GALVESTON BAY
DOLPHIN RESEARCH PROGRAM

Kristi Fazioli
Senior Research Associate
Environmental Institute of Houston (UHCL-Clear Lake)

Activities conducted under NMFS Scientific Research Permit #23203

Importance of Long-Term Monitoring
December 2022

GDRP Mission

Our mission is to better understand the bottlenose dolphins that live in the highly industrialized Galveston Bay estuary. We study the ecology, behavior, and health of this population and raise public awareness about dolphins.

GDRP: Why Study Dolphins?

Conservation Tool

- Bioindicators
  - long lived, top predators, residency
  - **Ideal sentinels for Bays and Estuaries**

- Data for ecosystem modeling

- Federally managed under the MMPA
  - Stocks are to be maintained as a *"significant functioning element of the ecosystem"*

- Flagship species

GDRP: Why Study GB Dolphins?

HIGH RISK ENVIRONMENT

- Ship and Barge Traffic
- Commercial & recreational fisheries
- Dredging and Construction
- Contaminants
- Fluctuating salinity
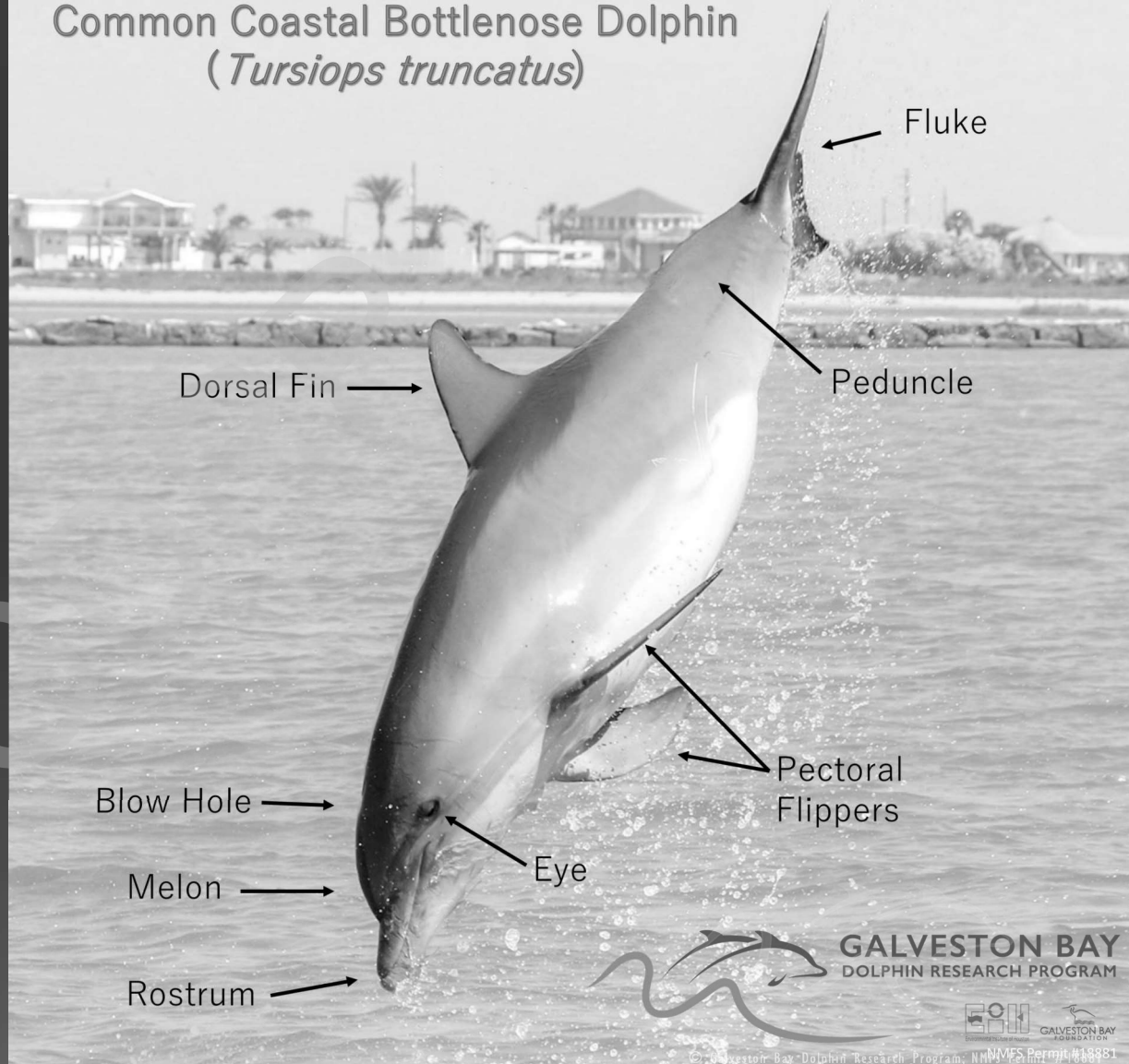
GB Dolphins 101

