Hurricane Harvey Research Symposium

August 23, 2018

Port Aransas Civic Center, Port Aransas, Texas

Welcome!

The University of Texas Marine Science Institute, Mission-Aransas National Estuarine Research Reserve, and Texas Sea Grant are proud to host the Hurricane Harvey Research Symposium, almost one year following landfall. We have a great program of talks and posters this year from presenters all around the state of Texas.

Restrooms are located in the foyer. Reusable water and coffee cups are available. Please do not throw them away, as we have limited quantities and no paper cups available. The symposium has longer than normal breaks so that you may enjoy the poster session. Lunch will be catered by La Playa restaurant courtesy of Texas Sea Grant. There will be a thirty minute break for lunch and invited speaker, Mr. Mike De Luca, will begin his presentation at 12:30 p.m.

Once again, thank you for participating and we hope you enjoy the meeting.

Hurricane Harvey Research Symposium Planning Committee
Jace Tunnell, Sally Palmer, Katie Swanson, and Kelly Dunning

A special thank you goes to volunteers and moderators:

Ed Buskey
Wyatt Hooks
Cammie Hyatt
Sara Pelleteri
Nicole Pringle
Lindsay Scheef
Amanda Taylor
Tracy Weatherall
Lauren Yeager

Follow the meeting on social media with #HARVEYSYMPOSIUM

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Invited Speaker Biography

Mr. Michael P. De Luca

Senior Associate Director, Office of Research, Rutgers University

Manager, Jacques Cousteau National Estuarine Research Reserve

Director, New Jersey Aquaculture Innovation Center at Rutgers University

Mike De Luca provides executive management and leadership for integrated programs of research, education and outreach, especially the Jacques Cousteau National Estuarine Research Reserve, Aquaculture Innovation Center and the Coastal Exploration Center. Other key duties include management of major external research, science education and service programs, government relations, marine and coastal science policy, program development and partnerships. He also oversees operation of major field facilities and serves as Chair of the Rutgers Dive Control Board. He has led efforts to capitalize on environmental sampling and sensing networks to inform coastal management and enrich K-12 science education. Most recently, he initiated Rutgers efforts to support the development, growth and prosperity of aquaculture in New Jersey and the Mid-Atlantic region. He currently leads efforts to restore the ecological integrity of coastal systems and communities in the aftermath of Superstorm Sandy, develops science-based strategies to enhance resilience of coastal communities and ecosystems, and designs innovative approaches to science-based management of coastal systems and management of marine protected areas. His efforts have also focused on restoring the ecological integrity of the Barnegat Bay watershed and estuary, and the design of innovative approaches to science-based management of coastal systems, and activities to advance management of marine protected areas. His experience includes service as the President of the National Estuarine Research Reserve Association, Chair of the Science and Technical Advisory Committee for the Barnegat Bay National Estuary Program, member of the Heinz Center Panel on Innovations in Coastal Zone Management, Chair of the Public Policy Committee for the National Association of Marine Laboratories (NAML), and President of NAML.

Schedule

7:15 AM - **Registration,** Port Aransas Civic Center, 710 W. Avenue A, Port Aransas, Tx 78373

8:00 AM - **Welcome and Opening Remarks,** Dr. Robert Dickey, Director, The University of Texas Marine Science Institute

HABITATS AND ECOSYSTEMS

8:15 AM - **Short-term stream responses to Hurricane Harvey along an aridity gradient**
J. Derek Hogan*, Christopher J. Patrick, Brandi Kiel Reese, Fernando Carvallo, Darcy Gonzalez, and Sean Kinard

8:30 AM - **A Tale of Two Storms: Wind and Rain Impacts of Hurricane Harvey**
Patrick, C.J.*, Yeager, L., Armitage, A.R., Carvallo, F., Congdon, V., Dunton, K., Fisher, M., Hardison, A., Hogan, J., Hosen, J., Hu, X., Kiel Reese, B., Kinard, S., Kominoski, J., Lin, X., Liu, Z., Montagna, P.A., Pennings, S., Walker, L., Weaver, C.A.,Wetz, M.

8:45 AM - **Hurricane Harvey, Freshwater Resources, and Wintering Whooping Cranes**
Elizabeth Smith, Ph.D.* and Nicole Davis

9:00 AM - **Impacts of Hurricane Harvey on Living Shoreline, 28 Constructed Reefs in Little Bay, Rockport, Texas**
Charles Belaire*, Sara Flaherty

9:15 AM - **Impacts of Hurricane Harvey on zooplankton and the hydrographic conditions in Galveston Bay**
Hui Liu*, Jillian Gilmartin, Chengxue Li, Alan Munoz, Michelle Dziewit

9:30 AM - **Water quality and plankton monitoring before, during and after Hurricane Harvey (SWMP takes a licking, and mostly keeps on ticking)**
Edward Buskey*, Cammie Hyatt, Tracy Weatherall, Kelley Savage and Lindsay Scheef

9:45 AM - **Impact of periodic storm events and Hurricane Harvey on phytoplankton community composition in the Mission-Aransas Estuary, TX**
Sarah Douglas*, Xianbiao Lin, Kaijun Lu, Xin Xu, Jianhong Xue, Amber Hardison, and Zhanfei Liu (Student presentation)

10:00 AM - **Impact of Freshwater Discharge from Hurricane Harvey on Coastal Phytoplankton Communities**
James M. Fiorendino*, Dr. Darren W. Henrichs, Dr. Lisa Campbell (Student presentation)

10:15 AM - **POSTER SESSION (30 min. - See page 7 for list of poster titles and presenters)**

10:45 AM - **Direct impacts to seagrass ecosystem structure in the wake of Hurricane Harvey**
Victoria Congdon*, Christina Bonsell, Meaghan Cuddy, Kenneth Dunton (Student presentation)

11:00 AM - **Degradation and Resilience of Seagrass Food Web Structure Following a Direct Impact by Hurricane Harvey**
Lauren Yeager*, Victoria Congdon, Patricia Janssen, Kylie Holt, and Kenneth Dunton

11:15 AM - **Shoreline erosion and plant damage within the mangrove-marsh ecotone following Hurricane Harvey**
Carolyn A. Weaver*, John S. Kominoski, Steven C. Pennings, Anna R. Armitage

11:30 AM - **Hurricane-induced flooding has minimal effects on east Texas forests**
Charlotte Reemts*, Jacqueline Ferrato, Shawn Benedict

11:45 AM - **A Flood of Data: Hurricane Harvey Data Archive**
David K. Arctur

12:00 PM - **LUNCH AND INVITED SPEAKER**
Lessons Learned from Superstorm Sandy
Mike De Luca, Senior Associate Director for the Office of Research at Rutgers University

WATER QUALITY AND CHEMISTRY

1:00 PM - **Freshwater inflow to and around Galveston Bay due to Hurricane Harvey**
Kristen Thyng*, Rob Hetland, Kerri Whilden, Nelun Fernando, Evan Turner, Caimee Schoenbaechler, Scott Socolofsky

1:15 PM - **Modeling the dramatic estuarine responses in Galveston Bay to Hurricane Harvey**
Jiabi Du*, Kyeong Park, Timothy Dellapenna

1:30 PM - **Recovery Times of Salinity in Galveston Bay: Comparison of Impact from Hurricanes versus Riverine Flooding**
Amanda Alva*, Caimee Schoenbaechler, Evan Turner (Student presentation)

1:45 PM - **Mobilization of Contaminants by during Hurricane Harvey flooding**
Knap, A.H.*, Camargo, K., Sericano, J.L., Liu, Y., Sweet, S.T., Bera, G., Horney, J., Jun, M., Rusyn, I. and Wade, T.L

2:00 PM - **Metagenomic analysis to assess fecal contamination and recovery of the Galveston Bay system following Hurricane Harvey**
LaMontagne, M.G.*, Le, D.N., Zhang, Y., Allen, M.

