Freshwater Inflows Abstracts

BIOINDICATORS FOR FRESHWATER INFLOWS. IMPORTANCE OF NUTRIENTS FOR PHYTOPLANKTON.

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Increased population growth and industrialization has resulted in intense development of coastal areas worldwide. Resulting land-use changes have exacerbated runoff, municipal discharges, agriculture and contaminant loading to estuaries. With nutrient loading, changes in phytoplankton biomass, productivity and community structure have been observed as well as an increase and frequency of harmful algal blooms. Galveston Bay, Texas, provides a unique opportunity to study this phenomenon. The Trinity River supplies nitrogen (N) primarily as nitrate while the San Jacinto River supplies N primarily as ammonium in the upper Bay. In the lower Bay, there is an opening to the Gulf of Mexico and freshwater inflows are less influential. We hypothesize that the phytoplankton communities will respond differently to both the quantity and quality of the nutrient pulses across the Bay. Phytoplankton pigment and microscopic analyses (2008-2014) show an increase in biomass and productivity in the upper Bay compared to the lower Bay. Frequently the peaks in biomass were closely timed with those of freshwater inflows, although seasonal patterns were stronger and more important. Inversely in the lower Bay, biomass and productivity were not related to freshwater inflows or nutrients, but more frequently influenced by season. Across the Bay, we see a temporal shift from diatoms and dinoflagellates in the cooler months to cyanobacteria in the summer months. In years when there are prolonged periods of low flow, warm weather, we frequently see dinoflagellate blooms, some of which include harmful species (ex. *Karenia brevis, Dinophysis ovum*). In years when there are multiple freshets and warm weather earlier, diatom blooms occur in both the spring and early fall. We will apply the findings of this long term data set toward a better understanding of the phytoplankton community in relation to the dynamical forcing factors varying spatially and temporally within Galveston Bay.

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Poster presentation requested, oral presentation acceptable.

Topical area: Freshwater Inflow and Bay Circulation

INFLUENCE OF WATER QUALITY & FRESHWATER INFLOW ON TROPHIC ORGANIZATION IN TEXAS: HOW DOES GALVESTON BAY FIT IN?

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Within coastal bay systems, several mechanisms influence abiotic and biotic elements. The Texas coast is subject to varying climatic influences including hurricanes, drought, and extended periods of heavy rainfall. Alterations in levels of freshwater inflow into the estuarine ecosystem can have dramatic effects on water quality, primary production, and the abundance, distribution, and organization of various organisms. Data from this study was collected in conjunction with data compiled for the US Environmental Protection Agency's (US EPA) National Coastal Condition Assessment (NCCA) during the summer of 2015. These data were compared to historical records collected by probabilistic sampling programs conducted by the US EPA, US Geological Survey (USGS), the National Oceanographic and Atmospheric Administration (NOAA), and the Texas Commission on Environmental Quality (TCEQ). Data compiled include water temperature, salinity, turbidity, various nutrients, primary production, and catch per unit effort (CPUE) rates on various trophic groups of nekton collected with otter trawl. Supplemental water quality data was compiled from the TCEQ's Surface Water Quality Monitoring Information System (SWQMIS). Freshwater inflow estimates were derived from historical data collected by USGS monitoring stations on rivers directly adjacent to Texas' bays. Additionally, precipitation data collected by NOAA weather stations and buoys were compiled. Data gathered by the US EPA in their 2010 NCCA sampling were compared to values recorded during the 2015 NCCA to determine overall changes in variables used to assess water quality and trophic status of bays within the state. Data collected for Galveston Bay was compared to other bay systems within the state in order to elucidate differences in water quality and tropic organization. By understanding the influence of land-use changes and historical trends in water quality and freshwater inflow on nekton within Texas' bays, researchers can assist resource managers in the long-term conservation and management of the Galveston Bay ecosystem.

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Presentation Type: Poster

Requested Panel Session: Monitoring and Research

MODELING 63 YEARS OF SALINITY CONDITION IN GALVESTON BAY

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Texas is prone to multi-year droughts interrupted by watershed-drenching episodes of rainfall. Texas estuaries, lying at the receiving end of these catchments, are affected by subsequent highs and lows of surface inflows draining from inland watersheds which directly impact salinity condition, nutrient loading, and a variety of estuarine attributes. Historic records provide some measured insights into salinity condition and species responses at particular locations and times, but broader insights into whole-bay patterns of salinity over extended periods do not exist ... until now. That is, until we developed a 63-year simulation of salinity condition in Galveston Bay using the Texas Water Development Board's TxBLEND hydrodynamic and salinity transport model. For this, we compiled input for river hydrology, tidal elevation, precipitation, evaporation, and salinity boundary condition and developed model grids representative of changing bathymetric conditions over a 63-year period from 1950 - 2012. This exploratory effort resulted in a modeling tool for examining the impact of long-term patterns of freshwater inflow, as a result of drought and water-planning activities, on salinity condition in Galveston Bay. The simulation period allowed for examination of salinity patterns from Texas' historic drought of record in the 1950s to the recent, ongoing drought of today.

TxBLEND simulates salinity condition, water level, and circulation in estuaries and has been calibrated and validated for velocity, water level, and salinity over the period 1987 – 2005. However, historic salinity records were critical for evaluating model performance for 1950 – 1986 and 2006 – 2012. Fortunately, nearly 6,000 independent measurements of salinity, in addition to long-term monitoring records from 13 stations, were available for model validation. Model performance was evaluated by r^2, root mean square error, Nash-Sutcliffe efficiency criterion, and percent bias. Overall, TxBLEND captured well the long-term rise and fall of salinity in response to periods of drought and high inflows, but tended towards overprediction during the earlier period and in upper estuary locations. The model also failed to accurately capture short-term, high frequency variability in salinity. Intended to be a proof of concept, results from this multi-decadal simulation of salinity condition will be presented and discussed with respect to future applications which also must consider model performance and the need to improve model validation through further refinement of TxBLEND and acquisition of additional salinity data, particularly during the drought of the 1950's. The report (Guthrie *et al.* 2014) is available here:
www.twdb.texas.gov/surfacewater/bays/major_estuaries/trinity_san_jacinto/index.asp.

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Oral presentation

Suggested areas: Freshwater Inflow & Bay Circulation

PRO-ACTIVE APPROACHES TO SECURE FRESHWATER INFLOWS: INVESTIGATIONS OF SCOPE, SCALE, AND FEASIBILITY

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Projections of future water use in the river basins feeding Galveston Bay indicate the potential for amplification of the length and intensity of naturally-occurring drought conditions. However, there are pro-active means available that could ameliorate the severity of these conditions. Examples are voluntary wastewater dedications or market-driven transactions with willing participants to dedicate or re-manage existing water diversions to maintain or increase freshwater inflows to benefit the estuary.

We are evaluating ecosystem benefits that could be attained with example projects, including Trinity River acquisitions and the recent wastewater dedication by the City of Houston in the San Jacinto basin. The tools employed for effects assessment include salinity change modeling and habitat quality assessments for key bio-indicators. The results thus far have provided significant insights into data needs and spatial scale for evaluating such projects.

Ideally, evaluation techniques should be ‘scale-able’ to allow assessment of benefits of both large and small projects. Unfortunately, we find that data to support finer-scale assessment of ecosystem bio-indicators and the resolution of evaluation tools, such as salinity models, often fall short of what is needed to assess smaller-scale projects. This points to the need to invest in development of finer-scale models and more site-specific habitat characterizations to inform future management decisions.

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Type: Oral Presentation

Suggested Topical Area: Freshwater Inflow and Bay Circulation

BIOINDICATORS FOR FRESHWATER INFLOWS: DROUGHT EFFECTS ON PHYTOPLANKTON

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Galveston Bay, the seventh largest estuary in the United States, includes in its watershed the Houston and Dallas-Fort Worth metropolitan areas. Increase of freshwater use due to increase in occurrence and severity of droughts in the watershed is a concern for productivity in this economically important estuary. We report on the spatiotemporal variability of phytoplankton community resource limitation as a result of freshwater inflows. Six cross-system sites, representing the gradient of freshwater inflows into the Bay and Gulf, were sampled over 3 years (2010 to 2012) in March and July (high and low freshwater inflows, respectively), including a year of severe drought (2011). Bioassay treatments included eight nutrient-addition combinations, shaded, and grazers excluded. High Performance Liquid Chromatography (HPLC), coupled with ChemTax, was utilized to characterize the structure of phytoplankton communities via photopigment biomarkers. Dominant phytoplankton groups changed spatially and seasonally, but varied little between treatments. Diatoms, cyanobacteria, and chlorophytes were dominant in 2010 and 2011, but dinoflagellates were dominant in 2012, particularly in the spring. This was contrary to expectations of different dominant phytoplankton groups in 2011 compared to non-drought years. Limitation specific to each group differed spatially between seasons and across years, when limitation was present. During 2011 more groups exhibited nutrient limitation than in non-drought, with the exception of one river basin station. NO_3^- (N) and P were co-limiting across all stations during high flow, in addition to the combination of N, P, Si, and NH_4^+ (A). N and A were limiting across all stations during low flow, in addition to light in the mid-bay. Across stations, 2010 was not different from 2011; 2012 was different from 2010 and 2011. The drought year was different from the non-drought years, with the exception of one mid-bay station.

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Oral presentation desired, will accept poster presentation
Topic: Freshwater Inflow and Bay Circulation

EVALUATING FRESHWATER INFLOW, NUTRIENTS, AND SEDIMENT SUPPLY FROM THE TRINITY RIVER INTO GALVESTON BAY

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Research by the U.S. Geological Survey on the Trinity River, in conjunction with the Texas Water Development Board and the Galveston Bay Estuary Program, shows that discharge data from upstream gages, commonly used to estimate freshwater inflows into coastal ecosystems, may not represent actual discharge into Galveston Bay. This discharge attenuation appears to be a result of tidal influences near the coastal entrance and overland storage during storm events. Thus, enhancements to individual measurements and subsequent discharge computations for continuous monitoring in the lowest reach of the river are needed to ensure an adequate understanding of the mixing and physical exchange in the estuarine water. Additionally, the supply of nutrients and sediment entering Galveston Bay through the Trinity River is not well known, particularly during high flow periods, when substantial pulses from the rivers have a potential to affect bay productivity. Obtaining accurate freshwater inflow and nutrient/sediment input is fundamental to the assessment of the physical, chemical, and biological processes governing this aquatic system and imperative for regulating environmental flows for a sound ecological environment.

In tidally affected areas, index velocity methods are commonly applied to compute discharge by using acoustic Doppler meters. This method differs from the traditional stage-discharge method by separating velocity and area into two ratings, and it is also more appropriate when more than one specific discharge can be measured for a particular stage. USGS, in cooperation with Texas Water Development Board and the Galveston Bay Estuary Program, installed an acoustic Doppler meter in the Trinity River (Station Number: 08067252) and developed and index velocity rating to obtain a continuous record of discharge. This continuous record is used to estimate freshwater inflows into Galveston Bay and compare to discharge data from upstream stations commonly used for these estimates. In addition, water quality samples were collected to determine nutrient and sediment concentrations over a range of hydrologic conditions and evaluate Trinity River contributions to the Galveston Bay ecosystem. These improved methods for determining freshwater inflow contributions of discharge, sediment, and nutrients may be useful for inclusion in hydrodynamic and water quality models and may help fill a data gap of the volume of freshwater inflow entering Texas coastal ecosystems.

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Oral Presentation

BIOINDICATORS OF FRESHWATER INFLOWS: PHYTOPLANKTON DIVERSITY

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Galveston Bay, the largest watershed in Texas, is impacted by anthropogenic nutrient inputs from two growing major cities: Houston and Dallas-Fort Worth. Expansion of the Panama Canal in 2016 will lead to an increase in shipping into Galveston Bay, which in turn will lead to an increase in discharge of ballast water into the bay. These two inputs combined are likely to lead to an increase in invasive phytoplankton species and nutrient inputs and ultimately an increase in the frequency of algal blooms, some of which may be harmful. Because of this, it is important to understand the current phytoplankton diversity in order to know which harmful algal species are present, when they are abundant, and when they are most likely to produce blooms. Ultimately this information will provide early detection, avoid human illness from shellfish poisoning and possibly lead to regulation of nutrient inputs. Historically, diatoms have been found to be the most abundant phytoplankton in the winter and spring, when nutrient inputs into Galveston Bay are higher due to increased freshwater inflows. Small flagellates and cyanobacteria have been found to be the most abundant phytoplankton during times of warmer weather and low nutrient inputs due to low freshwater inflows into Galveston Bay. Daily samples are being taken from Galveston Bay near the entrance to the Gulf of Mexico. These samples will be examined with an Imaging FlowCytobot to document community composition shifts down to lowest practical identification level. Diversity will be assessed with traditional indices including the Shannon-Weiner and Simpson’s diversity indices. Compared to previous studies, this approach will allow us to characterize much finer scale community composition changes concurrently with those in temperature and salinity. This information will also provide a library of phytoplankton types in Galveston Bay and, with concurrent water quality data, will be used to develop predictive tools or determine under which scenarios if any, harmful algal blooms are more likely to occur.

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Presentation Preference: Oral presentation preferred, will consider poster presentation if oral submittal not selected

Topic Area: Freshwater Inflow and Bay Circulation

BIOINDICATORS FOR FRESHWATER INFLOWS. IMPORTANCE OF PHYTOPLANKTON AS A METRIC FOR BAY HEALTH.

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Freshwater inflows play a key role in the biological complexity of estuarine ecosystems both temporally and spatially. Anthropogenic and natural stressors add to this variability and may negatively impact the biota. The population in Texas is expected to double by 2060 and with this growth comes a 27% increase in the demand on freshwater resources. To determine and then monitor the environmental quality within the Bay, a suite of freshwater bioindicators were selected. Included in a list with plants, clams, oysters (their disease and predators) as well as a variety of fish, are the phytoplankton. We have data for water quality and phytoplankton pigments from 2008 to 2013 for six fixed stations in Galveston Bay. A meta-analysis of this multi-year data set was used to examine significant relationships between biotic and abiotic factors. The multivariate statistic package PRIMER-e + and the PERMANOVA add on package were used to perform the analysis. Findings reveal that the following groups are the most important contributors to this Bay: cyanobacteria, diatoms, dinoflagellates, chlorophytes, and cryptophytes. In general, we found cyanobacteria were associated with higher salinities and warmer temperatures. This influenced the timing of blooms and the location. Diatoms by far appeared to be dominant across the entire bay and generally present at the highest concentrations during most times of the year. While dinoflagellates were present across the entire Bay, they were generally in lower concentrations than the diatoms but higher than the chlorophytes. Cryptophytes were associated with higher salinity waters and more prevalent after freshwater inflow events, but only if the freshets were significant in both magnitude and duration. The use of a variety of bioindicators of freshwater inflow is important for capturing the response to temporal and spatial changes in freshwater inflows over a variety of time scales. The findings from this study will be used to facilitate biological assessment of other Texas estuaries those further afield.

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Oral presentation requested, poster presentation acceptable.

Topical area: Freshwater Inflow and Bay Circulation

A Coastwide Perspective on Defining and Characterizing Drought Events in Texas Estuaries

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Texas estuaries are vulnerable to natural reductions in freshwater inflow now more than ever due to increasing demands for freshwater resources that have the potential to induce drought-like inflows at intervals more frequent than experienced by natural droughts. However, methods to identify drought effects in estuaries commonly are defined by conditions occurring within contributing watersheds as opposed to conditions occurring within the estuary itself. The focus of this study was to employ a method that allows conditions specific to an estuary (*i.e.,* surface inflow) to define a period of drought. Using a modified approach from Ward (2010), residual mass curves depicting cumulative inflow deficits were calculated for inflow records spanning up to 73 years to identify historical periods of drought in ten Texas estuaries. Droughts were defined as periods in which monthly inflow was below a specified drought criterion of 60 percent or less than long-term mean monthly inflow, for at least a minimum of one year. This presentation will describe drought characteristics and frequency among Texas estuaries as determined by the cumulative inflow departure method using drought metrics such as intensity, severity, and duration to compare drought events across estuaries and also will include an evaluation of corresponding salinity conditions.

Texas estuaries experienced between ten and 15 drought events over the 73 year period, and multi-year drought periods were common. In all ten estuaries, the cumulative inflow departure method identified either the drought of record (during the 1950's for most of Texas) or the recent, ongoing drought as one of the longest, most severe, or most intense. Surprisingly, upper coast estuaries that receive high annual inflow volumes recorded just as many drought events as the more arid lower-coast estuaries, although events on the upper coast tended to be of shorter duration. Upper-coast systems accumulated large deficits, upwards of 40 million acre-feet, during long drought events; whereas, the arid lower-coast estuaries accumulated less inflow deficit and also experienced less intense and less severe droughts. Increased salinity condition ranging from three to ten additional practical salinity units was observed during drought periods in all estuaries. This analysis demonstrated that drought is a frequent factor affecting estuarine health and productivity in Texas, but also that the cumulative inflow departure method identified periods in which estuaries experienced low inflow conditions that may not be captured by more typically reported terrestrial drought indices.

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Oral presentation

Suggested areas: Freshwater Inflow & Bay Circulation

WATER USE EFFICIENCY AND WATER CONSERVATION EDUCATION AS TOOLS TO MANAGE WATER RESOURCES IN THE GREATER HOUSTON-GALVESTON AREA

Emily Seldomridge, Galveston Bay Foundation, Webster, TX

Managing and protecting our water resources is one of the most critical issues facing Texas today. In particular, the population of Region H (the state water supply planning region of the Houston-Galveston area) is expected to roughly double between 2010 and 2060, which puts additional strain on currently limited water resources. About two-thirds of the total amount of water supply in Region H is surface water. The Initially Prepared 2016 Regional Water Plan projects Region H water shortages in the year 2020 to total 224,217 acre-feet per year, increasing to as much as 1,017,548 acre-feet per year in the year 2070. Improving water use efficiency allows communities to stretch existing water supplies and postpone or eliminate the need for expensive and environmentally damaging water supply projects, such as large reservoirs.

In Region H, one of the most cost effective measures to improve water use efficiency is to reduce discretionary water use (i.e., outdoor lawn and landscape irrigation). Current Region H outdoor water use accounts for one-third to nearly one-half of residential water use. Limiting outdoor irrigation to no more than twice per week may save as much as 38,000 acre-feet per year (based on current water use levels). By 2060 this equates to a savings of 62,348 acre-feet per year, which could potentially avoid $200 million in infrastructure costs. Houston's climate allows residents to use considerably less water on outdoor lawn and landscape irrigation, but Houstonians still use more water on a daily basis than the residents of drier regions such as Austin, El Paso and San Antonio. Therefore, water conservation education is fundamental to successful water use efficiency.

Through the Texas Living Waters Project, Galveston Bay Foundation in partnership with National Wildlife Federation and Sierra Club are working to advance water conservation education through a variety of tools including the Gulf Coast/Montgomery County Water Efficiency Network (a forum for water professionals to discuss successes and challenges to implementation of water conservation measures), an outdoor irrigation challenge to turn off automated controllers during winter months, a water conservation pledge to join the Galveston Bay Water Brigades, as well as public service announcements. Water use efficiency and water conservation education provide a significant opportunity to ensure water is available to meet all critical needs including water to support healthy rivers, bayous, and Galveston Bay.

While some water utilities have begun to realize the potential of water efficiency, the Houston-Galveston region has yet to take full advantage of the cheapest, most reliable, and most sustainable source of water – the one that's already on tap.

BIOINDICATORS FOR FRESHWATER INFLOWS: MICROBIAL TRAITS

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Heterotrophic microbial abundance and growth rates can be limited by inorganic nutrients in estuarine systems where allochthonous subsidies to autochthonous carbon spatiotemporally saturate heterotrophic carbon requirements. However, the eco-physiology of estuarine heterotrophic microbes in relation to nutrient availability in Galveston Bay remains poorly understood. A multivariate statistical analysis was conducted using the PRIMER/PERMANOVA packages and combined with a trait-based approach in order to target variability in the heterotrophic community associated with freshwater inflow events. Physiological groups were determined by differences in nucleic acid content using flow cytometry. Results indicate that there are significant temporal correlations between the relative abundances of heterotrophic physiological groups and a combination of temperature and dissolved inorganic nitrogen (DIN) availability. During warm temperatures (>28.1°C) and low DIN availability (<0.21 µmol L^{-1}) a unique heterotrophic physiological community structure was observed. Similarly, a significant shift was observed during a low salinity (<10.1) high DIN availability (>11.1 µmol L^{-1}) freshwater inflow event. Corresponding mesoscosm enrichment experiments validate episodic nitrogen limitation of heterotrophic groups. The timing of the different physiological groups response to nutrient enrichment supports the concept that lower nucleic acid fractions potentially have 'streamlined' genomes that garner a competitive advantage during nutrient limitation conditions while relatively higher nucleic acid fractions have more ecological plasticity and are more competitive during nutrient replete conditions. These findings suggest that nucleic acid content traits reflect ecological heterotrophic responses to environmental conditions, which could ultimately be utilized as bio-indicators of sustained freshwater inflow.

Bioindicators of Freshwater Inflows: Response to the TR/SJR BBEST recommendations

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Freshwater inflows play a key role in the biological complexity of estuarine ecosystems both temporally and spatially. Anthropogenic and natural stressors add to this variability and may negatively impact the biota. The population in Texas is expected to double by 2060 and with this growth comes a 27% increase in the demand on freshwater resources. With >11 million people currently residing within the Galveston Bay watershed pressure on freshwater resources will continue to increase. To determine and then monitor the environmental quality within the Bay, a suite of freshwater bioindicators were selected. The current bioindicators target both low salinity (*Rangia cuneata, Brevoortia patronus,* and *Ictalurus furcatus*) and high salinity conditions (*Lagodon rhomboides, Perkinus marinus* and *Stramonita haemastoma*). A meta-analysis of a 30 year data set pooled from various state agencies was used to examine significant relationships between biotic and abiotic factors using multivariate statistic package PRIMER-e + PERMANOVA add on package. Preliminary findings suggest that *Ictalurus furcatus, Perkinus marinus* and *Stramonita haemastoma* have a strong potential to be considered bioindicators of freshwater inflow and may be applicable to other bay systems. *R. cuneata*, *B. patronus* and *L. rhomboides* need further analysis before an evaluation can be finalized. Further efforts will be towards analyzing the variability in phytoplankton pigments in relation to environmental factors to determine their potential as bioindicators. The use of a variety of bioindicators of freshwater inflow is important for capturing the response to temporal and spatial changes in freshwater inflows over a variety of time scales. While phytoplankton would allow for early detection of disturbances, clams and fish provide an integrated view over a period of years. The findings from this study will be used to facilitate biological assessment of other Texas estuaries those further afield.

