Nutrient content and stable isotope ratios from seagrasses in Texas over one year following Hurricane Harvey

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Project
» RAPID: COLLABORATIVE RESEARCH: Mechanisms of seagrass community injury and resilience post Hurricane Florence: implications for increasingly stormy coasts (Hurricane impacts on seagrasses)

Contributors	Affiliation	Role
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Abstract
Nutrient content and stable isotope ratios from seagrasses in Texas over one year following Hurricane Harvey.

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Coverage

Spatial Extent: **N**:27.99366 **E**:-97.08199 **S**:27.75471 **W**:-97.15306
Temporal Extent: 2017-11-03 - 2018-12-01

Dataset Description

Nutrient content and stable isotope ratios from seagrasses in Texas over one year following Hurricane Harvey.

Methods & Sampling

Sampling sites
Sites were selected to correspond to long-term monitoring sites from the statewide Texas Seagrass monitoring data set (see Congdon et al. 2019 for a more detailed description of pre and post Hurricane sampling sites). We focused on 20 of the long-term sampling sites that varied in magnitude and type of impact from Hurricane Harvey. Eight of the sites were located in southern Aransas Bay (Redfish Bay area) experienced high freshwater runoff and longer retention time of freshwater (> 2 months). These sites included 4 that experienced high degrees of physical seagrass damage (>50 seagrass cover loss) and those with minimal seagrass loss (< 20% change in percent cover). Eight of the sites were located in northern Corpus Christi Bay (Redfish Bay area) and experienced freshwater runoff with shorter retention time (< 6 weeks). These sites included 4 that experienced high degrees of physical seagrass damage (>50 seagrass cover loss) and those with minimal seagrass loss (< 20% change in percent cover). Finally, 4 sites were located in the East Flat region of Corpus Christi bay which was further outside of the major impact zone and experienced lower

degrees of seagrass loss and freshwater runoff. The 16 Redfish Bay area sites were sampled in November 2017, March 2018, July 2018, and November 2018. The East flats sites were sampled during July and November 2018.

Field Procedures

At each station, two replicate cores were taken. A 15 cm inner diameter (ID) core was used to sample the seagrass species present within each quadrat. A PVC (polyvinyl chloride) core was used for the collection of below-ground and above-ground material. Care was taken to keep only the shoots that reside within the diameter of the core. Following placement of the 15 cm core on the seabed, the rubber stopper was removed from the top of the core. Before pressing the core into the sediment, the diver ran their fingers carefully around the bottom of the core. If grass was pulled under the core, it is removed. The diver pressed and twisted the core down into the sediment (10-15 cm depth). The stopper was re-installed in the 15 cm core, and the core was rocked back and forth. The diver worked their hand under the core and removed it from the grass bed, making sure to keep their hand under the bottom of the core in order to prevent loss of sample. Samples were then placed in pre-labeled Ziploc bags and immediately placed on ice.

Laboratory Procedures

Cores samples were kept in a refrigerator (4°C) until processing within one week of collection. Cores samples were sieved with filtered seawater through a 500 µm sieve to remove excess sediment. As *Thalassia testudinum* was the dominant species across sites, we focused our tissue analysis on this species. Seagrass tissue was carefully separated from infauna and shell harsh before further processing. From each core sample, six seagrass shoots were selected at haphazardly. Newly formed leaves (the youngest leaf in a shoot bundle) were gently scraped and rinsed in Milli-Q water to remove algal and faunal epiphytes. The rinsed tissue samples were then dried to a constant weight at 60°C and homogenized by grinding to a fine powder using a mortar and pestle. Tissue samples were re-dried in an oven overnight at 60ºC. Once dry, the samples were manually homogenized with a mortar and pestle and/or a Wig-L-Bug device. Approximately 1 mg of sample was weighed into tin capsules at the University of Texas at Austin – Marine Science Institute, Core Isotope Facility in Port Aransas, Texas. Samples were analyzed using an automated system for coupled nitrogen- and carbon-isotope measurements using a Thermo Fisher Scientific Flash EA-Isolink CNSOH elemental analyzer connected to a Thermo Fisher Scientific Delta V Plus isotope-ratio-mass-spectrometer. The isotope results are presented using the conventional δ-notation:

δ 13C (or δ 15N) = [(R sample /R standard) - 1] (in ‰)

where R sample and R standard = 13C/ 12C (or 15N/ 14N). All δ-values are reported relative to VPDB for carbon and AIR for nitrogen, unless otherwise stated (Coplen 1996). A two-point calibration of δ 13 C to VPDB and to δ 15 N to AIR is achieved using USGS-40 (−26.39‰,−4.52‰) and USGS-41a (+36.55‰, +47.55‰), respectively. Internal laboratory standards Peach Leaf and Casein were used to evaluate the accuracy and precision of the carbon and nitrogen isotope results, which should have a standard deviation of less than 0.2‰.

Data Processing Description

BCO-DMO Processing:
- changed "." to "nd" to indicate "no data";
- renamed fields;
- converted date to YYYY-MM-DD format;
- removed the percent sign from the values in the pcnt columns.

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Data Files

File
seagrass_nutrients.csv (Comma Separated Values (.csv), 17.20 KB) MD5:ce7d052b2cd12d77aa54cfe7667b484f Primary data file for dataset ID 822076

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Related Publications

Congdon, V. M., Bonsell, C., Cuddy, M. R., & Dunton, K. H. (2019). In the wake of a major hurricane: Differential effects on early vs. late successional seagrass species. Limnology and Oceanography Letters, 4(5), 155–163. doi:10.1002/lol2.10112
Methods

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Parameters

Parameter	Description	Units
Sample_Period	Month and year of sampling	unitless
Site_ID	Site name	unitless
Species	Name of species from which tissue was processed	unitless
Latitude	Latitude	decimal degrees North
Longitude	Longitude	decimal degrees East
Date	Date; format: YYYY-MM-DD	unitless
Depth_cm	Depth at sampling site in cm	centimeters (cm)
Replicate_ID	Replicate core from site	unitless
Tray_num	Tray number for sample run	unitless
Well_num	Well number of sample within tray	unitless
num_in_seqence	Number of position within run sequence	unitless
Foil_contents_weight	Sample weight of dry seagrass tissue in mg	milligrams (mg)
d15N_AIR	d15N relative to atmospheric N2 standard	per mil (‰)
umoles_N	umoles of nitrogen in sample	micromoles (umoles)
pcnt_N	Percent of seagrass tissue which is nitrogen by dry weight	unitless (percent)
d13C_VPDB	d13C relative to VPDB standard	per mil (‰)
umoles_C	umoles of carbon in sample	micromoles (umoles)
pcnt_C	Percent of seagrass tissue which is carbon by dry weight	unitless (percent)
Notes	Notes	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Drying Oven
Generic Instrument Description	a heated chamber for drying

Dataset-specific Instrument Name	Thermo Fisher Scientific Flash EA-Isolink CNSOH elemental analyzer
Generic Instrument Name	Elemental Analyzer
Generic Instrument Description	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

Dataset-specific Instrument Name	mortar and pestle and/or a Wig-L-Bug device
Generic Instrument Name	Homogenizer
Generic Instrument Description	A homogenizer is a piece of laboratory equipment used for the homogenization of various types of material, such as tissue, plant, food, soil, and many others.

Dataset-specific Instrument Name	Thermo Fisher Scientific Delta V Plus isotope-ratio-mass-spectrometer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

Dataset-specific Instrument Name	Diver
Generic Instrument Name	Manual Biota Sampler
Generic Instrument Description	"Manual Biota Sampler" indicates that a sample was collected in situ by a person, possibly using a hand-held collection device such as a jar, a net, or their hands. This term could also refer to a simple tool like a hammer, saw, or other hand-held tool.