2:15 PM - **Bayou chemical and microbiological water quality in Houston after Harvey**
Hanadi S. Rifai*, Amin Kiaghadi, Adithya Govindarajan, Rose Sobel, Mary Crum and Richard W. Willson

2:30 PM - **Impact of Hurricane Harvey on the Carbonate Chemistry of Galveston Bay, TX**
Tacey L Hicks*, Kathryn EF Shamberger, Cameron Henderson, Christine Jensen (Student presentation)

2:45 PM - **Impact of Hurricane Harvey on Spectroscopic Characteristics of Chromophoric Dissolved Organic Matter (CDOM) in Galveston Bay Over the Course of One Year**
Gerardo Gold-Bouchot*, Samuel Polis, and Lauren Castanon

3:00 PM - **Two Tales of One Storm - A comparative study of Hurricane Harvey on carbon cycling and carbonate chemistry of two adjacent south Texas estuaries**
Xinping Hu*

3:15 PM - **POSTER SESSION (30 min. - See page 7 for list of poster titles and presenters)**

RESOURCE IMPACTS

3:45 PM - **Maximum wind maps of Harvey's landfall from dual-Doppler retrievals**
Michael I. Biggerstaff *, A. Addison Alford

4:00 PM - **Engineering Perspectives on Residential Building Performance in Coastal Texas during Hurricane Harvey**
David B. Roueche*, Daniel J. Smith, Richard J. Krupar, Frank T. Lombardo

4:15 PM - **Long-term recovery assessment of infrastructure systems and communities following Hurricane Harvey: Case study for the city of Port Aransas**
Mohammad Aghababaei* and Maria Koliou (Student presentation)

4:30 PM - **Don't Throw It Away: Beneficial Use of Storm Debris for Beach and Vegetation Stabilization**
Tara Whittle*

4:45 PM - **PAH and PCB levels and associated biomarker activity in fish from Galveston bay following hurricane Harvey**
Beatrice Hernout*, Eleazar Hernandez, David Hala

5:00 PM - **Resilience Exemplified - Drum fish spawning doesn’t miss a beat**
Christopher R. Biggs*, Brad Erisman (Student presentation)

5:15 PM - **Positive impact of reduced fishing pressure on the popular recreational finfish of Aransas Bay following Hurricane Harvey**
Evan Pettis*

5:30 PM - **PROGRAM END**

POSTER TITLES & PRESENTERS

The symposium is structured with longer than normal breaks to allow for poster presentations - so grab your cup of coffee and check out some cool science.

A multi-tissue organotypic human in vitro model for rapid hazard identification of environmental chemicals and mixtures

Zunwei Chen*, Lora Yanagisawa, Weihsueh Chiu, Ivan Rusyn; Texas A&M University (Student poster)

The effects of Hurricane Harvey on dissolved and sedimentary toxic trace metals in Galveston Bay: a time-series analysis

Jessica Fitzsimmons*, Laramie Jensen, Hannah Adams; Department of Oceanography, Texas A&M University

Impact of Major Hurricanes to Hit Texas Coastal Bend Regions

Audrey Garza; Atmospheric Science Program; Department of Physical and Environmental Sciences – TAMUCC

Hurricane Harvey and South Texas Tropical Cyclones

Jacob Hale*, Anthony Romero, Ali Kohutek, Joseph Hill; Atmospheric Science Program; Department of Physical and Environmental Sciences – TAMUCC

Understanding Hurricane Harvey and its Challenges for Evacuation: The Case of Corpus Christi

[1]Dean Kyne, [2]Billy Delgato; [1]Assistant Professor, Disaster Studies MA Program, Department of Sociology and Anthropology, The University of Texas Rio Grande Valley; [2]Emergency Management Coordinator, Office of Emergency Management, City of Corpus Christi Fire Department

Impact of Hurricane Harvey on Benthos

Paul Montagna*, Xinping Hu, Michael Wetz; Texas A&M University-Corpus Christi

The Quiet During and After the Storm: Using Deviations in Social Media Activity to Identify Disaster

Rachel Samuels*, John Taylor; Georgia Institute of Technology (Student presentation)

Productive and Problematic Volunteer and Official Rescue Communication

Keri K. Stephens* Dhiraj Murthy, Brett Robertson, & Roth Smith; The University of Texas at Austin

Abstracts for Oral Presentations

HABITATS AND ECOSYSTEMS

Short-term stream responses to Hurricane Harvey along an aridity gradient

J. Derek Hogan*, Christopher J. Patrick, Brandi Kiel Reese, Fernando Carvallo, Darcy Gonzalez, and Sean Kinard; Texas A&M University - Corpus Christi

The frequency of intensity of weather driven disturbances is predicted to increase with global climate change. At the same time, long-term average precipitation and temperature regimes are also shifting. We can use a space for time approach along natural climate gradients to enhance our understanding of how these changes will affect the structure and function of stream ecosystems. Here we report on community and ecosystem responses of streams to Hurricane Harvey along a natural mean precipitation gradient. Diel cycling, water chemistry and nutrients, invertebrate and fish community composition and abundance were measured before and after the storm in streams receiving average annual precipitation ranging from 55 cm/yr to 110 cm/yr. Across the gradient, we observed a pattern of disturbance followed by variable rates of recovery among different ecosystem components. Biological communities recovered quickly whereas water chemistry shows longer-term changes. Long-term precipitation regime had the largest effect on mobilization of nutrients and dissolved organic carbon immediately after the storm, with the highest increases in concentration in the more arid streams.

A Tale of Two Storms: Wind and Rain Impacts of Hurricane Harvey

[1]Patrick, C.J.*, [2]Yeager, L., [3]Armitage, A.R., [1]Carvallo, F., [2]Congdon, V., [2]Dunton, K., [4]Fisher, M., [2]Hardison, A., [1]Hogan, J., [5]Hosen, J., [1]Hu, X., [1]Kiel Reese, B., [1]Kinard, S., [6]Kominoski, J., [7]Lin, X., [2]Liu, Z., [1]Montagna, P.A., [8]Pennings, S., [1]Walker, L., [1]Weaver, C.A.,[1]Wetz, M.; [1]Texas A&M University Corpus Christi, [2]University of Texas Marine Science Institute, [3]Texas A&M University at Galveston, [4]Texas Parks and Wildlife Department, [5]Yale University, [6]Florida International University, [7]East China Normal University, [8]University of Houston

Hurricane Harvey hit Texas on 25 August, 2017 as a category 4 storm. There were two distinct disturbances: 1) High wind and associated storm surge, and 2) Scouring floods and significant discharge of freshwater loaded with carbon and nutrients to the estuaries. Wind-driven disturbance damaged mangroves and seagrass, and increased sediment coarseness. Mangroves reduced coastal erosion. Rain-driven disturbance affected riverine fauna and caused hypoxia and low salinity in estuaries, affecting benthic fauna; estuarine fish exhibited minor response. Post-storm, estuarine biogeochemistry returned to baseline within four weeks, river fauna returned within twelve weeks, and remaining seagrass show elevated growth rates. Some ecosystem components displayed surprising resistance to immediate impacts; however, vegetation will take longer to recover. When comparing responses among ecosystems, we

observed a common trade-off between ecosystem resistance and resilience, with higher resilience associated with lower resistance, and shared response magnitudes within ecosystem components across different ecosystems.

Hurricane Harvey, Freshwater Resources, and Wintering Whooping Cranes

Elizabeth Smith, Ph.D.* and Nicole Davis; International Crane Foundation

Multiple organizations and agencies have recognized the importance of inland freshwater resources to wintering whooping cranes and other wildlife. Since 2013, the International Crane Foundation has been monitoring the use of freshwater ponds by wintering whooping cranes to assist in identifying sites for the installation of new water wells that would be most beneficial to whooping cranes. Two months after Hurricane Harvey made landfall directly through coastal marsh essential for the Aransas-Wood Buffalo whooping cranes, the International Crane Foundation sampled salinity levels in 36 ponds located throughout the Aransas National Wildlife Refuge and select adjacent private lands to assess the effect of storm surge on salinity levels. Eighteen of these ponds were continuously sampled throughout the last half of the winter season, and whooping crane use was monitored using game cameras. Out of the 18 ponds sampled, salinities in 14 ponds ranged 8.8 -13.7 ppt and salinities in three ponds was <1.0 ppt, all below the presumed threshold of 23 ppt satisfactory for dietary drinking water for whooping cranes and similar to the surrounding bays (~11 ppt). Preliminary results from 250,000 images captured from the game cameras indicate whooping cranes were present in 1.3% of the images, and they exhibited a non-uniform space-use of freshwater ponds throughout the winter range. Inland freshwater ponds on Blackjack Peninsula appear to be used the least of all four landforms monitored. Overall, pond salinities were sufficiently low enough to provide dietary water for wintering Whooping Cranes following Hurricane Harvey.