Weight: 300 – 1400 lbs

Length: 6 – 12.5 feet

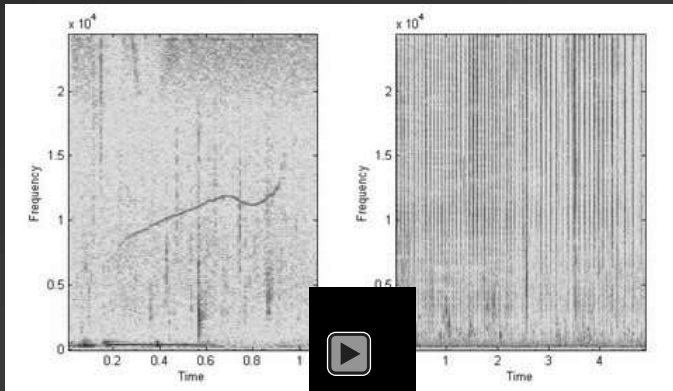Lifespan: 40-50+ years

Diet: invertebrates, squid, fish

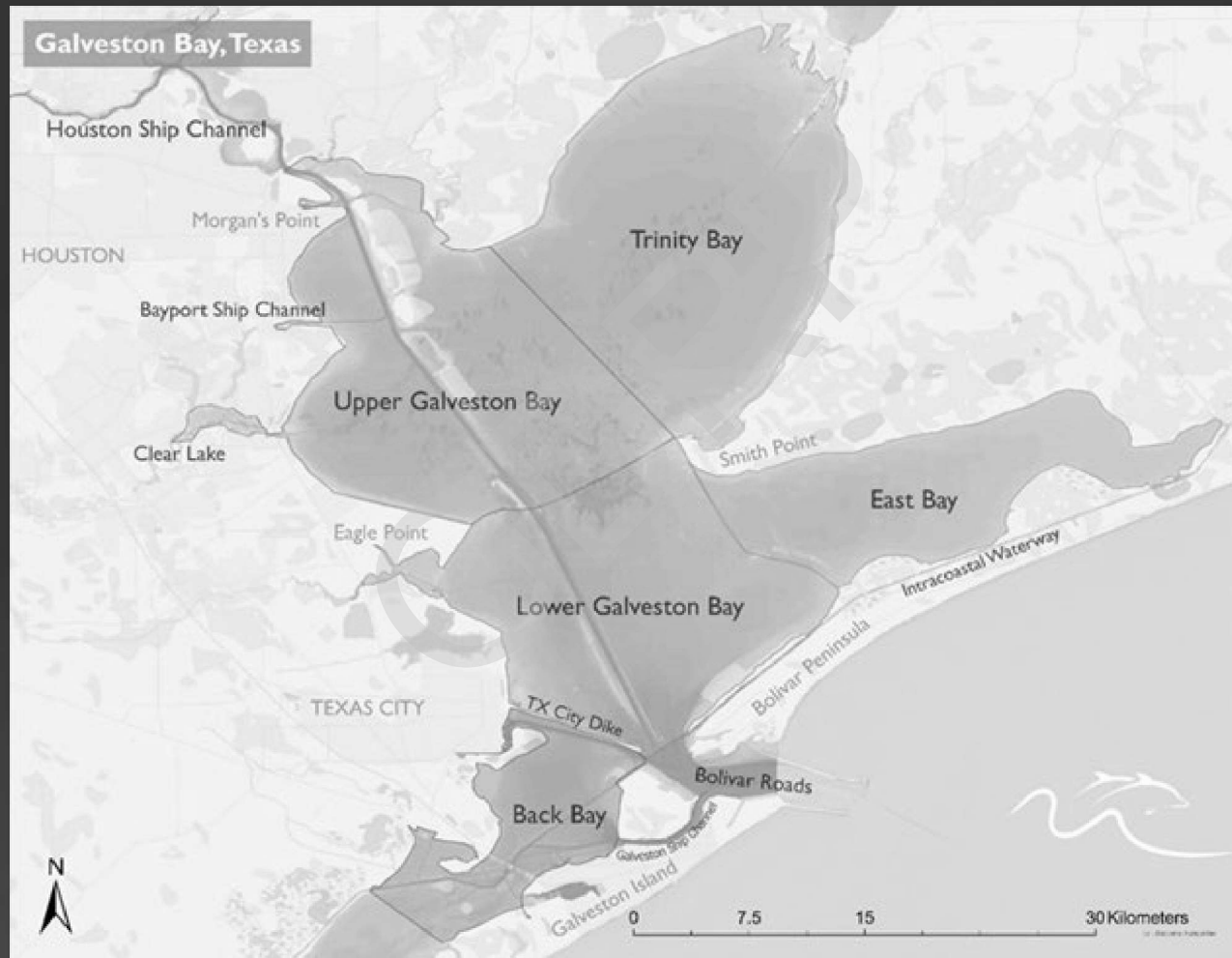Common Coastal Bottlenose Dolphin
(*Tursiops truncatus*)

Fluke

Peduncle

Dorsal Fin

Pectoral
Flippers

Blow Hole

Eye

Melon

Rostrum

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GALVESTON BAY
FOUNDATION

NMFS Permit #18881

Dolphin Society

- Fission – Fusion
- Nursery Groups
- Male Alliances
- Sound
- Site Fidelity

Credit: Sarasota Dolphin Research Program

Study Area

Galveston Bay, Texas

Houston Ship Channel · Morgan's Point · HOUSTON · Bayport Ship Channel · Trinity Bay · Upper Galveston Bay · Clear Lake · Smith Point · East Bay · Eagle Point · Lower Galveston Bay · Intracoastal Waterway · Bolivar Peninsula · TEXAS CITY · TX City Dike · Back Bay · Bolivar Roads · Galveston Island · Galveston Ship Channel

0   7.5   15   30 Kilometers

N

Research Methods: Visual Surveys

Research Methods: Visual Surveys and Photo-ID

What can we learn?

- Distribution
- Abundance
- Site Fidelity
- Survival & Fecundity
- Behavioral Activities
- Social Structure
- Foraging Strategies
- Human Interactions
- Visual Health Indicators

Research Methods: Biopsy Sampling

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Environmental Institute of Houston   GALVESTON BAY FOUNDATION

Galveston Bay Dolphin Research and Conservation Program

NMFS Permit #18881

DOLPHIN RESEARCH

University of Houston Clear Lake

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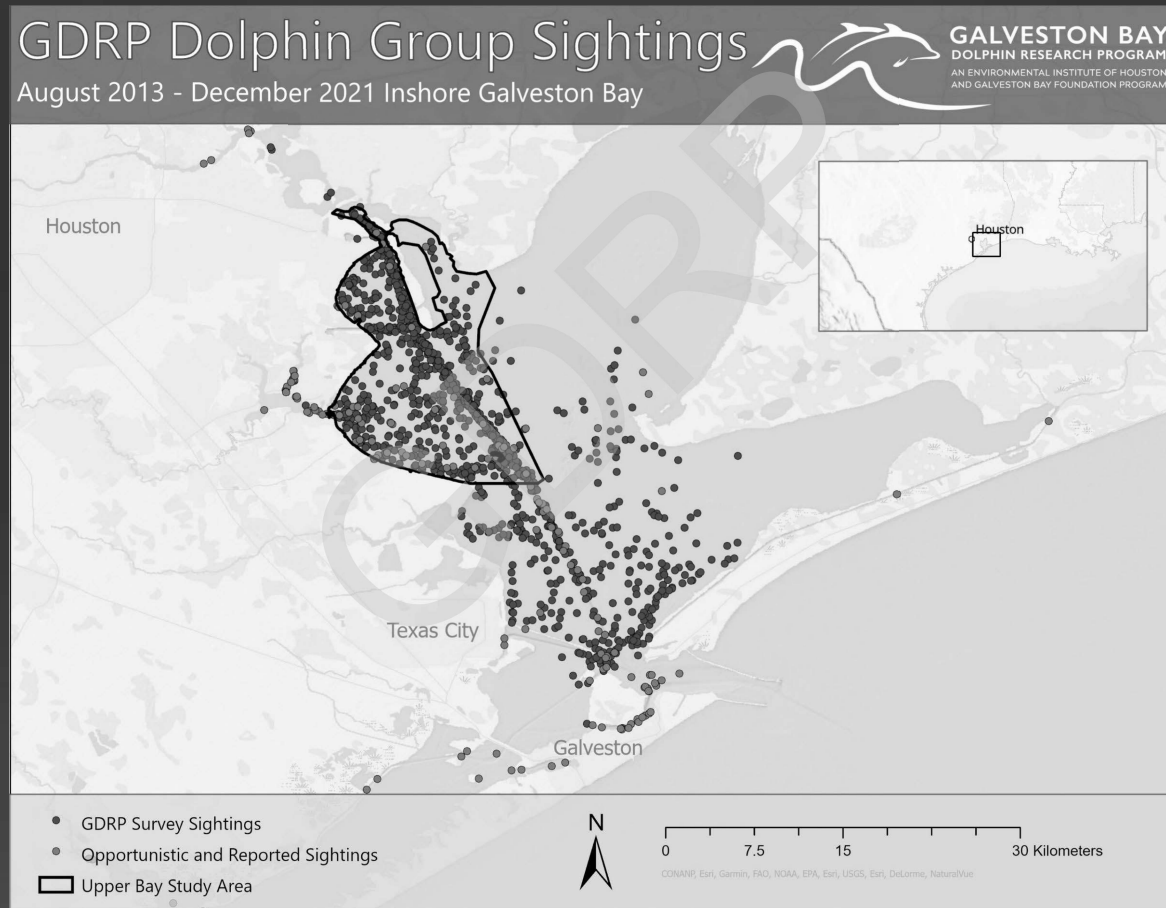# Research Methods: Biopsy Sampling

What can we learn?