BIOINDICATORS OF FRESHWATER INFLOW: *RANGIA CUNEATA*

Rachel Windham, Texas A&M University at Galveston, Galveston, TX

Antonietta Quigg, Texas A&M University at Galveston, Galveston, TX

Freshwater inflows are critical for success in both human and ecological spheres. Projections for growth in Texas predict increasing populations in coming decades which will increase demands on the state's available freshwater. To understand the relationship between environmental flow regimes and the ecosystems they support, environmental managers quantify the environment's demand by observing the responses of organisms within the ecosystem to changes in resource delivery. Organisms which are sensitive to such changes are known as bioindicators. In Texas, the brackish-water clam *Rangia cuneata* was selected as a potential bioindicator of the impacts of changes in freshwater inflow due to literature citing the organism's narrow range of salinity tolerance and limited mobility. For Galveston Bay, a vast historical record of both clam distribution and concurrent environmental parameters has been maintained by state agencies since 1983. A synthesis of this dataset was used to define trends in *R. cuneata* distribution and abundance and determine whether those metrics have historical relationships with environmental parameters. These data informed a present-day study of *in situ* populations of *R. cuneata* in Galveston Bay examining the relationship between clam health and environmental flows on a fine, qualitative scale. After three years of study from 2012 to 2014, a decrease in mean rangia meat indices and increases in mean shell lengths and areal density were observed. These findings support the hypothesis that rangia in Galveston Bay are aging faster than their rate of recruitment. Multivariate statistical analyses of clam health metrics and concurrent environmental parameters support a link between rangia health and variables influenced by freshwater inflow including salinity; however, the results were not robust enough to support the hypothesis that freshwater inflows are the primary driver of rangia health. This weakens the argument for its fitness as a bioindicator.

Habitat Protection Abstracts

MAXIMIZING WETLAND RESTORATION SUCCESS IN GALVESTON BAY: LESSONS ON THE INFLUENCES OF CONSTRUCTION TECHNIQUES AND THE SURROUNDING LANDSCAPE

Anna R. Armitage, Department of Marine Biology, Texas A&M University at Galveston, TX

Kathleen Bowers, Department of Marine Biology, Texas A&M University at Galveston, TX

Rebekkah Bergren, Department of Marine Biology, Texas A&M University at Galveston, TX

Antonietta Quigg, Departments of Marine Biology and Oceanography, Texas A&M University at Galveston, TX

Approaches to wetland restoration vary in construction technique, planting strategy, and placement within a larger landscape matrix of wetland habitat. Engineered marshes are often constructed by placing soil in terrace or mound formations; this approach is common in Galveston Bay. In contrast, the relatively less widespread beneficial uses (BU) approach deposits dredge material to fill continuous areas to emergent marsh elevation. Either construction approach can be planted with native species, or colonization can occur naturally. Likewise, either type of wetland can be isolated in a degraded area, or be situated within a network of relict and restored marshes. We investigated how restoration success was influenced by the localized configuration of individual restoration sites and by the placement of that site within a wetland matrix. In October 2014, we surveyed emergent plant characteristics in planted engineered and BU sites along with unplanted BU tidal brackish marshes that varied in size, isolation, and proximity to urban developments near Sabine Lake, TX (USA). Plant biomass, cover, and species richness in BU marshes were similar to reference conditions, regardless of planting technique. In contrast, site-level emergent plant biomass and cover were over 70% lower in engineered marshes than in BU and reference marshes. Restoration failure (defined as emergent plant cover < 10 % and biomass < 0.5 kg/m^2) occurred only in small (< 0.5 km^2) sites, though not all small sites failed. Plant species richness was up to 2x higher in more altered sites that were close (< 1 km) to roads or urban development. Individual restoration sites were highly dissimilar from each other, and some were failures in terms of emergent plant cover. However, when the failed sites were within a relatively large surrounding matrix of successful restored and reference sites, the ecosystem effects of that failure were minimized. Our analysis shows that construction method is less important than the placement of restoration projects within a fairly large wetland matrix in ensuring restoration success. These lessons are directly applicable to the design and implementation of future wetland restoration projects in Galveston Bay.

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Oral presentation requested, poster presentation acceptable.

Topical area: Habitat Protection

WETLAND MITIGATION IN THE HOUSTON-GALVESTON REGION AS RELATED TO REGIONAL TRANSPORTATION PLAN IMPLEMENTATION

Paniz Bighash
Community & Environmental Planning Department
Houston-Galveston Area Council
Houston, Texas

The development of transportation projects sometimes requires unavoidable impacts to wetland resources that normally convey a multitude of ecosystem services. In such circumstances, the US Army Corp of Engineers (USACE) requires transportation authorities to pursue compensatory mitigation to offset adverse impacts associated with a transportation project impacting jurisdictional wetlands. This system allows for communities to sustain the functionality and protection that wetlands provide while allowing prolonged economic development within the same area. Impacts to wetland areas must be avoided and minimized to the greatest degree practicable, but if impacts are ultimately unavoidable, there are various approaches that satisfy compensatory mitigation requirements set by the USACE.

The Houston-Galveston Area Council (H-GAC) has completed a professional white paper outlining the various approaches that satisfy compensatory mitigation requirements for Regional Transportation Plan (RTP) implementation. Also included in the white paper is information about existing and pending wetland mitigation banks in the region. Findings show that the distribution and availability of wetland mitigation credits is disproportionately distributed throughout the region making it clear that future planning should consider expanding the location and credits available to offset future wetland impacts from RTP projects. H-GAC will present an overview of wetland mitigation requirements for RTP implementation in the region as discussed in the white paper as well as provide suggestions for transportation planning and mitigation banking options for the future.

1. Paniz Bighash, Environmental Planner, Community and Environmental Planning Department, Houston Galveston Area Council, 3555 Timmons Lane, Houston, TX 77027, 832.681.2523, Fax: 713.993.4503, and paniz.bighash@h-gac.com.

2. Format Recommendation: Presentation. H-GAC recommends this subject as a presentation.

3. Optional: Suggest presentation would best fit in a Habitat Protection tract for topics such as, wetland impacts, federal requirements, and wetland restoration, protection and mitigation.

SEAGRASS COVERAGE AND AQUATIC HABITAT ASSESSMENT OF GALVESTON BAY

Emma Clarkson, Coastal Fisheries Division: Texas Parks and Wildlife Department, Rockport, TX

Aquatic habitat availability and distribution greatly influence the distribution and abundance of fish and invertebrate species. Therefore, determining the status and condition of aquatic habitats are a key factor in effective fisheries management. Seagrass habitats in particular are economically and ecologically beneficial for estuarine communities. Seagrass beds stabilize sediments, reduce erosion, improve water clarity and quality, and serve as nursery habitat for commercially and recreationally important fish and invertebrate species. Unfortunately, there are several natural and anthropogenic threats to seagrasses, including storm damage, sedimentation, and propeller scarring. Propeller scars occur when the propeller of a boat digs into the bay bottom and uproots seagrass, and the scars typically cause erosion and fragmentation of seagrass habitat.

In an effort to decrease the negative impact of propeller scars in Texas seagrass beds, the Texas Legislature passed a law which took effect September 1, 2013 preventing the uprooting of seagrass with the propeller of a boat. To assess the impact of this legislation, Texas Parks and Wildlife Department (TWPD) has been analyzing aerial imagery in Galveston Bay as well as several other Texas bays to establish the density of propeller scars in seagrass habitats. This imagery has also been used to map the current extent and condition (patchiness, density, etc.) of seagrass beds in these Texas bays.

At the time the Seagrass Conservation Plan for Texas was published (1999), Galveston Bay was predicted to have a severely decreasing trend in seagrass coverage, with only 280 acres of seagrass present in Christmas Bay. The Texas Seagrass Monitoring Workgroup has established a need for updated seagrass distribution estimates for the Texas coast. While intensive field-based seagrass monitoring is occurring on the lower Texas coast from Aransas Bay south to the lower Laguna Madre, no field-based monitoring is currently occurring in Galveston Bay. Therefore, the aerial imagery collected by TPWD in 2015 is the only source for the most current and extensive seagrass coverage mapping for Galveston Bay. In this presentation, the analysis of this aerial imagery will be discussed and updated estimates for seagrass coverage and propeller scar densities in West Galveston Bay and Christmas Bay will be provided.

In addition, current TPWD habitat assessment efforts and projects will also be summarized, with a focus on a newly implemented rapid-assessment habitat monitoring project. This new monitoring project will characterize the aquatic and shoreline habitats associated with TPWD routine resource sampling sites. When this habitat data is assessed at the end of 2016, an aquatic and shoreline habitat map will be interpolated for Galveston Bay from 240 sample sites and may serve to further identify seagrass distribution along the shoreline in Galveston Bay.

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COASTAL HABITAT RESTORATION: LESSONS LEARNED AND A PATH FORWARD TO SUSTAINABLE MANAGEMENT OF CRITICAL MIGRATORY BIRD STOPOVER HABITAT

Peter Deichmann* and Richard E. Gibbons - Houston Audubon

The threat of invasive species is difficult to overestimate. Plants and their microbial environments are the foundation for biological communities and it is this foundation that is being unraveled at key migratory bird stopover habitat on the Upper Texas coast. Invasive species, with no natural predators to keep them in check, outcompete natives for resources replacing highly diverse biotic communities with a drastically simpler community. The result is a reduced prey base in ecosystems (Tallamy 2009). Bird habitat on the Texas coast is at a premium with high demands placed on patchy coastal woodlots from migratory and resident birds. Chinese Privet (*Ligustrum sinense*) is an aggressive in Texas's most storied and visited birding spot. We estimate the extent of invasion to be 75% of the wooded area in the square mile that is High Island. Although volunteers and professionals have worked for years logging thousands of hours to halt the invasion, the number of seeds, runners, and year-round growth of the evergreen plant is outpacing these efforts considerably.

Houston Audubon staff and volunteers are now following a more intensive management regime for invasive species after consulting and working with local and regional invasive plant species experts. This includes a field station with full-time dedicated staff on the coast for habitat management and monitoring. Invasives management is being conducted with several different chemical and mechanical methods. Some methods have proved more effective and feasible given our specific habitat goals. Other methods, while efficient, are not practical for long term invasives control. We present in detail our approach to invasive species management, its successes and the valuable lessons learned.

1. Pete Deichmann, Sanctuaries Manager, Houston Audubon, 440 Wilchester Blvd, Houston, TX 77079; pdeichmann@houstonaudubon.org
2. Oral presentation preferred, panel session suggested for Houston Audubon bird conservation projects 90 minutes with panel session after 20-minute talks. Poster acceptable.
3. Habitat Protection

COMPARING SALT MARSH ECOSYSTEM RESPONSES TO DIFFERENT RESTORATION TECHNIQUES.

Jim Dobberstine; Math, Engineering, and Sciences Division, Lee College

Cindy Howard; School of Science and Computer Engineering, The University of Houston Clear Lake

Abstract

Coastal marsh ecosystems anchored by smooth cordgrass (*Spartina alterniflora*) are some of the most highly productive ecologic communities that provide a number of critical functions and services. In response to substantial loss of these ecosystems in Galveston Bay over the past 50 years, local, state, and federal partners have undertaken active restoration of numerous coastal wetland systems, a priority under the Galveston Bay Plan. Studies indicate that there may be a need to evaluate created and restored marshes to determine ecologic success at the functional level, using the acquired data to tailor restoration strategies accordingly in an effort to maximize success and ensure the persistence and resilience of these marshes into the future. This study focused on the Pierce Marsh complex, a series of restored wetlands within the lower Galveston Bay watershed, and examined whether functional differences are achieved through different marsh restoration techniques. Data collected included *Spartina alterniflora* density and biomass, plant community diversity and importance values, and benthic macroinvertebrate and microbial community diversity, among other metrics. These were collected at five restoration sites of four design types, and an unrestored, natural reference site all within the Pierce marsh complex. Differences were noted among the restored sites, and between the restored sites and the reference site, particularly when examining macronutrient values in the sediments and corresponding shoot densities, plant productivity, and benthic macroinvertebrate and microbial communities. The data suggest that restoration site design can impact ecologic success in restoration projects. Additionally, restoration design may be critical to resilience following disturbances such as tropical storms, further affecting ecologic functional efficacy.

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Presentation Type:
We would like to present as an oral presentation, and as a poster presentation

Topic Area (Optional):
- Habitat Protection
- Shoreline Management

Living Shorelines: Small-Scale Restoration Efforts and Their Ecological Impacts on Local Communities.

Jim Dobberstine; Math, Engineering, and Sciences Division, Lee College

Tia Hall; Math, Engineering, and Sciences Division, Lee College

Lee Anne Wilde: The Galveston Bay Foundation

Abstract

Living Shorelines are shoreline management options that help stop shoreline erosion and enhance aquatic habitat. These efforts are based on the premise that vegetated wetlands form a buffer between high-energy water and adjacent land, limiting or reversing shoreline erosion. Additionally, research suggests that the fringing marsh (wetland edge) is exceptionally important habitat for many important fishery species. Unfortunately, erosion along Galveston Bay's shoreline has exceeded 4 feet per year in many areas. A common response to erosion is to armor the shoreline with a hardened structure such as a bulkhead that offers limited habitat benefits and may increase erosion on adjacent shorelines. As the Galveston Bay system has lost as much as 8% of estuarine emergent wetlands and more than 50% of the freshwater emergent wetlands present in the 1950's through erosion, ground subsidence, and habitat conversion, efforts to restore and protect these important aquatic habitats are a priority under the Galveston Bay Plan.

Anecdotal evidence suggests Living Shoreline projects are an ecologically beneficial option for erosion control and property protection. However, much of the scientific data regarding ecologic function comes from larger scale habitat restoration projects rather than smaller, privately owned sites reflective of many Living Shoreline sites in the Galveston Bay system. For this ongoing study, data was collected at various Living Shorelines sites throughout the Galveston Bay system to attempt to assess the functional aspects of the biologic communities associated with these small-scale restoration projects. This data was compared to unrestored natural marsh reference sites and traditionally armored sites near each project site to ascertain what ecological benefits can be measured. The data suggests that the restored sites are similar to natural sites across a number of the ecologic community characteristics measured, although time may be required before community development achieves ecologic parity with comparable natural sites. Implications for this research suggest that these small-scale shoreline projects can provide viable aquatic habitat benefits while addressing shoreline management concerns of private landowners. As much of the Galveston Bay shoreline is coupled to private lands, the cumulative benefit associated with numerous small-scale projects across the bay system could be substantive.

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Presentation Type:
We would like to present as a poster presentation

Topic Area (Optional):
- Habitat Protection
- Shoreline Management

WETLAND FUNCTIONALITY IN RESPONSE TO ENERGY EXPLORATION AND PRODUCTION OPERATIONS

Stephanie M. Glenn, HARC, The Woodlands, TX

Erin L. Kinney, Coastal Ecology, HARC, The Woodlands, TX

Ryan M. Bare, HARC, The Woodlands, TX

Bradley S. Neish, HARC, The Woodlands TX

Likun Chen, HARC, The Woodlands, TX

Wetlands provide many positive benefits to surrounding coastal ecosystems, both terrestrial and aquatic. Physical benefits of coastal wetlands include wave dampening, flood control and sediment trapping. Chemical processes performed by wetlands include nutrient cycling and contaminant interception. Wetlands also provide ecosystem services that have direct commercial impacts including tourism, birding, hunting, recreational fishing and commercial fisheries. The different functionalities of wetlands are important for long-term resiliency of coastal communities. Wetland loss can contribute to property degradation and disturbance, habitat loss for endangered and commercially important species, disruption of food webs, increases in frequency and scale of flood events, release of land-derived contaminants to fragile coastal ecosystems and release of long-term carbon storage. These environmentally sensitive areas are often found in drilling and exploration properties on the Upper Texas Coast.

We analyzed impacts of oil and gas exploration and production (e.g. infrastructure, pipelines, exploration and drilling site impacts) on wetlands, specifically Upper Texas Coastal Wetlands, prioritizing impacts specific to wetland function (such as coastal flooding mitigation or density of wintering waterfowl). Our objectives were to prioritize wetland functions categorized by wetland type, location and availability of function. Then we cross-referenced these functions with possible energy exploration and production operational impacts on wetlands. This information was then used to develop a decision support tool that will aid managers in determining impact minimization measures (which includes best management practices) and making decisions about where to drill, technical alternatives to mitigate certain impacts and choice of options that will optimize mitigation effect given limited financial resources.

We created a web-based portal with two interactive tools: a Descriptive Tool and a Geospatial Tool. The Descriptive Tool allows the user to select a phase of drilling, wetland impact, or impact minimization measure (IMM) and see how items in each of the three categories are connected. Selecting a specific IMM will reveal the connections between the IMM, the appropriate wetland functionality impacts, and phases of drilling. Users can see the connections and evaluate which IMM might be the most appropriate for their site. In the same portal, we also created a Geospatial Tool that provides basemaps and GIS layers pertaining to wetlands on the Upper Texas Coast. Users will be able to search for an address or zoom to an area of the map. Potential site boundaries can be drawn directly on the map and GIS layers can be selected as hidden or shown. Once a boundary is drawn, a dialog box will appear with a list of potential wetland impacts connected to the GIS layers overlapping the site boundary. The list of potential impacts can then be used in the Descriptive Tool to identify potential IMMs for the selected site. Providing options to decisions makers in terms of technical alternatives or IMMs will enable resources to be developed in an environmentally sound manner.

Abstract Information

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2. Oral presentation desired

3. Suggested Topic Area: Monitoring and Research or Habitat Protection

GIS ANALYSIS AND MODELING OF GALVESTON BAY ROOKERY ISLAND EROSION RISK ALONG THE GIWW

Amanda Hackney, Audubon Texas, Texas City, TX

Luz Lumb, Audubon Texas, Texas City, TX

Doreen Whitley, National Audubon Society, New York, NY

The numerous coastal islands of Texas provide critical habitat for colonial waterbird rookeries. Prior to the extensive Gulf Intracoastal Waterway (GIWW) dredging projects of the early 1900s, birds were dependent on natural rookery islands. Few natural islands remain due to changes in hydrology and erosion rates. When the GIWW was completed in the mid-20th century, dredged material heaped along its sides formed new "islands" that became replacement rookeries sites. Today, those that remain are experiencing higher erosion rates due to large ship wakes, altered shorelines, disrupted hydrology, and overall sea level rise. Maintenance dredging for the GIWW provides vital material to slow and reverse this erosion, but this process requires significant funding to save rookery islands. The scope of Texas's rookery islands (Audubon Texas alone owns or leases 178) makes it difficult to catalogue and assess all sites' current conditions and habitats. As a result, islands that are less frequently visited by coastal managers can be overlooked when restoration projects are planned, and new sites may not provide the best type of nesting habitat.

We assembled GIS data and built a spatial, habitat-based model to predict the risk of rookery islands along the GIWW becoming unusable for nesting due to poor habitat or erosion damage. Parameters used to estimate site longevity included sea level rise estimates, erosion rates, elevation, habitat type/ conversion, and ship estimated wake damage. Model was used to predict islands most at-risk over a span of 5, 10, 25, and 50 years. High quality GIS data was assembled on all rookery islands within a 2500m buffer of the GIWW centerline (N= 25). Historical data ranged from 2004 to 2014.

Colonial waterbird breeding population data was then assembled for this time period for the following species: Brown Pelican, Laughing Gull, Royal Tern, Sandwich Tern, Snowy Egret, Roseate Spoonbill, and Forster’s Tern. Survey data was compared with the model results to gain a better understanding of how the island-risk model's predictions will affect different waterbird species and how species have responded to changes in habitat over time. Islands were ranked with "risk categories" of high, medium, and low. With greater funding opportunities coming to the Texas coast for habitat conservation, it is expected that this model will help inform partners on sites most in need of urgent restoration.

This island-risk model will be an assessment tool that can be used by all coastal managers to track habitat changes and needs and inform future coastal management decisions. It will be a science-based compliment to the Rookery Island Conservation Plan (RICP) currently being completed by Audubon Texas that is a statewide catalogue of important coastal sites and bay area issues based on interviews with field professionals.

Amanda Hackney, Audubon Texas Coastal Program

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Prefer oral presentation, can do poster if needed.

Topic: Habitat protection or monitoring and research

Effects of Pierce Marsh Restoration Site Design and Age on Naturally Recruited Plant Diversity.

Cindy Howard; School of Science and Computer Engineering, The University of Houston Clear Lake

Jim Dobberstine; Math, Engineering, and Sciences Division, Lee College

Abstract

In response to the substantial loss of marsh communities in Galveston Bay over the past 50 years, active restoration of numerous coastal wetland systems have been undertaken. The restoration of Pierce Marsh, in the lower Galveston Bay system (1999-2011), employed four different design techniques: grid, sinusoidal and zigzag terraces and levees filled with beneficial uses material (BUM). Each site was planted only with *Spartina alterniflora.* In 2008 and again in 2013, we evaluated the functional success of each restoration design, compared to a natural marsh reference site, focusing on a number of parameters, including changes in plant species diversity afforded by natural recruitment. In 2008, three transects were established randomly at each restoration site and sampling occurred at three stations along each transect. The same stations were sampled in 2013, with the addition of a site restored in 2011. A 1/4m^2 plot was set at each station and all species within the plot were identified and their areal coverage was recorded. Species richness in 2008 was highest at the grid site (oldest restored site); only one species (*Spartina alterniflora*) was present at the BUM leveed site, which had been only recently planted. However, in 2013, there was evidence of extreme erosion of the grid and sinusoidal designs, accompanied by significantly lower species richness at these sites. Maturing of the BUM leveed areas was noted by an increase in species richness.