Impacts of Hurricane Harvey on Living Shoreline, 28 Constructed Reefs in Little Bay, Rockport, Texas

Charles Belaire*, Sara Flaherty; Belaire Environmental, Inc

The Aransas County Navigation District (ACND) received a permit from the U.S. Army Corps of Engineers (USACE) on July 20, 2012 to construct a living shoreline consisting of 28 oyster reefs in Little Bay, Rockport, Texas. These reefs total 4.3 acres and extend 1.2 miles along the western shoreline of the bay. Construction of these reefs was completed in September 2015. The typical reef top was constructed to approximately 1.5 feet above the bay bottom, reaching an elevation of +0.5 ft NAVD 88, or -0.8 ft mean high water. Each reef consisted of a crushed concrete base with 6 inches of oyster shell placed on top. One stated goal for the reefs was to establish a population of five oysters per square foot of reef surface over the long term. A quantitative survey was conducted in early November 2017, approximately two months after Hurricane Harvey landfall and two years after completion of reef construction. The average oyster population density for the 28 reefs was 12 live oysters per square foot. The oyster sizes ranged from one to six inches. Except for some relatively minor debris deposits, the survey found minimal impacts to the reefs due to the hurricane. The absence of hurricane impacts can probably be attributed to the direction of prevailing hurricane force winds and the relative

absence of hurricane surge at the City of Rockport. The living shoreline project is considered highly successful.

Impacts of Hurricane Harvey on zooplankton and the hydrographic conditions in Galveston Bay

Hui Liu*, Jillian Gilmartin, Chengxue Li, Alan Munoz, Michelle Dziewit; Marine Biology Department, Texas A&M University at Galveston

Rapid response to large-scale natural disasters and subsequent assessments and restoration require long-term baselines of key ecosystem components. Zooplankton are sensitive indicators to climate events, hydrographic conditions and water quality. In August 2017, Hurricane Harvey brought catastrophic rainfall that led to extreme flooding in Southeast Texas, including the Galveston Bay watershed. Immediately, we started sampling zooplankton and hydrographic factors funded by NSF for assessing ecosystem restoration of Galveston Bay after the disaster. So far, we have conducted 4 frequent sampling cruises in September 2017 and 11 monthly cruises from October 2017 to August 2018 in Galveston Bay. Our data showed that the hydrographic conditions tend to recover quickly. Compared to our historic data zooplankton exhibited a significant decrease in species composition and overall abundance after Harvey and a relatively slow recovery. Next we will process all samples and quantify the duration of a full recovery with a year-round zooplankton time series in relation to the hydrographic factors. The findings will be useful to assess the impacts of hurricane-related disturbance on pelagic community in estuaries and the implications to ecosystem functions.

Water quality and plankton monitoring before, during and after Hurricane Harvey (SWMP takes a licking, and mostly keeps on ticking)

Edward Buskey*, Cammie Hyatt, Tracy Weatherall, Kelley Savage and Lindsay Scheef; Mission-Aransas National Estuarine Research Reserve at the University of Texas Marine Science Institute

The Mission-Aransas National Estuarine Research Reserve's System Wide Monitoring Program (SWMP) was established in April 2007. Water quality and meteorological data are collected with YSI data sondes and Campbell Scientific weather stations at 15 minute intervals. Nutrient, chlorophyll and plankton data are collected monthly. The summer of 2017 marked 10 years of monitoring data collection that helped reveal short term changes and longer term trends in water quality and planktonic food web structure. In particular, these long term data have been used to explain the effects of episodic freshwater inflows on ecosystem structure and function of the Mission Aransas Estuary. Then hurricane Harvey arrived. Two of the five monitoring stations were destroyed by the hurricane, and a third station was destroyed by a derelict oil drilling ship that broke free from its moorings a few days after the storm. For these stations, water quality data were taken at monthly intervals after the storm, but two stations were undamaged and continued the data stream of 15 minute sampling. Following the hurricane, salinities dropped sharply at all stations and a major phytoplankton bloom occurred throughout the estuary. In Copano Bay a massive bloom of a single species of copepod, *Acartia tonsa*, was observed. The impacts on the base of the planktonic estuarine food web

were short lived, however, and water quality and plankton indicators have returned to more characteristic values.

Impact of periodic storm events and Hurricane Harvey on phytoplankton community composition in the Mission-Aransas Estuary, TX

Sarah Douglas*, Xianbiao Lin, Kaijun Lu, Xin Xu, Jianhong Xue, Amber Hardison, and Zhanfei Liu; University of Texas Marine Science Institute (*Student presentation)*

Estuaries in south Texas, including the Mission-Aransas Estuary (MAE), are unusual in that they receive very low base freshwater inflow for much of the year, often multiple years, interspersed with sporadic pulses of precipitation and resulting high freshwater inflow events. These episodic storm events and variable riverine inflow are critical contributors to the MAE's dynamic salinity, nutrient availability, and particulate organic matter (POM) composition, including phytoplankton community variability. Estuarine food webs are largely fueled by POM, which includes both living and non-living organic material. Hurricane Harvey, a category 4 hurricane, passed directly over the MAE in late August 2017, impacting the entire estuary and lower portion of the Mission and Aransas River watersheds with heavy rain and winds up to 130 mph. POM sources and composition change dramatically from drought to flood conditions, but the impact of a category 4 storm on the MAE's POM composition and phytoplankton community structure is unknown. We compared pre- and post-hurricane phytoplankton communities using accessory pigments extracted from suspended particles collected biweekly from 4 sites across the MAE, as well as pre- and post- hurricane sediment grain size distribution from 20 sites across the MAE. Although we found significant sediment redistribution post-Harvey, no significant change in phytoplankton community composition was observed comparative to previous storm events. The dynamic nature of the MAE in non-drought conditions causes regular shifts in phytoplankton community composition following flood events, and the resilience of the phytoplankton community post-hurricane may be an indication of overall system resilience to major storms.

Impact of Freshwater Discharge from Hurricane Harvey on Coastal Phytoplankton Communities

James M. Fiorendino*, Dr. Darren W. Henrichs, Dr. Lisa Campbell; Texas A&M University (*Student presentation)*

Episodic disturbances like tropical cyclones alter marine environments and influence the composition of marine phytoplankton communities. Hurricane Harvey struck the Texas coast on August 25th, delivering record rainfall to the Houston area. The delivery of nutrient-rich fresh water to the Gulf of Mexico was expected to favor flagellates and dinoflagellates. One month after the storm, research cruises were conducted along the Texas coast from Galveston Bay to Port Aransas on September 23 (Leg 1) and September 29 (Leg 3), collecting data from seven stations on nutrients, hydrographic conditions, and phytoplankton community composition enumerated by an Imaging FlowCytobot. Stations closest to Galveston Bay were characterized by a shallow, less saline surface layer on Leg 1 which deepened by Leg 3. Stations furthest from Galveston Bay were well-mixed on both legs, though salinity decreased

by Leg 3. Nanoplankton and dinoflagellates were most abundant within phytoplankton communities; previously diatom-dominated communities became dinoflagellate and nanoplankton-dominated. Shifts in community composition relating to nutrient abundance were variable, while physical processes appeared to drive differential shifts in community composition between upcoast and downcoast stations. Diatoms and dinoflagellates, particularly in the genus Karenia, responded most dramatically with the largest relative increases in abundance. Notably, the potentially toxic bloom-forming diatom genus Pseudo-nitzschia increased in surface waters between cruise legs. Though the initial, large pulse of freshwater to the Gulf of Mexico and the associated phytoplankton community response occurred prior to the cruises, these results track the continuing influence of the freshwater plume.