- Genetics – Population Structure

- Sex

- Stable Isotopes – Foraging

- Persistent Organic Pollutants (POPs) – PCB's, Dioxins

- Heavy Metals - Mercury

- Toxicology and Gene Expression

- Hormones – Pregnancy and Stress

- Epigenetics – New!

>50 samples in hand or analyzed

What Have We learned?

GDRP Dolphin Group Sightings
August 2013 - December 2021 Inshore Galveston Bay

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Houston

Houston

Texas City

Galveston

- GDRP Survey Sightings
- Opportunistic and Reported Sightings
- Upper Bay Study Area

N

0   7.5   15   30 Kilometers

CONANP, Esri, Garmin, FAO, NOAA, EPA, Esri, USGS, Esri, DeLorme, NaturalVue

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Salinity and Water Temperature as Predictors of Bottlenose Dolphin (*Tursiops truncatus*) Encounter Rates in Upper Galveston Bay, Texas

Vanessa J. Mintzer[1,2,3*†] and Kristi L. Fazioli[4†]

[1] Galveston Bay Foundation, Kemah, TX, United States, [2] Fisheries and Aquatic Sciences Program, School of Forest, Fisheries, and Geomatics Sciences, University of Florida, Gainesville, FL, United States, [3] Wildlife Research Partnerships, Asheville, NC, United States, [4] Environmental Institute of Houston, University of Houston – Clear Lake, Houston, TX, United States

Bottlenose dolphins (*Tursiops truncatus*) that inhabit urban estuaries like Galveston Bay, Texas, are exposed to cumulative stressors including pollution, fisheries, shipping, freshwater inflows, and construction operations. With continuing development, it is imperative to understand the key environmental variables that make the Galveston Bay estuary suitable habitat for this protected species. The Galveston Bay Dolphin Research Program conducted monthly photo identification surveys of bottlenose dolphins in a previously understudied 186 km² area in upper Galveston Bay (UGB). To understand occurrence patterns in this region, we calculated monthly encounter rates of dolphins (dolphins/km) for four consecutive years (2016–2019). Using multiple linear regression models, we investigated the relationship between encounter rates, and water temperature and salinity. Monthly encounter rates ranged from 0.00 to 1.23 dolphins/km with an average of 0.34 dolphins/km (SE = 0.05). Over 80% of the variance was explained by the predictor variables water temperature and salinity (R^2 =0.820). Water temperature had a positive linear effect on encounter rates at over 23.37°C (SE = 1.42). Accordingly, higher encounter rates occurred during months with warm temperatures (May–September) compared to cooler months (November–April), indicating a predictable yearly movement pattern. Moreover, salinity was a highly significant predictor variable, with encounter rates dropping linearly with decreases in salinity. Higher numbers of dolphins are found in UGB during summer, but an exodus of dolphins occurs with low salinity levels, regardless of the time of year and water temperature. These findings should be considered during infrastructure projects (i.e., flood gate system) that may alter dolphin habitat and prey availability.

Keywords: marine mammals, seasonal movement, freshwater influx, environmental factors, industrial estuary, low salinity, flooding events, Gulf of Mexico

INTRODUCTION

Bottlenose dolphins (*Tursiops truncatus*) are commonly found in bay, sound, and estuarine environments (Leatherwood and Reeves, 2012; Vollmer and Rosel, 2013; Phillips and Rosel, 2014; Wells and Scott, 2018). These dynamic water bodies, where freshwater mixes with seawater, are among the Earth's most biologically productive systems (Kennish, 2002).

Short-term Effects of Hurricane Harvey on Bottlenose Dolphins (*Tursiops truncatus*) in Upper Galveston Bay, TX

Kristi Fazioli[1] · Vanessa Mintzer[2,3,4]

Abstract
From August 26 to 30, 2017, Hurricane Harvey inundated the Galveston Bay estuary in Texas with record-breaking rainfall. As a result, salinity levels in the bay declined rapidly from an average of 14 to < 1 ppt, altering aquatic habitat in the weeks following the storm. Long-term photo-identification monitoring efforts provided an opportunity to undertake a case study describing the effects of this extreme flood event on the bottlenose dolphins (*Tursiops truncatus*) inhabiting upper Galveston Bay. We compared dolphin encounter rates for the months preceding and following Harvey to a year with no hurricane, examined shifts in habitat-based encounter rates, and evaluated the prevalence and extent of dolphin skin lesions, typically presenting as ulcerated or degraded epidermis. Encounter rates decreased from 1.09 dolphins per linear kilometer (d/km) in August 2017 before Harvey to 0.29 d/km in September 2017 (compared to 0.85 d/km in August 2016 and 0.91 d/km in September 2016). While most dolphins evacuated the upper portion of the bay, many remaining dolphins shifted habitats from shallow open bay to deep channels where salinity increased with depth. Of the dolphins that were sighted in the upper bay during the low salinity event, 96% exhibited at least one lesion and 65% of those dolphins had lesions of medium or high extent (significant increases compared to pre-Harvey levels). After salinity returned to levels above 11 ppt (approximately 8 weeks after Harvey), encounter rates increased and extent of lesions decreased, but prevalence of lesions remained elevated for at least 4 months after Harvey.

Keywords: Freshwater influx · Salinity · Encounter rates · Skin lesions · Bottlenose dolphin · Marine Mammal

Introduction

Hurricane Harvey made initial landfall as a category four hurricane on the central Texas coastline, near Rockport, on August 25, 2017. In the week following landfall, the storm slowly moved over the Houston-Galveston region and into Louisiana. It dumped historic record-breaking rainfalls of up to 1.5 m and caused massive inland flooding, much of which drained into the shallow, brackish estuary of Galveston Bay (Blake and Zelinsky 2018). Freshwater inflow to the bay from this single event was estimated at 11.1×10^9 m³, nearly the entire mean annual inflow and equivalent to approximately 3 times the bay's total volume (Du et al. 2019; ... ... chler 2018). As a result, the estuary was inundated ... water, sediment, debris, and toxic pollutants (Du ... Ratnapradipa et al. 2018; ISHN 2017). Du et al. ... calculated that the entirety of Galveston Bay was ... and remained fresh (< 2 ppt) for 4 days. Salinity ... ... to pre-storm levels averaged 2 months, with the ...

