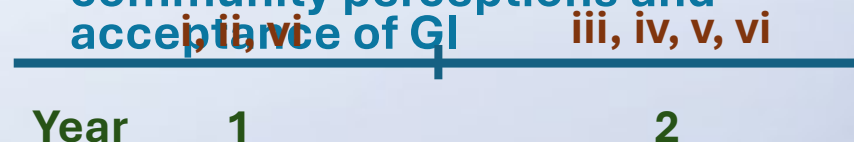
- Identifying the most beneficial Green Infrastructure for the lower Galveston Bay Watershed
- Deploying systems-based approach for multiple GI types
- Contextualizing mitigation of multiple stressors
- Leveraging GI expertise and community engagement from GBF
- Demystifying GI complexities



Tasks

Direct Cost \$181,081

- Develop a GIS-based mapped database of current and potential locations for GI
- Develop a knowledge base of the various types of GI and the criteria for their selection
- Develop a risk-based ranking decision support tool for exploring implementation of various GI and their associated benefits
- Illustrate with demonstration case studies for three pilot watersheds: coastal, rural and urban
- Design overarching decision support risk-based management framework
- Elucidate understanding of community perceptions and acceptance of GI



Outputs and Outcomes

Outputs:

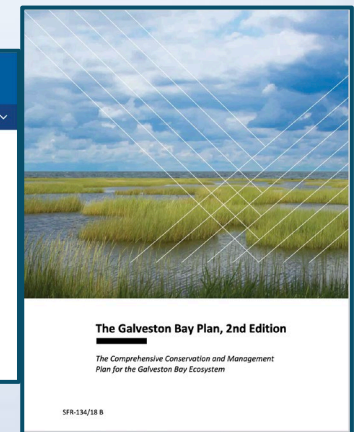
- Guidance for communities
- Case study demonstrations
- mapped database of current and potential GI within Galveston Bay
- system-level risk-based decision support tool
- Time, Cost, and Scale-level Supporting Information

Outcomes:

- *Re-shaping the conversation about GI from individual projects to an integrated distributed, interconnected network of natural and engineered systems that reduces multiple risks simultaneously while considering community and stakeholder perceptions and acceptance*
- *Informing watershed action plans*

Alignments: (WSQ and M&R)

- Implements several actions:
 - Evaluating best management practices (RES-6)
 - Evaluating ecosystem services and economic valuation (RES-7)
 - Completing coastal resiliency and acclimation studies (RES-8).
- Increases access to Galveston Bay ecosystem information (ACS 1, 2 & 3)
- Engages communities (PEA 1 & 2)
- Contributes to ensuring safe human and aquatic life use (NPS 1 & 3)
- Protects and sustains living resources (HC 3)



Directly aligned with EPA interests and direct focus on GI for improving water quality

Expanded Evaluation of Micro- and Nanoplastic Pollution through Emerging Methods

Lead-PI: Mandi Gordon; gordon@uhcl.edu

Co-PI: Dr. Ruaa Al-Mezrakchi; almezrakchi@uhcl.edu

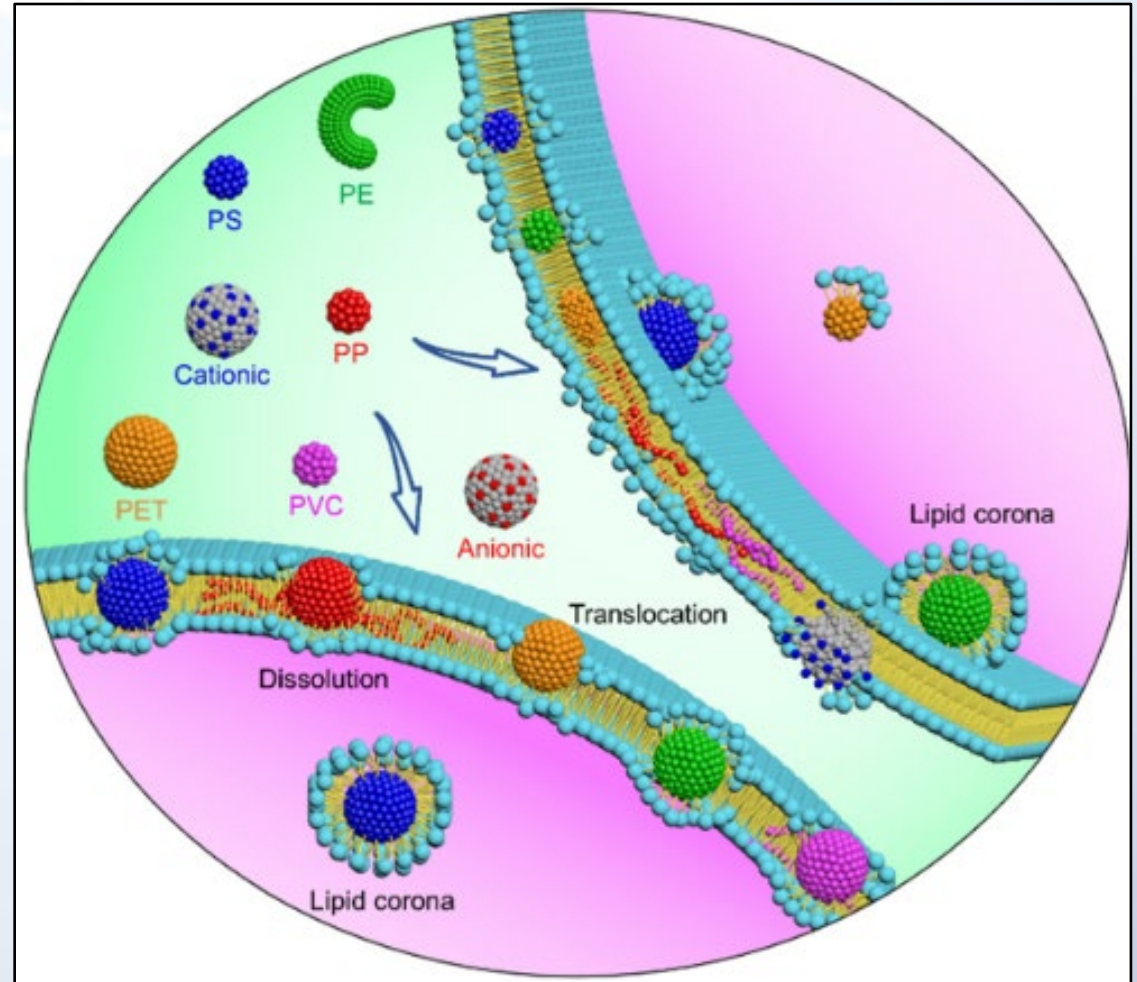
Co-PI: Dr. Asif Mortuza; mortuza@uhcl.edu

Co-PI: Dr. Jenny Oakley; jenny.oakley@h-gac.com



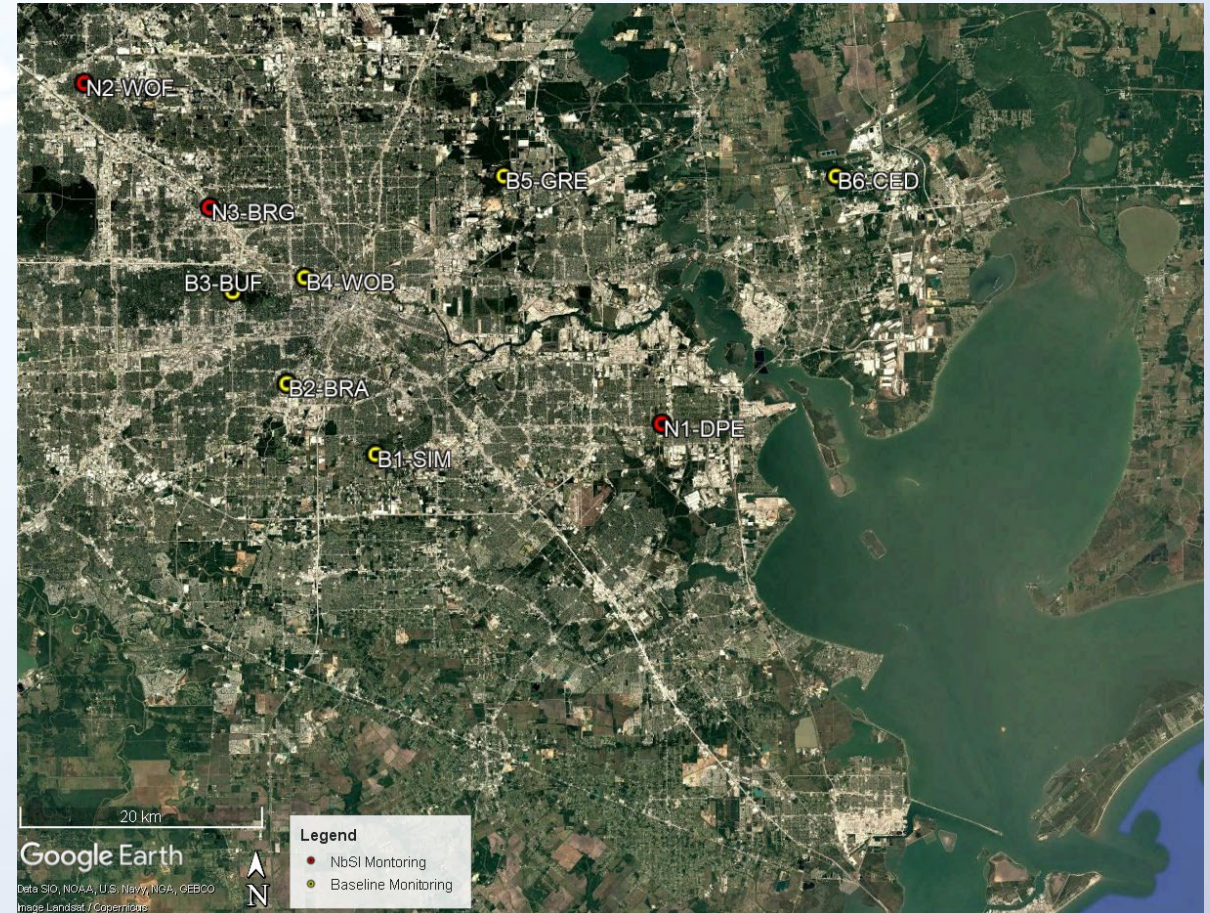
Risks of Nanoplastics

- Size definitions:
 - Microplastics (MP) < 5mm
 - Nanoplastics (NP) < 1 μm
- Embedded and digested
- Membrane-crossing
 - Negative surface charge
 - Nano-diameters and fiber shapes
- Inflammation and oxidative stress
- May extend to carcinogenicity or teratogenicity