Direct impacts to seagrass ecosystem structure in the wake of Hurricane Harvey

Victoria Congdon*, Christina Bonsell, Meaghan Cuddy, Kenneth Dunton; University of Texas Marine Science Institute (*Student presentation)*

Severe meteorological events can impart extensive damage to coastal ecosystems depending on the intensity and proximity to the storm. Hurricane Harvey battered the Texas coast on August 25, 2017 with maximum winds of 130 knots and produced prolific rainfall as the storm stalled over the state. We investigated the resistance of seagrass meadows to this major hurricane by evaluating the immediate response of seagrass structure to wind intensity. For both dominant species, *Halodule wrightii* and *Thalassia testudinum*, greater wind intensity corresponded with a decrease in mean blade lengths relative to pre-storm measurements. Rapid growth rates of *T. testudinum* observed post-storm suggest that regrowth may have occurred in areas where aboveground tissues were severed but belowground biomass remained intact. Only *T. testudinum* displayed reductions in percent cover, however, with some stations exhibiting complete loss of aboveground and belowground biomass. Our observations document the acute effects of wind intensity on habitat structure in response to a Category 4 hurricane. The severe wind damage to *T. testudinum* plants together with poor colonization abilities of this species indicate that a long period of time may be necessary for the complete recovery of community structure and function in seagrass meadows directly impacted by Hurricane Harvey.

Degradation and Resilience of Seagrass Food Web Structure Following a Direct Impact by Hurricane Harvey

Lauren Yeager*, Victoria Congdon, Patricia Janssen, Kylie Holt, and Kenneth Dunton; University of Texas Marine Science Institute

Disturbance is recognized as a major organizing force in marine communities and hurricanes may serve as a natural experiment to examine how different forms of disturbance interact to affect ecosystem structure and function. Hurricane Harvey made landfall August 25, 2017 on San Jose Island, Texas as a Category 4 storm. The intense wind energy and storm surge was a devastating physical force and the extreme rainfall and freshwater run-off created a low

salinity event that persisted for months. Following documented losses in physical habitat structure of seagrass (*Thalassia testudinum*) meadows, we are attempting to tease apart effects of these multiple stressors associated with the storm on biodiversity and food web structure. Serve but localized losses in seagrass cover resulted in cascading shifts in epifaunal community structure and declines in mesograzer abundance, indicating a shift in the base of the food web. These effects did not appear to propagate to the highest trophic levels, however, as predation rates did not vary between impacted and reference sites. These initial results highlight the complex impacts of the two forms of disturbance on seagrass food webs, with lower trophic levels displaying vulnerability to loss, while higher trophic level interactions we more resistant to hurricane impacts.

Shoreline erosion and plant damage within the mangrove-marsh ecotone following Hurricane Harvey

[1]Carolyn A. Weaver*, [2]John S. Kominoski, [3]Steven C. Pennings, [4]Anna R. Armitage; [1]Department of Life Sciences, Texas A&M University-Corpus Christi; [2]Department of Biological Sciences, Florida International University; [3]Department of Biology and Biochemistry, University of Houston; [4]Department of Marine Biology, Texas A&M University at Galveston

The capacity of coastal wetlands to stabilize shorelines and reduce erosion is a critical ecosystem service, which may vary depending on the vegetation mosaic. Salt marshes (dominated by low-stature grasses and forbs) are common in Texas. Mangroves (woody plants) are also present and interspersed with marsh vegetation. An increase in mangrove coverage has been reported over the last few decades, making it increasingly important to understand how a transition from marsh to mangrove dominance may alter shoreline protection. In August 2017, Hurricane Harvey made landfall near a mangrove removal experimental site established in 2012, providing a unique opportunity to address the question: how do mangrove and marsh densities affect shoreline protection during a major storm event? The experimental site consists of ten large (1008 m2) plots ranging from 0-100% mangrove cover, allowing a direct comparison of shoreline protection across multiple mangrove and marsh densities. Following Hurricane Harvey, mangrove cover decreased by 25-40%, regardless of initial plot-level mangrove density; marsh plants were relatively resistant to storm effects. Plots with <33% mangrove cover had higher shoreline erosion, but overall vertical accretion was higher and more variable within marsh patches. Organic matter accretion was higher in mangrove patches, whereas marsh patches had higher inorganic matter accretion. The amount of debris deposited in the study area did not vary with plot-level mangrove cover. In general, mangroves reduced shoreline erosion more than marsh vegetation, but mangroves were more susceptible to wind damage, which may reduce their shoreline protection capacity on a longer time scale.

Hurricane-induced flooding has minimal effects on east Texas forests

Charlotte Reemts*, Jacqueline Ferrato, Shawn Benedict; The Nature Conservancy

Rainfall from Hurricane Harvey caused unprecedented flooding in parts of east Texas, including The Nature Conservancy's Sandyland Sanctuary (Hardin County). Areas of the preserve over 1 km away from Village Creek were flooded for multiple days. In spring 2018, we re-surveyed 72 bird survey points that had previously been surveyed in 2015-2017. In summer 2018, we re-sampled 66 vegetation plots (previously been sampled in 2014-2017). The areas sampled included upland longleaf pine savanna, wet savanna, and baygalls. Preliminary analyses show that very few canopy-sized trees had died after the flood. In areas where flood waters were deep, some longleaf pine seedlings and saplings had died. Bird analyses are on-going. We expect that the long-term impact of the flood will be minimal, but will continue monitoring to confirm our expectation.

A Flood of Data: Hurricane Harvey Data Archive

David K. Arctur; University of Texas at Austin

In August-September 2017, Hurricane Harvey became the largest storm of up to 5 days duration ever recorded in the United States. Over 60 inches of rain fell in places, and flooding and associated damage were extensive, with the storm extending across Texas and neighboring states. During the first few days following this event, even the most elementary kinds of questions about flood inundation depths, extents, and impacts could not be answered because we lacked the ability to collect important data and the ability to assimilate available data into decision relevant information. To fill these gaps and improve our understanding of and capability to prepare for and respond to such extreme events, it was important that data from these events be organized, archived, and made available for research. In October 2017, NSF granted RAPID funding to bring this about, utilizing the CUAHSI HydroShare community repository. This presentation describes the near-final results of this compilation for Harvey, which can be accessed at http://arcg.is/001jje.

WATER QUALITY AND CHEMISTRY

Freshwater inflow to and around Galveston Bay due to Hurricane Harvey

[1]Kristen Thyng*, [1]Rob Hetland, [2]Kerri Whilden, [3]Nelun Fernando, [3]Evan Turner, [3]Caimee Schoenbaechler, [4]Scott Socolofsky; [1]Texas A&M Oceanography, [2]Texas A&M Civil Engineering, [3]Texas Water Development Board, [4]Texas A&M GERG

Galveston Bay went fresh from Hurricane Harvey rainfall in August 2017 due to the massive amount of water that entered the bay. Using publicly available data from Galveston Bay, we estimate the amount of freshwater that flowed into the bay from this rainfall to be 22 km3, about 8.5 times the volume of Galveston Bay itself. We also have had a series of three cruises both within and offshore from the bay to measure the temperature and salinity with depth to assess the freshwater structure in the bay, and freshwater plume outside the bay on ebb tide. We additionally have had CTD moorings in East and West Bays since earlier this year.

The flow rate into the bay was over 30,000 m3/s for 4 days and over 40,000 m3/s for 2 days.

For comparison, in over 10 years the USGS gauge station on the Mississippi River at Baton Rouge, LA, has seen a flow rate over 35,000 m3/s for only 3 flooding periods (though these floods lasted more like 6 weeks instead of a few days). This fresh water flowed into the bay over different time scales throughout the bay, depending especially on the storm's movement, as reflected in salinity station data. While the bay typically sees a large variation in salinity throughout the year, the short time scale of this massive influx of freshwater was notable.