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Presentation Type:
We would like to present as an oral presentation, and as a poster presentation

Topic Area (Optional):
- Habitat Protection
- Shoreline Management

Of potholes, prairies, forests, and waters:
A significant nexus to a sustainable and resilient future.

John S. Jacob, Ph.D. Texas AgriLife Extension and Texas Sea Grant

The Upper Gulf Coast of Texas is often referred as a flat, featureless plain. But to the knowing eye, it is a rich landscape of intricately connected highs and lows, an unmatched template for floral and faunal biodiversity - an irreplaceable template formed through an eco-geologic medley of flowing rivers, the sculpting of the wind, and the wallowing of mastodons and bison. Incredibly, a few hundred-thousand of acres of prairies and forests can still be found on undisturbed remnants of this landscape.

Houston, however, spreads out, impervious to the significance of this landscape. Most of what remains will be gone in the next 40 years, with only the names of the landscape features to grace new subdivisions. E.g., Seven Meadows, The Forest of Friendswood, etc. An irreplaceable legacy will be lost. But more than a legacy will be gone –the nexus to a sustainable future will also be gone. We are all rentiers living on interest from the ecological capital built up long before our time. We are destroying in decades what accumulated over millennia. With no capital there will be no interest for us to live off of.

All is not lost –there is enough ecological capital to sustain future generations if we take action now. The capital is there; the question is whether or not the political will is there to take action.

Over the past 20 or so years I have engaged in research with a number of partners with the intent of illuminating the status and function of Texas Gulf Coast habitats, particularly wetlands, in the hope of generating some will to take action. I present a summary of that research here.

The Eco-Logic map was developed in conjunction with the Houston-Galveston Area Council and others to delineate significant habitat fragments 100 acres or larger in size. There are many significant small pieces (and very many smaller pieces less than 100 acres in size and thus not included in this project), but the most significant result of this exercise was the revelation that there are many significant large pieces of un-land-leveled landscapes left in our area, with many individual pieces exceeding 30,000 acres each. These fragments do not all have an endowment of pristine vegetation, but the undisturbed template for their restoration is there, and thus an ark to our future.

Wetlands color all of our habitats. But their value is not recognized within the jurisdictional framework of the Clean Water Act in this area. We and others have conducted solid research documenting a “significant nexus” between prairie pothole wetlands and traditional navigable waters in the Houston region. The research is currently informing legal action to bring these wetlands under jurisdiction.

Finally, we have quantified the amount of wetland loss in our region as well as the efficacy of mitigation for that loss. It is becoming increasingly clear that the status quo will not ensure that the legacy we have been given will be passed on to future generations, compromising the sustainability of their future. It is not enough to study these landscapes. It is not enough to preserve small museum pieces, important though these are. It is time for us to take a broader view and make a bigger appeal of our community. Our technical skills will be required, but much more importantly, our imagination.

LOOKING BEYOND ECOLOGICAL FUNCTIONS TO THE VALUE OF ECOSYSTEM SERVICES: INCORPORATING ECOSYSTEM SERVICES INTO INFRASTRUCTURE AND POLICY DECISIONS IN THE GREATER HOUSTON REGION

Deborah January-Bevers, President & CEO, Houston Wilderness, Houston, Texas

Courtney Hale, Intern, Houston Wilderness & Rice University, Houston, Texas

Taylor Britt, Intern, Houston Wilderness & Rice University, Houston, Texas

Lauren Harper, Environmental Policy Specialist, Houston Wilderness, Houston, Texas

Lindsey Roche, Intern, Houston Wilderness & Rice University, Houston, Texas

Natural landscapes and organisms serve our wellbeing in a great variety of ways: water purification, flood protection, recreation, recharging of aquifers, protection from damage by hurricanes and tropical storms, pollution reduction, carbon sequestration and more. The Greater Houston region, which encompasses a huge and diverse assemblage of forests, prairies, bottomlands, wetlands and bays receives a tremendous amount of benefits (ecosystem services) from the ecological functions of the natural world. This policy paper explores case studies of how various entities in the Greater Houston Region are working to identify and better understand the services provided by urban riparian, upland and coastal ecosystems that traverse this region. In the paper, we discuss the recent urban riparian and other ecosystem successes in enhancing and/or restoring ecosystem services to solve infrastructural needs, often at a lower cost than traditional solutions. With examples provided, we find that the outcome is often even better than the initial cost saving assessments: solving a problem using ecosystem services by preserving, restoring, or engineering an green infrastructure can produce a whole host of ecosystem services in addition to the single service needed to accomplish the function of the infrastructure. We look closely at a defining aspect of the urban core of Houston and the extended Houston Region – its myriad of connecting bayou and creek systems and how they affect Galveston Bay. Creeks and bayous play an integral role in flood protection, air and water quality and wildlife habitat for the region and are prime examples of ways that ecosystem services can be added or enhanced and more effectively benefit the health of the bay system.

Without the ecosystem services provided by these 10 ecoregions, the Greater Houston Region and Galveston Bay would economically and environmentally suffer in trying to provide equivalent services to its residents, industries, and wildlife. Incorporating the value and benefits of ecosystem services into infrastructure and policy decisions in the Greater Houston Region is still evolving but a few best management practices now exist. For an expanding urban core such as the Houston Area, there is a critical need to: (1) Provide more opportunities for regional recognition and support of the 10 unique ecoregions in the Greater Houston Region; (2) Engage in more region-based research on ecosystem services to better understand natural benefits and the cost-effective infrastructure solutions that this understanding will enable; (3) Compare the economic value of ecosystem services to other alternative approaches when making public policy decisions regarding land-use and infrastructure; and (4) Incorporate ecosystem services into infrastructure and water-based decisions.

1. Presenter:

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2. Oral presentation is desired. A poster presentation would be accepted if we are not selected for an oral presentation.

3. This abstract falls under multiple topical areas: Economic Valuation and Impact of Estuarine Resources, Habitat Protection, Monitoring and Research, and Public Participation and Education.

Coastal habitat restoration and conservation in the Galveston area following Hurricane-Ike

Nathan Johnson, Non-Profit, Artist Boat, Galveston, TX

Karla Klay, Non-Profit, Artist Boat, Galveston, TX

It is estimated that Hurricane Ike flooded 100,000 Texas homes, dropped between 10-20 inches of rain on the Houston/Galveston region over a period of two days, and caused 19 feet of storm surge within areas of Galveston Bay. In addition to the economic devastation, Ike brought about enormous ecological destruction within Southeast Texas. Regions containing valuable coastal upland prairie, coastal dune, and wetland habitat were flooded and the associated ecosystems drastically changed. Communities such as Galveston and Bolivar rely heavily on income from ecotourism and outdoor recreation, making habitat loss in these areas incredibly damaging to their local economies. Artist Boat, an environmental nonprofit in Galveston dedicated to promoting awareness and preservation of coastal ecosystems through science and art, has developed numerous habitat restoration programs to address this issue. Since 2005, Artist Boat has restored and conserved approximately 419 acres of coastal habitat throughout Galveston Island, Follet's Island, and Bolivar Peninsula. Not only has this increased available habitat in these regions, it has helped foster a culture of environmental stewardship throughout the Galveston area.

Artist Boat's habitat restoration programs offer volunteer opportunities for a wide variety of under-targeted audiences. From 2009-2011, the organization partnered with Texas Parks and Wildlife Department to restore 10 acres of coastal prairie and dune habitat at the Galveston Island State Park. Participants in these events were students from the Galveston Independent School District, the Clear Creek Independent School District, and Texas A&M University at Galveston. GISD and CCISD, along with Houston Independent School District and Pasadena Independent School District, came out again to help Artist Boat restore 26.95 acres of coastal dunes on Galveston Island and Follet's Island from 2011-2013. Through partnerships with U.S. Fish and Wildlife, TPWD, the Galveston Island Park Board of Trustees, and the National Fish and Wildlife Foundation, Artist Boat has taught over 8,000 volunteers the importance of environmental stewardship.

In 2014, Artist Boat received funding from the Houston Advanced Research Center to launch its Stewardship Training program. This unique program provides opportunities for members of the oil and gas industry and their families to participate in free habitat restoration events. Approximately 100 volunteers from eight different companies have taken part as of May 2015, and in doing so have planted 10,000 plants in dune and prairie habitats throughout the Galveston/Bolivar area.

Though it continues its habitat restoration program, Artist Boat recently turned its focus towards land conservation and stewardship. The organization is currently securing the final 154 acres of its 367-acre Coastal Heritage Preserve. The Preserve, located on the west end of Galveston Island, contains a suite of estuarine wetland, upland coastal prairie, tidal flat, and open bay habitats. Because wetlands and coastal prairies are rapidly disappearing throughout the U.S., securing this land is vital to long-term habitat conservation activities. By purchasing the Coastal Heritage Preserve and stewarding it for conservation and educational purposes, Artist Boat has ensured that this area will provide crucial habitat for wildlife while offering ecological and economic benefits to the surrounding community for years to come.

Nathan Johnson
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Oral presentation is preferred, but presenter will accept a poster presentation if not selected for an oral presentation

Symposium topic best suited for talk: Habitat Protection

ARMAND BAYOU NATURE CENTER - PRAIRIE RISING
A MODEL FOR COLLABORATIVE SERVICE LEARNING

Mark Kramer

Coastal tallgrass prairie habitats are critically imperiled with an estimated one percent still remaining. These landscapes once dominated the greater Houston area but today are almost completely gone. Armand Bayou Nature Center (ABNC) is located in southeastern Harris County and manages one of the largest remnant prairies along the western shore of Galveston Bay. Sadly, these beautiful areas are poorly understood by local residents and are generally not included in local curricula. The ecology of these grasslands was historically maintained by fire and large herds of grazing animals, particularly the American bison. Remnant prairies quickly degrade in the absence of these key ecological influences. Today prairies have become people dependant habitats which require active management in order to survive. These management strategies include invasive species control, prescribed fire, prescribed mowing, vegetation monitoring and native plant introduction.

Through a collaborative effort of ABNC volunteerism, community based events and service learning projects, ABNC is bringing back the natives and restoring these grasslands to their former grandeur and teaching local grassland ecology to area residents and students. ABNC volunteers cultivate large amounts of locally rare plant materials which are used for restoration projects and local high school and college students assist with installing these locally rare grasses and wildflowers into degraded prairie landscapes. After the work day is completed students retire to a brownbag lunch lecture for a deeper discussion of prairies as the Houston areas ecological heritage. A handout booklet captures the prairie lecture content and serves as a "take home" for further reflection and classroom discussion. The Prairie Ecology booklet will be distributed to State of the Bay participants which are present for the Prairie Rising lecture. This model blurs the line between restoration and education and has proven successful at effecting change at the landscape level and providing meaningful local ecological curriculum for area teachers.

RESILIENCEY TO ENVIRONMENTAL CHANGE IN THE GALVESTON BAY ESTUARY

Joshua Owens
Community & Environmental Planning Department
Houston-Galveston Area Council
Houston, Texas

On November 20, 2007, Houston-Galveston Area Council's Board of Directors established an expert panel to develop recommendations for local governments to adapt to potential changes in the region's climate and associated environmental effects. Foresight Panel on Environmental Effects ("the Panel") was comprised of experts in climate change and local infrastructure planning. The purpose of the Panel was not to address the validity of climate change models or the potential contributions of human activity to climate change. Rather, its charge was to recommend sound strategies for local governments to adapt to the potential effects of climate change should it occur. The Panel produced a report primarily focused on adaptation strategies local governments can employ to offset the potential impacts on these systems produced by the environmental effects of climate change.

The Houston-Galveston Area Council (H-GAC) would like to convene the experts from the Panel for a discussion nearly ten years after its initiation. The Panel will discuss the state of Galveston Bay's resiliency in 2016; including responding to updated information regarding forecast population growth and land cover change in the estuary's watershed. The panel will also discuss what local governments have done to implement the panel's recommendations to mitigate the impacts of climate related change and what needs to be done moving forward to ensure the area remains resilient to the changing environment. The Panel will also respond to questions, so that participants may gain further understanding into the local and regional policies impacting the resiliency of the Galveston Bay estuary. Panel participants may include the following experts: Dr. Philip Bedient (Professor, Rice University), Dr. Peter Bishop (Associate Professor, University of Houston), Alan C. Clark, (Manager, Transportation and Air Quality, Houston-Galveston Area Council), Dr. Robert Harris (President and CEO, Houston Advanced Research Center), Dr. Neal Lane (Professor, Rice University), Dr. Barry Lefer (Assistant Professor, University of Houston), Dr. Eugene Leong, (environmental scientist and engineer) Michael D. Talbott (Director, Harris County Flood Control District), Dr. Arnold Vedlitz, (Chair, Texas A&M University).

1. Joshua Owens, Senior Regional Planner, Community and Environmental Planning Department, Houston Galveston Area Council, 3555 Timmons Lane, Houston, TX 77027, 832.681.2613, Fax: 713.993.4503, and Joshua.Owens@h-gac.com.

2. Format Recommendation: Panel Discussion. H-GAC recommends this subject as a Panel Discussion.

3. Optional: Suggest presentation would best fit in a Habitat Protection tract for topics such as wetland protection and coastal resiliency.

THE TEXAS COAST: A BLUEPRINT FOR THE FUTURE

By: Linda R. Shead, P.E., Texas Coastal Partners

The Texas Coast needs a blueprint for its future, a comprehensive master plan to guide future decisions on growth, development, erosion response, habitat protection and restoration. The *Houston Chronicle* called for such a master plan in March 2014. The Texas General Land Office issued a Request for Information in 2014 for guidance on how to pull together all the various ideas, proposals, and projects that have been put forth by different entities, but not funded. The recognition is there, but as yet there is no agreement on the elements of such a plan and how the plan can be funded. Let's talk about approaches, elements and funding ideas.

RESTORATION OF FRESHWATER EMERGENT WETLANDS ON THE SOUTHEAST TEXAS COASTAL PLAIN

Marissa G. Sipocz (Texas AgriLife Extension Service, Houston, Texas, USA)

Andrew V. Sipocz (Texas Parks and Wildlife Department, Houston, Texas, USA)

Freshwater palustrine emergent wetlands occupied 25% of the southeast Texas coastal plain prior to settlement. They occur within wind-deflated basins, on flats and within broad sumps. Most have been severely altered or destroyed by land leveling, drainage and fill associated with agriculture, pasturage and urban development.

Traditionally, freshwater palustrine emergent wetland restoration within an upland prairie matrix has mostly consisted of holding water within existing rice fields or similar agricultural areas for an extended period of time, or the excavation of relatively small basins into uplands without consideration of historic wetland location or basin morphology. This has led to mixed results or failures, created wetlands with soils, hydroperiods and plant communities unlike that of the reference coastal freshwater emergent wetlands.

The Texas Parks and Wildlife Department (TPWD) developed a restoration template at Sheldon Lake State Park (SLSP) which rebuilds actual historic emergent wetlands sites. Using historic and current aerial photographs, topographic maps and soil pit surveys, TPWD precisely located actual historic emergent wetlands and, with the assistance of many partners, excavated the sites down to the original basin elevation. Locally collected native plants were then transplanted into the excavated basins, by effort of volunteers working on the Wetland Restoration Team-a joint effort between Texas Master Naturalist and Texas A&M AgriLife Extension Service.

Fourteen years following the successful implementation of Phases 1 to 4 of the wetland restoration, the SLSP restored wetlands show remarkable establishment. The return of local wetland fauna, specifically wading birds and migratory waterfowl, demonstrates the success of this habitat restoration while also providing water quality improvements (e.g. load reduction) for Carpenter’s Bayou watershed.

Living Shorelines: Small-Scale Restoration Efforts and Their Ecological Impacts on Local Communities.

Lee Anne Wilde; The Galveston Bay Foundation

Abstract

Living Shorelines are attractive shoreline management options that provide erosion control benefits while working with nature to enhance the existing natural shoreline habitat and protect valuable natural resources. As opposed to bulkheads or armoring, Living Shorelines are designed to allow natural coastal processes to take place. They allow for the movement of organics in and out of the marsh, they absorb wave energy from wind, boats and storm events and they filter pollutants from runoff. Perhaps more importantly, they can create critical habitat for economically important finfish and shellfish, and provide nesting and foraging areas for birds. Additionally, modified living shorelines can be built in front of existing bulkheads or armoring to provide additional protection and increase the ecological value of an area by converting open water to fringing marsh. Emerging research is showing positive ecological benefits from both small and large scale living shoreline installatios.

Because much of the Texas coastline is privately owned, the Galveston Bay Foundation has worked with individual landowners to install living shorelines as erosion management tools. Additionally, GBF has utillzed living shorelines as part of their large scale environmental restoration practices. This presentation will review current projects that fit the living shoreline definition in the Galveston Bay watershed and place them in a national context highlighting the areas in which the Galveston Bay restoration community can set national standards as well as particular areas where we can benefit from other practices around the country.

Lee Anne Wilde
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Presentation Type:
Oral presentation

Topic Area (Optional):

- Habitat Protection
- Shoreline Management
- Living Shorelines

Monitoring and Research Abstracts

THE GALVESTON BAY REPORT CARD PART I: CONNECTING PEOPLE TO THEIR ESTUARY - BUT WAIT, WHAT'S AN ESTUARY?

Anja M. Borski, Galveston Bay Foundation, Webster, Texas

Erin L. Kinney, HARC, The Woodlands, Texas

The Galveston Bay Report Card is a public interest driven, scientific analysis of the health of Galveston Bay, made possible by a grant from Houston Endowment and implemented by the Houston Advanced Research Center (HARC) and the Galveston Bay Foundation (GBF). The report card will provide the public with easy to understand information that will encourage meaningful, science-based discussion about the bay, and inspire action through events, activities and management decisions that protect and preserve the bay for the future.

We believe that communities are more likely to take an active role in protecting the environment when they understand what it is they are trying to protect. The report card concept is designed to distill information about conditions in the Galveston Bay system into an easy to access format that fosters interest and understanding from the public. Instead of presenting indicators as we have in the past, based on how scientists address environmental issues, we first consulted the public to find out what they are interested in, so that we could tailor the report to categorize and prioritize topics in a way that mirrors the way our audience thinks. Through a series of surveys and presentations, we gathered input from more than 1500 community members, providing us with unique insight into the way the public interprets and understands the types of environmental data being collected, and encouraged us to carefully consider the way we talk about and categorize the report card data.

The report card products, scheduled to be released in the summer of 2015 and updated annually thereafter, will include a user-friendly and engaging Galveston Bay Report Card website, a printed summary report available for distribution by partner organizations and businesses, and a complete report available for download. A specialized, environmentally-focused communications firm has been hired to design the website and direct media relations to maximize outreach efforts throughout the Galveston Bay watershed and beyond.

Research and personal experience have shown that our public is not just interested in the status of Galveston Bay; they want to know what they can do to make it better. To encourage this interest, the report card will prominently feature "What You Can Do" calls-to-action, harnessing that enthusiasm and optimism and turning it into positive change for the bay.

Outreach metrics including publicity value of media exposure, social media interactions, survey submissions, and information and presentation requests will be used to measure project success, and ongoing community input will be used to expand report card topics and features in annual updates. Two-way communication with the public about Galveston Bay will help inform scientists and funding entities about emerging issues, attitudes, and changes in public concern.

The Galveston Bay Report Card project embodies the spirit of scientific inquiry, collaboration, and communication. From the initial process of identifying, analyzing and compiling large volumes of public data, to our extensive public outreach efforts, which will get the data into the

hands of the people whose actions can make a difference, we look forward to a bright future for Galveston Bay, inspired by an informed and enthusiastic community.

Abstract Information

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   Lisa A. Gonzalez, Vice President, Houston Advanced Research Center, 4800 Research Forest Drive, The Woodlands, TX, 77380, Phone: 281-364-6044, Fax: 281-364-6001, lgonzalez@harcresearch.org

2. Oral presentation desired
   Due to the large scope of this project, we are proposing two oral presentations (The Galveston Bay Report Card Part I and Part II), back to back. In the event that symposium timing restrictions would not allow for two separate presentations, abbreviated versions of each could be combined into a single presentation.

3. Suggested Topic Area(s): Monitoring and Research, Public Participation and Education

MACROBENTHIC COMMUNITIES OF GALVESTON BAY, 1988-2012

Linda Broach

Texas Commission on Environmental Quality, Houston, Texas

Benthic infauna are an important component of the estuarine food web and they are sensitive to disturbances in their environment. These organisms live in the sediments and are relatively sedentary so that they cannot avoid adverse environmental conditions. Because of this, macrobenthic communities are often used to evaluate the condition or health of a water body.

Soft-bottom macrobenthic communities have been collected in Galveston Bay using consistent methods since 1988 by the Texas Commission on Environmental Quality and its predecessor agencies. This data set includes over 400 samples from both fixed and randomly located stations. This analysis will compare the characteristics of the benthic community in different areas of the bay and over time. The effects of salinity, nutrients, chlorophyll a, dissolved oxygen, grain size, and freshwater inflows will be discussed. This extensive data set allows an evaluation of background conditions and variability in these communities in the Galveston Bay system.

AN UPDATE ON THE GALVESTON BAY ESTUARY PROGRAM STATUS AND TRENDS MAINTENANCE PROJECT

Stuart Carlton, Texas Sea Grant College Program, Galveston, TX

Will Mobley, Texas A&M University, College Station, TX

Helen Walters, Texas A&M University Galveston Campus, Galveston, TX

Morgan Wilson, Texas A&M University Galveston Campus, Galveston, TX

Samuel Brody, Texas A&M University Galveston Campus, Galveston, TX

Galveston Bay is surrounded by urban, suburban, industrial, and agricultural land uses, and it supports commercial and recreational fishing industries, industrial and municipal water uses, shipping and recreational activities. With so many activities depending upon a healthy ecosystem, it is important that the parameters pertaining to the system's health are monitored and analyzed on a regular basis. By analyzing the current status and past trends on specific indicators at an integrated, ecosystem level, it is possible to assess the overall health of the complex bay ecosystem. The Status and Trends Maintenance Project was created to collect, study, store, maintain, and display data so that the public can better understand the basic conditions of the Galveston Bay ecosystem. The Center for Texas Beaches and Shores at Texas A&M – Galveston recently took over the maintenance of the Status and Trends database. In this presentation, we will describe recent updates and changes we've made to database and discuss major changes in the health of Galveston Bay. We will show how the database has been integrated into a web-GIS platform, the Texas A&M Coastal Atlas, where users can visualize, query, and analyze a variety of different environmental spatial layers. Additionally, we will demonstrate the types of spatial information the database and Atlas make available to scientists, students, educators, and local decision makers. Finally, we will discuss potential future directions with the database and Atlas.