Project Expansion Details

- Current GBEP-funded study scope:
 - Quarterly sampling in 6 watersheds
 - Treatment efficiency of 3 NbSI sites for reduction/removal of MP
 - **MP range: 100 μ m-5mm**
- Proposed expansion scope:
 - Concurrent samples
 - **Increases MP range to < 100 μ m)**
 - Emerging technologies:
 - Differential Scanning Calorimetry (DSC)
 - Pyrolysis-Gas Chromatography-Mass Spectrometry (Py-GC-MS)



Project Urgency and Timeline

- QAPP for NbSI study still in review by TCEQ
- Field sample collection intended to start in FY27 Q1
- Samples for study expansion can be collected and stored until FY28
- Last opportunity for NbSI study to be expanded in it's current timeline

Month/Year	Project Activity
December 2025 – June 2026	NbSI QAPP Development
June 2026 – August 2026	NbSI QAPP Review and Finalization
June 2026 – August 2026	NbSI Study Method Testing
September 2026 – August 2027	NbSI Field Data Collection
September 2026 – August 2027	Concurrent Expansion Field Sample Collection and Storage
September 2026 – October 2027	NbSI Laboratory Analyses
September 2027 – February 2028	Study Expansion QAPP Development
October 2027 – March 2028	NbSI Data Analysis and Reporting
March 2028 – May 2028	NbSI Final Report Revision(s)
March 2028 – February 2029	Study Expansion Sample Analyses
March 2029 – May 2029	Study Expansion Data Analysis and Reporting
June 2029 – August 2029	Study Expansion Final Report Revision(s)

Project Budget and Priorities Met

- Leverage:
 - FY26-28 NbSI Study: \$221,928
- Total Project Costs: \$390,900 (43% requested)
- Galveston Bay Plan Priorities:
 - **NPS-1, NPS-3**
 - **PHA-4, PHA-5**
 - **RES-1, RES-5, RES-6**
 - **ACS-2, ACS-3**
- WSQ and M&R FY28 Priorities

Cost Category	FY28 Total	FY29 Total	Project Total
Salary	\$ 53,021	\$ 53,828	\$ 106,849
Fringe	\$ 11,743	\$ 11,977	\$ 23,720
Equipment	\$ -	\$ -	\$ -
Travel	\$ -	\$ 2,600	\$ 2,600
Supplies (M&O)	\$ 2,500	\$ 2,500	\$ 5,000
Contractual	\$ -	\$ -	\$ -
Other	\$ 4,000	\$ 4,600	\$ 8,600
Sub-total	\$ 71,263	\$ 75,506	\$ 146,769
IDC (16%)	\$ 10,762	\$ 11,441	\$ 22,203
Total	\$ 82,026	\$ 86,947	\$ 168,972

A Gap-Free, Multi-Parameter Water Quality Observatory for **Galveston Bay** Using **Satellite Remote Sensing** and **AI**

Dr. Adnan Rajib

Assistant Professor of Civil Engineering
Director, Hydrology & Hydroinformatics Innovation Lab
University of Texas at Arlington



adnan.rajib@uta.edu



UNIVERSITY OF
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ARLINGTON

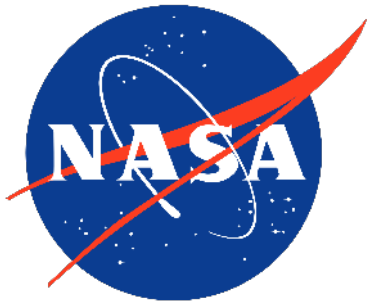
H2I Lab @Civil Engineering

Parent Project Supporting the Initial Proof of Concept for this Proposal

PUBLISHED ON MAR 1, 2023

A New NASA Model Brings Open Science to Target Water Quality Problems

NASA's earth observations can inform water quality and resource protection decisions



Featured as a NASA Success Story

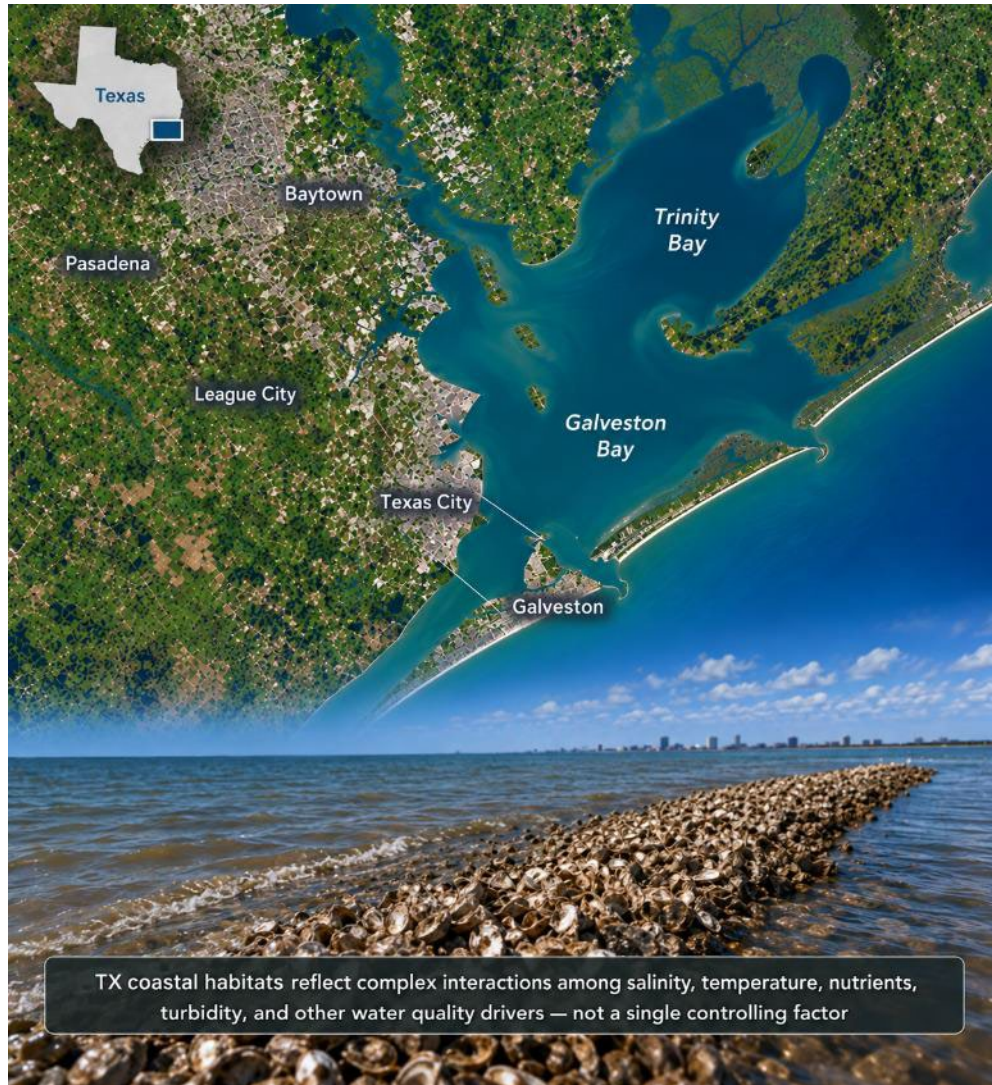
<https://www.earthdata.nasa.gov/dashboard/stories/wq-models>

TV News

<https://youtu.be/XEDRXFODnag>

Existing Gaps in Water Quality Mapping for Galveston Bay

There is **NO spatially complete & temporally continuous** maps or databases that bring multiple **inter-connected WQ parameters** under one platform



[1] Most existing coastal WQ studies focus on a **single parameter**

[2] Lack of **reproducibility or consistency** of methods

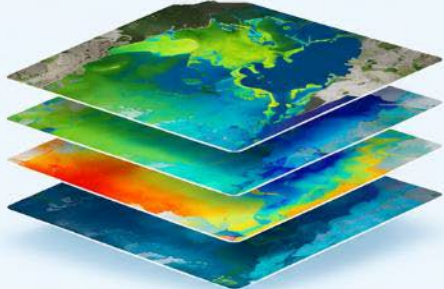
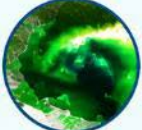
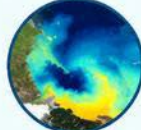
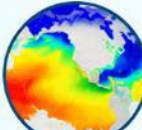
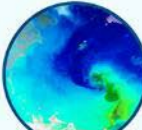
[3] Common “remote sensing” **misperceptions**:

- + Remote sensing alone is cure-all
- + Covers near-shore waters

[4] **Operational HAB hazard platforms** exist, but permitting/leasing/project evaluation decisions need constituents WQ parameters