Modeling the dramatic estuarine responses in Galveston Bay to Hurricane Harvey

Jiabi Du*, Kyeong Park, Timothy Dellapenna; Texas A&M University at Galveston

Hurricane Harvey, one of the worst hurricanes that hit the United States in recent history, poured record-breaking rainfall in the Houston area. Based on observational data from various sources and numerical simulations, we examined the estuarine response inside Galveston Bay to the extreme precipitation event by estimating the freshwater load and simulating the temporal and spatial variation of river plumes. To well reproduce the Harvey conditions, it is critically important to accurately estimate the freshwater load into the Galveston Bay. By applying a freshwater fraction method with the available current and salinity data at the bay entrance, we estimated that the freshwater discharged into Galveston Bay during Harvey and the following month was 8.98±2.62×10^9 m3, 1.7 to 3 times the volume of the entire Galveston Bay. Such amount of freshwater input had completely renewed the estuarine water inside the bay and kept the entire bay under virtually fresh status for 4 days. A validated unstructured-grid numerical model with domain covering Texas-Louisiana shelf was applied for the Hurricane Harvey. The model successfully reproduced the featured storm conditions including elevated water level, sharp decreases of salinity, extraordinary along-channel current, and huge river plumes that extended 80 km offshore. Transport of low-salinity water was furthered examined based on the numerical simulations. The direction of river plumes changed accordingly with the shelf and ocean circulations. After the hurricane, salinity inside the bay gradually recovered to its pre-storm condition through tidal pumping for the following 2-3 months.

Recovery Times of Salinity in Galveston Bay: Comparison of Impact from Hurricanes versus Riverine Flooding

Amanda Alva*, Caimee Schoenbaechler, Evan Turner; Texas Water Development Board (*Student presentation)*

Wind driven-circulation and freshwater inflow can drive rapid salinity fluctuations within the shallow bays of the Texas Gulf Coast. Such salinity fluctuations can have far-reaching impacts on the physiological processes of estuarine organisms. Hurricanes and non-hurricane induced flood events are common disturbances to Texas estuary ecosystems, delivering significant amounts of freshwater inflow which can increase shallow water habitat, contribute to the dilution of harmful contaminants, maintain low salinity nursery habitats, and enhance the biogeochemical cycling of essential nutrients (Longley 1994). This study aims to examine salinity changes in mid-Galveston Bay from inflow delivered by ten landfall hurricanes

compared to two major riverine flood events. Daily salinity data derived from the TxBLEND 2D hydrodynamic model from 1982 to 2015 was combined with long-term datasonde observations from 1986 to 2018 to determine the change in salinity due to storm and flood events. Major riverine flood events, of 1992 and 2015, maintained salinity below 5 PSU for 2-3 months throughout the studied area. There were no inflow events resulting from hurricanes, including Harvey, which maintained salinity below 5 PSU for the same duration. Determining the differences in impact between these extreme weather events is important for characterizing future salinity recovery times for estuarine habitats.

Mobilization of Contaminants by during Hurricane Harvey flooding

Knap, A.H.*, Camargo, K., Sericano, J.L., Liu, Y., Sweet, S.T., Bera, G., Horney, J., Jun, M., Rusyn, I. and Wade, T.L.; Geochemical and Environmental Research Group, Texas A&M University

Hurricane Harvey made landfall in Texas August 25, 2017, bringing massive rains and flooding that impacted soils in a residential neighborhood in East Houston. Trace metals, organochlorine pesticides, polycyclic aromatic hydrocarbons (PAHs), polybrominated diphenyl ether fire retardants (PBDEs) and polychlorinated biphenyls (PCBs) were determined in 24 soil samples. All concentrations found in soils were low, other than total PAHs, which ranged from 1,310 ug/kg to 85,700 ug/kg with a mean of 12,600 ug/kg. Analysis of specific PAH ratios indicate the source of the PAHs were dominated by pyrogenic rather than petrogenic sources. Chlordanes were detectable in the area where the likely local source is for ant control. While Hurricane Harvey was responsible for the redistribution of many contaminants, the large volume of rain and floodwater likely transported contaminants from the land areas and into the Houston Ship Channel and Galveston Bay.

Metagenomic analysis to assess fecal contamination and recovery of the Galveston Bay system following Hurricane Harvey

LaMontagne, M.G.*, Le, D.N., Zhang, Y., Allen, M.; University of Houston Clear Lake, University of North Texas Health Science Center

Hurricane Harvey deluged the Houston metro area with greater than 50 cm of rain and generated floodwaters that were loaded with bacteria associated with feces. These floodwaters drained into Galveston Bay but little is known about the resilience of the microbial communities in waters that receive microbial contaminants. We applied metagenomics to assess the recovery of the Galveston Bay system to this extreme weather event. Water samples were waters collected by filtration in and around Clear Lake, an estuary connected to Galveston Bay, before and after the storm. We also created a mock contaminated sample by mixing sewage and estuarine water at a ratio of 1:9 (sewage:water). Bacterial community structure was assessed by next generation sequencing of 16S rRNA gene fragments PCR-amplified with primers specific for the bacterial domain. Cluster analysis suggested that the bacterial communities in samples collected immediately following Hurricane Harvey resembled those in the mock contaminated samples. The community structure then changed over time over the next few weeks and it took about two months for the bacterial community

to return to what it looked like a day before Harvey. This suggests that metagenomic analysis can provide a method of both detecting fecal contamination and the recovery of systems that receive fecal contamination.

Bayou chemical and microbiological water quality in Houston after Harvey

Hanadi S. Rifai*, Amin Kiaghadi, Adithya Govindarajan, Rose Sobel, Mary Crum and Richard W. Willson; University of Houston

Sampling in Houston bayous and Galveston Bay was initiated immediately after Harvey with the goal of understanding the longitudinal response of the stream network to the more than 50 inches of rainfall. A number of watersheds that were developed to different levels and exhibited differing characteristics such as land use and land cover, industrial activities, and population demographics were selected for the study and were sampled multiple times over the course of several weeks post Harvey. Results showed impacts from Harvey on dissolved oxygen levels, pH, total suspended solids, microbial diversity and trace metals. Additionally, significant amounts of sediment were mobilized, transported and deposited within the studied waterways. Persistent organic pollutant concentrations post-Harvey indicated elevated concentrations of dioxins and polychlorinated biphenyls and changes in their distribution within the studied systems.

Impact of Hurricane Harvey on the Carbonate Chemistry of Galveston Bay, TX

[1]Tacey L Hicks*, [1]Kathryn EF Shamberger, [1,2]Cameron Henderson, [3]Christine Jensen; [1]Texas A&M University, Department of Oceanography; [2]University of South Carolina, School of Earth, Ocean, and Environment; [3]Coastal Fisheries Division, Texas Parks and Wildlife Department (*Student presentation)*

Galveston Bay is an estuarine ecosystem on the Texas coast containing oyster reefs that provide critical ecosystem services including natural water filtration, shoreline protection, and support of several fisheries. Following the landfall of Hurricane Harvey in August 2017, there was a dramatic decrease in salinity throughout the entire bay due to Harvey rainfall draining from the Houston area into the bay. The entire bay reached a salinity of approximately 0 and remained fresh for anywhere from 5 days to over 2 weeks. This dramatic decline in salinity led to an oyster freshwater die-off event in the bay, with some reefs in East Bay experiencing 100% mortality. The recovery of these important ecosystems is at least partly dependent on whether aragonite saturation state (Ωar) levels support oyster larval production and recruitment. Negative impacts on larval oyster shell growth and development have been recorded at Ωar levels of 1.2 to 2. In June 2017, before Harvey, Ωar in Galveston Bay ranged from 1.4 to 3.2. Following Hurricane Harvey in September 2017, the majority of the bay was undersaturated, with $\Omega ar < 1$. By November 2017, much of the bay had returned to pre-Harvey Ωar levels; however, Ωar near East Bay was 1.6, which could potentially slow or inhibit oyster reef recovery. Here, we compare data collected pre- and post-Harvey from June 2017 to June 2018 to assess the impact of this storm on the carbonate chemistry of the bay and to investigate the potential recovery of the oyster reefs.