Site fidelity of common bottlenose dolphins (*Tursiops truncatus*) in a highly industrialized area of the Galveston Bay estuary

Vanessa J. Mintzer[1,2,3] | Alyssa Quackenbush[1] | Kristi L. Fazioli[4]

[1] Galveston Bay Foundation, Kemah, Texas
[2] Fisheries and Aquatic Sciences Program, School of Forest, Fisheries and Geomatics Sciences, University of Florida, Gainesville, Florida
[3] Wildlife Research Partnerships, Asheville, North Carolina
[4] Environmental Institute of Houston, University of Houston Clear Lake, Houston, Texas

Correspondence
Vanessa J. Mintzer, Galveston Bay Foundation, 1725 Highway 146, Kemah, TX 77565.
Email: vmintzer@galvbay.org

Abstract
Coastal common bottlenose dolphins (*Tursiops truncatus*) that inhabit urban estuaries are exposed to a myriad of anthropogenic threats. To manage and conserve these populations, it is imperative to understand their habitat use and residency patterns. In this study, we evaluated the site fidelity of common bottlenose dolphins in upper Galveston Bay (UGB), a heavily industrialized area of the Galveston Bay estuary. We aimed to identify groups within the population with varying affinity to UGB and to determine if there are resident dolphins in UGB. The Galveston Bay Dolphin Research Program conducted monthly photo-identification surveys in UGB between January 2016 and December 2019. We identified 442 distinct dolphins within UGB and used their sighting histories to calculate occurrence, permanence, and periodicity. These site fidelity metrics were incorporated into a cluster analysis that revealed three ... Group 1 (n = 192, 43%) consisted of individuals ... ...hest site fidelity to UGB and were classified as ... or seasonal long-term residents. Group ... 32%) were transients and Group 3 (n = 109, ... short-term users of UGB. This study identified ... ...phins in UGB, and we recommend that this ... ...nitored closely, as they are particularly vulnera... ...rs in the upper estuary.

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Current Research Projects/Questions

▶ **Distribution and Habitat Preferences**
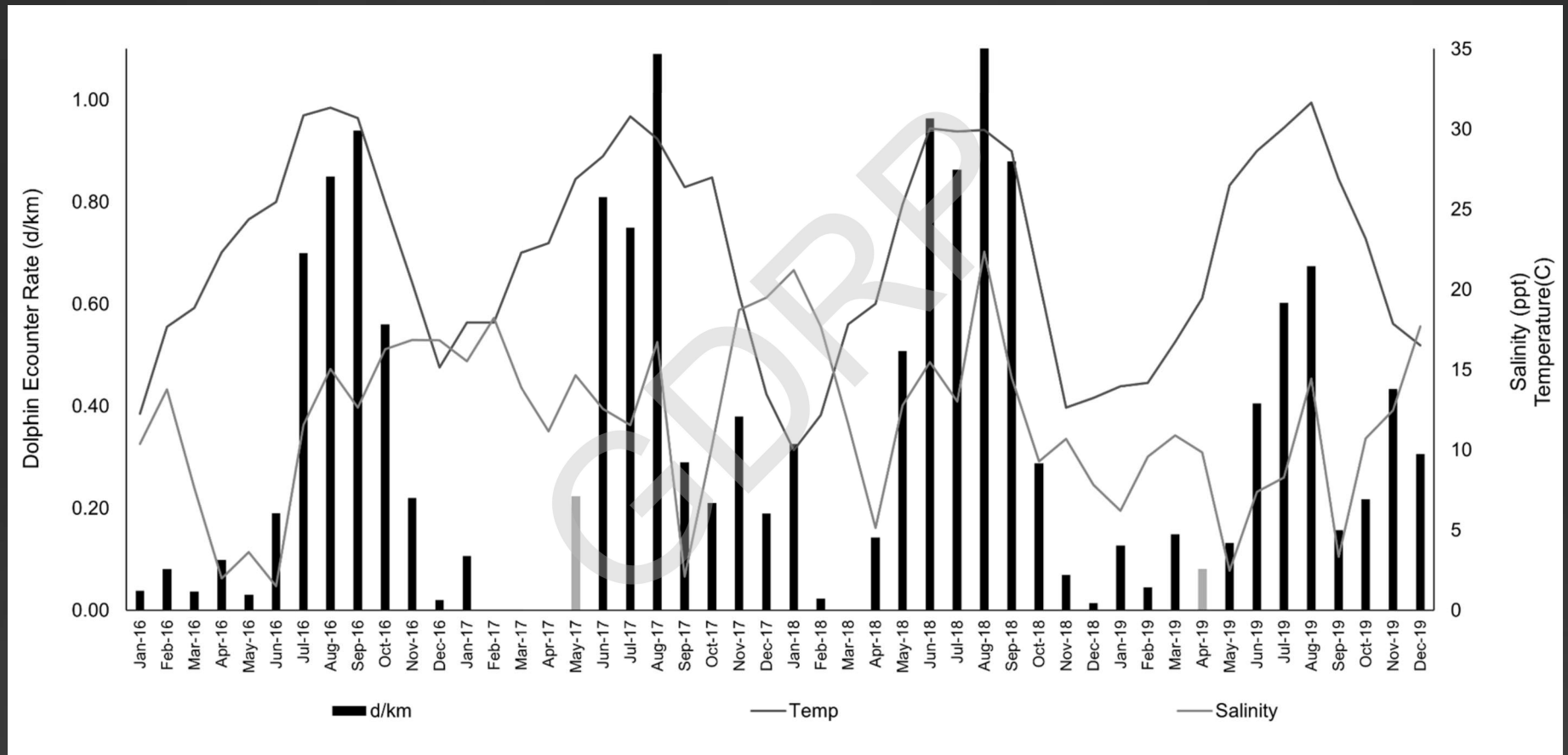
▶ **Site Fidelity-Residency**

▶ **Freshwater Exposure**

▶ **Contaminants**

▶ **Genetics and Stock Delineation**

▶ **Foraging Ecology**

Temperature & Salinity

Upper Galveston Bay encounter rates (# dolphins / km)

Hurricane Harvey

Low Salinity Event (LSE)