Project Outcomes

Key Deliverables

 Product	 WQ parameters	 Resolution & Coverage
Gap-free, continuous daily water quality maps covering entire Galveston Bay system 	 Chl-a  TSM  CDOM  SST  SSS	 300-meter  Daily  2016 to present (with ~3-day latency) 

Chl-a = Chlorophyll-a, **TSM** = Total Suspended Matter, **CDOM** = Colored Dissolved Organic Matter, **SST** = Sea Surface Temperature, **SSS** = and Sea Surface Salinity

Dissemination

An interactive, **open-access** data visualization and download platform via Google Earth Engine

Partnerships & Stakeholder Training

Three in-person training workshops (one/year) co-hosted with **TWDB** and **GBEP**

Requested budget: \$160,790 for 3-years

Proposed Method: Harmonization & Integration via AI, Validation with In-situ Data

 Parameter	 Source	 Resolution	 Start Year
Satellite Remote Sensing Sources			
 Chl-a, TSM, CDOM Water quality	 PACE OCI	1.2-km, 1-2 days	2024
	 MODIS	1-km, daily	2000
	 VIIRS	750-m, daily	2011
	 Sentinel-3 OLCI	300-m, 1-2 days	2016
 SST Sea surface temperature	MODIS, VIIRS, Sentinel-3 SLSTR	750-m to 1-km, daily	2000
 SSS Sea surface salinity	SMOS–SMAP combined	14-km, daily	1993
Ancillary Models & In-situ Data for Validation			
 SSS Sea surface salinity	 Hydrodynamic model TWDB BayCast	250-m, daily	2015
 SST, SSS, TSM, DO In-situ observations	 NOAA IOOS, GCOOS	In-situ, daily	Variable

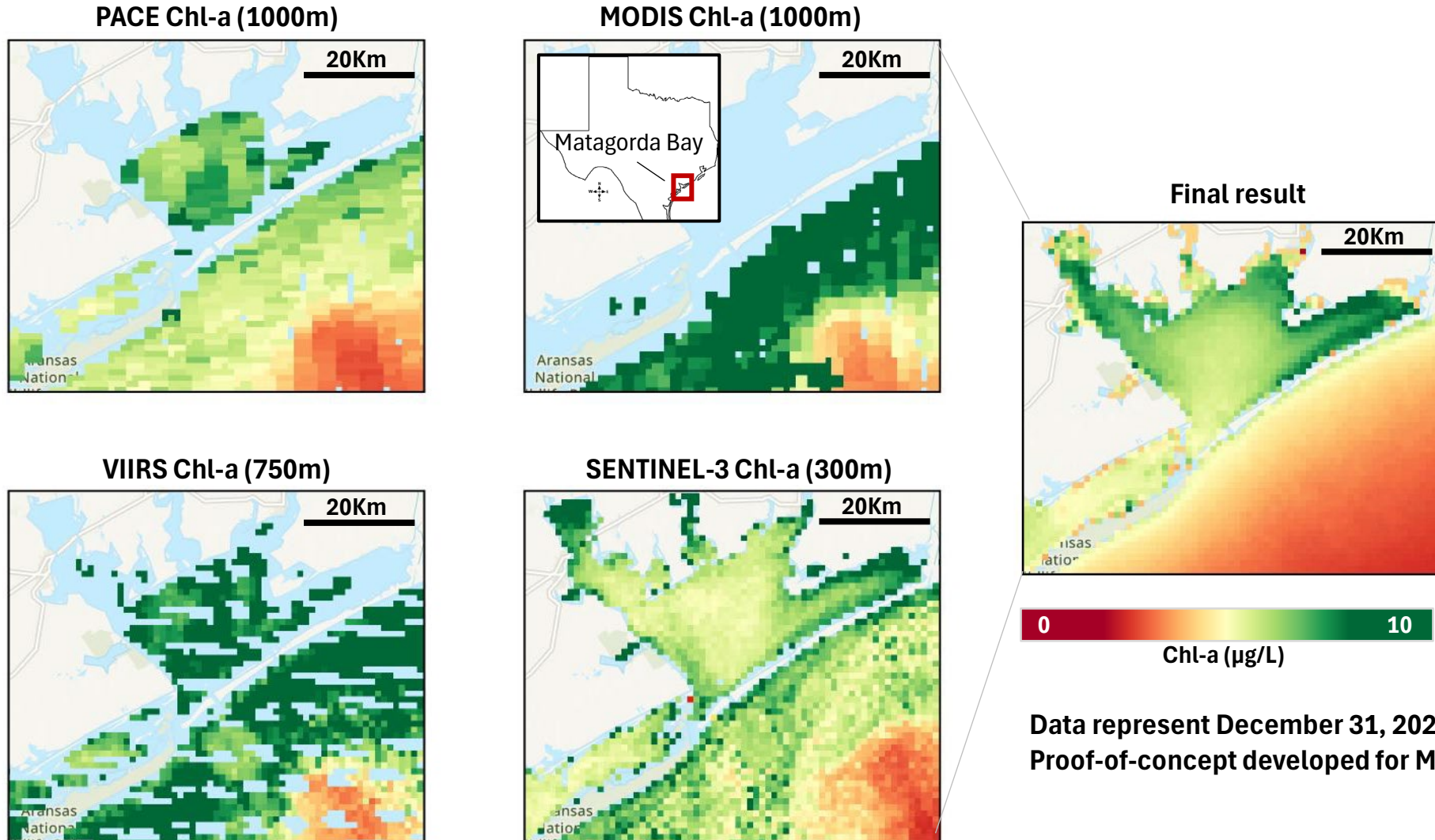
Chl-a = Chlorophyll-a
TSM = Total Suspended Matter