Presenter Contact Info (other co-authors will not present):
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Oral or Poster: Oral. We would not accept a poster presentation if oral is not available.

Topic area: Don't care, but maybe monitoring and research?

THE GALVESTON BAY REPORT CARD PART II: USING SCIENCE TO ADDRESS STAKEHOLDER CONCERNS

Erin L. Kinney, HARC, The Woodlands, Texas

Anja M. Borski, Galveston Bay Foundation, Webster, Texas

Lisa A. Gonzalez, HARC, The Woodlands, Texas

The Galveston Bay Report Card categories and indicators apply the most recent and accurate scientific research to reflect the concerns and priorities of stakeholders. Environmental indicators were chosen by the Galveston Bay Foundation (GBF) and the Houston Advanced Research Center (HARC) to specifically address the questions and concerns raised in stakeholder meetings and surveys. HARC used data collected by state and national agencies to evaluate the indicators and provide a snapshot of the current state of the Galveston Bay ecosystem. The most recent datasets were researched and compiled for analysis to highlight what data are available as well as what gaps may exist based on public interest and concerns. Results for each indicator were framed within the context of the larger landscape and community.

Six indicator categories (water quality, pollution events and sources, wildlife, habitat, human health risks, and coastal change) were chosen to span the full range of available environmental data available for Galveston Bay. The initial list of indicators represent the current issues of greatest concern to the stakeholders. Future report cards can expand the list of indicators to reflect emerging issues and/or changing public concerns. Standardizing such a wide range of ecological indicators in order to simply and concisely depict the condition of the Bay was one of the greatest challenges to this project. The way an individual defines a “healthy” bay is often related to how we value the services that the system provides us, such as seafood harvests, clean water for drinking and playing, and habitat that protects and stabilizes shorelines and nurtures the animals that bring the bay to life. We consider the Bay’s health to be a question of sustainability and resiliency – do the available data portray a system that will continue to provide habitat, food, clean water and protection from storms; or a system so impaired that it ceases to support the resources and services valued in the ecosystem?

Each indicator category was evaluated and given a “grade” that reflected the real scientific implications of the indicator as well as how it should be interpreted by the public. We also considered how other estuaries are graded and how they could be compared to Galveston Bay in the future. We tailored a grading method to each indicator to best represent the current status of the indicator within the context of Galveston Bay’s recent history. Some indicators have regional, state or nationally defined targets, and we compared the most recent data to those targets when available. In other cases, no targets were available and data collection frequency and methods differed across time and indicators. In those instances, we chose to use data from 2000 to today as our general “baseline” so as to be sure to include a decade’s worth of data.

The Galveston Bay report card represents the best scientific annual assessment of the Galveston Bay ecosystem created for the public based on their concerns and priorities. As an annual report card, it offers a unique opportunity to encourage education and inspire action in a simple yet dynamic format.

Abstract Information

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2. Oral presentation desired
   Due to the large scope of this project, we are proposing two oral presentations (The Galveston Bay Report Card Part I and Part II), back to back. In the event that symposium timing restrictions would not allow for two separate presentations, abbreviated versions of each could be combined into a single presentation.

3. Suggested Topic Area(s): Monitoring and Research, Public Participation and Education

CHANGES IN ECOSYSTEM SERVICES FROM GALVESTON BAY AND SURROUNDING WATERSHEDS OVER 40 YEARS

L. James Lester, President, HARC, The Woodlands, Texas

Lisa A. Gonzalez, Vice President, HARC, The Woodlands, Texas

In the early years of the 1970's, the US passed landmark environmental legislation including the Clean Water Act, formed the Environmental Protection Agency and launched the first Landsat multispectral Earth observing satellite. Thus began the current national commitment to monitoring changes in Earth's ecosystems and processes. It was not until 30 years later when the Millenium Ecosystems Assessment provided a framework that could be used to evaluate the wide variety of benefits people obtain from these ecosystems. In this presentation, I will combine 40 years of available evidence documenting a set of ecosystem services (ES).

The Bay ES that will be discussed are in the categories of a) provisioning: fisheries, minerals (shell), and fuel (oil); b) regulation: waste treatment (water and air contamination), nutrient regulation, and water regulation (flooding); c) cultural: recreation; and d) supporting: primary production. The provisioning ES have declined for shell and oil because exploitation exceeded the rate of replenishment and impacted other services. The value of provisioning from fisheries is quite variable and shows some trends for the major catch species of shrimp and oysters due to factors such as weather, fishing pressure, and regulation. The value of ES for waste treatment has increased as the volume of waste streams around the Bay has increased. The ES value of the Bay and local watersheds for regulation of nutrients and storm water has decreased over time due to the conversion of land and shoreline to developed uses. While recreational ES values are complicated and difficult to document, it appears that the value of recreational services has increased over time. This is likely related to the increasing costs of various forms of recreation rather than increased opportunity to obtain the service. Finally, the supporting ES obtained from primary production has declined across both aquatic and terrestrial habitats in and around the bay.

While the change in quantity of service can be deduced from monitoring and observational data, the value of those services is difficult to assign. Value changes as demands and markets change. Value for some services, e.g. storm water retention, can be highly location specific. The data on change in value of fisheries, waste treatment and recreation will be summarized. Based on the available data, the current economic values of services for waste treatment and recreation exceed the others for which there is data. This results in an interesting conflict between valuable uses of local ecosystems. Increasing the service for waste treatment can deteriorate the service for recreation.

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2. This abstract is proposed for an oral presentation. It is not appropriate for a poster presentation.
3. Suggested topic area: Economic Valuation and Impact of Estuarine Resources.

DRIFTER PROJECT COLLABORATION

Lisa A. Vanderbloemen, PhD, XI4/NASA JSC/Jacobs Technology, Houston, TX

Glenn Ellis, Science Department/Jacobs Technology, Houston, TX

William Stefanov, PhD, XI4/NASA JSC, Houston, TX

Jacobs initiated a collaboration with NASA, Armand Bayou Nature Center, and Clear Springs High School (CSHS) to build and deploy a Drifter Buoy based on a design obtained from NASA Stennis. Jacobs' staff successfully built two drifters with this design and deployed one at Armand Bayou Nature Center (ABNC). This drifter model uses a custom designed circuit board assembled with COTS components that includes GMRS cell phone technology with GPS included. The drifter measures water temperature and conductivity (used to derive salinity) and uses the cell phone technology to 'tweet' the data to a Twitter account at a user specified frequency. The original drifter continues to tweet data every 15 minutes and is readily available to the public at https://twitter.com/jscdrifter2. Students at Clear Springs High School have analyzed the temperature and salinity data from ABNC to better understand temporal and spatial variability within the Bayou.

NASA JSC's ARES Division (XI) expressed a desire to enhance the sensor suite of the existing design to include the ability to measure dissolved oxygen, turbidity, microbiological content, and potentially other variables. NASA also expressed some concerns about the Twitter based data collection and logging method. We therefore initiated a new design, Drifter 2.0, for the Drifter electronics that would provide more flexibility for sensor selection and a better data logging and storage capability. Such improvements would contribute to NASA's regional remote sensing research efforts to support JSC sustainability and climate change research, ultimately requiring construction of additional drifters. Simultaneously, our Communities in Schools partner Clear Springs High School developed their own design to encompass additional sensors and data logging.

The Jacobs Drifter 2.0 model was a proof-of-concept breadboard prototype constructed using an existing COTS small electronics CPU, USB sensors, storage devices, and power supply. The CSHS model also contained a ruggedized prototype environmental housing design and configuration for outdoor use.

The enhanced Drifter will provide data to NASA ARES critical to the success of the Climate Adaptation Science Investigator (CASI) effort at JSC. The new design may be adopted as the baseline for JSC area water measurements as part of the regional remote sensing efforts. NASA ARES has expressed a desire to have as many as 30 Drifters deployed in the local watershed for monitoring and research related to climate change.

1. Presenter(s): Lisa A. Vanderbloemen, PhD (Primary presenter)
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XI4/NASA JSC/Jacobs Technology

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2. Poster presentation preferred

3. Topic Areas: Monitoring and Research, Public Participation and Education

Nonpoint Source Pollution Abstracts

HOUSTON-GALVESTON REGION'S RIPARIAN BUFFER MAPPING AND INFORMATION TOOL

Paniz Bighash
Community & Environmental Department
Houston-Galveston Area Council
Houston, Texas

The Houston-Galveston region is experiencing a wide range of water quality impairments and concerns, many of which are linked to contaminants originating from stormwater runoff. In an effort to improve water quality, land owners have the opportunity to protect or construct riparian buffers on their property in order to naturally protect a waterway from the impact of adjacent land uses. State and Federal agencies have many funding and incentive programs available to assist and encourage land owners to implement riparian buffers on their property. However, the resources and information necessary to pursue the construction of a buffer is widely dispersed and difficult to obtain. The Houston-Galveston Area Council (H-GAC) has put together a new riparian buffer mapping and information tool that includes all required information in one online portal that land owners and other interested parties can access quickly and easily.

Included in the riparian buffer mapping and information tool is a watershed map with each watershed ranked based on the areas water quality recovery potential. The Environmental Protection Agency's (EPA) Recovery Potential Screening (RPS) tool was used to rank each watershed based on specific attributes that either improve or impair a waterways potential for water quality improvements through the use of riparian buffers. The attributes used in the RPS ranking are similar attributes that state and Federal agencies use when distributing funds to land owners. The RPS rankings may also be used to estimate potential water quality contaminant reductions based on watershed characteristics. Another feature of the riparian buffer tool is the ability for land owners to calculate the ultimate cost of implementing a riparian buffer on their property. A calculator widget will be available for users to input information pertinent to their property and better understand how the implementation of a buffer will affect their land value and annual production rates. In addition to the watershed rankings and buffer strip calculator, H-GAC's riparian buffer tool includes the contact information of local funding agencies, as well as links to application forms, incentive programs, and other resources that aid in the planning and implementation of a riparian buffer.

H-GAC will demonstrate how to use the riparian buffer mapping and information tool and walk through all its functions and capabilities. This tool will hopefully serve as a valuable resource for not only those interested in implementing a riparian buffer on their property, but also for local agencies and entities involved with regional watershed planning including work with TMDLs, WPPs, and other habitat conservation projects.

Wetlands in Suburbia: a response to water quality, flooding, and habitat loss in the Greater Houston region

Mary Carol Edwards
Stormwater Wetland Program Coordinator
Texas Coastal Watershed Program, Texas Sea Grant/ Texas A&M AgriLife Extension
Houston, TX

Suburban sprawl in the Houston-Galveston region contributes to the destruction of natural resources, but existing low density development also provides an opportunity to reinsert functional green space into the built environment. Stormwater wetlands, one of the larger stormwater Best Management Practices (BMPs), are an example. Integrated into flood control basins, stormwater wetlands mimic the functions of natural wetlands in order to cleanse, slow or infiltrate stormwater runoff. By detaining runoff in wetland-containing flood control basins, contaminants can be removed naturally before reaching the bayous and bay. Other benefits, wildlife habitat and park space, can be developed at a stormwater wetland site as well.

Because of the region's soils, hydrology, and the legacy of coastal prairie pothole marshes, networks of recreated wetlands are an important strategy for combating non-point source stormwater pollution, flooding, and even habitat loss. Because of the low density of much of the development in the Houston-Galveston region, space for larger BMPs such as stormwater wetlands is often available. To demonstrate the benefit of this combination of factors, the Texas Coastal Watershed Program (TCWP) is implementing stormwater wetland pilot projects with a range of scales, locations, and basin types. In all areas, educational outreach and volunteer opportunities for the public, students, and municipal staff is an integral part of the project.

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I would prefer to give a presentation.

Potential topic areas: Water and Sediment Quality, Non Point Sources of Pollution, Habitat Protection, Public Participation and Education

MAKING OUR WATERS TRASH FREE

J. Douglas Jacobson, EPA Region 6, Dallas, Texas

Trash cleanups along roads, waterways, and beaches remove millions of tons each year in the United States. However, until people change their habits, the need for these activities will not end. In 2013, the U.S. Environmental Protection Agency adopted the goal of zero loadings of trash in ten years for its Trash Free Waters program. Working with other governmental agencies, non-profits, corporations and other organizations, EPA seeks to move beyond clean up events to end improper disposal of trash materials.

EPA Region 6 developed a strategy to work with our coastal states to educate citizens about aquatic trash and its impacts and to eliminate it. It also seeks to address the issue through the Non Point Source program and utilize 319 funds to remove trash. Additionally, EPA Headquarters drove across the Gulf in the summer of 2014 and met with folks in many cities. A workplan was developed for the Gulf region, and projects are being conducted to reduce and eliminate trash.

EPA continues to support clean up events, and it sponsors many through the National Estuary Programs, local events, and the Coastal CleanUp which has been sponsored by the Ocean Conservancy for more than 25 years. Other efforts are important links, as well, such as the partnership with Texas Audubon to reduce plastics and monofilament line that imperils birds. Even more important is working to make citizens aware of the impacts of trash and change their behaviors – end littering and increase recycling – which the Back The Bay campaign is working to achieve.

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I would prefer to make an oral presentation on the same panel of the Non Point Source Pollution track with and before Texas Audubon's presentation on bird entanglements and GBEP's presentation on the Back The Bay campaign. A poster would be acceptable.

FLUSHING OUT ONSITE SEWAGE FACILITY (OSSF) PROBLEMS
Innovative Mapping and Education Help Lead the Way

William Merrell
C&E Department
Houston-Galveston Area Council
Houston, Texas

In the Houston-Galveston region, approximately 50% of stream miles are impaired by bacteria. Failing onsite sewage facilities (OSSFs) have been identified as one of many potential sources. Through the development of Bacteria Implementation Plans (I-plans) and Watershed Protection Plans (WPPs), the Houston-Galveston Area Council (H-GAC) identified data gaps and educational shortfalls that if addressed could help lower the number of failing OSSFs in the region. H-GAC focused on two problems: 1) identifying the location of OSSFs and information about them and 2) a lack of knowledge about OSSFs by real estate professionals. Between June and August of 2010, H-GAC worked with twenty Authorized Agents to build a database that contains over 90,000 OSSF permits. Using the permit addresses and ArcGIS mapping software, all records were matched to an X-Y coordinate, and then mapped in H-GAC's geographic information system (GIS).

An analysis was conducted to establish the locations of systems installed before mandatory permitting of OSSFs. These systems, commonly referred to as "grandfathered systems," have a high propensity for failure given that they were installed without consideration to sewage yield, soil type, and climate, among other factors. In order to identify potential grandfathered systems, a model was created within GIS to identify residential properties that did not have an existing OSSF and were outside of areas served by sanitary sewer. This analysis yielded potential target areas, which contain large numbers of unpermitted or grandfathered systems in close proximity to impaired water bodies.

In October of 2012 the OSSF Information System mapping service was made available on the web. The OSSF Information System is an online mapping tool that allows access to all regional OSSF data by regional permitting and inspection professionals, water quality researchers and planners, and the general public. Layers included within the OSSF Information System are OSSFs by Agent, OSSFs by Age, OSSF density, and the residential grandfathered OSSF analysis layer.

In March of 2013, H-GAC submitted a continuing education course, *Real Estate Inspections for OSSFs* to the Texas Real Estate Commission (TREC). The course was designed to instruct real estate professionals to properly inspect OSSFs, in an effort to identify failing systems during a point of sale inspection. They are also able to educate clients on how to properly maintain OSSFs. This TREC approved course is offered free of charge. Over 80 home inspectors have attended the two courses held in the Houston area.

H-GAC's OSSF initiatives have seen participation from over twenty local entities, and have been utilized in many projects, such as the Bacteria Implementation Group I-plan, the Upper Gulf Coast Oyster Waters TMDL I-plan, the Cedar Bayou WPP, and the San Bernard WPP.

POTENTIAL SITES FOR STORMWATER WETLANDS IN THE CLEAR CREEK WATERSHED

Paula Swearingen, University of Houston Clear Lake, Houston, Texas

When it rains, where does the stormwater runoff go? Historically, rainwater would flow through wetlands where plants would slow the water, allowing the water to soak into the ground and filter pollutants. Today, however, most of Houston's natural wetlands and the streams that carry the stormwater have been paved over or converted into concrete channels, which then flow into Galveston Bay. One exception is the Clear Creek Watershed. Most of Clear Creek remains as a natural creek, although it does have pollution problems. There are several potential sites for stormwater wetlands in this watershed. Stormwater wetlands are designed to simulate the natural functions of wetlands and help control flooding. One of the challenges facing organizations such as the Texas Coastal Watershed Program (TCWP) is to locate potential sites for new stormwater wetlands. The purpose of this poster is to explain what happens to stormwater, what is a wetland and why it is important, and help locate potential sites for stormwater wetlands.

Paula Swearingen, Graduate Student, University of Houston – Clear Lake

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Poster presentation

EVALUATING THE EFFECTIVENESS OF LOW IMPACT DEVELOPMENT PRACTICES AT THE GHIRARDI FAMILY WATERSMART PARK, LEAGUE CITY, TEXAS

Charriss York, Texas A&M AgriLife Extension Service, Houston, TX

Dr. John Jacob, Texas A&M University, Houston, TX

The Ghirardi WaterSmart Park is the first-of-its-kind assemblage of publically-accessible and monitor-able Low Impact Development (LID) practices in the Houston-Galveston Region. This park showcases how LID can be used in a suburban setting and serves as a demonstration site for citizens, elected officials and local decision makers.

In this study, LID practices (rain garden, green roof, rainwater harvesting, and pervious pavers) were installed at the 3.75 acre Ghirardi WaterSmart Park in League City, Galveston County, Texas. This study evaluates the effectiveness of LID in reducing nitrogen, phosphorus and bacteria found in stormwater on the Texas Gulf Coast in a suburban area where clayey soils and high water tables are common obstacles. The study area lies within the Clear Creek watershed which has a Total Maximum Daily Load for E. coli and is listed as impaired for both bacteria and dissolved oxygen by the Texas Commission on Environmental Quality. All LID practices were monitored for total phosphorus, nitrite, nitrate and E. coli during rain events beginning in the fall of 2014. Results suggest that the application of LID practices reduced the overall volume of runoff from the site as well as decreases in monitored parameters.

The effectiveness of Low Impact Development (LID) practices is well established for much of the United States; however, there is a still a need to evaluate these practices in the field and to collect quantitative data on LID performance, especially in Texas and for the Gulf Coast region.

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Oral presentation preferred but would accept a poster presentation

Potential topic areas: Nonpoint Sources of Pollution, Monitoring and Research

Public Participation and Education Abstracts

CITIZEN ENGAGEMENT FOR IMPROVED WATER QUALITY IN GALVESTON BAY

Charlene Bohanon, Advocacy Team, Galveston Bay Foundation, Webster, TX

Neally Rhea, Advocacy Team, Galveston Bay Foundation, Webster, TX

Water quality is not always the most attractive topic in which to engage citizens, but the outreach, volunteer, and advocacy programs that will be presented during this session have shown great success around Galveston Bay. Galveston Bay Foundation has partnered with local organizations, universities, marinas, and municipalities to empower stakeholders to do 'sexy' things like reduce sewer overflows and stormwater runoff, eliminate illegal boat sewage discharges, and report pollution events. Program models, results, lessons-learned, and opportunities for improvement will be discussed and participants will be given activities and takeaways from each program that they can implement at their organization upon leaving.

Four topics will be covered, including Galveston Bay Foundation's Rain Barrel Program, Dockwalker Volunteer Program, Cease the Grease Campaign, and Galveston Bay Action Network mobile app. The session will highlight how these programs have been designed to maximize cost-effectiveness, generate loads of in-kind match, attract sponsorships, and deliver results. For example, through partnerships with Coca-Cola Bottling Company, and corporate and non-profit sponsorships, GBF has now partnered with 11 local organizations to sell-out nine Rain Barrel Workshops per year, which generate tens of thousands of dollars of match, and no longer requires grant funding. The Dockwalker Volunteer Team is increasing the reach of our boater waste education campaign, decreasing staff time in the marinas, and generating data that will aid our request for a federal No Discharge Zone in Galveston Bay. The Cease the Grease Campaign is using united messaging to connect the 27,000 square mile Galveston Bay watershed through active municipal participation and public awareness about fats, oils, and greases causing sanitary sewer overflows. The Galveston Bay Action Network mobile app is connecting citizens with a simple-to-use tool for reporting pollution, which not only maps the report for public use, but also instantly emails the report to the correct authority thanks to increasing buy-in from those authorities to facilitate this communication.

All of these presented projects stem from management measures identified in the Implementation Plan for Eleven Total Maximum Daily Loads for Bacteria in Waters of the Upper Gulf Coast. The goal of this I-Plan is to reduce bacteria concentrations in Upper Gulf Coast waters to levels that meet oyster water standards through adaptive management and implementation strategies.

Join us to gain ideas and strategies to apply to your existing programs or for adopting new programs that maximize your budgets and citizen engagement for improved water quality.

Texas Estuarine Resource Network

Kari Howard Audubon Texas

The Audubon Texas Coastal Program began in 1923, when Audubon established a system of island sanctuaries along the Texas Coast. These island sanctuaries are home to twenty-plus species of colonial waterbirds, several of which are considered endangered or threatened. The majority of waterbirds that nest along the Coast from the Texas-Louisiana border to the Texas Mexico border utilize islands that are Audubon owned or leased. The Texas Estuarine Resource Network or T.E.R.N. is a citizen science program that continues Audubon's legacy of protecting colonial waterbirds through monitoring surveys to gather valuable data about bird populations in foraging grounds and rookery habitats. The data collected through citizen science programs can be incorporated into management and conservation plans, and influence local, state and federal policy development.