Fazioli, K. & Mintzer, V. (2020). Short-term Effects of Hurricane Harvey on Bottlenose Dolphins (*Tursiops truncatus*) in Upper Galveston Bay, TX. *Estuaries and Coasts* 43: 1013-1031.
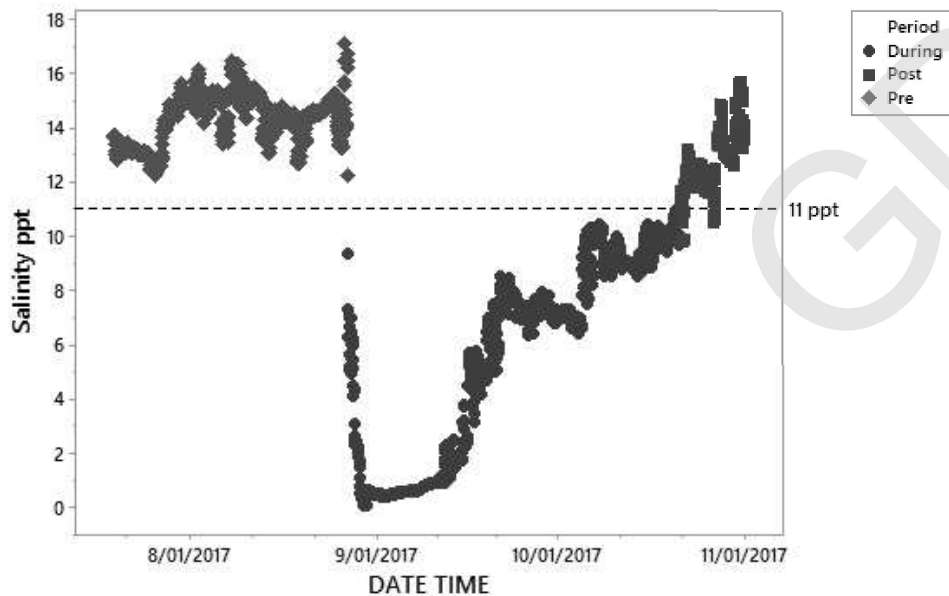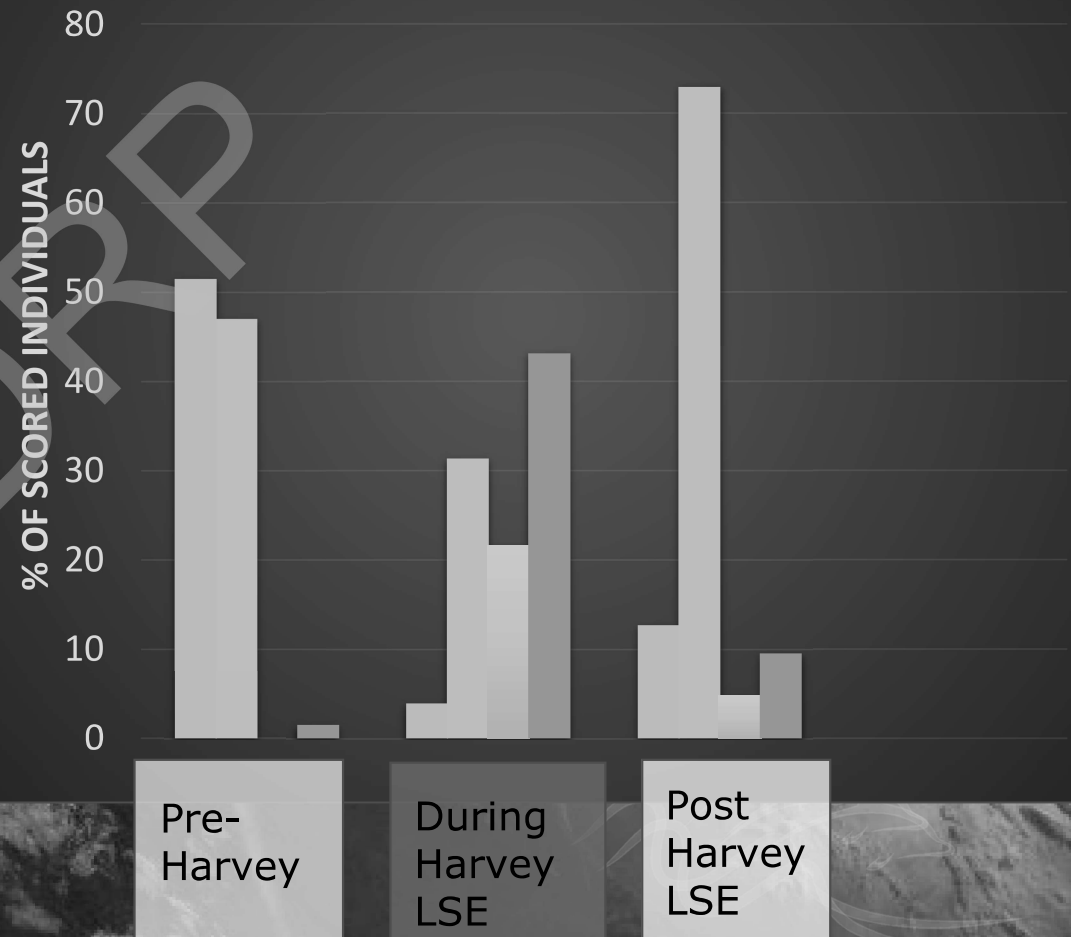
Remaining Questions

- Areas of refuge
- Long-term health effects
- Potential effects of coastal infrastructure

Lesion extent and healing

- Age Class
- Immunity
- Range Patterns
- Access to higher salinity

Expert Workshop - 2023

Tissue Sample Analyses

- Genetics – need more samples

- Sex – sampling bias
  - Male = 41
  - Female = 9

- Contaminants "Persistent Organochlorine Pollutants (POPs)"
  - PCBs, pesticides, PBDE, DDT, Dioxins

	Female (N=15) ng/g	Male (N=40) ng/g	Total (N=55) ng/g
Lipid (%)			
Geom Mean (95% CI)	33.71 (27.51, 41.31)	25.96 (23.13, 29.14)	27.88 (25.15, 30.90)
Range	17.00 - 58.00	13.00 - 60.00	13.00 - 60.00
HCB			
Geom Mean (95% CI)	126.80 (68.12, 236.03)	232.76 (196.31, 275.99)	197.23 (159.34, 244.13)
Range	9.44 - 480.77	78.33 - 967.26	9.44 - 967.26
dieldrin			
Geom Mean (95% CI)	252.90 (133.55, 478.90)	538.67 (466.52, 621.97)	438.29 (354.07, 542.54)
Range	27.22 - 882.35	143.33 - 1895.83	27.22 - 1895.83
mirex			
Geom Mean (95% CI)	87.56 (59.46, 128.95)	239.80 (193.00, 297.94)	182.19 (146.03, 227.30)
Range	19.74 - 344.83	50.00 - 1200.00	19.74 - 1200.00
∑CHLDs			
Geom Mean (95% CI)	1548.82 (797.02, 3009.77)	5315.07 (4639.19, 6089.41)	3797.18 (2970.17, 4854.47)
Range	127.78 - 7931.03	2310.34 - 14136.90	127.78 - 14136.90
∑DDTs			
Geom Mean (95% CI)	2632.66 (1338.90, 5176.56)	11499.05 (9778.79, 13521.93)	7692.08 (5850.79, 10112.84)
Range	233.33 - 14137.93	4090.91 - 54666.67	233.33 - 54666.67
∑HCHs			
Geom Mean (95% CI)	68.14 (31.40, 147.86)	199.17 (169.31, 234.30)	148.66 (114.23, 193.46)
Range	1.91 - 294.12	35.00 - 483.87	1.91 - 483.87
∑45PCBs			
Geom Mean (95% CI)	**23561.00 (14504.44, 38272.48)**	**70704.07 (61341.72, 81495.35)**	**52394.43 (42552.85, 64512.17)**
Range	**5714.29 - 100000.00**	**32075.47 - 206250.00**	**5714.29 - 206250.00**
∑PBDE			
Geom Mean (95% CI)	1303.38 (770.96, 2203.51)	4034.13 (3558.84, 4572.88)	2964.34 (2400.06, 3661.29)
Range	278.57 - 5517.24	1416.67 - 9434.52	278.57 - 9434.52