Impact of Hurricane Harvey on Spectroscopic Characteristics of Chromophoric Dissolved Organic Matter (CDOM) in Galveston Bay Over the Course of One Year

Gerardo Gold-Bouchot*, Samuel Polis, and Lauren Castanon; Texas A&M University

Galveston Bay is a shallow, highly urbanized estuary. It is the largest estuary in Texas, and its watershed includes almost 50% of Texas population. CDOM plays an important role in the carbon biogeochemical cycle, is also important to ensuring correct satellite-based estimates of primary productivity and can produce a shadow effect on phytoplankton. Water samples were taken at eight sampling stations in Galveston Bay, and analyzed for absorbance and fluorescence using a Horiba Aqualog spectrofluorometer, and Coble's peaks, fluorescence indices (fluorescence, biological and humification), spectral slope, spectral slope ratio, and absorption coefficient at 350 nm were calculated using the packages 'cdom' and 'eemR' in the 'R' statistical environment. Sampling was done in June, September, and November 2017, and in March and June 2018. Coble's peaks demonstrated a significant negative correlation with salinity, which demonstrates riverine input from the Trinity River, and conservative mixing. Fluorescence indices had no correlation with salinity, except for the fluorescence index that had a positive correlation in November 2017. The main impact by Harvey was a four-fold increase in the humification index and a decrease in spectral slope in September, indicating a large input of terrestrial organic matter with a lower molecular weight. Multivariate analysis (non-metric multidimensional scaling, NMDS) showed CDOM values going back to pre-Harvey levels until March 2018. The June 2018 CDOM values are completely different from the other months, and particularly the June 2017 values, suggesting the bay has not recovered from Harvey after a year.

Two Tales of One Storm - A comparative study of Hurricane Harvey on carbon cycling and carbonate chemistry of two adjacent south Texas estuaries

Xinping Hu*; Texas A&M University-Corpus Christi

Extreme natural disturbances such as hurricanes and tropical storms can cause significant changes to both estuarine carbon cycling as a result of changing estuarine metabolism, and water carbonate chemistry due to changing hydrological conditions. In this study, we examined the carbon dioxide system in two adjacent estuaries in the northwestern Gulf of Mexico, Mission-Aransas Estuary (MAE) and San Antonio Estuary (SAE), before and after Hurricane Harvey. One estuary experienced strong wind impact (MAE) and the other had large floodwater influence (SAE). MAE appeared to respire less carbon after the hurricane compared to the pre-hurricane year, while SAE showed a doubling in annual carbon loss to the atmosphere with only one month of enhanced "exhaling" window post Harvey. This difference was attributed to the different forcing at play during the progression of the storm. MAE mostly experienced local precipitation and small-scale runoff, which may have introduced nutrients into the bay system. As a result, MAE water primary production increased, which then led to a

reduction of overall respiration in this otherwise heterotrophic water body. In comparison, SAE received copious amount of freshwater runoff from the carbon dioxide- and organic matter-rich river water. Such runoff greatly enhanced estuarine respiration and carbon loss. Because of the difference in the freshwater addition, carbonate chemistry also exhibited different temporal changes in these two estuaries. Implications of these changes on calcifying organisms, along with changing salinity, will be discussed in this presentation.

RESOURCE IMPACTS

Maximum wind maps of Harvey's landfall from dual-Doppler retrievals

Michael I. Biggerstaff *, A. Addison Alford; School of Meteorology, University of Oklahoma

A mobile C-band SMART radar was deployed along the Texas coast in advance of Hurricane Harvey and coordinated with the Corpus Christi, TX WSR-88D radar to retrieve the airflow during landfall. Volumetric data were taken every five minutes over a nearly continuous 19-hour period. Radar wind retrievals around the time of landfall were used to develop a record of the maximum winds aloft and the time the maximum wind occurred at each grid point. Aerodynamic surface roughness estimates were used to project the 500-m altitude radar maximum wind field to 10 and 2.25 m altitude. The 2.25-m wind estimates were compared against an in situ array of StickNets to determine how well the projected radar maximum winds matched the observed winds. For the data examined here, the radar projections had Root Mean Squared Error of 3.9 m s-1 and a high bias of 2.3 m s-1.

Additionally, it was found that mesovorticies in Harvey's eyewall produced the strongest radar observed maximum winds and were responsible for local enhancements of the background flow. This study demonstrates the utility of mobile C-band Doppler radars in providing spatially continuous observations of wind maxima during hurricane landfalls, which is important for understanding property loss and helping to develop better standards for built structures along the coast. An overview of past SMART radar hurricane deployments and future plans will also be presented.

Engineering Perspectives on Residential Building Performance in Coastal Texas during Hurricane Harvey

David B. Roueche*, Daniel J. Smith, Richard J. Krupar, Frank T. Lombardo; Auburn University, James Cook University, Berkshire Hathaway Specialty Insurance, University of Illinois at Urbana-Champaign

Hurricane Harvey struck the coast of Texas on 25 August 2017 with wind gusts as high as 140 mph and up to 7 ft of storm tide. After landfall, the authors conducted an extensive field survey with the support of a National Science Foundation Rapid Response Research (RAPID) grant, documenting the performance of nearly 1,200 individual residential structures in coastal communities of Texas including Rockport, Port Aransas, and Ingleside, and inland communities such as Refugio and Sinton. Following the field surveys, the team augmented the

building performance dataset with supplemental information, including key building attributes (e.g., year built, roof shape, construction materials), Texas Department of Insurance compliance certificates, and local terrain characteristics. This presentation will provide an engineering perspective on the team's observations, including patterns of damage with respect to the wind speeds estimated to have occurred at the location of each building. The presentation will highlight key factors that affected building performance, specifically addressing the dissimilar damage that was so often observed in nearby buildings. The engineering perspectives and lessons learned will provide valuable guidance to local communities in their efforts to build back better to reduce the impacts of future events.

Long-term recovery assessment of infrastructure systems and communities following Hurricane Harvey: Case study for the city of Port Aransas

Mohammad Aghababaei* and Maria Koliou; Texas A&M University (*Student presentation)*

Hurricane Harvey struck the US between August 25 and August 31, 2017 affecting the communities in its path, damaged buildings, lifelines, and transportation infrastructures significantly. A longitudinal field study is currently underway in the Port Aransas region, Texas, which was impacted heavily by Hurricane Harvey to evaluate the long term recovery following Hurricane Harvey. By now, two field study waves have been conducted as parts of the longitudinal study, the first on September 26, 2017, and the second on March 10 and 11, 2018. The first wave mainly focused on engineering attributes and was conducted through two damage assessment procedures, namely, rapid and detailed. These assessments resulted in developing a dataset of damage observations, damage failure modes, and distribution of damage to structural and nonstructural components. In addition, the status of safety, occupancy, and functionality of the buildings at the time of the inspection was determined. Based on the observations, a number of outcomes were resulted, such as the most vulnerable components and the most common damage modes, and some recommendations have been made to decrease the damage in buildings, such as strengthening the connections of the envelope of the building. The second wave mainly focused on socio-economic attributes of the recovery. In addition, the recovery path of the community was captured in the second inspection to see what the status of the community is. Based on the observations of these studies, the community is recovering slowly and more buildings were classified as safe compared to the first field study wave. However, a significant portion of the buildings was still not functional in March. Further field studies will follow up within the next few months focusing on collection of additional data which will be the basis of developing, validating, and calibrating infrastructure and community modeling frameworks.

Don't Throw It Away: Beneficial Use of Storm Debris for Beach and Vegetation Stabilization

Tara Whittle; Texas General Land Office

Texas General Land Office (GLO) staff began emergency operation storm response a few days after Hurricane Harvey passed and identified public beaches which had debris washed up that posed a risk to human health and safety. The majority of debris was removed and disposed of

in permitted landfills, but one area on the upper Texas coast, Sargent Beach, posed access limitations due to soft sand and clay, as well as strong tides. This beach is narrow and highly dynamic, and has been identified as critical wintering habitat for threatened and endangered piping plover (*Charadrius melodus*) and red knot (*Calidris canutus*) shorebirds, which made it an ideal candidate for a stabilization project. 456.5 cubic yards of vegetative and woody storm debris was placed at specific intervals along a 5,100 linear foot area adjacent to the surf line, at the approximate boundary between public beach and privately owned uplands. A great deal of interagency cooperation occurred in a short amount of time at the state and federal level, including stabilization design and approval, and the stabilization project was completed, start to finish, in less than one month.