CDOM = Colored Dissolved Organic Matter
SST = Sea Surface Temperature

SSS = and Sea Surface Salinity
DO = Dissolved Oxygen

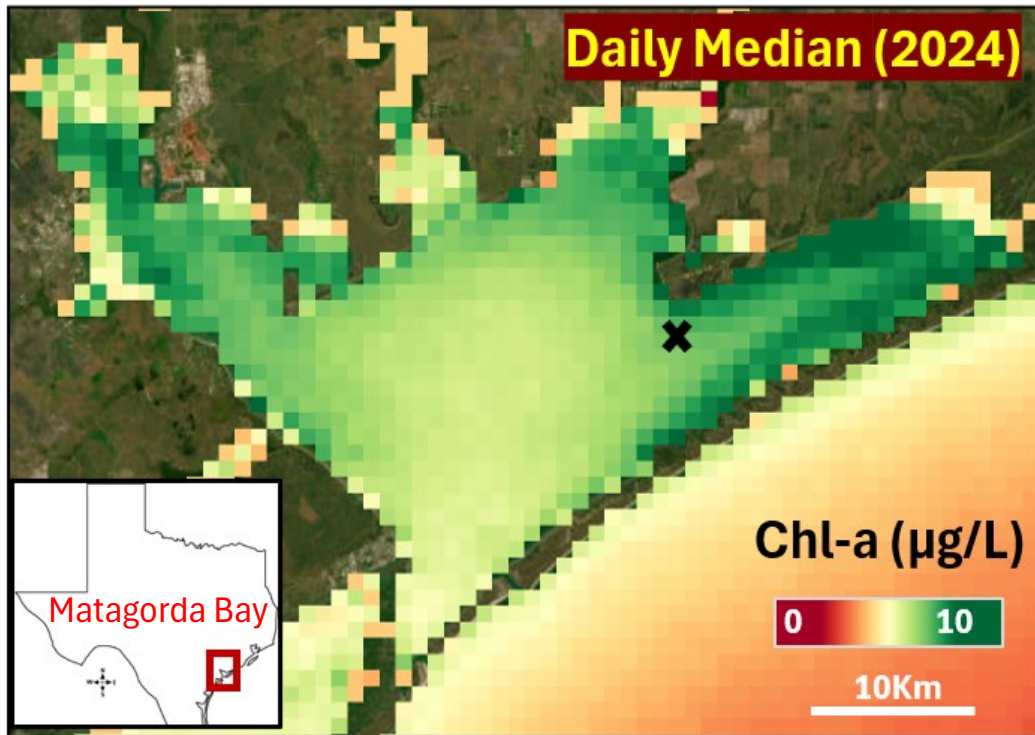
Initial Proof of Concept Results

Spatially complete & temporally continuous Chlorophyll-a data

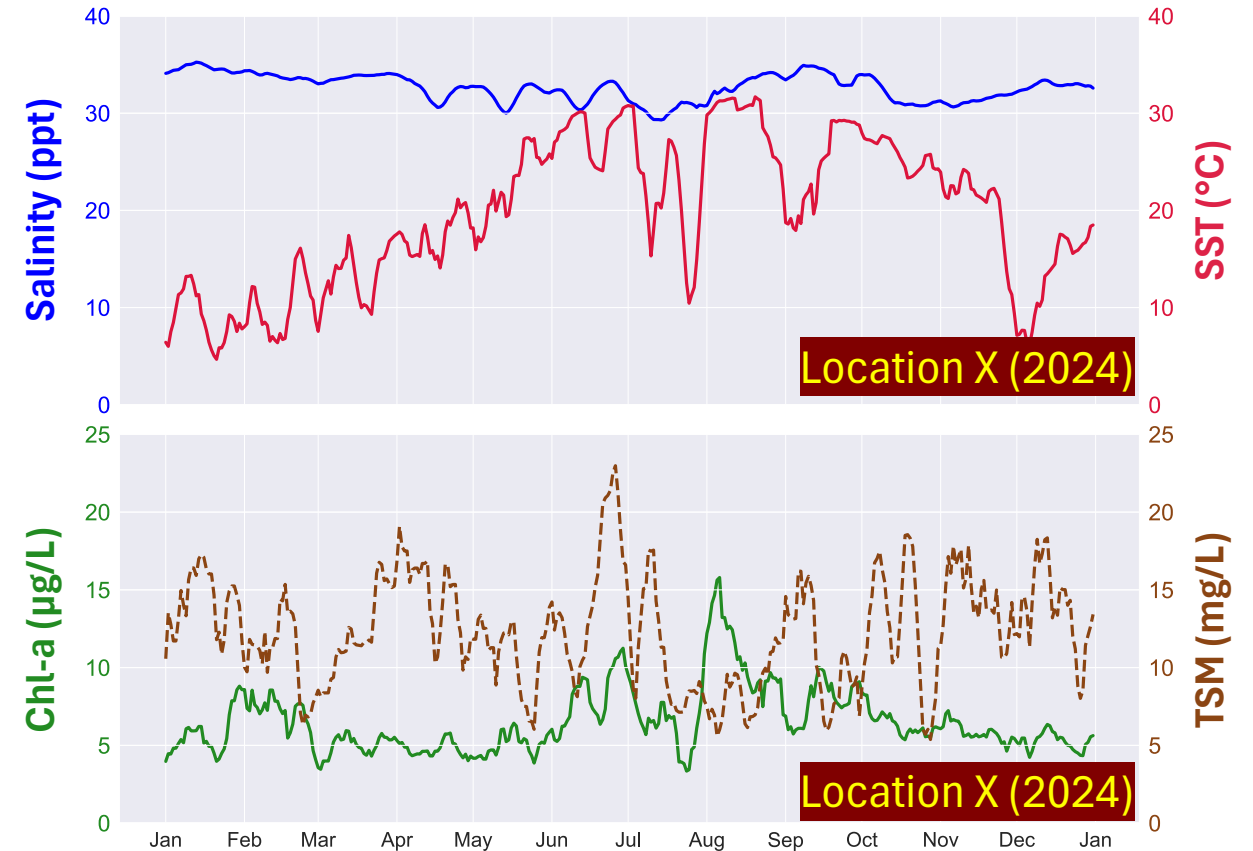


Initial Proof of Concept Results

Spatially complete & temporally continuous multi-parameter water quality data



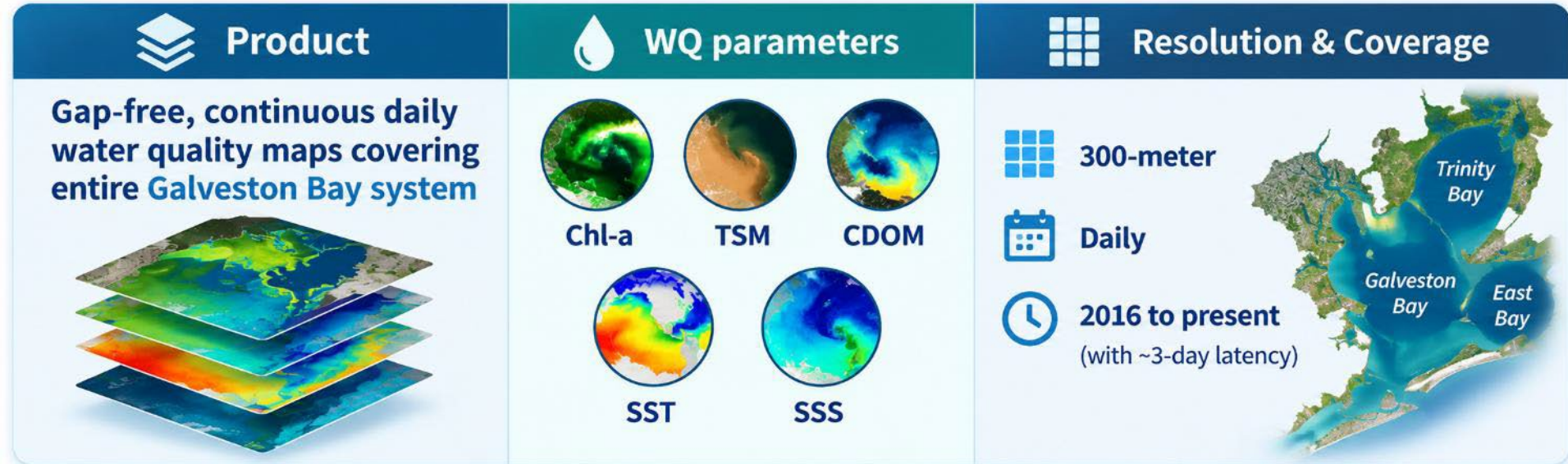
Proof-of-concept developed for Matagorda Bay



Can include **additional water quality parameters** and utilize local data as the project develops, based on **stakeholder suggestions** and **GBEP priorities**

Key Takeaways

A Gap-Free, Multi-Parameter Water Quality Observatory for Galveston Bay



The project, if funded, will fill a long-standing gap, and **for the first time**, bring a more comprehensive picture of Galveston Bay's aquatic health under one framework

Interactive dashboard will make data **immediately available** to stakeholders

Finally, flexible methods would allow **future extension** highly efficient



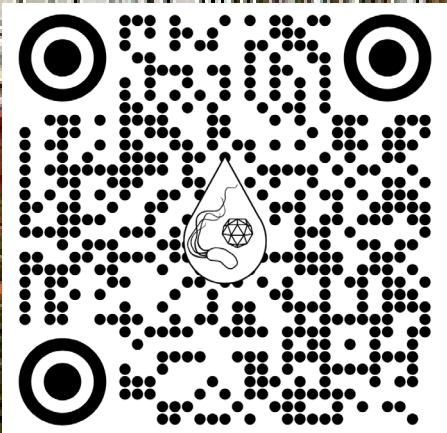
adnan.rajab@uta.edu

Informing contact recreation safety: linking salinity and temperature to fecal indicator organism, enteric virus, and *Vibrio vulnificus* occurrence in Galveston Bay