PCB Profile – unique markers

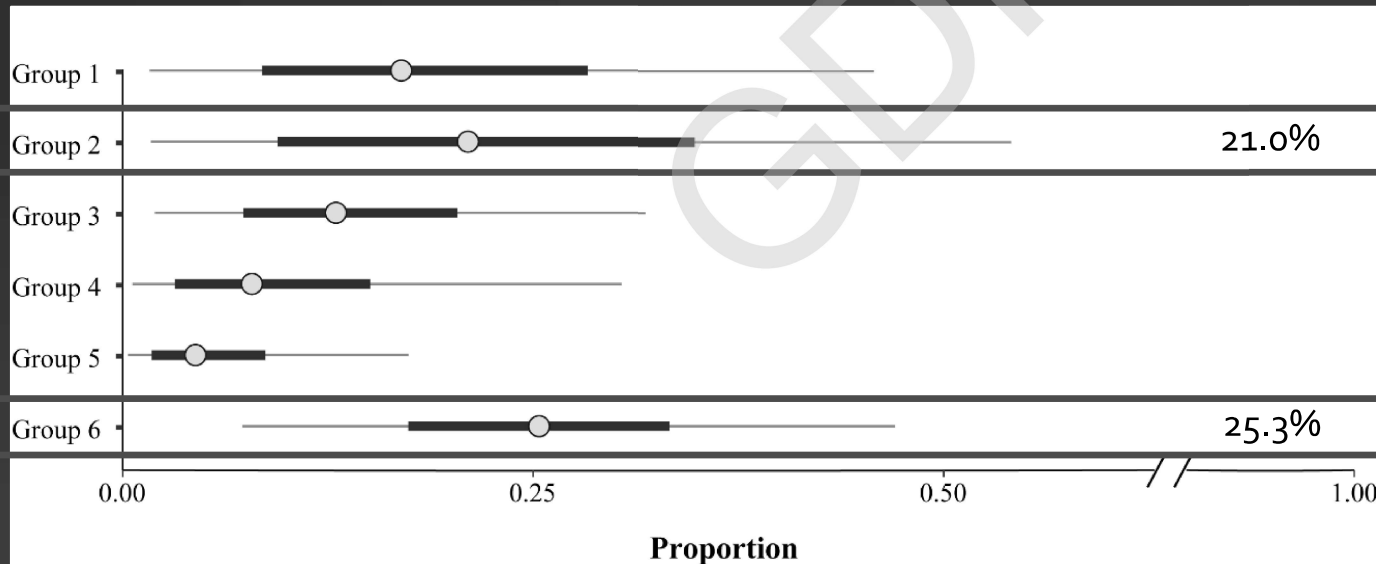PCB congener means - Galveston Bay Bottlenose Dolphins
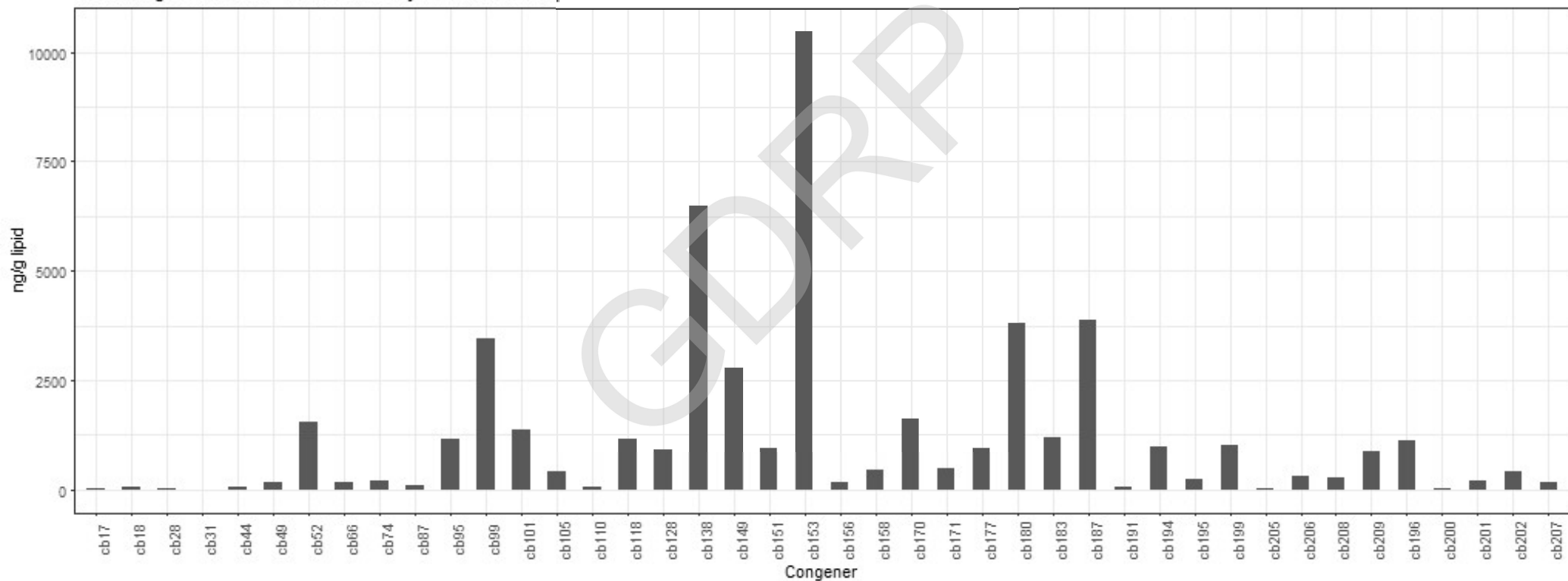
Foraging Ecology

Estimate likely proportions of different prey items consumed by dolphins

- Isotopic signatures are transferred to consumers from prey and are assimilated in tissue
  - Carbon and Nitrogen

Group 1

Group 2 — 21.0%

Group 3

Group 4

Group 5

Group 6 — 25.3%

0.00   0.25   0.50   1.00

Proportion

Atlantic Brief Squid
Hardhead Catfish
Striped Mullet

White Mullet

Site Fidelity in upper Galveston Bay

Evaluate the site fidelity of dolphins in upper Galveston Bay (UGB)

tendency for an animal to reuse and return to an area

Are there groups within the population with varying affinity to UGB?

Is there a resident population of dolphins within UGB?