The Texas Estuarine Research Network collects data in two essential habitats: colonial waterbird rookeries and waterbird foraging habitat. Successful rookery islands cannot exist without adequate foraging habitat and foraging habitat quality can have an effect on the production of chicks in nearby rookeries. All information gathered by volunteers is entered and stored in an online database. This online database will be developed for participants to submit their observations as well as access resources required for monitoring and receive updates from the TERN program coordinators. The data collected from this website will be utilized for GIS modeling and an interactive map designed to locate areas of high productivity and areas highly used by waterbirds. The Coastal Conservation Program is utilizing this data to keep an eye on healthy and highly used foraging habitats in relation to rookery locations, diversity of species, and types of habitats most used by these waterbirds. In addition to the Audubon Texas usage, partnering organizations have access to this data with capabilities of filtering the dataset for specific bird species, types of habitat, behaviors, and more.

The TERN program has developed a network of highly trained volunteers comparable to a fleet of graduate technicians, but more enduring and each provide a unique skill set from previous experience. Through this program volunteers are trained on how to identify local species of colonial waterbirds, monitor rookery island and wetland foraging grounds, learn current scientific survey protocols and data collections, and assist researchers with conducting these surveys by boat and by land, much like a graduate student or technician would experience. TERN volunteers are offered free trainings, educational workshops, opportunities to participate in habitat restoration, and learn more about their local wildlife and natural resources along the Texas Coast. Volunteer participation is highly active in areas of education, skill development, and in implementing monitoring activities and bird surveys. In addition to providing value in data and service to the TERN program, many of the volunteers have been utilized to expand the "network" of TERN by participating in many other bird related research projects, patrols, and surveys. Partners of the Coastal Conservation Program have utilized TERN volunteers in activities ranging from monitoring American Oystercatcher nests to picking up monofilament line and trash clean ups throughout the bay system. This provides variety for the volunteer and offers an elite pool of skilled helpers for partners to choose from.

PUBLIC OUTREACH METRICS: OPPORTUNITIES & CHALLENGES

Kathy Janhsen
C&E Department
Houston-Galveston Area Council
Houston, Texas

The purpose of water quality outreach is to inform and ultimately cause a change in behaviors that will improve water quality including picking up pet waste, properly disposing of fats, oils and grease, or keeping foreign debris out of storm sewers and wastewater infrastructure. Additionally, public outreach is required in some form for all state- and/or federally-funded grants and is a compliance requirement for Phase I and II stormwater permits. As such, it is often treated as a box to check, with few or difficult to prove metrics associated with evaluating and proving the successes of various outreach activities.

This panel will focus on metrics established and used by three existing outreach campaigns. Three presenters will present the components of their respective campaigns, focusing specifically on metrics proving useful in obtaining additional funding, metrics proving water quality benefits, and/or metrics that were less successful in measuring campaign goals. The goal of this panel is to provide participants an opportunity to explore new and/or successful metrics to use for in future campaigns.

Presenter One will focus on a multi-county/jurisdictional campaign specifically geared towards general water quality outreach and broad behavioral change. “Back the Bay” is an example of this type of campaign.

Presenter Two will focus on a campaign to inform an audience about a specific behavioral change that impacts water quality in a regional program. “Patty Potty” through the San Jacinto River Authority is an example of this type of campaign.

Presenter Three will focus on a targeted campaign to improve water quality within a specific geographic area, such as a single city. The efforts of the City of Pasadena are an example of this type of campaign.

H-GAC staff would moderate the panel discussion and facilitate a question and answer session immediately following the discussion. It is not anticipated that an H-GAC campaign would be featured as a presentation.

Attendees should leave the session with information on how to use quantitative and qualitative metrics to better measure the results of water quality outreach efforts by their organizations.

GALVESTON BAY SEAFOOD ADVISORY EDUCATION CAMPAIGN: METHODS, LESSONS LEARNED AND THE PATH FORWARD

Scott Jones, Director of Advocacy, Galveston Bay Foundation, Webster, Texas

The Galveston Bay Foundation, utilizing Coastal Management Program grant funds and the in-kind contributions of labor and materials from local city and counties, implemented a Galveston Bay Seafood Advisory Education Campaign. The purpose of the campaign was to educate area fishermen, crabbers, and residents in general about the risks of human consumption of seafood contaminated with toxic substances, in particular subsistence fishermen.

The first phase, conducted from October 2010 to March 2012, emphasized reaching areas of Harris County Precinct 2 and local municipalities contained therein and included the development of a Galveston Bay Foundation webpage; the design, production and installation of seafood advisory signs and brochure holders; and the development of brochures and flyers for distribution to local community groups, schools and the public. Throughout the period, the Galveston Bay Foundation also made presentations to various audiences and exhibited materials at various events.

Based on lessons learned from the first phase, a second phase was conducted from October 2013 to December 2014 and focused solely on placing more signs in areas of Harris County Precinct 2 where gaps in coverage existed as well as moving upstream on the Houston Ship Channel where the worst of the seafood advisories are in place.

This presentation will include lessons learned from the garnering of partners and the development of the campaign to Galveston Bay Foundation's recommended path forward to educate not only subsistence fishermen, but all Galveston Bay fishermen.

PLACE HOLDER FOR

CITY OF PASADENA'S SUCCESSFUL ENVIRONMENTAL EDUCATION AND AWARENESS PROGRAMS

Luz Locke
Environmental Services
Engineering Department
Pasadena, Texas

The city of Pasadena has engaged in several education and outreach programs for residents and vendors who contract with the city. They city is also a regional leader in the National Flood Insurance's Community Ratitng System. Luz Locke would present these programs, how they were developed, how the outreach events/programs are conducted, how they are report, how they successes are measured.

ENVIRONMENTAL STEWARDSHIP AT THE PORT AUTHORITY

Author: Nikki Loya, Environmental Affairs/ Port of Houston Authority
Author: Leah Oberlin, Environmental Affairs/ Port of Houston Authority

The Port of Houston is a 25-mile-long complex of diversified public and private facilities along the Houston Ship Channel. These facilities include over 150 private industrial companies along with the eight public terminals owned, managed and leased by the Port of Houston Authority (PHA or Port Authority). The Port Authority is directly responsible for the environmental management of its eight terminals and 14,000 acres of property located within the greater Port of Houston. The Port Authority strives to be an environmental leader for all industries and terminal operators located along the Houston Ship Channel. PHA is committed to conducting port operations in a manner that protects and preserves the natural environment and promotes the port as a maritime industry leader. PHA would like to use the 10th State of the Bay Symposium as a platform to share with the community PHA's stewardship efforts, as they relate to habitat protection, spills and dumping, stormwater management efforts, informing and involving bay users in bay protection. PHA's stewardship efforts include:

· The Port Authority is continually seeking beneficial uses for dredged materials and has successfully begun creation of over 3,300 acres of wetlands in Galveston Bay. PHA cares for the communities near its facilities, and proactively manages environmental conditions at the dredge material placement areas along the channel. The Port Authority pioneered the use of dredge material to create marsh and wildlife habitat. All dredge material, from Port Authority facilities, must undergo a rigorous testing process and be evaluated prior to receiving approval for placement into a Port Authority owned dredged material placement area.

· The design of PHAs Bayport terminal had taken into account the preservation of more than 450 acres of wetlands, forested uplands, open-water habitat, and coastal prairie along the lower part of the San Jacinto River. This terminal has an extensive terminal storm water collection system to protect Galveston Bay. The storm water system is designed to collect all rainwater runoff to reduce potential material from the terminal grounds before it ever reaches the bay.

· PHA is one of the only ports in the country to audit tenant compliance with local, state, and federal environmental requirements. The auditing program also provides environmental compliance and stewardship advice and assistance to tenants who are out of compliance.

· PHA's Educational Outreach and community participation efforts include but are not limited to participation in the Bayou Preservation Association, Buffalo Bayou Partnership, Bayou Land Conservancy, and educational displays for students at the Centennial Family Festival at the Bayport Cruise Terminal, Port Family Day, Bay Day, and Earth Day.

In striving to be the recognized maritime industry leader in environmental stewardship, PHA has a commitment for environmental restoration activities in the Galveston Bay and keeps the protection of the Bay as a high priority item in all business decisions, best management practices and programs, mitigation efforts and by communicating all these activities to stakeholders.

Plastic Pollution Prevention Partnership

Stennie Meadours, Houston Audubon, Houston/Galveston, Texas

Amanda Hackney, Audubon Texas, Texas City, Texas

Kari Howard, Audubon Texas, Texas City, Texas

Marine debris and plastic pollution is one of the greatest threats to our environment and wildlife yet the simplistic nature of this problem holds the greatest potential for immediate solutions and measurable results. These threats occur worldwide, and are, also, apparent along the recreational shorelines of Galveston Bay. The impacts and prevention of non-point source pollution generated by high human recreational use along the shorelines of Galveston Bay is the focus of this presentation.

On Galveston Island in December 2014, 124 juvenile brown pelicans were found sick, injured, entangled, and distressed as a direct result of plastic pollution and discarded monofilament line. These 124 pelicans were successfully rehabilitated and released by the Wildlife Center of Texas, and countless others did not survive their injures. Similarly a juvenile American Oystercatcher was found unable to fly near a nesting site in Galveston Bay and was taken to a wildlife rehabber. The bird died the next day. The determined cause of death was ingestion of monofilament. In another situation, well meaning beach goers chased windblown trash into a colony of beach nesting birds, dramatically disturbing incubation, and increasing the chance of predation.

In response to these incidents, the Plastic Pollution Prevention Partnership (Partnership) was formed among several Houston and Galveston based non-profit organizations and government agencies. At the time of this submittal, Partnership additional joining organizations include;, Galveston Bay Estuary Program, Environmental Protection Agency, Galveston Bay Foundation, Galveston Bay Area Chapter-Texas Master Naturalist, Turtle Island Restoration Network and Trash Fee Waters. The Partnership is addressing non-point source pollutants that impact wildlife and water quality, particularly, plastic litter and monofilament found on the shores of Galveston Bay. The Partnership seeks to collaborate and coordinate internal resources and volunteers to enhance our collective response to shoreline non-point source litter, much like an incident command center in the case of an oil or chemical spill. In addition, the Partnership is broadening existing efforts from the reaction to pollution already on the ground to preventing pollution through changing minds and attitudes about litter and trash through both education and action. As one of the largest cities complexes in Texas, Houston/Galveston and surrounding cities has an urgent need for education, outreach, and stewardship opportunities based on the high population and the close proximity to our many waterways, rivers, bayous, creeks, drainage ditches, Galveston/Trinity Bay and the Gulf of Mexico.

The Partnership presentation will outline a plastic pollution response plan where each organization fills a niche or particular focus that contributes to the common goals of education, and containment. In addition, the presentation will identify measures the Partnership has taken. Some of these measures include; existing programs that are being more fully utilized to expand non-point source pollution prevention to new areas. Others include,convenient methods of reporting plastic pollution shoreline “drop” spots, fish kills, spills, or other environmental hazards; deploying, monitoring, and updating monofilament recycling bins at popular fishing spots; organizing more frequent strategically based area litter clean-ups of specific beaches, bays, and bayous; and working with a number of site managers to provide educational signage at high use areas to inform the public of the impact plastic pollution and monofilament line on wildlife. Finally, the actions and future plans of the Partnership will be reported.

REDUCING HUMAN DISTURBANCE OF BEACH-NESTING BIRDS ON THE TEXAS COAST USING TARGETED OUTREACH

Kacy Ray - American Bird Conservancy

David Newstead – Coastal Bend Bays and Estuaries Program

Susan Heath – Gulf Coast Bird Observatory

From 2012 to 2014, American Bird Conservancy (ABC) and its partners launched a public awareness campaign about beach- and island-nesting birds along the Texas coast during the breeding season. A public service announcement (PSA) targeting recreational boaters, fishermen, and beach visitors to raise awareness about beach- and island-nesting birds was filmed (in year 1) and placed in Texas television and internet markets in the greater Houston area, San Antonio, and Corpus Christi. We also utilized print and Smart Phone advertising to distribute the messaging. The 30-second PSA features Gary P Nunn, the Music Ambassador of Texas, who asks boaters to "Fish, Swim, and Play from 50 yards away…" from nesting birds on islands and beaches, so as to not disturb them or put young at risk of overheating, depredation, and death.

To gain insight into the public's general awareness and attitudes about beach- and island-nesting birds and to determine the level of market saturation of the PSA, Coastal Bend Bays and Estuaries Program (CBBEP) and Gulf Coast Bird Observatory (GCBO) provided volunteer and staff resources to conduct educational evaluative surveys. Surveys were conducted at boat ramps and marinas along the central and upper coasts of Texas. Houston Audubon also provided support during the campaign, by conducting similar surveys on the beaches of Bolivar Flats and the Texas City dike north of Galveston.

In 2012 we conducted 103 surveys representing 220 people, in 2013 we administered 148 surveys reaching 238 people, and in 2014 we carried out 169 surveys that equated to 258 respondents. Over the three years, we observed an increase in the number of people who said that large groups of birds (10 to 100 or more) influenced the distance at which they anchored their boats and/or recreated from the group (2012=54%, 2013=78%, 2014=82%). Most people were aware of regulations protecting birds (52-57% of respondents) and very few had experienced territorial or mobbing behavior indicative of avian behavior in response to being disturbed (by predators or people). Boaters along the upper Texas coast were asked what they would do if they saw signs around an island that indicated a cautious approach or discouraged close anchoring (less than 30-50 yards) to islands with nesting birds. The most common answer in all 3 years was that the boaters would go elsewhere. We asked people at what distance they thought was suitable to recreate at from groups of nesting birds. We saw a decrease in responses of "> 50 yards from shore" over the three years, and most people indicated "within 30 yards of shore" or "as close as possible without disturbing the birds."

Further education and targeted outreach is needed for coastal recreationists to influence behavior change and reduce disturbance to nesting birds on islands and beaches. Additional market research conducted by professional firms would address potential biases in survey responses and assist in developing new effective messaging. This campaign and other similar ones has spurred the Texas Coastal Wildlife Outreach Program (TCWOP), a large consortium of partners including US Fish and Wildlife Service and Texas Parks and Wildlife Department, that are working to develop programming and strategies to address recreational disturbances

and to implement new technologies and messaging that will effectively reach people before they reach the coast.

1. Kacy Ray, Gulf Conservation Program Manager, American Bird Conservancy, 267 E Constance Rd, Debary, FL 32713; kray@abcbirds.org; 614.218.8838
2. Oral presentation, panel session with Houston Audubon bird conservation topics
3. Species Protection

INCREASING ESTUARINE WATER QUALITY AND QUANTITY THROUGH WATERSHED EXPERIENTIAL EDUCATION

Amanda Rinehart, Non-Profit, Artist Boat, Galveston, TX

Karla Klay, Non-Profit, Artist Boat, Galveston, TX

Students participated Eco-Art Workshops and Eco-Art Kayak Adventures. Eco-Art Workshops ~~(80 two-hour sessions in class)~~ were two-hour, in-class sessions using a hands-on watershed model to demonstrate human impacts on estuaries and plein-air water coloring to teach students about the flora/fauna of the ecosystem. Eco-Art Kayak Adventures ~~(80 four-hour adventures)~~ were four-hour field labs at the Galveston Island State Park (Galveston Bay), t~~T~~he Nature Conservancy-Cohn Preserve and Lighthouse Lakes (Corpus Christi Bay). ~~and the Galveston Island State Park (GISD).~~ Kayak adventures provided a feet-in opportunity for participants to learn~~-~~ about the current status of ~~the source of water~~freshwater input ~~water quality and quantity~~ to ~~the~~ estuaries (quality and quantity)~~y~~,~~;~~ water quality testing~~;~~, marsh restoration~~ed and~~,~~; natural marshes~~ and interpretation of ~~their~~ observations using plein-air water coloring.

The goal of WaterIQWet was that participants learn about water quality issues along Texas coasts and will change their attitude and behaviors for the benefit of estuarine health. To evaluate this goal, we used student pre and post surveys, student blogging, and teacher evaluations. We then calculated the change in student knowledge and stewardship behaviors/attitudes between the surveys. Similarly, we monitored the blog for vocabulary and stewardship behaviors/attitudes. We calculated the average of the teacher evaluation, which served as an additional assessment of the quality of the WaterIQWet program.

WaterIQWet was structured around the “An Ocean-Oriented Approach to Teaching Science Standards Ocean Literacy the Essential Principles of Ocean Sciences K-12.” This is a nationally accepted format for promoting ocean literacy in schools. This program meets the nationally recognized standards of NOAA Bay and Watershed Education Training Meaningful Watershed Education by including a preparation phase via the in-class Eco-Art Workshops for students and the Coastal Waters Institute for teachers; an experiential outdoor studies component vial the Eco-Art Adventures via a kayak; and each component of the program includes a reflection phase via creation of watercolors in the habitats and the production of mini blogs by students.

Amanda Rinehart (presenter)
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Presentation type: We would prefer an oral presentation.

Topical areas: Public participation and Education, nonpoint source pollution, freshwater inflow and circulation

Media Partnerships for Public Awareness and Education Campaigns

John Rizzuti, Senior Account Executive KPRC-TV

Placeholder for presentation on engaging media as a partner for a public awareness and education campaign. The planning, stakeholder involvment and successes of the Back the Bay and Cease the Grease campaign.

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Presentation Submission
10th State of the Bay Symposium
20 Years of Successfully Preserving Galveston Bay

Wednesday and Thursday, January 13-14, 2016
Moody Gardens Hotel and Convention Center, Galveston, Texas
Deadline for submission: May 15, 2015

PARNTERING WITH COLLEGES TO PROMOTE THE SUSTAINABLE INOVLVEMENT OF CITIZENS IN ENVIRONMENTAL MONITORING FOR THE HOUSTON-GALVESTON AREA

Author

Dr. Brian R. Shmaefsky
Professor of Biology and IRB Chair
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Lone Star College – Kingwood, Kingwood, TX

Abstract

College, government, and corporate scientists have many opportunities to partner with NGOs by serving on advisory boards and partner directly with citizens by collaborating through programs such as Citizen Science programs, On-Call Scientists, Science Buddies, and Volunteer Science. A model program is being developed at Lone Star College System to connect science faculty and students with NGOs and citizen groups to assist with environmental quality monitoring locally and globally. This model branched off from international service learning projects in Colombia, Honduras, and the Philippines in which faculty and students helped impoverished communities sustainably monitor and remediate water resources.

The first stage of the current project resulted in an inexpensive and portable method for citizens to presumptively detect harmful levels of coliform endotoxins in waterways. Students designed this project to correspond with the Houston-Galveston Area Council's Clean Waters Initiative. The test mimics a very sensitive endotoxin test called the limulus amoebocyte lysate test. A second project is in development and was funded by a grant to purchase a mass-spectroscopy unit. College students and faculty in this project will provide presumptive water quality analyses for citizen clients interested in investigating the presence

of organic molecule pollutants in their waterways.

Participants in this session will learn how to search for programs that connect volunteer scientists with the community. Strategies for developing stakeholder-centered projects will also be described. Citizen-based projects can include advocacy training, public education approaches, and the development of sustainable environmental quality monitoring programs. So far, the completed projects have proven successful based on citizen surveys and have been disseminated in peer reviewed and at invited-speaker conferences.

Format

Oral presentation. A poster session can be done if the oral presentation is not selected.

Symposium Topics Areas Covered

Public Participation and Education – assessment of public attitudes towards environmental protection; involving citizens and volunteers in estuary and watershed protection; implementing adult education and outreach; involving local government in estuary protection; developing and implementing student estuary curricula; informing and involving bay user groups (business, industry, agriculture; commercial/recreational fishing, boaters/marinas; ecotourism interests, etc.) in bay protection; measuring the effectiveness of outreach and education efforts.

Monitoring and Research – unique or emerging technologies or methods to assess ecosystem function; developing environmental and programmatic indicators.

Abstracts must be received in electronic format at the Estuary Program no later than May 15, 2015 via e-mail. Abstracts will be reviewed by a symposium committee, which will try to accommodate the authors' desire for an oral or poster presentation, or panel session. You will be notified if your presentation or session has been accepted for inclusion in the symposium by July 10, 2015. At that time, further information will be provided about event registration and submittal of biographical sketches, presentation slides and full papers.

Contact Information

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PUBLIC OUTREACH TOOLBOX: CREATING A COMMMUNITY IN YOUR COMMUNITY

Amanda Thorin
C&E Department
Houston-Galveston Area Council
Houston, Texas

The reaction of the public can be the wildcard for many projects. The Houston-Galveston Area Council, through a recent regional planning effort, developed a toolbox to facilitate successful community engagement, participation and education: the Community Ambassador Toolbox.

Community Ambassadors are community members engaged in community outreach who would like to more actively participate. This presentation will highlight outreach challenges and train attendees to effectively utilitze the Community Ambasador Toolbox for water quality projects.

Topics covered include:
Organize Your Way to Success: Participants can achieve community goals one project at a time with this step-by-step review on how to organize before the efforts get started. (Presentation)

No Need to be Fearful: Participants will be given facilitation tips to aid in participation when encountering challenging or adversarial community members during public gatherings.(Presentation/Discussion)

Activities That Get People Talking: Participants will be introduced to and participate in activities that get people to talk but also reap rewards in communication with you and others in their community. (Presentation/Activity)

Toolbox for Getting Started: Participants will be introduced to and take home a toolbox equipped with traditional and outs-of-the-box ideas for entities and organizations to use when engaging the community. During this segment participants will be presented with pros and cons of each element and participate in a real-time discussion. (Discussion/Participating)

H-GAC staff will lead the presentation and guide the participants in an interactive exploration of the toolbox.

Attendees will leave the session with confidence to take the toolbox home and use the community resources, tools and network-building elements for greater support in future projects in water quality and beyond.