Lauren C. Kennedy

lkennedy@utep.edu

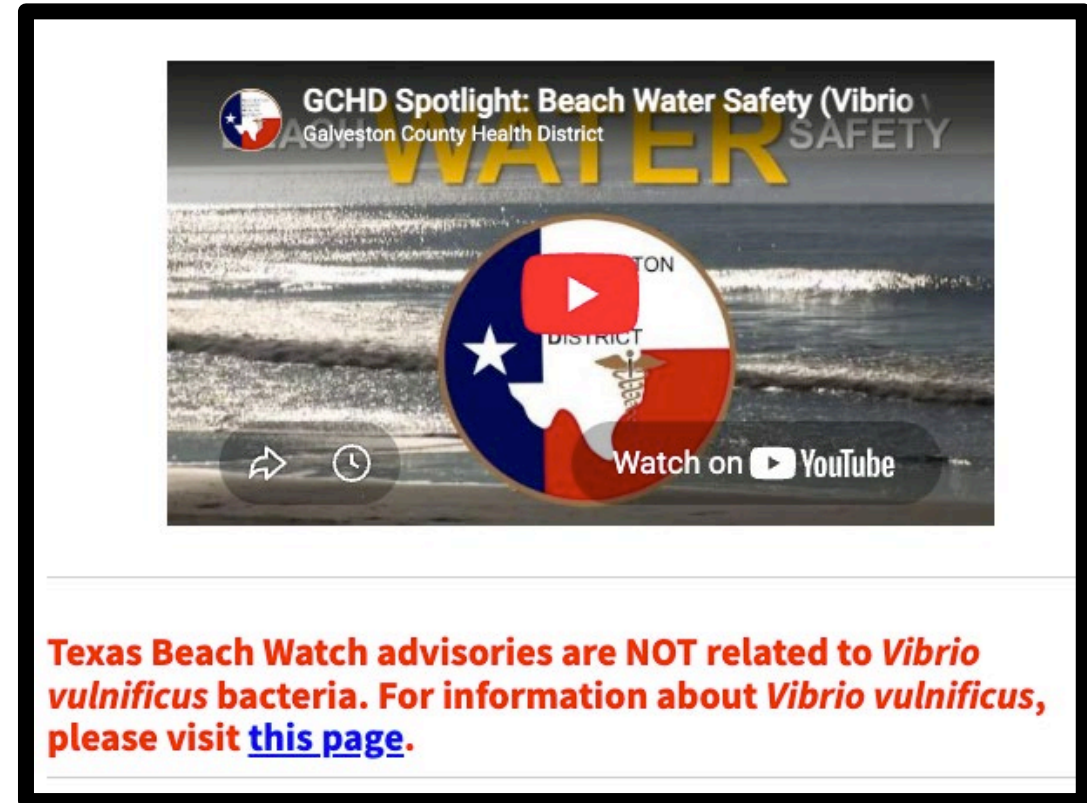
M&R Subcommittee meeting



WATER LABS

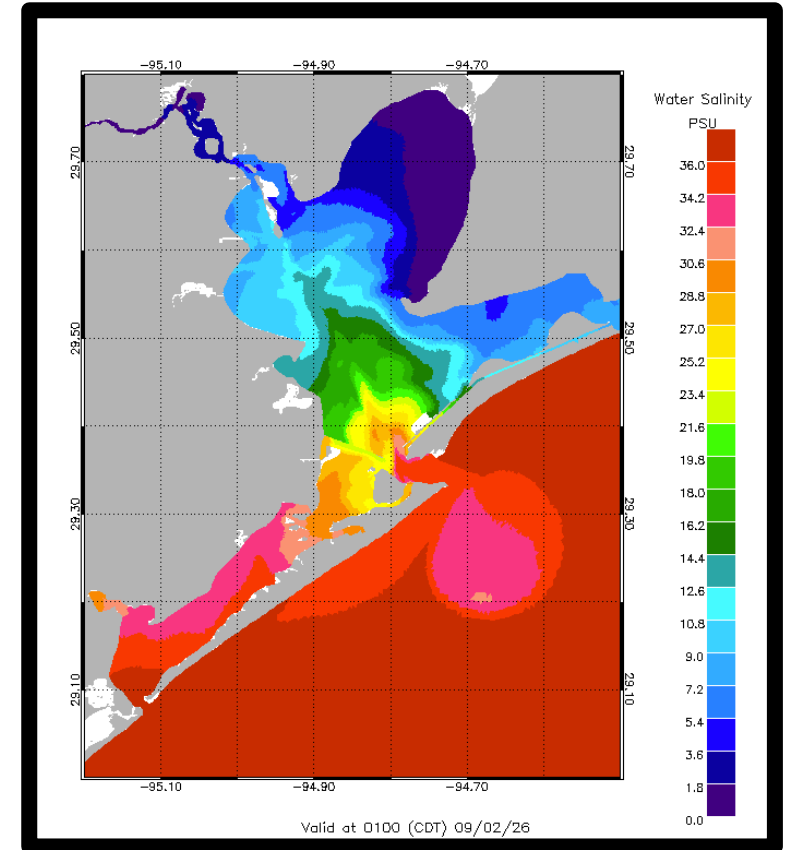
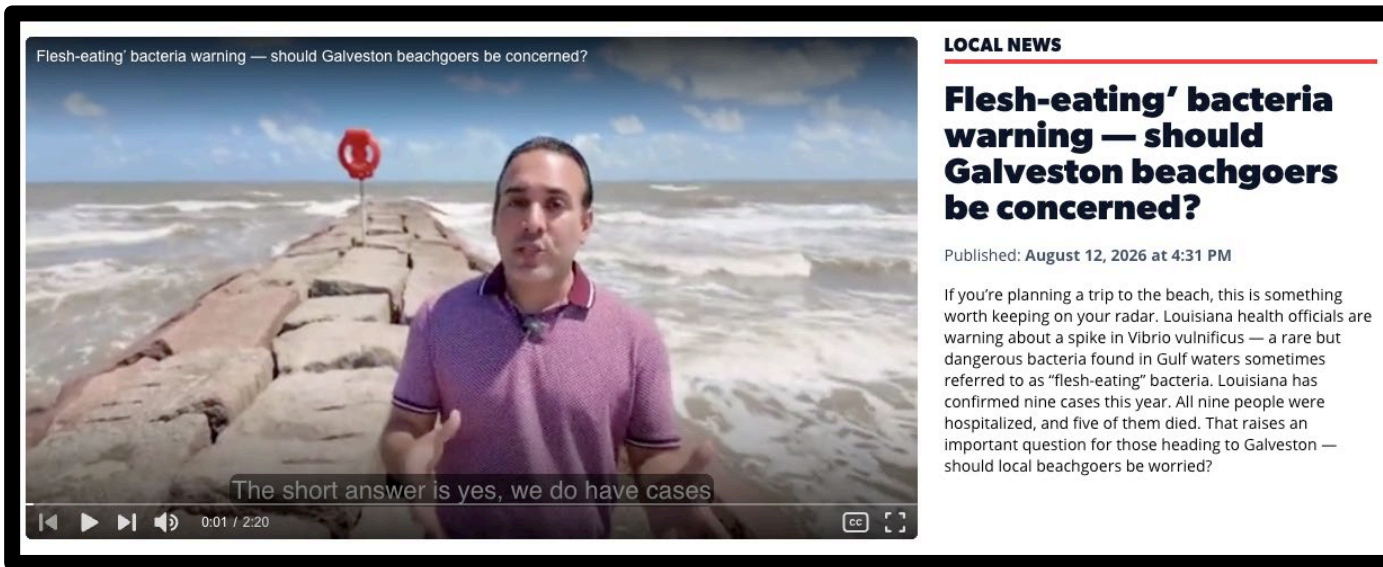
Current recreational water quality monitoring practices do not capture all contact recreation risks.

- Recreational water quality monitoring in Texas relies on fecal indicator bacteria, such as *Enterococcus*
- We have observed that enteric viruses differ in persistence from fecal indicator organisms.¹
- Naturally occurring pathogens, such as *Vibrio vulnificus*, are not captured by fecal indicator monitoring² and can cause severe and life-threatening infections.³



1. Kennedy, LC et al. Temperature and particles interact to affect human norovirus and MS2 persistence in surface water. *Environmental Science: Processes & Impacts*. 2023.
2. Galveston County Health District. *Vibrio vulnificus* bacteria.
3. Centers for Disease Control and Prevention. About *Vibrio* infection. May 14, 2024.

Despite low case numbers, Galveston Bay's brackish waters⁴ support *Vibrio vulnificus*,⁵ contributing to public concern.⁶



4. NGOFS2 – Galveston Bay Salinity Forecast Guidance. Tides and Currents. NOAA.

5. Kelly, MT. Effect of temperature and salinity on *Vibrio* (*Beneckea*) *vulnificus* occurrence in a Gulf Coast environment. *Applied and Environmental Microbiology*. 1982.

6. KPRC 2 Houston. Flesh-eating bacteria warning — should Galveston beachgoers be concerned? August 12, 2026

What if readily available salinity and temperature data could help identify contact recreation risks missed by current monitoring?

Objective i: Determine whether temperature and salinity help explain differences between fecal indicator bacteria, enteric viruses, and *Vibrio vulnificus* across the Galveston Bay watershed.

Objective ii: Quantify the effects of salinity and temperature on the persistence of *Enterococcus faecalis* and *Vibrio vulnificus* under controlled conditions.

Objective iii: Translate findings into a decision support tool and white paper for watershed managers as well as peer reviewed publications to help the academic community build on the findings.

We request \$199,433 to complete the proposed research from September 2027 through May 2030.

Budget Category		Requested amount
Salary / Wages		\$69,590
Fringe Benefits		\$11,341
Travel		\$10,000
Supplies		\$30,000
Graduate student tuition		\$13,804
Indirect costs		\$64,698
Total		\$199,433

This project would address GBEP monitoring, research, and data access priorities.



- **RES-4:** This project addresses a contact recreation monitoring gap by evaluating whether readily available salinity and temperature data can help identify conditions associated with enteric virus and *Vibrio vulnificus* risks that fecal indicator monitoring alone cannot capture.



- **ACS-2:** Data and code shared through GitHub and Zenodo will support reproducible recreational water quality research and management.



- **M&R priority 3:** The project compares enteric viruses and *Vibrio vulnificus* with current fecal indicator standards to determine when environmental conditions may signal exposure risks not fully represented by *Enterococcus* thresholds.



PHA-3 is also addressed.

Assessing PFAS Occurrence in Galveston Bay Dolphins

Yina Liu^{1,2} (yinaliu@tamu.edu), Michael Shields², Heidi Whitehead³

¹. Department of Oceanography, Texas A&M University, College Station

². Geochemical and Environmental Research Group, Texas A&M University, College Station

³. Texas Marine Mammal Stranding Network, Galveston



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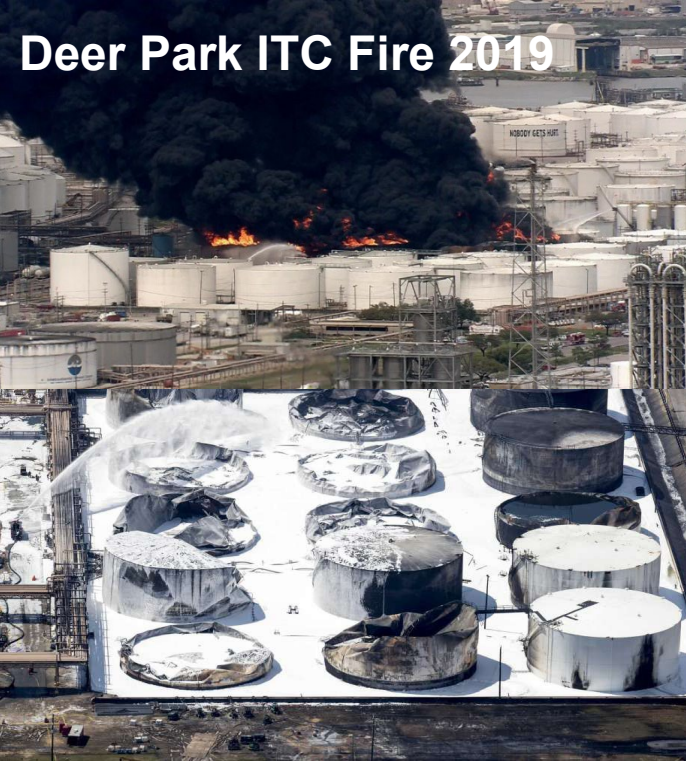