Mintzer, V. J., Quackenbush, A., & Fazioli, K. L. (2022). Site fidelity of common bottlenose dolphins (*Tursiops truncatus*) in a highly industrialized area of the Galveston Bay estuary. *Marine Mammal Science*, 1– 18.
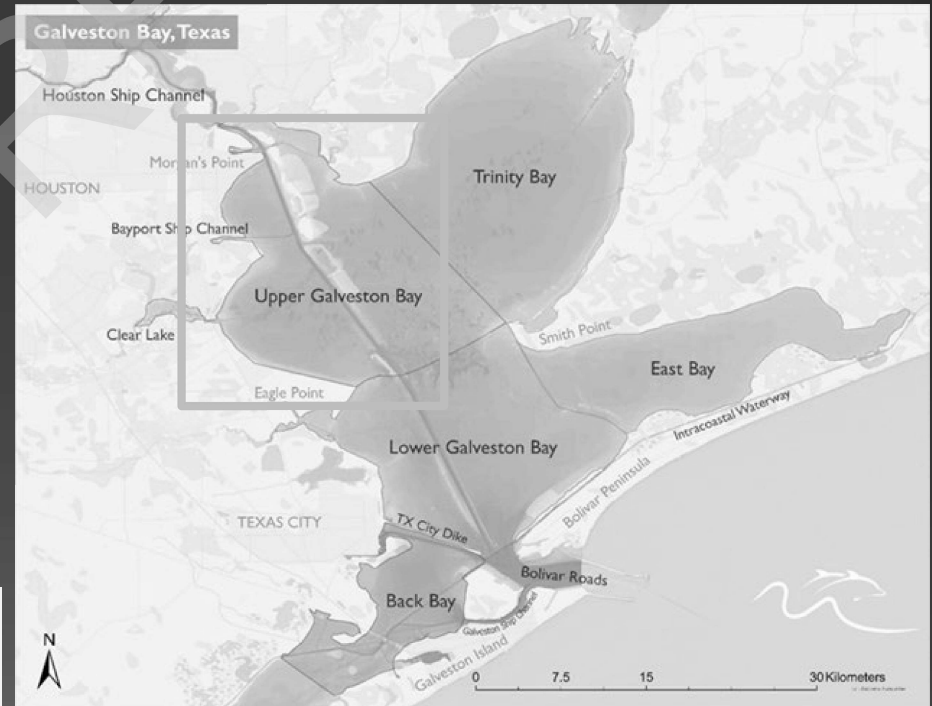
Site Fidelity in upper Galveston Bay
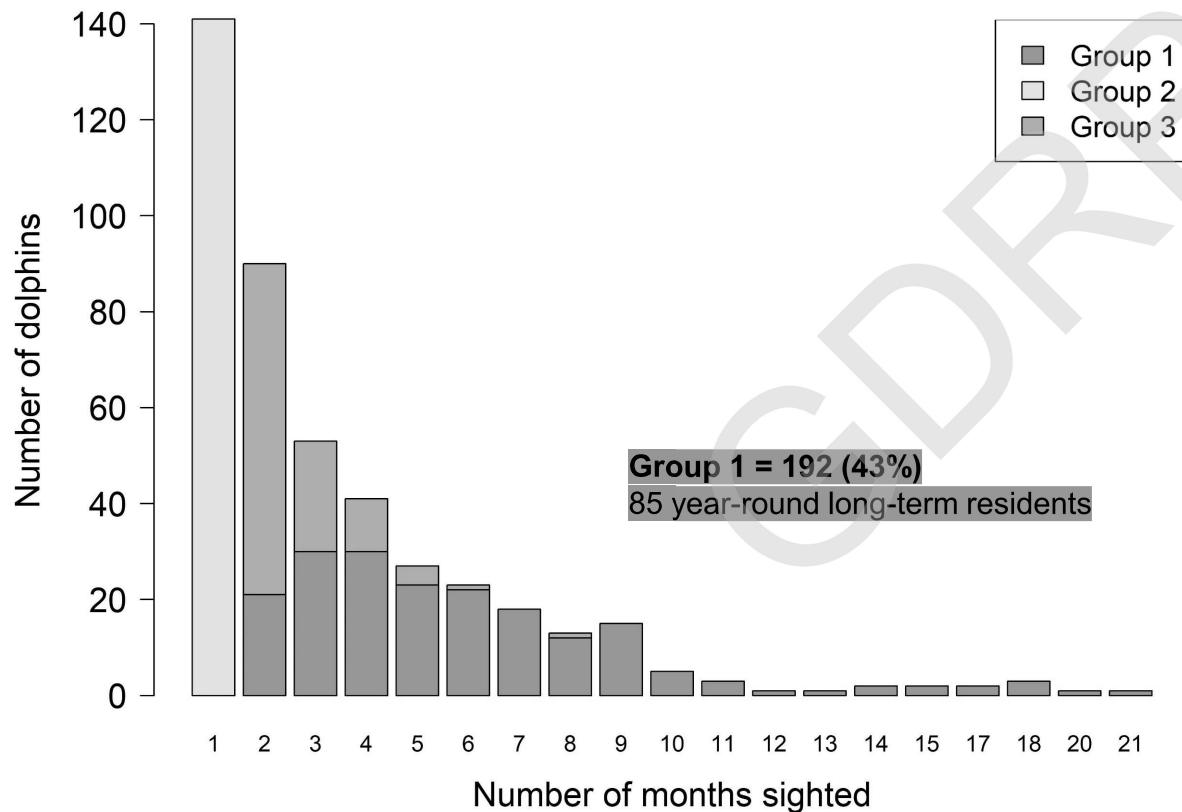
Group 1 (n=192, 43%)
Year-round residents
Seasonal recurring residents

Group 2 (n=141, 32%)
Transients/one-time visitors

Group 3 (n=109, 25%)
Short-term users

Mintzer et al. 2022

Site Fidelity in upper Galveston Bay

- About 200 dolphins use UGB as an important part of their range (underestimation)

- Transient dolphins are using UGB

- We need more data to determine # of residents in all of Galveston Bay (Group 3)

- Continuous exposure to multiple stressors in UGB...
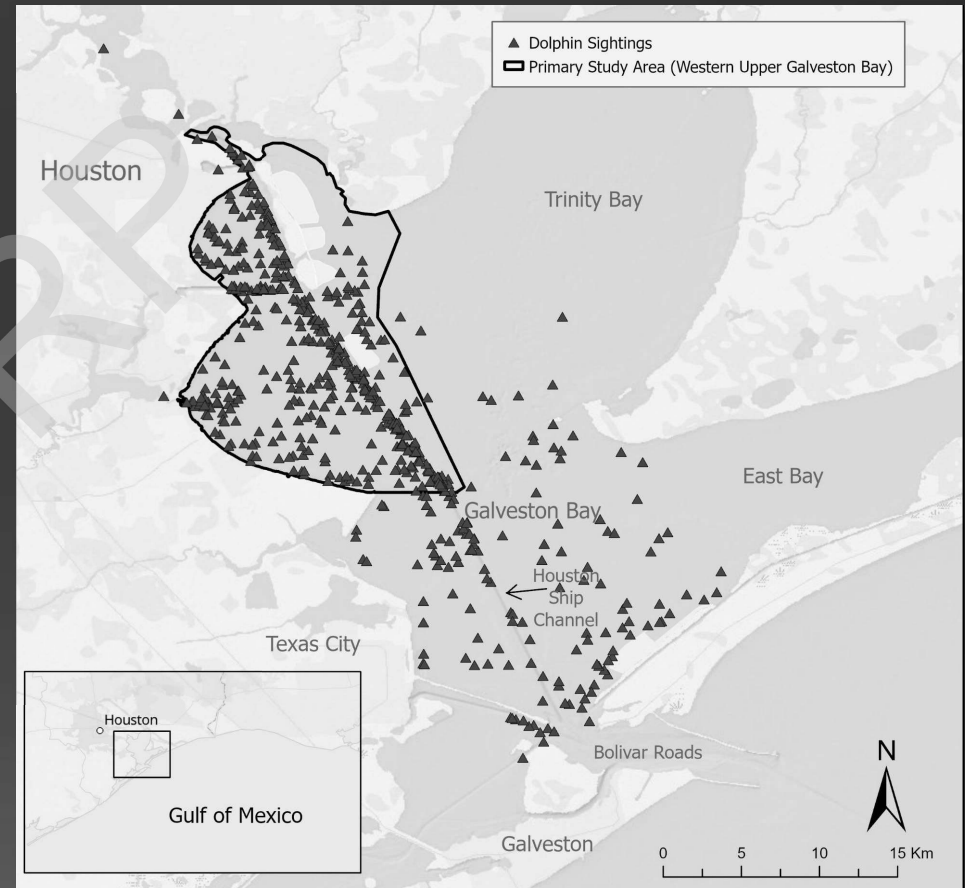
Mintzer et al. 2022

Multiple Stressors

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Dolphins potentially affected → NRDA?
- Numbers
- Important Habitats
- Life History Variables
- Comparable Metrics – before and after
- Follow-up Monitoring

Oil and Chemical Contamination

Coastal Storm Barrier

- High density use area for dolphins

- Important foraging habitat

- Potentially multiple populations – mixing zone

- 10 years construction

- Lasting environmental and secondary effects?