Dataset-specific Instrument Name	PVC core
Generic Instrument Name	Push Corer
Dataset-specific Description	PVC (polyvinyl chloride) core of 15 cm inner diameter
Generic Instrument Description	Capable of being performed in numerous environments, push coring is just as it sounds. Push coring is simply pushing the core barrel (often an aluminum or polycarbonate tube) into the sediment by hand. A push core is useful in that it causes very little disturbance to the more delicate upper layers of a sub-aqueous sediment. Description obtained from: http://web.whoi.edu/coastal-group/about/how-we-work/field-methods/coring/

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Project Information

RAPID: COLLABORATIVE RESEARCH: Mechanisms of seagrass community injury and resilience post Hurricane Florence: implications for increasingly stormy coasts (Hurricane impacts on seagrasses)

Coverage: Coastal North Carolina and Texas, USA

NSF Award Abstract:
Seagrass meadows are conspicuous features of many estuarine and nearshore environments. By some estimates, these meadows contribute an average of $20,000 per hectare per year in goods and services. These include nutrient cycling, sediment stabilization, carbon burial, and provision of nursery habitat for juvenile fishes, crabs, and shrimps. Alarmingly, seagrasses are threatened by several environmental and human-driven stressors, and loss of seagrass habitat remains a key concern for conservation and sustainable development programs. Anticipated increases in storminess (frequency and intensity) and rainfall under many climate change modeling scenarios make understanding hurricane impacts on valuable coastal habitats such as seagrass meadows important on local, national, and global scales. Indeed, seagrass meadows potentially serve as a 'canary in the coal mine' regarding the effects of increased hurricane activity as they are found at shallow depths and are affected by turbidity and salinity; seagrasses are also vulnerable to burial or erosion due to large storms. Seagrasses (1) include a suite of species with distinct growth and reproductive strategies; (2) live in a range of meadow sizes and degrees of 'patchiness;' and (3) present divergent seasonal cycles. This represents a tremendous opportunity to explore the conditions and attributes that result in seagrass resilience or vulnerability to hurricanes as a model for coastal ecosystem responses more broadly.

Hurricane Florence made landfall along the NC coast on September 14, 2018. Florence stalled approaching shore, and storm-related winds/rains persisted for >4 days (13th-16th) in southeastern NC. Subsequently, record high sea-level stands (surge + tide) were observed across the NC coastline. Furthermore, Florence became the second wettest US storm, behind only Harvey in 2017, dumping 65 trillion L of rain over land that depressed estuarine salinities for over a month. NC seagrasses are dominated by three species: eelgrass, shoalgrass, and widgeon grass. Meadows exist as polycultures or monocultures, and exhibit a diverse range of spatial configurations. Meadows are also defined by strong seasonality: eelgrass shoots senesce in summer due to heat stress, with sites transformed either into shoalgrass-dominated meadows or mudflats. Subsequent to dieback, eelgrass depends upon a combination of seedbank and surviving apical meristems for regeneration each winter. Using key seagrass datasets collected by the research team dating back decades across ~40 Florence-impacted meadows, several fundamental ecological questions are being addressed: (1) how sexual (eelgrass: seedbank) v. asexual (shoalgrass: vegetative growth and fragment colonization) life histories promote susceptibility or resilience of seagrass to disturbance; (2) how meadow landscape configuration and plant diversity modulate the effect of storms on seedbank retention; (3) how meadow disturbance (intense physical v. more chronic physiochemical drivers) affected community dynamics, with special focus on plant productivity and the critical 'nursery role' of seagrass habitat; and (4) how seasonality and species traits amplify or attenuate the effects of intense disturbance on seagrasses. This research expands upon previous post-hurricane studies by considering the interactive effects of hurricanes, landscape configuration, and biodiversity on ecosystem responses. It also leverages ongoing, NSF-supported work along the TX coast to compare-and-contrast the responses of different seagrass phenology/growth strategies to storm disturbance (e.g., turtlegrass in TX is a "leaf-on" species throughout the year while eelgrass and shoalgrass in NC both exhibit strong seasonality in biomass). Collectively, this work will result in more generalizable models of coastal ecological resilience to storminess.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1906622

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