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Oceanography



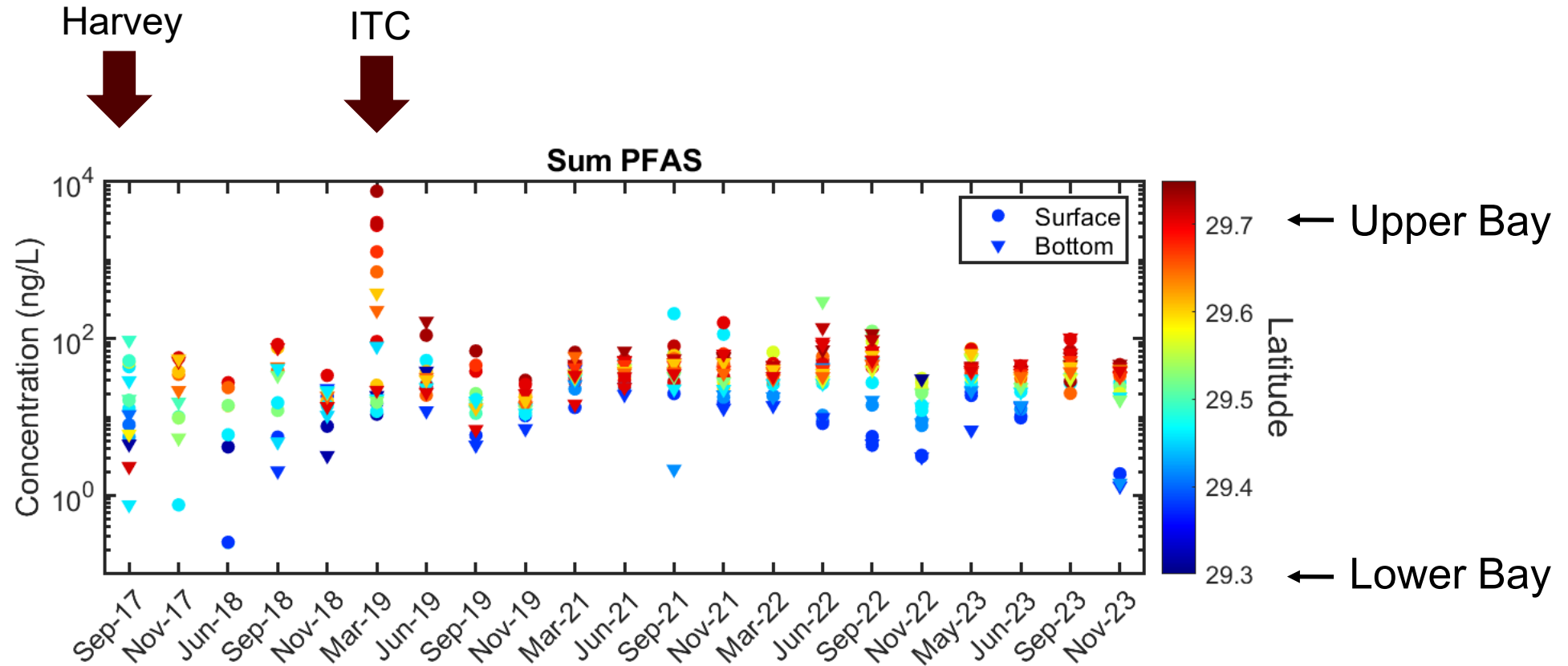
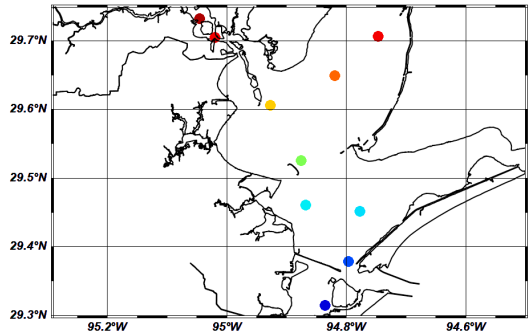
GEOCHEMICAL AND
ENVIRONMENTAL RESEARCH GROUP
TEXAS A&M UNIVERSITY

PFAS in Galveston Bay



- Per- and polyfluoroalkyl substances (PFAS, or the “forever chemicals”) are a group of persistent man-made chemicals (>15,000 known chemicals)
- Produced in the US since the 1940s for different consumer products
- Bioaccumulative in humans and marine life, and potentially toxic
- PFAS were found in Galveston Bay water and sediment
- Significantly elevated PFAS concentrations were found during and months after the ITC fire

The First PFAS Time Series in Texas from 2017 to 2023



- We have a five-year record of PFAS, previously funded by GBEP
- **But how does it translate to understanding ecosystem health?**

Why Dolphins?

- Dolphins are sentinel species for environmental and human health
- Bottlenose dolphins (*Tursiops truncatus*) are a **Species of Greatest Conservation Need (SGCN)** in Texas
- As mammals, dolphins and humans have similar lifespans, diets, and contaminant exposure pathways
- Dolphins eat the same fish we do from the same waters
- Biomagnification provides insight into the impact of Galveston Bay water quality on humans and animals
- **Health impacts in dolphins signal threats to the ecosystem and human health**



Project Objectives

Objective 1: Determine Organ-Specific PFAS Partitioning.

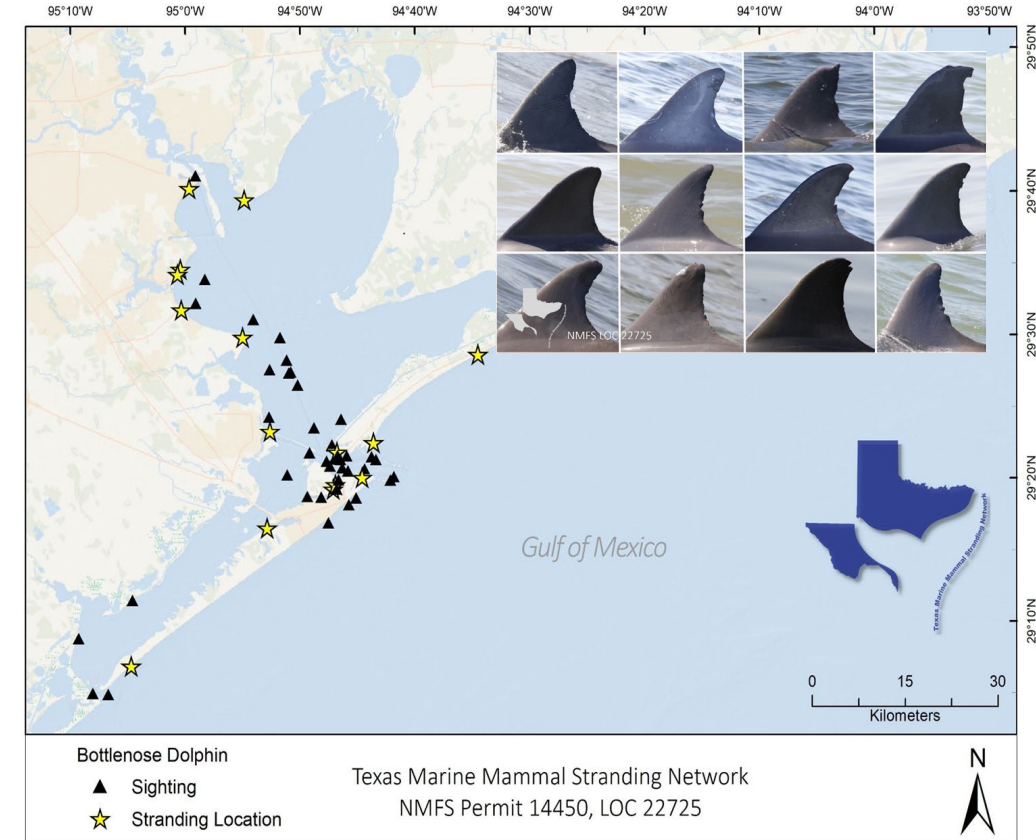
Quantify **PFAS concentrations** in liver, brain, kidney, lung, and blubber, as well as stomach contents (when available).

Objective 2: Conduct Non-targeted Emerging Contaminant Screenings.

High-resolution mass spectrometry permits screening of these biological tissues for a wider suite of polar and semi-polar emerging contaminants, identifying **novel chemical threats** that escape standard targeted monitoring programs.

Objective 3: Integrate Environmental and Biological Datasets.

- Connect sighting information and previous **PFAS time-series data**.
- Legacy contaminant datasets are also available for these individuals, providing maximum leverage on understanding how Galveston Bay dolphins are affected by **multiple emerging and legacy contaminants (geochemical stressors)**.



Assessing emerging contaminants in game waterfowl and their habitats

Dr. Jacquelyn Grace¹, Dr. Yina Liu², and Dr. Michael Shields²

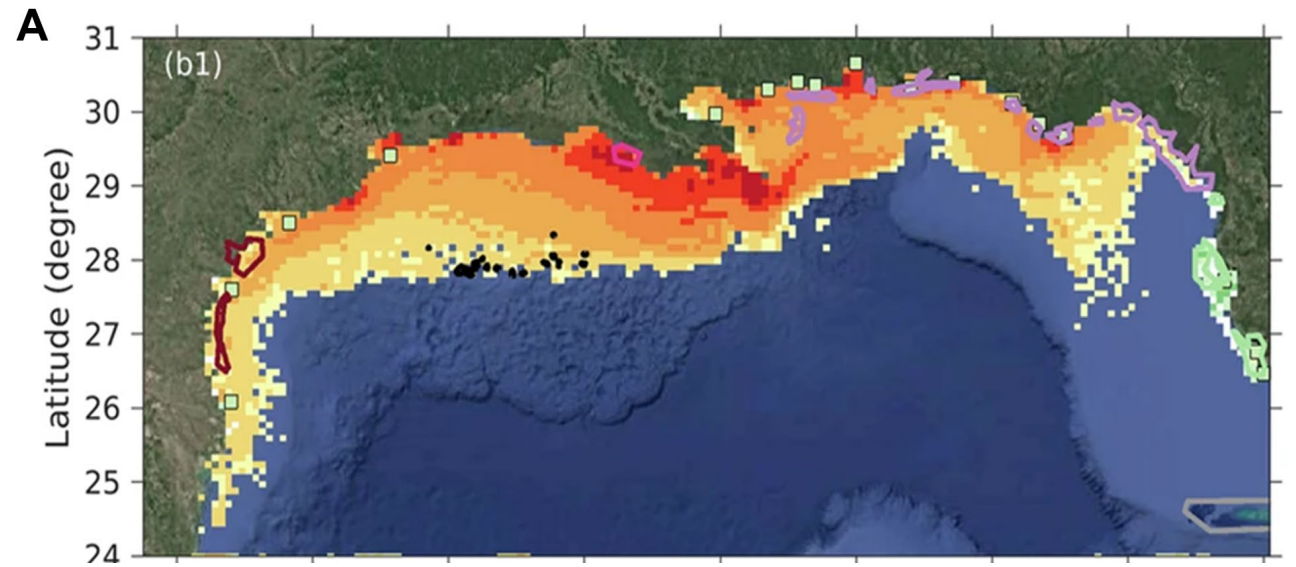
¹Dept. of Ecology and Conservation Biology