PAH and PCB levels and associated biomarker activity in fish from Galveston bay following hurricane Harvey

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The recent catastrophic flooding of Houston caused by the landfall of Hurricane Harvey (August 25th, 2017) led to massive urban runoff into Galveston Bay (GB). Approximately 1 trillion gallons of rainwater fell onto Houston, with most of it draining into GB. This massive flooding event is suspected to have re-suspended polluted sediments, potentially releasing adsorbed 'legacy' contaminants, such as polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). In this poster, the potential physiological effects of PAHs and PCBs on fish sampled from GB were studied. In partnership with Texas Parks and Wildlife (TPW), various fish species sampled prior to Harvey's landfall (11/2016), and two months following Harvey's landfall (11/2017) were analyzed for hepatic detoxification enzyme activities and pollutant body-burdens. Specifically, hepatic enzyme activities for cytochromeP450 1a1 (CYP1A1) and Glutathione-S-transferase (GST) was determined using spectrophotometry. The bio-accumulation of PAHs and PCBs in hepatic tissues of fish was also quantified using gas chromatography and mass spectrometry (GCMS). Comparisons of enzyme activities pre- vs. post-Harvey showed no significant differences in activities. Similarly, comparisons of pollutant body-burdens also showed no differences in hepatic PAH and PCB concentrations in pre- vs. post-Harvey samples. Despite this lack of statistical significance, PAH and PCB levels in fish hepatic tissues were within range of those reported for fish in GB. Therefore, it appears that Hurricane Harvey may not have significantly impacted pollutant (PAH and PCB) bio-accumulation in resident fish species, however more comprehensive studies are needed to assess potential impacts.

Resilience Exemplified - Drum fish spawning doesn't miss a beat

Christopher R. Biggs*, Brad Erisman; Marine Science Institute, University of Texas at Austin (*Student presentation)*

Spawning locations, timing, and periodicity are important aspects of productivity and resilience in fishes, because they are directly related to reproductive success. Passive acoustic

monitoring can be used to study these aspects for species that produce spawning associated vocalizations. We acoustically monitored spawning in seatrout from April through September 2017 at 16 sites near Port Aransas, Texas, which coincided with landfall of a category 4 hurricane (Harvey) on 25 August. Spawning sounds within the peak frequency bandwidth of seatrout chorusing (250-500 Hz) were observed on every day of the study and across all sites with an average SPL of 121.8 + 0.15 (CI95%) dBrms re: 1 μPa, which was significantly greater than the background noise level of 103.9 + 0.05 (CI95%) dBrms (CI95%) ($w=420410$, $p<0.01$). Spawning was confirmed during the hurricane at two sites within the eye of the storm. Daily spawning continued after the hurricane, but the onset of spawning shifted 2.2 hours earlier ($w=4948$, $p<0.01$) for five days after the hurricane before returning to the pre-storm time. These results illustrate that spotted seatrout are extremely resilient and may explain why regional populations and fisheries landings have remained stable despite persistent, intense fishing pressure and environmental variation.

Positive impact of reduced fishing pressure on the popular recreational finfish of Aransas Bay following Hurricane Harvey

Evan Pettis*; Texas Parks & Wildlife Department, Coastal Fisheries

In the wake of Hurricane Harvey, significant reductions in fishing pressure contributed to increased abundances of recreationally-important finfish in the Aransas Bay system. The Texas Parks and Wildlife Department (TPWD) assessed fisheries dependent and independent data in the months immediately before and after the storm for the most highly-sought species in this bay system (Red drum and Spotted seatrout) and compared it to our historical datasets. In September 2017, local fishing pressure declined more than 85% compared to the previous year due to a number of factors. As a result, fall gill net catch rates for both species increased compared to catch rates in 2016. Moreover, angler catch rates documented in TPWD creel surveys increased in the months following Harvey. While fishing pressure rapidly rebounded to expected levels through spring 2018, the abundance of these species appears to have continued trending upwards. TPWD will continue closely monitoring these trends to further assess the long-term impacts of the storm.

Abstracts for Poster Presentations

A multi-tissue organotypic human in vitro model for rapid hazard identification of environmental chemicals and mixtures

Zunwei Chen*, Lora Yanagisawa, Weihsueh Chiu, Ivan Rusyn; Texas A&M University (*Student poster)*

Environmental disasters such as flooding during hurricane Harvey in August 2017 may have led to redistribution of contaminants from industrial and hazardous waste sites that may result in the risk to the residents who live in close proximity. Traditional assessment methods cannot quickly determine the chemical composition and potential hazard of the exposures to hazardous mixtures after emergency events. Therefore, new methods are urgently needed to give faster response to environmental emergency events. This study aimed to test whether a compendium of human cell lines can serve as a model to evaluate potential health hazards of complex environmental mixtures in a rapid manner. Towards this goal, 42 chemicals that are known contaminants at Superfund sites that represent a diverse range of chemical classes (heavy metals, pesticides, industrial chemicals, polycyclic aromatic hydrocarbons and plasticizers) were used and 16 mixtures were prepared from these chemicals as a test. We used human induced pluripotent stem cell (iPSC)-derived hepatocytes, neurons, endothelial cells and cardiomyocytes to model different tissues. Dose-response testing included evaluation of both physiological and cytotoxicity endpoints using high-content imaging. Point of departure values were derived and integrated in ToxPi software. Our data revealed group-specific similarities among 42 representative chemicals. Data integration in ToxPi software further identified group-specific clusters and cell-specific effects of different groups and chemicals. The data from 16 designed mixtures indicated that there effects were dose-dependent and mixture-dependent. In summary, we demonstrate the potential applicability of in vitro screening approaches to be used to test and group complex environmental mixtures thereby providing faster response to environmental emergency events.

The effects of Hurricane Harvey on dissolved and sedimentary toxic trace metals in Galveston Bay: a time-series analysis

Jessica Fitzsimmons*, Laramie Jensen, Hannah Adams; Department of Oceanography, Texas A&M University

Galveston Bay is an “anthropogenic” estuary that experiences both natural estuarine processes and also significant anthropogenic fluxes from the greater Houston and Dallas-Ft. Worth metropolitan areas upstream. Galveston Bay pollution can be especially significant because of the manifold petroleum, chemical, and manufacturing industries that lie within its watershed, though significant cleanup has been undertaken for decades. Of particular concern are heavy metal concentrations, such as lead, mercury, arsenic, cadmium, antimony, chromium, nickel, copper, and zinc, which can result from industrial pollution. These metals can reach toxic levels in both waters and sediments, with carcinogenic and neurotoxic effects on humans but

also detrimental or even fatal effects on the fisheries and wildlife of the waters and benthos. Here, we will present the effects of Hurricane Harvey's >1m of rain that flooded the greater Houston metropolitan area on toxic metal loads, both dissolved in the waters and also in sediments, from four cruises to Galveston Bay: one before Harvey in June (baseline), two in the 3 weeks immediately following Harvey in September (impact), and one in November (recovery) after about one residence time of bay water flushing after Harvey. We recorded >10x increases of dissolved lead to the waters of Trinity Bay following Harvey, while dissolved cadmium, nickel, copper, and zinc concentrations were diluted or remained constant in Galveston Bay following Harvey. In the sediments, arsenic was enriched in Trinity Bay following Harvey, while mercury was enriched in North Bay, both to concentrations "at risk" of toxicity to the benthos.