Galveston Bay

Gulf of Mexico
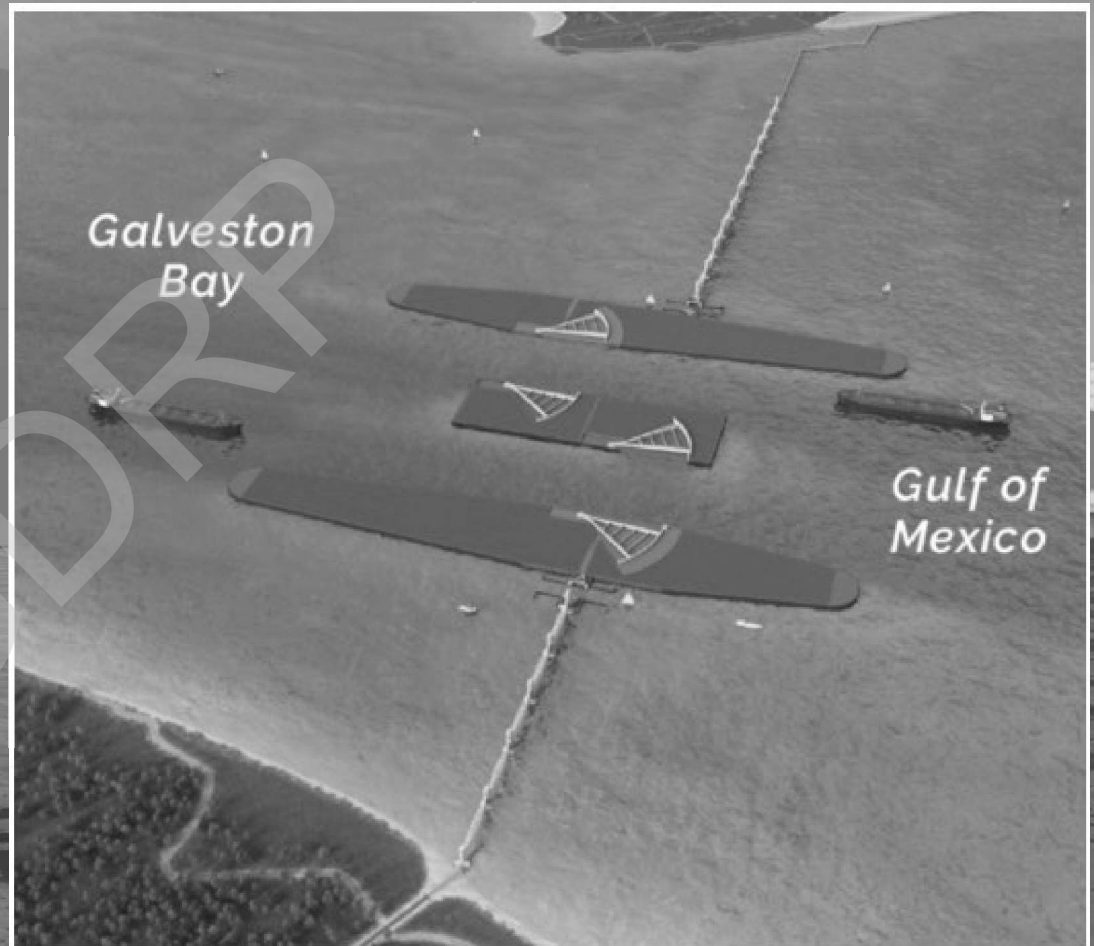
Conceptual drawing of proposed gate structure across Bolivar Pass

Marine Mammal Protection Act of 1972
http://www.nmfs.noaa.gov/pr/dontfeedorharass.htm

...people may not harass, feed, hunt, capture, collect, or kill any marine mammal or part of a marine mammal without a permit

NMFS Scientific Research Permit #23203

Dolphin Safe Fishing Tips
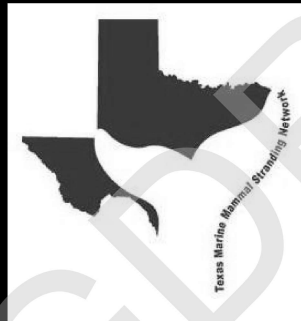
Help Protect Wild Dolphins While Fishing

Dolphin Safe Viewing Guide

Help Protect Wild Dolphins While Boating

Boaters and Beachgoers....
Call the TMMSN for ALL sick, injured or dead marine mammals

Texas Marine Mammal Stranding Network

http://dolphinrescue.org

FOR STRANDING EMERGENCIES CALL
1-800-9-MAMMAL

Texas Marine Mammal Stranding Network

Release Catch Quietly Away From Dolphins
· When and where it is possible to do so without violating any state or federal fishing laws.

Check Gear and Terminal Tackle
· Inspect your gear often to avoid unwanted line breaks

Use Circle and Corrodible Hooks
· Circle hooks may reduce injuries to fish, dolphins, and sea turtles.
· Corrodible hooks (any hook other than stainless steel) eventually dissolve.

Stay at Least 50 Yard Away
· Maintaining a safe distance helps keep dolphins wild.

Recycle Fishing Line
· Place all broken or used fishing line in a monofilament fishing line recycling bin.
· If no recycling bins are available, cut line into pieces and place in a lidded trash can.

Stash Your Trash
· Littering is illegal and can be harmful to wildlife.

- Do not chase, encircle or entrap dolphins with your vessel
- Do not intentionally direct your vessel to encourage bow-riding
- Avoid abrupt movements or loud noises
- Give more space to moms with calves (avoid separating them!)
- Slowly leave the area if dolphins show signs of disturbance

NEVER TOUCH, SWIM WITH OR FEED WILD DOLPHINS!

Report feeding or harassment of wild dolphins: NOAA Fisheries Office of Law Enforcement 1-800-853-1964
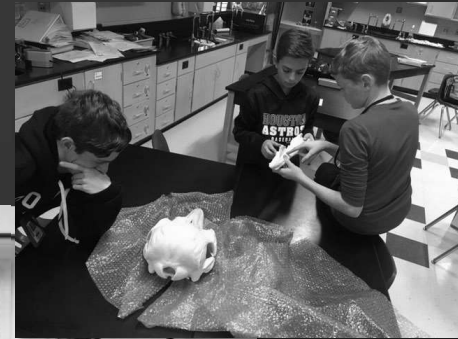Report an injured or entangled dolphin: Texas Marine Mammal Stranding Network 1-800-9-MAMMAL

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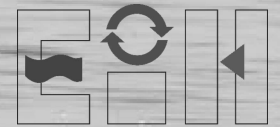
Please Share!

THANK YOU!

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