²Geochemical and Environmental Research Group

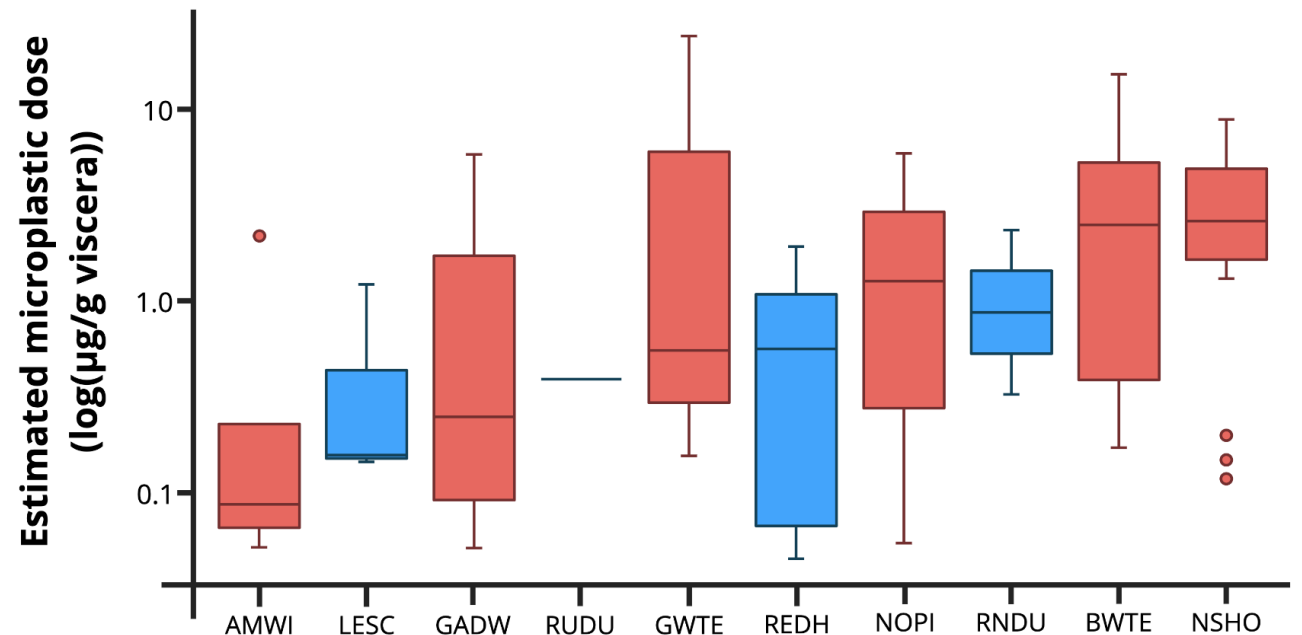
Texas A&M University

Plastic waste is growing issue and wildlife are ingesting microplastics

- Plastics are very resistant to degradation.
- Texas and Louisiana are hot spots for microplastics.
- Our prior work from Texas and Louisiana shows that at least 30% of ducks are ingesting microplastics at any one point in time.

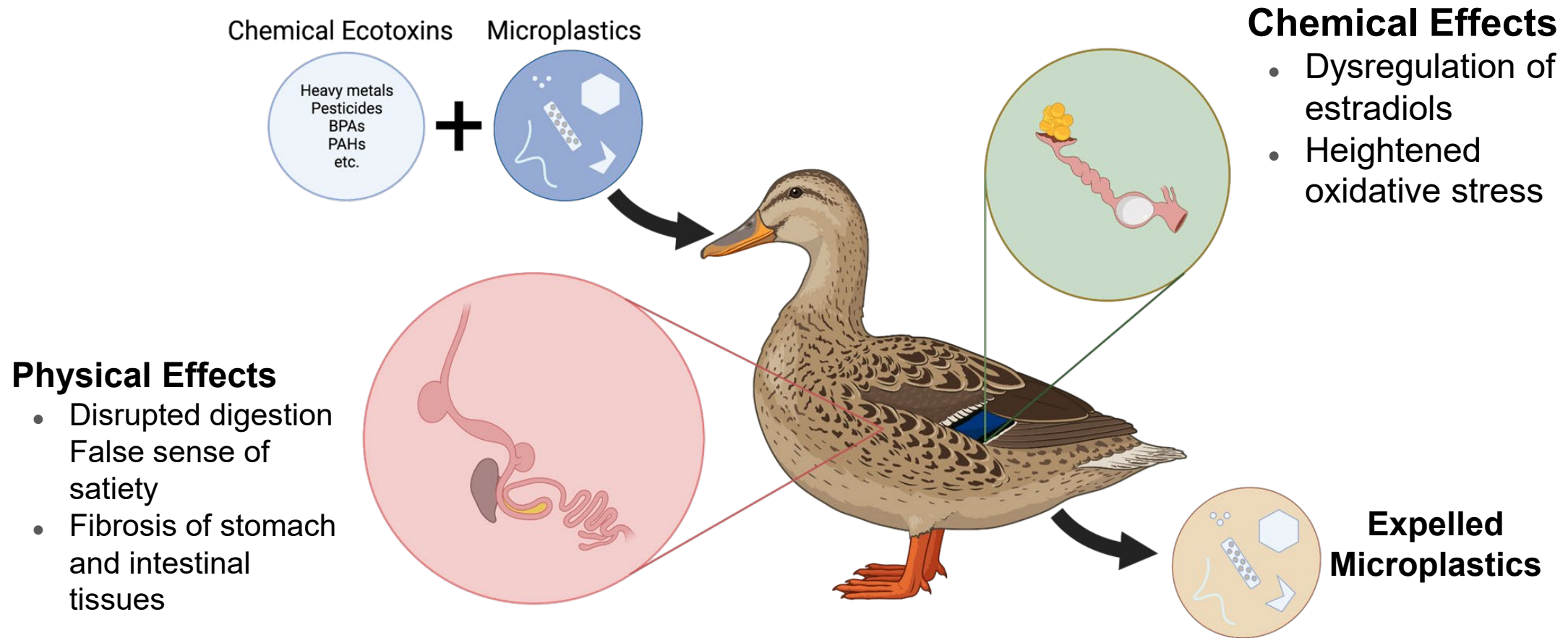


From: Zhou, et al. 2025. npj Emerging Contaminants



Funded by the Gulf of America Alliance and Louisiana Sea Grant

Microplastics can harm birds



Pharmaceutical and Personal Care Products (PPCPs) are present in Galveston Bay, “stick” to plastics and can harm wildlife.



Microplastics and associated chemicals are emerging contaminants of concern that may be stressors for wildlife and those that consume them in Galveston Bay.

Project goals:

1. Quantify PPCP and microplastic concentrations in duck tissues and their habitats.
 - Extend the prior PPCP time series
2. Assess relationships between environmental contaminant loads and tissue loads.

Methods

1. Focus on hunted ducks (teal and mottled ducks).
2. Collect harvested duck donations from hunters across two years.
3. Collect water and sediment samples from hunting locations and locations that were sampled previously.
4. Analyze collected and previously archived samples for microplastics and PPCPs.



Expected outcomes:

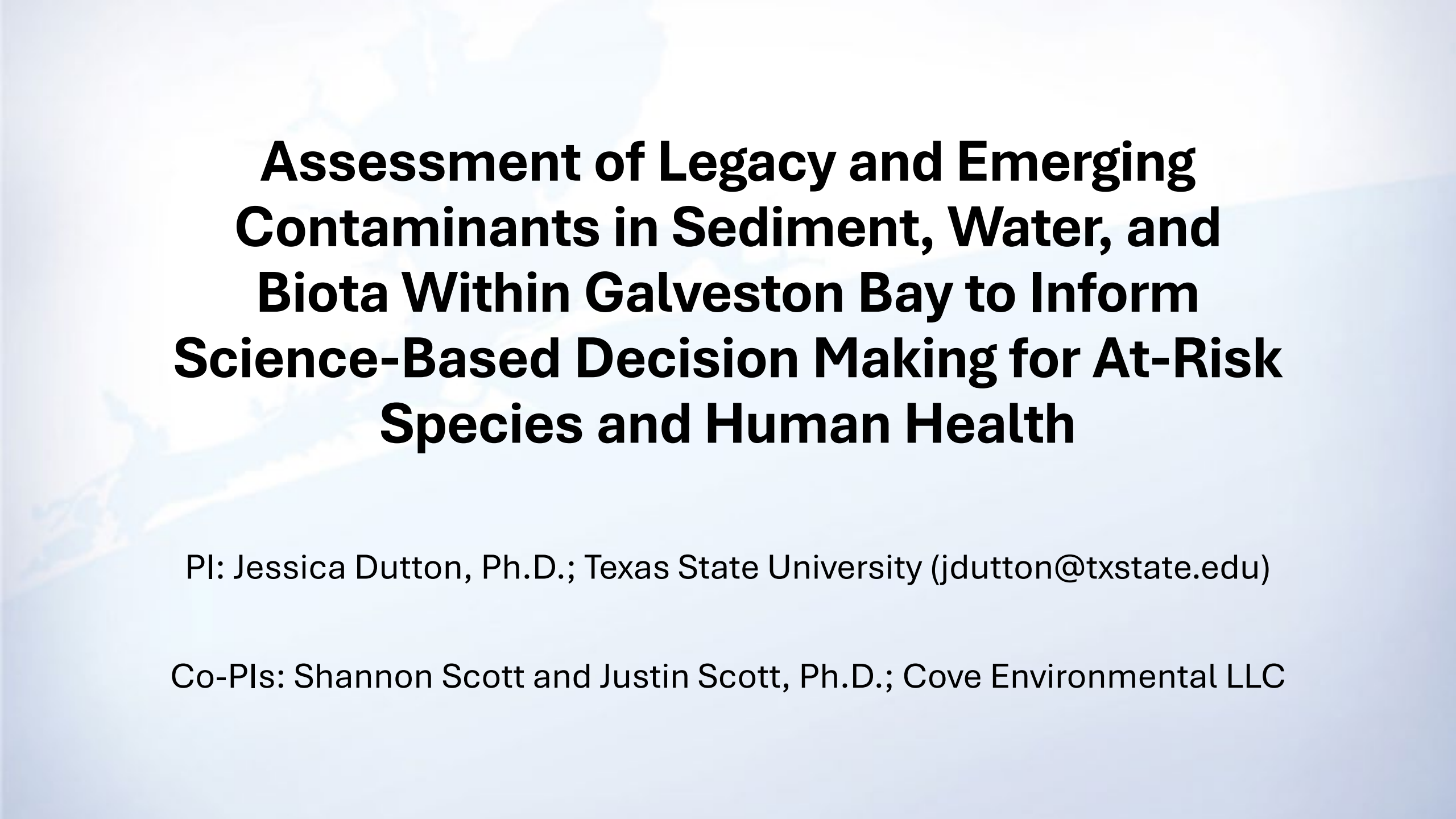
1. Establish a public dataset of PPCP and microplastic concentrations in Galveston Bay waterfowl, water, and sediment.
2. Enhance our understanding of potential risk for wildlife and those that consume them.
3. Make recommendations for conservation.