Shoreline Management Abstracts

GALVESTON BAY STORM SURGE MITIGATION

Alyssa Adams-Texas A&M University at Galveston, Maritime Administration and Logistics, Galveston, TX

Hurricane Ike cost the Houston and Galveston area $38 billion in 2008 and flooded over 100,000 homes and businesses which prompted discussions regarding mitigation strategies for Galveston Bay such as the implementation of the Ike Dike. The development of such a project is worth the investments of time and money because it will protect the national economic impact of Houston industries, local human capital, and the diverse wildlife of the Galveston Bay estuary. The Houston area is home to over six million people and the second largest petrochemical complex in the world which employs over 60,000 workers. Galveston Bay is the seventh largest estuary in the United States and contains over 4,000 acres of created wetlands which serve as erosion and flood control while providing nursery habitats for many valuable species.

The Houston and Galveston area is the most dangerous hurricane spot in the nation. Hurricane Ike could have been far more devastating to Galveston;; Ike would have more than doubled the number of flooded establishments if it had hit just 20 miles southwest. When the Bay is struck by its next storm, there is a significant chance of oil pollution occurring from the thousands of tanks stored in the area. Experts fear that the Galveston Bay estuary is not prepared for another large hurricane. The Galveston region of the Gulf Coast sustains a significant storm every six years on average which is why it is integral for the area to proactively anticipate future damages. This paper is a call for building the Ike Dike as the most feasible, proactive measure in mitigating storm surge damages to social, ecological, and industrial structures.

The present dike structure in Texas City provides mitigated protections for industrial complexes within the Port of Houston but neglects storm surge protections for the social infrastructure of this community and the surrounding wildlife habitats including national parks. Issues such as recruiting and relocating a temporary workforce into the area, rebuilding homes and communities, and disruption of operations are costly for companies. The existing infrastructure also fails to protect the wetlands and recreational activities associated with Galveston Bay. When the next storm strikes the area, these realities will impact local business activities including operations within the Port of Houston and Galveston fisheries. These disruptions will reverberate nationally because Houston is strongly interconnected to industries within the United States.

The most viable option for protecting the Galveston and Houston area from future storms is the implementation of the Ike Dike. This infrastructure would cost $6,478,200,000 with opportunistic benefits to the area of $14,042,424,000. These benefits would include ensuring a stable workforce, protection of Bay flora and fauna, and the continuation of business operations. The study phase of implementing the Ike Dike is pending approval by Congress but requires sustained political support from state and federal representatives. Support is needed from businesses, politicians, scholars, and community members in order to protect the economic investment and community infrastructure of the area.

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Oral presentation preferred, will accept poster
Topic: Shoreline Management-mitigation of coastal hazards

INFORMED PRESERVATION AND MANAGEMENT: THE DEVELOPMENT OF THE BEACH AND COASTAL MANAGEMENT PORTAL

David R. Baca

Laura McElfresh

Alexandra Mitchell

Jack K. Williams Library
Texas A&M University at Galveston
Galveston, Texas

Management of coastal areas is critical for world coastlines. In the US, for example, over 55% of the population lives along the coast. These areas are sources of important economic activity, providing food, commerce, creation and energy production. They protect human life and property and protect from other environmental impacts. Managers of these areas need access to best practices by other managers, innovative ideas, beach and coastal data and working documents.

The vision for the Beach and Coastal Management Portal is to become the primary document and publication resource for public beach and coastal area managers and professionals. It will serve as the premiere information access point for data, documents, best practices and news pertaining to beach management around the world. The Portal will serve as the clearinghouse for beach and coastal management resources and will give managers daily access to information they need and want.

The Portal is a partnership between Texas A&M University at Galveston and the Galveston Park Board of Trustees started in January, 2014. Staff and faculty at Texas A&M University at Galveston Jack K. Williams Library manage the technical side of the operation, setting up the repository, loading documents and resources and operating the “back end” of the Portal. TAMUG in turn partners with the Texas Digital Library to maintain the site and provide legacy access to resources. Park Board staff assist with identifying resources that are useful to beach mangers, publicizing the site and assisting with development of new partnerships.

This presentation will present the vision for the Portal, discuss present activities and milestones and will demonstrate the Portal for the audience. The goal is to introduce members to the Portal and to get them actively participating in the Portal’s growth and utility.

David R. Baca, Director – Primary Contact

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Oral presentation but will accept poster

Shoreline Management

CHANGES IN THE DELIVERY OF ECOSYSTEM SERVICES IN GALVESTON BAY, TEXAS, UNDER DIFFERENT SEA-LEVEL RISE SCENARIOS

Greg Guannel, The Nature Conservancy
Jorge Brenner, The Nature Conservancy
Joe Faries, Stantec
Anne Guerry, Natural Capital Project
Jesse Silver, Natural Capital Project
Michael Thompson, Research Planning, Inc.

Galveston Bay is the 7th largest estuary in the United States, home to the 2nd port in the country by tonnage, and is a favorite recreation destination. The bay's rich ecosystem also hosts the most valuable fisheries resource in Texas, and its wetlands can store millions of tons of carbon. However, the region also suffers severely from the impacts of rapid sea level rise (SLR), resulting in a rapid displacement of marshland. As a result, it becomes critical to know whether the bay's coastal habitats will be able to deliver in the future all the benefits on which many Texans depend. In this presentation, we discuss how the delivery of ecosystem services in Galveston Bay will change under different SLR scenarios. We quantify the landward migration of coastal habitats by SLR and potential subsequent changes in the delivery of coastal protection, storm water retention, fisheries habitat and population, and carbon storage and sequestration services. These unique modeling outcomes will be useful to any decision makers and stakeholders across the globe that need reliable methods to evaluate changes in ecosystem services delivery under different climate change scenarios.

Presenter's information:

Jorge Brenner, *Ph.D.*
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The Nature Conservancy – Texas Chapter
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ORAL presentation is first choice.

Topics:

- Ecosystem services and impact of estuarine resources
- Shoreline management

SPECIES PROTECTION ABSTRACTS

MONITORING THE URBANIZED DOLPHINS OF UPPER GALVESTON BAY

Kristi Fazioli – Environmental Institute of Houston, University of Houston-Clear Lake, Houston, TX

Vanessa Mintzer – The Galveston Bay Foundation, Webster, TX

George Guillen - Environmental Institute of Houston, University of Houston-Clear Lake, Houston, TX

Critical data gaps exist for all Texas bay, sound and estuary bottlenose dolphin (*Tursiops truncatus*) stocks and managers consider Galveston Bay a high priority for research. Surveys conducted in 2013-2015 suggest that a bottlenose dolphin population regularly utilizes upper Galveston Bay and the Houston Ship Channel. This highly industrialized region of the bay was previously thought to have very little dolphin activity. An increasing trend of dolphin activity in this area could reflect the success of efforts to protect Galveston Bay and improve water quality over the past 30 years, however little is known about habitat use, site fidelity or stock structure in the region. Elevated exposure to contaminants in upper Galveston Bay, combined with additional anthropogenic stressors such as habitat loss, harmful algal blooms, noise pollution and human and fisheries interactions, place dolphins at high risk.

The Galveston Bay Foundation has partnered with the Environmental Institute of Houston at the University of Houston, Clear Lake to conduct research on this understudied population and establish the Galveston Bay Dolphin Research and Conservation Program (GDRCP). Through long-term photo-id monitoring, mark-recapture techniques and remote biopsy darting, this program aims to tackle fundamental questions pertaining to the population's ecology, health and behavior. Additionally, GDRCP is examining historical data and conducting a survey of long term bay users to provide context to current trends.

As of March 2015, we have conducted 16 boat-based surveys, resulting in the observation of 364 dolphins in 56 groups. A total of 196 dolphins have been uniquely identified through photo-identification. Dolphins were sighted year-round and of the marked dolphins, 30% were sighted more than once, suggesting the possibility of a resident population. Observations indicate an increase in abundance during the summer and fall months, which supports previous data suggestive of a seasonal coastal migration between Texas bays. Findings also indicate high levels of association with shrimp trawlers (30% of groups sighted) and vessels traversing the Houston Ship Channel (bow-riding observed in 23% of groups sighted). Considering the exceptionally high levels of human activity in UGB, it is imperative to continue monitoring this population, with focus on understanding residency and habitat use patterns, as well as the impact of anthropogenic threats.

BIRD MONITORING IN THE GALVESTON BAY WATERSHED: CURRENT EFFORTS AND OPPORTUNITIES TO FILL DATA GAPS

Richard E. Gibbons* and Peter Deichmann

Wildlife conservation requires an understanding of the distribution, abundance, and movement of organisms across wide geographic space and over sufficient periods of time. Monitoring wildlife is essential for measuring efficacy of local and regional management actions and estimating population trends. Current bird monitoring efforts in the Galveston Bay Watershed are directed toward targeted assemblages such as waterfowl counts, colonial waterbirds, seabirds, and shorebirds, and single species monitoring such as Wilson's Plover, Piping Plover, and Rusty Blackbird. Additional regional monitoring projects, such as Houston Audubon's Monthly Bird Counts, aim to gather bird community samples using volunteer citizen scientists. Finally, the venerable Christmas Bird Counts and Breeding Bird Surveys are long-term programs that are the classic indices that measure wintering and breeding birds respectively.

Still, gaps remain in our knowledge for important groups of birds, such as secretive marsh birds, non-game waterbirds, many shorebirds, and scores of migratory species that pass through using working farmland and various habitats as stopover habitat. With improving technology and a growing interest in wildlife observation and citizen science, opportunities exist to bring partners and stakeholders together to gather data for these poorly known species. These opportunities will be discussed and proposals made to fill some of the gaps.

1. Richard E. Gibbons, Conservation Director; Houston Audubon, 440 Wilchester Blvd, Houston, TX 77079; rgibbons@houstonaudubon.org; (225) 614-4008
2. Oral presentation, panel session with Houston Audubon bird conservation topics
3. Monitoring and Research

INVASIVE SPECIES MONITORING, MANAGEMENT, AND PREVENTION

Lisa A. Gonzalez, HARC, The Woodlands, Texas

Stephanie M. Glenn, HARC, The Woodlands, Texas

The Galveston Bay Plan (*The Plan*; 1995) and the Galveston Bay Strategic Action Plan (2006) include goals, objectives and actions that relate to reducing or eradicating populations of exotic invasive species and preventing new species invasions. The original objective of *The Plan* was to reduce the abundance of selected exotic invasive species by ten percent by the year 2005. The Strategic Action Plan identified a ten-year approach with objectives relating to invasive species management, research, and public education (for the purpose of prevention).

In 2004, the Galveston Bay Estuary Program, HARC and regional stakeholders conducted a comparative risk assessment of aquatic and terrestrial species that were invasive and potentially invasive to ecosystems in the Lower Galveston Bay Watershed. The exercise yielded a list of invasive species for the Houston-Galveston region never before compiled. 296 invasive aquatic and terrestrial plants and animals were identified as current or future invaders of the Lower Galveston Bay Watershed; especially high risk species were also identified.

Much has changed since the Galveston Bay Invasive Species Risk Assessment was completed in 2004. Some of the species identified by the risk assessment have indeed invaded the Lower Galveston Bay Watershed, while new invaders that were not imagined during that inaugural effort have also been identified in the region. Citizen science and traditional natural resource monitoring programs now contribute information to national databases that track species invasions at county and watershed levels. New risk assessment tools for species entering through the nursery and aquarium trades and other introduction pathways have been developed by HARC and others around the US. New invasion pathways, such as internet sales, have materialized. Some attempts to strengthen local, state and federal rules regulating the flow of exotic and invasive species through trade have succeeded while others have failed. The use of technology, such as social media and smart phones, have become mainstream for outreach and education efforts. Government agencies, universities and nonprofit organizations are using these methods for invasive species education campaigns. At the time the Galveston Bay Plan was written, it was estimated that the public cost of new actions over 5 years would be less than $450,000. We now know the costs to control and prevent species invasions and restore habitats are much higher.

The proposed session will feature speakers that are working on invasive species issues. Presentations will provide information describing the current status of species invasion (plants, animals, and disease organisms) in the Lower Galveston Bay Watershed; programs to monitor species invasions; techniques to manage invasive species in aquatic and terrestrial systems; developments in invasive species regulation in Texas; and public education efforts and risk assessment tools to prevent future species invasions.

1. This abstract is proposed for a panel session. It can be pared down for an oral presentation if desired.

2. Session moderators:

    a. Lisa A. Gonzalez, Vice President, Houston Advanced Research Center, 4800 Research Forest, The Woodlands, Texas 77381, 281-364-6044 (office); 281-364-6070 (assistant); 281-364-6001 (FAX), lgonzalez@harcresearch.org

    b. Stephanie M. Glenn, Hydrology and Watersheds, Houston Advanced Research Center, 4800 Research Forest, The Woodlands, Texas 77381, 281-364-6042 (office); 281-364-6001 (FAX), sglenn@harcresearch.org

3. Proposed panelists (number can vary depending on available time):

    a. Invasive species overview/status of invasion: Ms. Lisa A. Gonzalez, HARC

    b. Invasive species monitoring: Dr. Damon Waitt, University of Texas, Ladybird Johnson Wildflower Center, Texas Invaders Program

    c. Species invasion spotlight on zebra mussels in the Trinity River: Dr. Robert McMahon, University of Texas at Arlington

    d. Techniques to manage invasive species in aquatic and terrestrial systems: Mr. Mark Kramer, Armand Bayou Nature Center

    e. Developments in invasive species regulation in Texas: Ms. Leslie Hartman, Texas Parks and Wildlife Department, Coastal Fisheries Division, and the Gulf South Atlantic Regional Panel (GSARP) on Invasive Species

    f. Public education and tools to prevent future species invasions: Dr. Stephanie M. Glenn, HARC

4. The content of this abstract deals with “Species Protection.”

Low-cost mapping of intertidal reefs using side-scanning sonar and drone systems

George Guillen, Environmental Institute of Houston, University of Houston Clear Lake, Houston, Texas

Mustafa Mokrech, Environmental Institute of Houston, University of Houston Clear Lake, Houston, Texas

James Earl Yokley, Environmental Institute of Houston, University of Houston Clear Lake, Houston, Texas

Oyster reefs provide important environmental services including water filtration and purification, protection of seagrass beds and saltmarshes from wave action, forage for some invertebrates and finfish, and habitat for numerous marine organisms including commercially and recreationally important finfish. Mapping the physical extent and conditions of these reefs provides scientists and managers with data on the current status of oyster populations and hard bottom habitat within an estuary as well as information needed for ongoing oyster conservation and restoration efforts. Although subtidal reefs in relatively deeper water have been mapped using sonar and other traditional technologies, the extent and conditions of intertidal reefs have not been sufficiently inventoried in most states. The geographic extent and conditions of intertidal oyster reefs and shell bottoms, including small patch reefs, are important to document and inventory for assessing the extent of parental adult stock and to determine potential recruitment bottlenecks for oysters within an estuary. Mapping intertidal shallow reefs are usually impeded by navigation and the inability to use traditional side scan sonar and survey methods. This research project applies side-scanning sonar system (where water depth > 3 feet) combined with drone photography (for shallow water where water depth < 3 feet) together with digital image processing techniques to identify and map selected intertidal oyster reefs and shell bottom at two selected sites in West Bay and Christmas Bay.

The low-cost side scanning sonar is mounted on a shallow draft boat to map shallow water habitat not accessible to larger draft vessels that utilize commercial grade side scan sonar instrumentation. The shallow subtidal represents a transition zone along with intertidal area that provides habitat for wading birds and other organisms and contains a potentially large numbers of oysters that provide key ecosystem services and provides habitat for wading birds, juvenile fish and invertebrates that remains unsurveyed. This novel approach for surveying the shallow subtidal zone provides this critically needed information. On the other hand, the low-cost low altitude photography using drones uses high-resolution digital cameras to acquire high-resolution images at the selected sites to evaluate the ability to map intertidal reefs at reasonable costs. The collected images are digitally processed through multiple steps including spatial registration, spectral enhancement and classification. Field verification through diving, walking and shallow boat surveys are considered in the validation process.

This project presents the initial results of the combined use of these technologies and the new information on the distribution of intertidal and shallow subtidal oyster reefs and shell hash with a discussion on potential applications of these technologies.

Primary Presenter:
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Presenter:
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Type of presentation: Poster

Potential topical area: Monitoring and Research

TRENDS IN THE ABUNDANCE OF TEXAS DIAMOND-BACKED TERRAPIN, *MALACLEMYS TERRAPIN LITTORALIS* IN GALVESTON BAY

George Guillen[1],
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School of Science and Computer Engineering
University of Houston-Clear Lake
Houston, Texas

Jenny Oakley[1]

Bryan Alleman[1]

Mandi Gordon[1]

Alecya Gallaway[1]

Abstract

The Texas Diamondback, *Malaclemys terrapin littoralis*, is the only naturally occurring species of turtle found in estuaries ranging from Sabine Lake to Baffin Bay. Terrapin have been identified as a species of concern by state and federal agencies. The primary objectives of our study were to 1) determine distribution and trends in abundance and 2) determine critical factors affecting terrapin in Galveston Bay and the Texas coast. We conducted a literature review, interviews, and field studies during 2014. Information on location, method captured, habitat, and environmental data were collected to evaluate their possible relationship with terrapin distribution. The first report of terrapin in Texas is 1841. The primary factor causing major declines in terrapin from 1841 to the 1920 was commercial harvest of the species for food. During 1912 through 1975 the shell dredging industry removed large amounts of oyster shell in Texas including shell beaches and small islands. One of the largest known populations of Texas terrapin today are found in the West Galveston Bay near or on isolated islands with shell beaches. The only reported sightings of nesting terrapin have been on shell beaches located in West Bay and nearby Moses Lake. We conclude that the two primary factors causing major declines in terrapin before the 1970's were overharvesting and loss of nesting habitat. Current anthropogenic sources of mortality include bycatch associated with the blue crab fishery and boat collisions. Due to a small home range ($\leq$ 254 hectares), loss of nesting and marsh foraging habitat, terrapin face an increased risk of extirpation.

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THE STATUS OF AMERICAN OYSTERCATCHERS IN GALVESTON BAY

Susan A. Heath
Gulf Coast Bird Observatory
Lake Jackson, TX

The Gulf Coast Bird Observatory has committed the last five years to investigating the status of the American Oystercatcher (*Haematopus palliatus palliatus*) in the western Gulf including Galveston Bay, Texas. The American Oystercatcher is a species of high concern in the U.S. Shorebird Conservation Plan, a National Fish and Wildlife Foundation priority species, and a Texas Wildlife Action Plan priority species. This species is at risk due to its low overall population size, the fact that it is confined to the coastal zone, a low overall reproductive success, and a delayed breeding system. Prior to the initiation of our study, there had been much research conducted on the Atlantic coast concerning this species but no investigation of their status in the western Gulf of Mexico.

The western Gulf population of oystercatcher represents about 5% of the total population in the U.S. with approximately 500 birds located in Texas. The majority of oystercatchers in Texas are located on the Upper and Central coasts with very few pairs nesting south of Corpus Christi. The Galveston Bay area supports approximately 80 pairs of nesting oystercatchers with an unknown number of sub-adults that have not entered the breeding population. Oystercatchers do not breed until they are at least three years of age. Sub-adults appear to congregate in areas of high food abundance including Rollover Pass, San Luis Pass, and reef systems throughout the bays that are not included in adult feeding territories.

In general, the greatest negative factors for nesting oystercatchers are predation, overwash, and human disturbance. On that Atlantic coast, mammalian predation may be the single most negative factor but because western Gulf oystercatchers nest primarily on bay islands mammalian predation is not an issue. Avian predation from Laughing Gulls can have a significant effect on nest success, however. Gulf wind driven tides present a significant overwash threat and therefore weather may the single most negative factor for western Gulf oystercatchers. Human disturbance is also a significant factor because it keeps adults away from eggs and young chicks leaving them vulnerable to predation from hungry Laughing Gulls.

Western Gulf oystercatchers initiate nesting in February with the latest nests found in June. Chicks are fledged by the end of July but remain with their parents for a number of months while they learn to feed efficiently. Oystercatchers with failed nests will attempt to re-nest two or three times until it becomes too late in the season for success. Productivity during our study has ranged from a low of 0.21 to a high of 0.78 meaning that 21% and 78% of pairs, respectively, fledged at least one chick. Overall productivity was 0.49 which is slightly higher than that of Atlantic coast birds.

In the Galveston Bay system, nesting habitat appears to be a limiting factor for this species. American Oystercatchers are not colonial waterbirds, therefore they nest singly within colonial waterbird colonies or on small islands as single pairs. They prefer shell substrate for nesting but must also have access to sub-tidal reefs for feeding. When adult pair member abandons a mate or dies, they are replaced within two weeks indicating a population of unpaired adults waiting for a nesting opportunity. GCBO biologists are working with several organizations on habitat restoration specifically designed for oystercatcher nesting.

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Oral presentation requested within George Guillen's proposed "status and trends" session
This presentation falls within the "species protection" topic

STATUS AND MANAGEMENT OF PUBLIC OYSTER REEFS IN GALVESTON BAY

Christine C. Jensen, Coastal Fisheries Division, Texas Parks and Wildlife Department, Dickinson, Texas

Oysters are an essential component of the Galveston Bay ecosystem on many levels. They serve as refuge and foraging habitat for a variety of fish and invertebrates, improving water quality, stabilizing habitat, and producing large reef complexes in addition to serving as a food source for humans. Prior to the mid-2000s, Galveston Bay produced approximately 80 percent of the oysters commercially harvested in Texas producing 3.5 million pounds of meats worth $12.3 million in today's dollars. Since that time, that number has dropped to around 50 percent with the average harvest reduced to 2.5 million pounds worth only $9.6 million despite increases in demand and price per sack. Catch rates of Texas Parks and Wildlife monitoring data have shown a similar decline in oyster resources. In addition, new mapping data shows that many reefs, particularly in East Bay, are shrinking or disappearing. A combination of factors such as reduced freshwater inflow, increased salinity, drought, predators, disease, Hurricane Ike, and high fishing effort has likely contributed to the reduction in oyster production in recent years. Texas Parks and Wildlife has been working in conjunction with the oyster industry to manage commercial oyster harvest based on the percent of undersized oysters observed in each harvest area, but there has not been an improvement in the resource. New techniques and management tools are being tested to better manage the fishery and achieve the goal of sustainable harvest.