Impact of Major Hurricanes to Hit Texas Coastal Bend Regions

Audrey Garza; Atmospheric Science Program; Department of Physical and Environmental Sciences – TAMUCC

The purpose of this research is to compare and contrast past hurricanes such as, Carla, Beulah, and Celia, to the recent hurricane Harvey that struck the Texas Coast, in order to establish meteorological backgrounds associated with these storms. The different categories of comparison include: hurricane strengths and tracks, historical rainfall totals, and local impacts. Much of the local impacts for the past storms are summarized from preliminary and final reports published by the Army Corps of Engineers, correspondence and reports from the Russell Mozeney Collection and other sources located in the Special Collections and Archives Department of the Mary and Jeff Bell Library at Texas A&M University Corpus Christi, the Daily Weather Map online site, the Monthly Weather Review, the Weather Underground website, and the online National Oceanic Atmospheric Administration Library. The preliminary results of this study demonstrate that hurricanes Carla in 1961, Beulah in 1967, and Celia in 1970 have many similarities to the recent hurricane Harvey in 2017. Both, hurricane Carla and Harvey are similar in size and strength. Each of these storms was massive in size and reached category four in strength. All of these storms possessed a similar hurricane track. Rainfall totals between hurricanes Beulah and Harvey were unpresented at the time each occurred. Thus far, the historical data reveals that both hurricane Harvey and Beulah devastated different areas of Texas with historic floods. In conclusion, the synoptic scale patterns exhibit that what occurred with hurricane Harvey was unique, but not unseen in the past. Hurricanes Carla, Beulah, and Celia all displayed certain characteristics and atmospheric conditions that mirrored hurricane Harvey.

Hurricane Harvey and South Texas Tropical Cyclones

Jacob Hale*, Anthony Romero, Ali Kohutek, Joseph Hill; Atmospheric Science Program; Department of Physical and Environmental Sciences – TAMUCC

Hurricane Harvey made landfall near Port Aransas, Texas, August 25-26, 2017. Hurricane Harvey was the first hurricane to hit the Texas Coast since Hurricane Ike in September 2008 (US Department of Commerce, NOAA, National Weather Service, 2017). Varying degrees of

damage occurred along much of the Texas Coastal Bend providing an opportunity to study and place this major hurricane in the context of previous Texas Hurricanes. During the period 1950-2017, ten major hurricanes impacted South Texas: Audrey (1957), Carla (1961), Beulah (1967),Celia (1970), Allen (1980), Alicia (1983), Bret (1999), and Harvey (2017) (Roth, 2010). Harvey was the first major hurricane to strike South Texas since Celia in 1970 (U.S Department of Commerce, 2017). With all of the recent press coverage of major hurricanes in 2017, it is important to put them into context with past land-falling hurricanes in Texas. This study examines Hurricane Harvey and its local landfall, and compare it to past major hurricanes that also made landfall in South Texas. Factors we consider in comparing Harvey to other past hurricanes include maximum sustained winds, minimum central pressure, and storm surge. Several of the past hurricanes to make landfall in South Texas experienced rapid intensification including, Celia, Brett and Harvey. We evaluate each of these hurricanes' process of rapid intensification and potential secondary eyewall replacement where applicable. Furthermore, we address the magnitude of the damage that each hurricane caused on the communities they impacted. In order to evaluate Hurricane Harvey observations will be gathered from the Texas A&M University – Corpus Christi (TAMUCC) weather station, as well as stations surrounding the coastal bend that are monitored by the Texas Coastal Ocean Observation Network (TCOON) and the National Water Level Observation Network (NWLON). The ERA-Interim reanalysis product from the European Center for Medium-Range Forecasting is also used to fill in gaps of data where necessary.

Understanding Hurricane Harvey and its Challenges for Evacuation: The Case of Corpus Christi

[1]Dean Kyne, [2]Billy Delgato; [1]Assistant Professor, Disaster Studies MA Program, Department of Sociology and Anthropology, The University of Texas Rio Grande Valley; [2]Emergency Management Coordinator, Office of Emergency Management, City of Corpus Christi Fire Department

On Friday August 25, 2017, Hurricane Harvey made landfall in an area between Port Aransas and Port O'Connor, Texas. The City of Corpus Christi, which was in close proximity to the landfall area, was impacted. Hurricane Harvey developed from a tropical wave to Category 4 hurricane during the course of 19 days. During that time, the hurricane development demonstrated a volatile nature with dynamic changes in the forecast information, which was essential for authorities to prepare and plan for evacuation. Based on the changes in hurricane forecast information, the City's authorities had to adjust the plan for evacuation and execute the evacuation order at an appropriate time. This study examines the relationship between the Hurricane Harvey timeline and the timeline of the authorities' disaster and emergency management activities during the 19 days in Corpus Christi. This included planning for evacuation, formulating mitigating strategies, making necessary adjustments to the evacuation plan, and coordinating with other agencies. The study utilizes a case study method with a focus on the Corpus Christi area. The study's findings contribute to a better understanding of the hurricane evacuation process and best practices.

Impact of Hurricane Harvey on Benthos

Paul Montagna*, Xinping Hu, Michael Wetz; Texas A&M University-Corpus Christi

Hurricane Harvey made landfall Friday 25 August 2017 as a Category 4 hurricane, which is the strongest hurricane to hit the middle Texas coast since Carla in 1961. After the wind storm and storm surge, coastal flooding occurred due to the storm lingering over Texas for four more days producing a flood event. The Texas coast is characterized by lagoons behind barrier islands, and their ecology and biogeochemistry are strongly influenced by coastal hydrology. The ensuing inflow event replaced brackish water with fresh water that was high in inorganic an organic matter, significantly enhancing respiration of coastal blue carbon, and dissolved oxygen went to zero for a long period of time. Benthos were severely reduced in the aftermath of the storm, but recovered by spring 2018. The rapid recovery indicates that natural ecosystems are resilient.

The Quiet During and After the Storm: Using Deviations in Social Media Activity to Identify Disaster

Rachel Samuels*, John Taylor; Georgia Institute of Technology (*Student presentation)*

In the midst of disaster, real-time information from affected persons is integral to emergency management agencies' understanding of the distribution of damage on the ground. The need for real-time data was particularly evident in the context of Houston during Hurricane Harvey, in which flood predictions were dangerously inaccurate. Previous research has shown that spikes in social media activity are significantly correlated with areas experiencing hurricane damage and could be used as a near real-time indicator of hazard; however, these studies failed to account for the possibility of people who have lost access to internet, power, or who otherwise lack the ability or compulsion to use social media. Areas of weaker energy infrastructure or intermittent internet access are likely to house disadvantaged populations, and focusing on spikes of social media activity would ignore these populations who might need help the most. Our research finds a significant correlation between hurricane damage and deviations in social media activity, which catch both irregular spikes and activity drop-offs. Using deviations instead of spikes will incorporate the populations who have lost the ability or inclination to Tweet, thus incorporating them into a more equitable and, as our research shows, stronger near real-time indicator of the impact of hurricane damage.

Productive and Problematic Volunteer and Official Rescue Communication

Keri K. Stephens* Dhiraj Murthy, Brett Robertson, & Roth Smith; The University of Texas at Austin

Widespread disasters can overload official agencies' capacity to provide assistance, and often volunteer, citizen-led groups emerge to assist with disaster response. This was the case in Hurricane Harvey as citizens who needed rescue experienced problems calling 9-1-1, and by working together, officials and volunteers answered these "calls for help." But the communication platforms used in this 2017 disaster were different from past hurricanes: social media has expanded and mobile phones have reached critical mass. Here we report the

findings of Phase I of our NSF-funded research by focusing on how rescuees and rescuers harnessed network and mobile tools. We conducted field interviews that included Photo-Elicitation Interview (PEI) techniques to understand how text and images on social media functioned during rescues. Phase II is underway and we are using the Phase I findings to train our artificial-intelligent computer agents to identify when people need rescue. We found that volunteer rescuers used diverse mapping and radio apps, along with shared social media-related platforms, to play one of three roles: rescuer, dispatcher, or information compiler. The key social media coordination challenges these rescuers faced were incomplete feedback loops, unclear prioritization, and communication overload. A big communication hurdle was interoperability. The proprietary radio-based systems used by official rescuers were disaster resilient, but excluded civilian communicators, as well as officials in neighboring counties who did not use compatible systems. Dr. Keri K. Stephens (BS TAMU biochemistry, Ph.D. UT Austin organizational communication and technology) uses her biochemistry and environmental chemistry background to conduct social scientific research.