Urgency:

- *Mottled ducks are declining.*
- *Seamlessly build on prior GBEP funding assessing PPCPs in Galveston Bay.*
- *Archived waterfowl tissues must be analyzed soon to prevent degradation of some compounds.*

A large flock of ducks is captured in flight over a body of water. The ducks are in various stages of flight, with wings spread, creating a sense of movement. The background is a soft-focus landscape with water and distant trees. A semi-transparent grey box is centered over the image, containing the text "Questions?".

Questions?



Assessment of Legacy and Emerging Contaminants in Sediment, Water, and Biota Within Galveston Bay to Inform Science-Based Decision Making for At-Risk Species and Human Health

PI: Jessica Dutton, Ph.D.; Texas State University (jdutton@txstate.edu)

Co-PIs: Shannon Scott and Justin Scott, Ph.D.; Cove Environmental LLC

Legacy and Emerging Contaminants

- Legacy
 - trace elements (e.g., As, Cd, Cr, Hg, Pb)
 - polycyclic aromatic hydrocarbons (PAHs)
 - polychlorinated biphenyls (PCBs)
 - dioxins
 - nutrients
- Emerging
 - micro-/nano-plastics

Water

Sediment

Biota

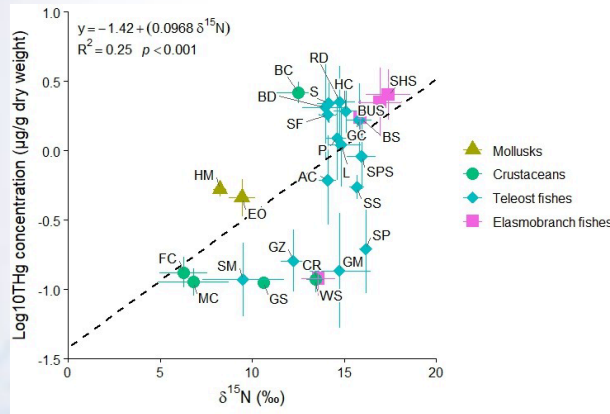
Spatial variability throughout Galveston Bay



Field Concentrations

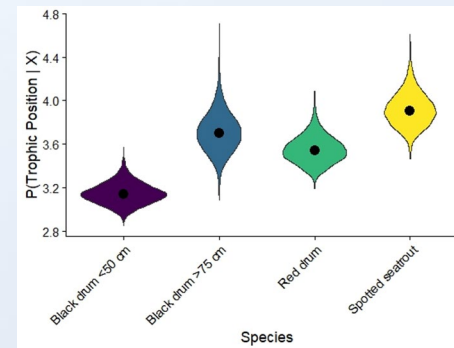
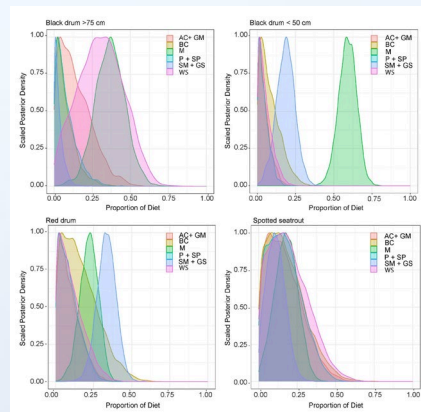
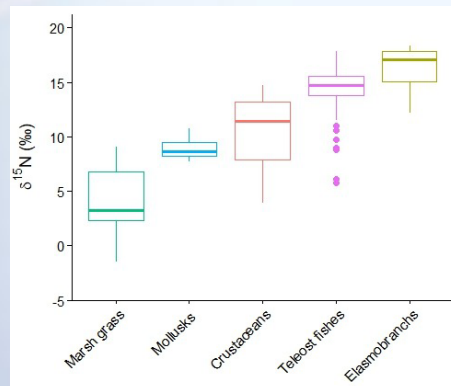
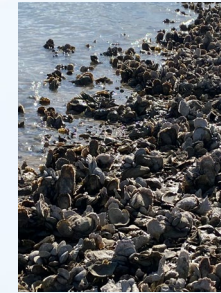
Sediment

Water



Biota

- marsh grass
- grass shrimp
- worms
- shrimp
- oysters
- crabs
- teleost fishes



Stable Isotopes

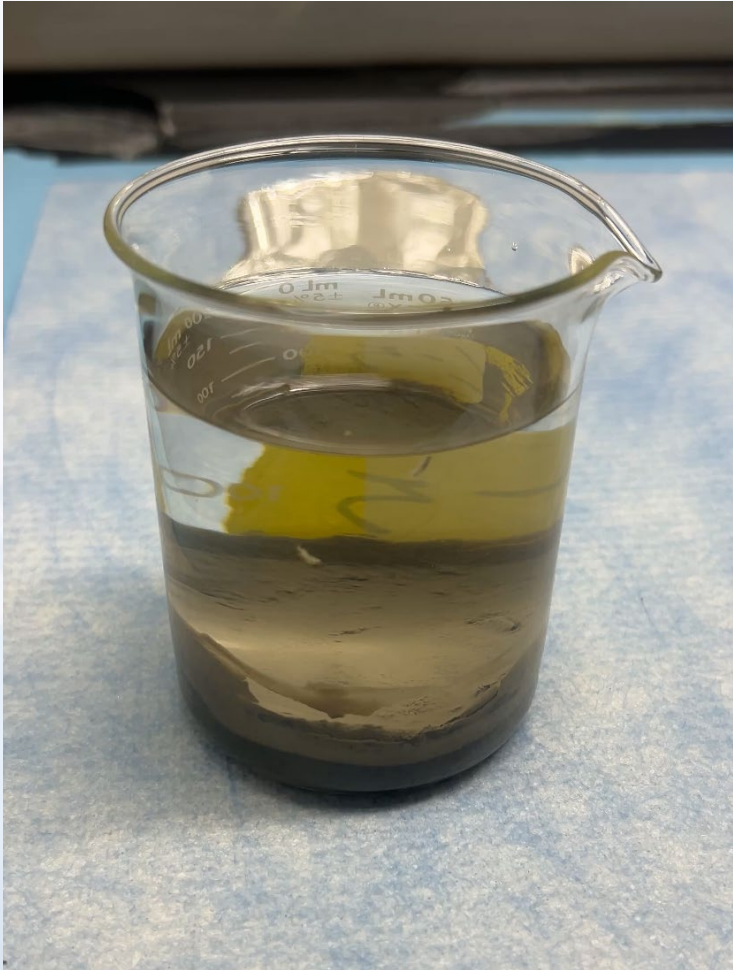
- $\delta^{13}C$
- $\delta^{15}N$

Comparison to Quality Guidelines and Threshold Levels

- Water and sediment quality guidelines for the protection of estuarine/marine organisms
- Biota sediment accumulation factors (BSAFs)
- Adverse biological effects threshold levels
- Advisory levels for human health



Aqueous and Sediment Toxicity Tests



- Acute and chronic toxicity tests
- Lethal and sublethal endpoints
- Field collected water and sediment
 - contaminant mixture
- Benthic amphipods, worms, and grass shrimp
- Follow standardized EPA testing methods

Integrated Legacy and Emerging Contaminant Assessment Framework for the Galveston Bay System

- The study will result in geospatial analyses, supporting analytical data, recommendations for future monitoring and restoration, and a comprehensive technical report for the Galveston Bay Estuary Program
- Results can be used for watershed management decisions by establishing a scientifically defensible baseline that can be refined and expanded through future collaborative investigations
- Fish and invertebrate species examined in this study are an important food source for SGCN species. Elevated levels of contaminants in these investigated species may indicate that species with greater conservation and management needs are at risk of deleterious health effects.
- Determine if people who consume fish and shellfish from the bay are at elevated risk of exposure to certain contaminants, and if so, the findings can be discussed with the Texas Department of State Health Services (TDSHS) who oversee advisories