Additional Info Requested:

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Oral presentation desired but poster acceptable

Suggested symposium topic: Species Protection

FORAGING ECOLOGY OF COMMON BOTTLENOSE DOLPHINS (*TURSIOPS TRUNCATUS*) IN GALVESTON BAY

Sherah Loe, School of Science and Computer Engineering, University of Houston-Clear Lake, Houston, Texas

Kristi Fazioli, Environmental Institute of Houston, University of Houston-Clear Lake, Houston, Texas

Dr. George Guillen, Environmental Institute of Houston, University of Houston-Clear Lake, Houston, Texas

Galveston Bay (GB) is the largest estuary in Texas and is located downstream of the fourth most populous city, the second largest port and the largest petrochemical complex in the United States. Galveston Bay is comprised of four sub-bays: Galveston, Trinity, West, and East Bays. The Houston Ship Channel (HSC) divides GB and is an avenue for heavy maritime traffic ending at the Port of Houston (POH) in the northwest. Consequently, GB has suffered degraded water quality due to multiple anthropogenic influences including permitted discharges, non-point source pollution, oil and chemical spills and unauthorized disposal sites. Current concerns include heavy metals, chlorinated organic compounds, which have resulted in multiple seafood advisories, making GB a high priority for biological monitoring. Bottlenose dolphins (*Tursiops truncatus*) are an ecologically important long lived apex predator in GB and are exposed to these anthropogenic stressors. Currently, crucial data gaps exist for bottlenose dolphins in GB and the National Marine Fisheries Service considers GB a high priority area for research. A resident community of dolphins has been previously documented in West Bay. Dolphins are also present in lower GB near Bolivar Roads, whereas previous studies have revealed only limited dolphin activity in East Bay, Trinity Bay, and upper GB. Recent surveys (2013-2015) suggest dolphins regularly utilize upper GB, including the HSC near the POH, year round. One of the most important factors affecting bottlenose dolphin movement patterns is the spatial and temporal distribution of prey resources therefore determining the foraging ecology of these animals is crucial to understanding their life history. Stable isotope analysis (SIA) is a commonly used method to determine the trophic ecology of various species of animals including mammals. Our objectives for this research are to: 1) estimate habitats in the GB system used for foraging by pairing photo-identification population survey data and stable isotope analysis, 2) estimate proportions of different prey consumed by bottlenose dolphins using stable isotope mixing models (SIMM), and 3) delineate year-round residents and seasonal transients. This multidisciplinary approach will provide critical data to better understand habitat use, site fidelity, and foraging ecology of GB dolphins. Information presented on these topics based on preliminary data collected as part of our monitoring program and analysis of historical data.

Poster Presentation (Species Protection)

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THE EFFECT OF FOUR ENVIRONMENTAL PARAMETERS ON THE STRUCTURE OF ESTUARINE COMMUNITIES

R. McFarlane, Houston Advanced Research Center, The Woodlands, TX

A. Leskovskaya, Elite Research, Carrollton, TX

J. Lester, Houston Advanced Research Center, The Woodlands, TX

L. Gonzales, Houston Advanced Research Center, The Woodlands, TX

We modeled 25 years of overdispersed coastal fishery monitoring data with zero-inflated negative binomial regression to determine the effect size of four environmental parameters ¾ temperature, salinity, dissolved oxygen, and turbidity ¾ for 64 species of fishes, shrimps and crabs. Each parameter exhibited both positive and negative effects on the abundance of various species. Surprisingly, there were a number of species with negligible effects. It is these unaffected species that dominate the estuarine macroconsumer shoreline community of the Texas coast.

1. Presenter:

Dr. Robert W. McFarlane, Fellow
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2. An oral presentation is desired. A poster presentation is unacceptable.

3. Topical area:

Freshwater Inflow and Bay Circulation

Where Them Fish At?

An Overview of the Population and Habitat Characteristics of the Saltmarsh Topminnow (*Fundulus jenkinsi*) in Galveston Bay and Sabine Lake, TX

Josi Robertson[1]

Stephen Curtis[2]

Jenny Oakley[2]

George Guillen[1,2]

[1]University of Houston- Clear Lake, School of Science and Computer Engineering
[2]Environmental Institute of Houston

Fundulus jenkinsi has a preference for low to moderate salinities and is primarily found along the edge of saltmarsh habitat surrounding small intertidal creeks along the Gulf of Mexico. The Saltmarsh Topminnow has been listed as a species of concern within many of the gulf coast states. Not much is known about *F. jenkinsi*'s range or abundance within the state of Texas. *Fundulus jenkinsi* is under consideration for federal listing and given this species' restricted range in Texas and recent projections of land development, land subsidence, and sea level rise it is important to document its habitat requirements and distribution. The objectives of this study were to 1) document the distribution and abundance, 2) habitat use, and 3) assess the population characteristics of *F. jenkinsi* within the Galveston Bay and Sabine Lake watershed. Tidally influenced mesohaline sites were chosen to evaluate the influence of salinity gradients on *F. jenkinsi* occurrence. Fish communities were sampled quarterly in Galveston Bay and Sabine Lake with additional monthly sampling done within the Moses Bayou of Galveston Bay. Water depth, tide stage, water quality, dominant vegetation, and habitat type were recorded during each sampling even. When collected, specimens of *F. jenkinsi* were identified, counted, and measured before being sacrificed and preserved. For each sampling event, fish abundance, species abundance, species richness, species diversity, and evenness were calculated. Fish community assemblages were analyzed using multivariate ordination methods to identify environmental and biological factors relating to spatial and temporal trends in *F. jenkinsi* presence across sites. In addition, gonadal somatic indexes (GSIs) were calculated from the monthly collections.

1.) Contact Information:

Primary Presenter: Josi Robertson, Master's Candidate, University of Houston- Clear Lake

Environmental Institute of Houston, University of Houston-Clear Lake, 2700 Bay Blvd, Box 540, Houston, TX 77058

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2.) Presentation section: Oral (poster acceptable if cannot accommodate oral presentation)

3.) Topic Areas: Species Protection, Environmental Science

RESTORING OYSTER HABITATS IN GALVESTON BAY: CURRENT ACHIEVEMENTS AND FUTURE CHALLENGES

William Rodney, TPWD Coastal Fisheries Division

The Galveston Bay Ecosystem has historically been Texas' largest producer of oysters. Even before the devastation brought by Hurricane Ike in 2008, oyster production in Galveston Bay, as measured by Texas Parks and Wildlife Department's (TPWD) fishery independent dredge sampling program, had fallen well below the 30 year average. This decline was likely due to a suite of stressors including hurricanes, drought, hydrologic alterations, disease, predators, commercial fishing impacts and other factors. Hurricane Ike's massive storm surge resulted in large scale sedimentation impacts to the Bay's oyster reefs. About half of Galveston Bay's 16,000 acres of oyster reef habitat were damaged or destroyed with the greatest impacts occurring in East Galveston Bay where more than 70% of the natural oyster reefs were buried. Texas Parks and Wildlife Department began oyster habitat restoration efforts in 2009 and these efforts continue to the present. To date about 440 acres of oyster habitat have been restored using cultch planting methods. Most of these restorations (93%) were designed to benefit the commercial oyster industry. A small percentage (7%) of restoration acreage was designed to enhance oyster reef ecosystem services. Monitoring these projects has provided TPWD with some valuable insights on the ecological and economic benefits of oyster reefs. Oyster populations developed readily on newly restored reefs and, when left undisturbed, oyster densities between 100 and 200 oysters per square meter were easily achieved. On these new reefs, fish abundance and species richness was observed to be greater than nearby unrestored reefs and non-reef control sites. Once opened to commercial oyster harvest, oyster density was rapidly reduced to levels similar to those seen on natural oyster reef control sites. However, on the new reefs, where clean cultch was still abundant, recruitment of oyster spat greatly exceeded what was observed on natural oyster reefs. This insight, combined with results from applying state of the art modelling tools to our restoration monitoring data, suggests that oyster reefs can be managed for sustainable harvest if the level of harvest pressure can be quantified and controlled so as to maintain habitat quality and quantity. As TPWD's oyster restoration project moves forward, new approaches to restoring and managing oyster habitat will be needed in order to attain maximum ecological and economic benefit from these important habitats.

1. Presenter Information:

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Organization: Texas Parks and Wildlife Department

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2. Presentation Type:

   Oral

3. Topical Area:
   Habitat Protection or Species Protection

DETERMINING FACTORS AFFECTING DERMO DISEASE OF OYSTERS IN GALVESTON BAY, TEXAS

Elizabeth H. Silvy**,** Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843

Francis I. Gelwick**,** Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843

George J. Guillen, Environmental Institute of Houston, University of Houston-Clear Lake Houston, Texas 77058

Abstract: The Gulf Coast has seen a dramatic decline in oyster take in recent years. Lack of fresh water flow and other environmental variables have been suggested to cause an increase Dermo disease of oysters, caused by the parasite, *Perkinsus marinus*, which attacks the tissue of the oyster and is responsible for oyster and reef kills along the Gulf Coast. As such, a disease has its biggest detrimental effect when conditions create an abrupt increase in density for either the disease or host population. Therefore, correlating the Dermo parasites distribution and prevalence in the eastern oyster *(Crassostrea virginica)* to water conditions could be beneficial to the eastern oyster throughout its range. This study addressed the ecologically conditions, parasite distribution and prevalence within the oyster host populations in Galveston Bay, Texas. Specific objectives were to determine in Galveston Bay the: (1) prevalence of Demo in oysters, (2) distribution of Demo infected oysters, (3) concentrations of *Perkinsus marinus* within infected oysters, and effects of salt concentrations (i.e., fresh water flow) on prevalence of Demo in oysters. Oysters were collected at 4 study sites (April Fool Reef, Fishers Reef, Frenchys Reef, and Confederate Reef) bimonthly during 2015. Fishers Reef was a site that was close to the Trinity River and was most affected by fresh water flow. At each site an oyster dredge was pulled behind a boat for 10 minutes in slow circles and repeated 3–8 times if necessary to collect 20 market-sized oysters. Oysters were placed on ice until processed. If a reef was accessible to wading, oysters were collected by hand. At each site, water quality data (turbidity, depth, salinity, temperature, and wave height) were collected. Once collected, oysters were taken to the University of Houston–Clear Lake for processing. Oysters from each site were numbered from 1–20 and kept separated by site. Each numbered oyster shell was measured with calipers to the nearest millimeter. Data recoded included date of culture, bill condition of each oyster (i.e., sharp or dull). Each oyster was shucked using an oyster knife and gloves. The oyster meat was left in the cupped half shell and meat condition was recorded (i.e., shrunken [small, shrunken, dehydrated appearance] or plump [round, lush, creamy]). After shucking, 0.05 ml of the Chloromycetin/Nystatin working mixture was added to each Dermo tube (Thio medium) and was mixed by inverting the tube. For each oyster, a 5 mm^2 piece of anterior mantle was placed into a separate Dermo tube and shaken until the tissue is in the fluid. Tubes were labeled by reef and number of the oyster. Tubes were stored at room temperature for a week and then the tissue was placed on a slide, masticated with a tweezers, and 1–2 drops of Lugols iodine solution was applied and blended in using the tweezers, then placed under a cover slip, and read under a microscope giving it a rating on the Mackin Dermo Intensity Scale. Environmental data collected from the oyster reef surveys were used to correlate Dermo prevalence, distribution of Demo infected oysters, and concentrations of *Perkinsus marinus* within infected oysters with salt concentrations (i.e., fresh water flow). Above normal precipitation during 2015 appears to have decreased Demo prevalence and distribution in oysters from historic levels in Galveston Bay.

1) Elizabeth Silvy, Masters Student, Texas A&M University College Station, Texas (979)219-1724, 14703 I and GN road College Station, Texas 77845, bsilvy88@yahoo.com

2) Presentation desired, will accept poster

TRENDS IN FINFISH AND INVERTEBRATE ABUNDANCE IN GALVESTON BAY

Glen Robert Sutton
Texas Parks and Wildlife Department
Coastal Fisheries Division

Abstract: Trends on common finfish and invertebrate species are available through Texas Parks and Wildlife's Coastal Fisheries Division's long-term fishery-independent monitoring program. These data have been collected systematically in Texas estuaries using 182.9-m gill nets (since 1975), 18.3-m bag seines (since 1977), 6.1-m bay trawls (since 1982), and 6.1-m Gulf trawls since 1985 to assess trends in abundance and size of marine organisms captured. These provide the baseline data for tracking relative abundance on individual estuarine species. Long-term fluctuations in these trends data can sometimes be difficult to understand given the many interactions between species and environment. These often lead to perplexing end states that are impossible to quantify through simple linear relationships. Part of this is due to the complex nature of marine ecosystems and the multiple influences affecting single populations. While traditional drivers such as fishing pressure play a huge role, others such as high versus low precipitation years should also be considered. Notable changes in abundance of common species are compared to predictions from a previous large-scale ecosystem model from 2007. These predictions were as follows: 1) higher salinities increase the vulnerability of some estuarine species to predation by marine species, which favor higher salinities, 2) reduced shrimp trawling decreases mortality on some finfish bycatch species, but can affect ecosystem structure by increasing mortality on their prey, and 3) the effect of reduced freshwater inflow on the current ecosystem structure has short-term and a long-term consequences. Short-term consequences include a beneficial condition for some species (increased prey availability) and an adverse condition for others (increased predation). These predictions are compared to new data collected to test model performance.

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Panel session: Monitoring and Research

Oral presentation desired but poster acceptable

BEACH-NESTING BIRD MANAGEMENT AT TWO GALVESTON BAY LOCATIONS

Kristen Vale, Stephanie Bilodeau, and Richard Gibbons - Houston Audubon

Kacy Ray - American Bird Conservancy

This is the fourth year that Houston Audubon Society (HAS) and American Bird Conservancy (ABC) have implemented a Beach-nesting Bird Conservation Program on the upper coast of Texas. Through this program, we seek to advance conservation efforts for the Least Tern (*Sternula antillarum*), and Red Status Watch List species Wilson's Plover (*Charadrius wilsonia*) and Snowy Plover (*Charadrius nivosus*) by implementing protective measures (i.e. signs and fencing), public outreach, and nest site stewardship at two sites: Bolivar Flats on the Bolivar Peninsula and East Beach in Galveston. The Bolivar Flats Shorebird Sanctuary is recognized as both a Western Hemisphere Shorebird Reserve Network site of global importance and a Globally Important Bird Area by ABC.

In 2014 and 2015, we trapped, banded, and re-sighted Wilson's and Snowy Plovers. Banding individuals allows us to better estimate in-season reproductive output, track fledging success, document movement of plovers along the Texas coast, estimate second year return rate (in 2015), and later (years 3 and beyond), and calculate regional survival for these species. The goal of the program is to maintain and/or grow these species populations through conservation activities on the ground.

In 2014, we estimated 30 Wilson's Plover and 80 Least Tern breeding pairs at Bolivar Flats, and 15 Wilson's Plover, 63 Least Tern, and 3 Snowy Plover breeding pairs at East Beach. Between the two sites, we documented 18 Wilson's Plover fledges (0.40 fledges/breeding pair), 33 Least Tern fledges (0.23 fledges/breeding pair), and 3 Snowy Plover fledges (1.0 fledges/breeding pair). Overall, the apparent nest success for Wilson's Plovers was 56%, Least Terns were 18%, and Snowy Plovers were 80%. The leading causes of nest failure were coyote and ghost crab depredation and washouts from heavy rains. The 2014 nesting season was the first year monitoring and outreach was conducted at East Beach. Conservation efforts implemented at East Beach, one of the most popular public beaches on Galveston Island, resulted in a relatively successful nesting season (especially for Snowy Plovers), considering these birds share the beach with thousands of tourists and beach-goers during the nesting season. We reached 304 people on the ground via stewardship and public outreach efforts at East Beach on busy weekends and holidays. Through the use of ABC's *Help Gulf Birds* Community Facebook page, we reached over 29,000 more people. We will present the 2015 results at the symposium.

1. Kristen Vale, Shorebird Conservation Technician, Houston Audubon, 440 Wilchester Blvd, Houston, TX 77079; Vale.Kristen@gmail.com; 832.703.767
2. Oral presentation, panel session suggested for Houston Audubon bird projects 90 minutes with panel session after 20-minute talks
3. Species Protection

Colonial Waterbirds in Galveston Bay: Status, Restoration, and Conservation Needs

Jarrett (Woody) Woodrow, Jr., U.S. Fish and Wildlife Service, Houston, Texas

Conservation of colonial waterbirds and their habitat is one of the priorities of the Galveston Bay Estuary Program. The Program and its members have recognized that changes to the bay's environment have led to changes in the distribution, abundance and diversity of colonial waterbirds in Galveston Bay. Several species of colonial waterbirds have shown declines across the Texas coast and within Galveston Bay. Various state and non-governmental partners have invested significant resources in restoring colonial waterbird nesting islands in the Bay including funds from Deepwater Horizon related sources. Despite these investments, there remain opportunities to improve conditions for several species in decline. This presentation will provide an overview of the status of colonial waterbirds, restoration efforts to date, and identify remaining needs for the Galveston Bay Ecosystem.

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Presentation, panel or poster – if poster may modify substantially

Habitat or Species Protection

Spills and Dumping Abstracts

SAN JACINTO RIVER WASTE PITS SUPERFUND SITE: COMMUNITY EDUCATION AND CLEAN UP STATUS

Scott Jones, Director of Advocacy, Galveston Bay Foundation, Webster, Texas

The San Jacinto River Waste Pits (SJRWP) is an abandoned waste pits site on the west bank of the San Jacinto River immediately upstream of the Interstate 10 Bridge in Channelview, Texas. The site contains paper mill wastes contaminated with dioxins, an extremely toxic family of compounds which can cause cancer and other serious illness in humans. It was placed in the U.S. EPA Superfund Program in 2008.

The Galveston Bay Foundation (GBF) has provided information to the public on the SJRWP since 2011, through its position as the site's Technical Assistance provider. Through the Technical Assistance grant from the U.S. EPA, GBF also contracted with the Houston Advanced Research Center (HARC) to produce summary reviews of the site technical reports, which were then placed on GBF's SJRWP webpage. These summaries provide the layman with an explanation of the technical cleanup documents produced by the responsible parties. In addition to providing these electronic materials, GBF has participated in multiple EPA public meetings as well as hosted its own public meeting in January 2013 where GBF and HARC answered many questions posed by citizens.

This presentation will provide an overview of GBF's community education activities; examine the various government and community groups that have a stake in the site and an update on the status of the cleanup at the site.

Water and Sediment Quality Abstracts

MODELING BACTERIAL LOADS IN A COASTAL WATERSHED

Ryan M. Bare, HARC, The Woodlands, TX

Stephanie M. Glenn, HARC, The Woodlands, TX

Bradley S. Neish, HARC, The Woodlands, TX

The Double Bayou watershed is situated in the eastern portion of the Lower Galveston Bay. Double Bayou has two forks, the West and East Forks, which converge above the mouth of the Bayou on the eastern shoreline of Trinity Bay. Current water quality problems include reduced dissolved oxygen (DO) and elevated bacteria in the bayous. The Texas State Soil Water Conservation Board, Galveston Bay Estuary Program, United States Geological Survey, Shead Conservation Solutions and the Houston Advanced Research Center are all working together with the stakeholders to restore and maintain water quality through the development of a Watershed Protection Plan for Double Bayou.

The use of the Spatially Explicit Load Enrichment Calculation Tool (SELECT) model to estimate potential pollutant loadings from bacteria across the Double Bayou watershed will be discussed. SELECT was developed by the Department of Biological and Agricultural Engineering and the Spatial Science Laboratory at Texas A&M University. Modeling was performed to estimate bacterial loadings from various sources and to identify critical loading areas within the watershed. SELECT works within an ArcGIS environment and spatially characterizes the bacterial loads in the watershed - in this example, the distribution of livestock, wildlife, wastewater treatment plants, and septic systems and the contributions from each are quantified through source specific bacterial production rates. Rankings of each contribution source were assessed for the entire watershed. Modifications to SELECT, implemented with stakeholder input to achieve a more accurate model taking into account data availability and specific characteristics of the watershed, will be discussed. All model inputs as well as model results were discussed with stakeholders, and outputs were assessed for different kinds of Best Management Practice (BMP) implementation.

To maximize potential pollutant reduction and the efficiency of available funding, SELECT results will be transitioned to on-the-ground BMPs. For example, a riparian herbaceous buffer coupled with fencing and alternate water sources for livestock were suggested to control the bacterial contributions from both feral hog as well as livestock fecal waste. Other examples of management measures resulting from SELECT modeling will be discussed. SELECT provides insight to watershed stakeholders as they are selecting voluntary BMP strategies to include in the Double Bayou Watershed Protection Plan.

Abstract Information

1. Ryan M. Bare, Research Assistant, Hydrology & Watersheds, Houston Advanced Research Center, 4800 Research Forest Drive, The Woodlands, TX, 77380, 281-364-4017, (fax) 281-364-6001, rbare@harcresearch.org
   Dr. Stephanie M. Glenn, Program Director, Hydrology & Watersheds, Houston Advanced Research Center, 4800 Research Forest Drive, The Woodlands, TX, 77380, 281-364-6042, (fax) 281-364-6001, sglenn@harcresearch.org
   Bradley S. Neish, Research Associate, GIS & Remote Sensing, Houston Advanced Research Center, 4800 Research Forest Drive, The Woodlands, TX, 77380, 281-364-6085, (fax) 281-364-6001, bneish@harcresearch.org

2. Oral presentation desired

3. Suggested Topic Area: Water and Sediment Quality

EMERGING WATER QUALITY HAZARDS IN URBANIZING TEXAS ESTUARIES

Bryan W. Brooks, Department of Environmental Science, Baylor University, Waco, Texas.

W. Casan Scott, Department of Environmental Science, Baylor University, Waco, Texas.

Bowen Du, Department of Environmental Science, The Institute of Ecological, Earth, and Environmental Science, Baylor University, Waco, Texas.

Samuel P. Haddad, Department of Environmental Science, Baylor University, Waco, Texas.

S. Rebekah Burket, Department of Environmental Science, Baylor University, Waco, Texas.

Christopher Breed, Department of Environmental Science, Baylor University, Waco, Texas.

Martin Kelly, Texas Parks and Wildlife Department, Austin, Texas.

Linda Broach, Texas Commission on Environmental Quality, Houston, Texas.

C. Kevin Chambliss, Department of Chemistry and Biochemistry, Baylor University, Waco, Texas.

In the rapidly urbanizing watersheds and estuaries of the Gulf of Mexico in Texas, instream flows are increasingly influenced and dominated by reclaimed water, which inherently contain diverse mixtures of inorganic, organic and biological contaminants. Though active pharmaceutical ingredients (APIs) and personal care products have received increasing attention in freshwater systems over the past decade, many research questions remain unanswered, and very few studies have focused on the occurrence, assessment, or management of pharmaceutical contaminants in marine systems or estuaries. Studies of APIs and other contaminants of emerging concern (CEC) in bays and estuaries of the Gulf of Mexico are even more limited. However, the rapidly urbanizing watersheds and estuaries of Texas represent a unique opportunity to understand influences of pronounced annual rainfall and urban gradients on emerging water quality challenges. We examined occurrence and bioaccumulation of wastewater tracers and selected CECs in tidally influenced segments of Buffalo Bayou, Dickenson Bayou, the Brazos River and the Guadalupe River over a two year period. Spatial and temporal fluctuations in pH within and among study sites altered the probability of encountering pharmaceutical water quality hazards to fish. We then compared predicted fish plasma concentrations of pharmaceuticals to measured plasma levels from various field collected fish species. The common pharmaceuticals diphenhydramine and diltiazem were observed in plasma of multiple species, and diltiazem exceeded human therapeutic doses in largemouth bass, catfish and mullet inhabiting these urban estuaries. Though the present study only examined a small number of target analytes, which represent a microcosm of the exposome of these fish, coastal systems are anticipate to be more strongly influenced by urbanization over the next fifty years when the state of Texas expects to double in population. Unfortunately, aquatic toxicology information for many of these emerging urban contaminants are not understood in fish, but such field observations strongly suggest that potential adverse outcomes should be examined.

Presenter:

Bryan W. Brooks, Ph.D.

Professor

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Presentation Type: Oral

Topical Area: Water and Sediment Quality

DIFFERENTIAL TROPHIC POSITION ACCUMULATION OF SELECT CONTAMINANTS OF EMERGING CONCERN IN BUFFALO BAYOU, TEXAS

Bowen Du, Department of Environmental Science, The Institute of Ecological, Earth, and Environmental Science, Baylor University, Waco, TX, USA.

Samuel P. Haddad, Department of Environmental Science, Baylor University, Waco, TX, USA;

Andreas Luek, Department of Biological Sciences, University of Lethbridge, Lethbridge, AB, Canada.

W. Casan Scott, Department of Environmental Science, Baylor University, Waco, TX, USA.

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Joseph B. Rasmussen, Department of Biological Sciences, University of Lethbridge, Lethbridge, AB, Canada.

C. Kevin Chambliss, Department of Chemistry and Biochemistry, Baylor University, Waco, TX, USA

Bryan W. Brooks, Department of Environmental Science, Baylor University, Waco, TX, USA

Though pharmaceuticals and other contaminants of emerging concern (CEC) occur in inland surface waters and accumulate in aquatic organisms, an understanding of bioaccumulation of many CECs and the associated risks to different trophic positions remain poorly understood in coastal systems. During the summer of 2012 and 2013, we examined the occurrence of CECs in different aquatic species collected downstream of a major municipal wastewater treatment plant (WWTP) in Houston, Texas, USA. This WWTP discharges ~200 million gallons of reclaimed wastewater daily to Buffalo Bayou, which is tidally influenced and flows to Galveston Bay. Isotope dilution LC/MSMS was used for the quantitation of target CECs in water and tissue samples; various target compounds were observed in multiple aquatic species (invertebrates, fish) during both years. IR/MS was employed to obtain stable isotope data.. The R package Stable Isotope Analysis in R (SIAR) was used to characterize functional feeding chains based on stable isotope signatures and help characterize the food web. Lastly trophic magnification factors (TMFs) were calculated by regressing trophic position and CEC concentrations to examine whether target CECs result in trophic magnification or trophic dilution in this urban coastal ecosystem. Our findings highlight the importance of characterizing bioaccumulation pathways of ionizable pharmaceuticals and other CECs by different aquatic organisms in urban-izing coastal ecosystems. Such considerations will be important during future ecological risk assessments of ionizable CECs, particularly in rapidly urbanizing coastal regions.

Presenter:
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Presentation Type: Poster

Topical Area: Water and Sediment Quality

DESIGNING FOR IMPACT: PROMOTING LOW IMPACT DEVELOPMENT IN THE HOUSTON-GALVESTON REGION

Mary Martha Gaiennie
Community and Environmental Department
Houston-Galveston Area Council
Houston, Texas

As the Houston-Galveston region continues to grow and develop, opportunities exist to develop in an environmentally conscious manner. By implementing low impact development (LID) practices, the Houston-Galveston area can manage growth in a manner that reduces development impacts. LID techniques can promote the natural movement of water within an ecosystem improving storm water quality while benefiting the development community by reducing infrastructure costs, increasing developable property and increasing property values.

The Houston-Galveston Area Council (H-GAC) has been awarded a grant from the U.S. Environmental Protection Agency – Gulf of Mexico Program to address water quality, coastal ecosystems improvement, community resilience, and environmental education in the Gulf of Mexico region and its watersheds. The project, *Designing for Impact,* seeks to create policy recommendations and implementation tools that advance the use of LID techniques to mitigate negative impacts of development within the Houston-Galveston area. H-GAC will highlight obstacles to implementing LID practices and identify methods for successfully overcoming these challenges. This information will be collected and published in a regional guide to LID that will give an overview of the benefits of LID communicated through a visual and economical comparison of conventional and LID site plans. The guide will also include a “LID toolbox” containing a range of LID elements that are appropriate for the 13-county Houston-Galveston region.

A key component to the project aims to provide opportunities for collaboration among designers, policymakers, citizens, environmental organizations, and other stakeholders interested in land use and development issues. To achieve collaboration, H-GAC is hosting a design work session to bring together designers, planners, and engineers of the public and private sectors to work together to improve conventional site plans with LID techniques. Also, starting in 2016, H-GAC will host a series of workshops to share the regional guide to LID and educate the public on the benefits of using LID in our region.

1. Mary Martha Gaiennie, Regional Planner, Community and Environmental Planning Department, Houston Galveston Area Council, 3555 Timmons Lane, Houston, TX 77027, 713.993.2468, Fax: 713.993.4503, and marymartha.gaiennie@h-gac.com. Ms. Gaiennie would serve as a panelist/presenter.

Steven Johnston, Senior Environmental Planner, Community and Environmental Planning Department, Houston-Galveston Area Council, 3555 Timmons Lane, Houston, TX 77027, 832.681.2579, Fax: 713.993.4503 and steven.johnston@h-gac.com. Mr. Johnston would serve as panel moderator.

2. Format Recommendation: Panel. H-GAC recommends this subject as a panel and will work with the Galveston Bay Estuary Program to identify other panelists. H-GAC would serve as moderator and as a panelist/presenter. Suggested panelists include: Houston Land Water Sustainability Forum, Local Developer/Consultant, Texas Coastal Watershed Program, Harris County, and the City of League City.

3. Optional: Suggest panel would fit in a Water and Sediment Quality tract for topics such as, BMPs, LIDs, and stormwater management.

TWENTY YEARS OF SUCCESS: SUCCESS, FAILURES AND OPPORTUNITIES IN WATER QUALITY PLAN IMPLEMENTATION

Steven Johnston

Todd Running

Community & Environmental Planning Department
Houston-Galveston Area Council
Houston, Texas

The Region's water quality planning efforts beginning with the *Galveston Bay Plan* in 1995, have seen twenty years of successful execution. These successes have not come without identified failures and challenges which many times result in opportunities. Documenting success has proven difficult and linking that success to direct management decisions, even more challenging. Numerous adaptive management planning efforts, including TMDL Implementation plans and Watershed Protection Plans, are engaged in this endeavor. These projects continue to move forward despite limited budgets and the challenge of a rapidly developing landscape.

H-GAC will define water quality successes, including improving trends in environmental parameters, within the context of the implementation planning. We will review the water quality planning process, stakeholder involvement, and plan execution over the past twenty years. Case studies will be used to highlight meaningful water quality improvements and associated management practices. H-GAC will discuss planning and evaluation tools used to document and communicate success as well as the difficulties. H-GAC's new Water Resources Information Map, analyses of Sanitary Sewer Overflow and Discharge Monitoring Report data, the Regional OSSF Information System and the Galveston Bay Foundation's *Galveston Bay Action Network* will be discussed

1. Todd Running, Water Resources Program Manager, Community and Environmental Planning Department, Houston Galveston Area Council, 3555 Timmons Lane, Houston, TX 77027, 713.993.4549, fax number and todd.running@h-gac.com. Panel Moderator.

Steven Johnston, Senior Environmental Planner, Community and Environmental Planning Department, Houston-Galveston Area Council, 3555 Timmons Lane, Houston, TX 77027, 832.681.2579, fax number and steven.johnston@h-gac.com. Panelist/Presenter.

2. Panel. H-GAC recommends this subject as a panel and will work with the Galveston Bay Estuary Program to identify other panelist. H-GAC would serve as moderator and as a panelist/presenter. Potential identified panelist include: GBEP, GBF, Texas Coastal Watershed Program, Plum Creek Watershed Protection Plan, and the Hickory Creek Watershed Protection Plan

3. Optional: Suggest panel would fit in a Water and Sediment Quality or Monitoring and Research tract.

MERCURY MONITORING IN TEXAS WATERS OF THE GULF OF MEXICO: A CONCURRENT STUDY WITH THE NATIONAL COASTAL CONDITION ASSESSMENT

Nicole Morris[1]

Dr. George Guillen[2]

University of Houston Clear Lake
School of Science and Computer Engineering[1]
Environmental Institute of Houston[2]
Houston, TX

Our study examined the prevalence of mercury in various species of finfish including Atlantic croaker (*Micropogonias undulatus*) in eight Texas bays along the Gulf of Mexico. The data collection and analysis aspect of the research was conducted as a concurrent study with the 2015 National Coastal Condition Assessment; an EPA-sponsored program that monitors the state of the United States coastal waters. The results gathered from this study were supplemented by historic mercury data on Atlantic croaker collected through other programs and independent researchers. These data were compared against local and federal mercury standards, including proposed and adopted aquatic animal health standards and screening values. Results of the study are contrasted with spatial and temporal trends in mercury loading in Galveston Bay. Results of this evaluation of 30 years of mercury monitoring in Atlantic Croaker provides essential data needed by federal, state, and local communities responsible for protection of natural resources and human health.

Presenting and Corresponding Author:

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Presentation Type: Oral (Poster acceptable if unable to accommodate)

Requested Panel Session: Monitoring and Research

A Geospatial Approach to Estimate *E. Coli* Loadings into Waterways

Thushara Ranatunga
Department of Community and Environmental Planning
Houston-Galveston Area Council
Houston, Texas

More than half of water bodies in Houston-Galveston region are contaminated by elevated levels of bacteria which increases possible health risks to people who use them for contact recreation activities (such as swimming, wading, diving, etc.) . The Houston-Galveston Area Council (H-GAC) with the help of local stakeholders has developed several Watershed Protection Plans in an effort to bring the impaired water bodies back into compliance with contact recreational standards. In order to manage the water quality and lower the bacteria loading into waterways, it is necessary to identify the potential sources and distribution of the bacteria loading.

H-GAC applied geospatial analytical techniques integrated with bacteria load estimating methods to identify the spatial distribution of *E. coli* loading from sources into nearby streams. The analytical technique is a modification of the existing Spatially Explicit Load Enrichment Calculation Tool (SELECT) modeling, which estimates the potential loadings of fecal bacteria from varying sources.

This presentation illustrates bacteria loads estimated from different sources such as failing septic systems, discharges from wastewater treatment facilities, waste from wildlife, livestock, pets, and storm water runoff from urban surfaces. The analysis was conducted based on land use/land cover classification of NOAA C-CAP dataset in a GIS environment. The USEPA recommended protocol for developing pathogen TMDLs was used in fecal indicator loading assessment. The resulting cartographic maps illustrate the bacteria loading from each source in their occupied land cover types. The presentation will discuss the additions of a buffer approach as an adaption to the original SELECT methodology to simulate general transmission potential, based on stakeholder feedback.

A LOCAL GOVERNMENT'S GUIDE TO REDUCING BACTERIA IN AREA WATERWAYS: TECHNIQUES THAT WORK

Todd Running
C&E Department
Houston-Galveston Area Council
Houston, Texas

Clean water is our most important natural resource. But, despite an abundance of water in the H-GAC region (16,000 miles of streams and shoreline), 80% of waterbodies in the area are impaired in one way or another.

Bacteria is the number one pollutant in the region, impairing more than half of the waterways. Ten years ago, the bacteria problem was getting so bad that many people thought it could never get better. However, many are improving.

So why is water quality getting better? Because individuals, organizations, communities, and local governments are targeting their efforts to specifically reduce bacteria. This panel will focus on five successful projects highlighted in H-GAC's Water Resource Guide for Local Governments, scheduled for release the winter of 2015.

Presenter One will speak about maintaining and improving sanitary sewer systems and reducing the number of overflows and illegal connections.

Presenter Two will discuss successful steps taken to ensure that wastewater treatment facilities do not release water with high bacteria levels into surface water.

Presenter Three will give an overview of existing programs for the maintenance or repair of on-site sewage facilities.

Presenter Four will highlight projects that managed stormwater while also improving water quality.

Presenter Five will discuss how to successfully increase public awareness about water quality.

H-GAC staff would moderate the panel discussion and facilitate a question and answer session immediately following the discussion. It is not anticipated that an H-GAC project would be featured as a presentation.

Attendees should leave the session with information on how to implement water quality best management practices in their respective communities.

1. Presenter: Todd Running
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2. A panel is preferred. A poster display about the Water Resources Guide for Local Governments could work as an alternative.

3. The topical area most relevant to this abstract is Public Participation, though Nonpoint Sources of Pollution, Point Sources of Pollution, and Water & Sediment Quality are also applicable to some panel topics.

TIDAL INFLUENCES ON AQUATIC HAZARDS OF PHARMACEUTICALS, NUTRIENTS, AND PATHOGENS IN DICKINSON BAYOU, TEXAS

W. Casan Scott, Department of Environmental Science, The Institute of Ecological, Earth, and Environmental Science, Baylor University, Waco, TX, USA.

Samuel P. Haddad, Department of Environmental Science, Baylor University, Waco, TX, USA;

S. Rebekah Burket, Department of Environmental Science, Baylor University, Waco, TX, USA.

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C. Kevin Chambliss, Department of Chemistry and Biochemistry, Baylor University, Waco, TX, USA.

Bryan W. Brooks, Department of Environmental Science, Baylor University, Waco, TX, USA

In the rapidly urbanizing watersheds and estuaries of the Gulf of Mexico in Texas, instream flows are increasingly influenced and dominated by reclaimed water. Unfortunately, few studies have focused on the occurrence, assessment, or management of pharmaceutical contaminants in marine systems or estuaries. Studies of pharmaceuticals and other contaminants of emerging concern (CEC) in the Gulf of Mexico are even more limited. Dickenson Bayou, historically affected by low dissolved oxygen and pathogens, is also notorious for water quality impairment from improperly functioning onsite waste water systems. Dickinson Bayou also receives discharge from a wastewater treatment plant located just downstream of Hwy 3 in downtown Dickinson, Texas. Approximately 70% of all pharmaceuticals on the market are ionizable and subject to bioavailability alterations from pH. The primary objective of this study was to explore the spatial and temporal dynamics of contaminant exposure, including pharmaceuticals, nutrients, and human pathogens, as a function of tidal influence. Isotope dilution LC/MSMS was used for the quantitation of target CECs in surface and bottom water samples. Standard methods were similarly employed for nutrient and pathogen analyses. We also explored the spatial and temporal variability of pH with depth in Dickinson Bayou. We then employed a novel water quality hazard modeling approach, which predicts the internal dose of pharmaceuticals in fish expected to result from surface water exposure. We specifically observed pH variability and low and high tides to differentially influence water quality hazards of select pharmaceuticals along a longitudinal gradient of Dickenson Bayou. These results provide a diagnostic approach to evaluate emerging water quality challenges across gradients of rapidly urbanizing coastal bays and estuaries.

Presenter:

W. Casan Scott

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Presentation Type: Poster

Topical Area: Water and Sediment Quality

EXAMINATION OF THE SPATIAL RELATIONSHIP BETWEEN DEVELOPMENT AND AQUATIC NUTRIENT LOADING IN THE GALVESTON BAY ESTUARY

Helen Walters
Research fellow: Center for Texas Beaches and Shores; Texas A&M University Galveston

Dr. Samuel Brody
Professor: Texas A&M University Galveston

Houston-Galveston is one of the fastest growing regions in the United States. With this rapid growth comes increased development and associated impervious surfaces. Increased impervious surface area is not only a development indicator, but also a known catalyst for ecosystem degradation. Given that the Galveston Bay Estuary (as defined by the National Estuary Program) contains an ecologically unique and diverse ecosystem, and that land use is directly correlated with water quality, understanding how this increase in impervious surface area affects water quality is crucial.

Galveston Bay Estuary is an ecologically diverse area in southern Texas. Non-point source pollution, developing from impervious surface runoff, has detrimental impacts on the aquatic environment within the Estuary. This study examines the degree to which specific development patterns impact aquatic nutrient loading, within rivers in the Galveston Bay Estuary. The focus will be on several development metrics, such as patch size, density, and proximity to a river or stream. Subwatersheds (roughly a hydrologic unit of 12 as defined by the National Hydrography Program) will be delineated and used as the unit of analysis in this study.

Spatially evaluating developmental patterns on a watershed level is a relatively new approach. In previous literature, much of the impact of development analysis is evaluated within jurisdictional boundaries. Instead of taking human-defined boundaries, this study examines the area at a hydraulically-driven scale, the subwatershed level. In addition to utilizing an ecosystem approach, there has been minimal research conducted on the relationship between aquatic nutrient loading and development metrics in Texas. The Texas Coast, and particularly Galveston Bay, is important economically due to its fisheries and petrochemical industry, as well as for its leisure and tourism industry. In addition, there are many unique ecological habitats contained within the Bay system. It is important to understand how human development affects this ecologically diverse and productive region.

The implications and broader impacts of this study are numerous. Understanding how close development patches can be to rivers before there are substantial detrimental effects on the aquatic environment is critically important. Once the size of the buffer zone is understood, policy makers can better plan development while remaining conscious of its impact on water quality. This will in turn help stakeholders and planners keep the rivers of Galveston Bay more pristine.

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Oral presentation is desired but a poster presentation will be accepted if oral presentation submittal is not selected.

Topical Areas: nonpoint source of pollution and water and sediment quality

STREAMBANK STABILIZATION, RIPARIAN STEWARDSHIP, AND SEDIMENT LOAD REDUCTION IN HARRIS COUNTY WATERSHEDS

Carolyn White, Harris County Flood Control District, Houston, Texas

The Harris County Flood Control District ("FCD" or "District") mission to provide flood damage reduction projects that work, with appropriate regard for community and natural values is inherently complex. Layering on the District's requirement to enhance stormwater quality, as dictated by its Municipal Separate Storm Sewer System ("MS4") discharge permit, the balance of flood damage reduction goals with environmental considerations is increasingly important. Channel roughness and conveyance capacity is balanced with streambank stabilization provided by riparian habitat. In addition, right-of-way is often a limiting factor in achieving stable channel geometry and allowing for proper interception of stormwater flows prior to reaching the receiving waters and Galveston Bay.

This paper presents the results of the HCFCD's watershed planning efforts that include fluvial geomorphic assessments and determination of streambank erosion rates. Results of sediment and pollutants load studies in urban streams demonstrate the need to stabilize local streambanks and provide stable channels.

Design initiatives to incorporate principles of fluvial geomorphology or natural stable channel design are presented within the context of the Houston area urban drainage system. Regional curves that provide channel dimension relationships for geomorphically stable channels have been developed by the District to guide local stream design. Other resources and design manuals available to guide local development of natural channels will be provided and their application discussed.

CHARACTERIZATION OF AMBIENT WATER QUALITY AND INFLUENCING CHARATERISTICS IN NATURAL AND CREATED WETLANDS OF THE TEXAS COAST

Natasha Zarnstorff, School of Science and Computer Engineering, University of Houston-Clear Lake, Houston, TX

George Guillen, Environmental Institute of Houston, University of Houston-Clear Lake, Houston, TX

Environmental agencies, limnologists and oceanographers have long recognized the fundamental difference in ambient water quality between open water systems and wetlands and the need to develop specific protective water quality standards for each type of system. Saltwater wetlands provide a variety of ecosystem services, but little research has been published on water quality of these marshes. In addition to the paucity of information that exists on saltmarsh water quality, there has been no critical studies looking at the differences in water quality between created and natural coastal marshes. This information is critically needed for developing criteria and evaluating the success of created saltmarsh wetlands.

The results of our study document the range of water quality conditions and modifying factors of coastal wetlands in Texas. During our study we measured surface water quality of an open water site, a natural marsh, and a created marsh within three bays of the Galveston Bay system. Surface water quality was measured every other month with a YSI sonde and collection of grab samples. Deployable water quality monitoring devices were also used to document dissolved oxygen, temperature, and conductivity for three days prior to water sample collection. Vegetation densities and species composition was determined for each marsh using random points and vegetation quadrates. Soil nutrients and grain size was also determined at the random points were vegetation data was collected. Seining was conducted to collect nekton from each marsh. Water quality trends and comparisons are presented for natural and created saltmarshes. Other marsh characteristics were identified and compared with water quality data to identify factors influencing biological and water quality characteristics of these wetlands.

10th State of the Bay Symposium 2016, Abstract Submittal

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Presenter: Natasha Zarnstorff,

Presentation Type: Oral, but will accept poster if oral presentation net selected

Category: Habitat Protection, or Water and Sediment Quality

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