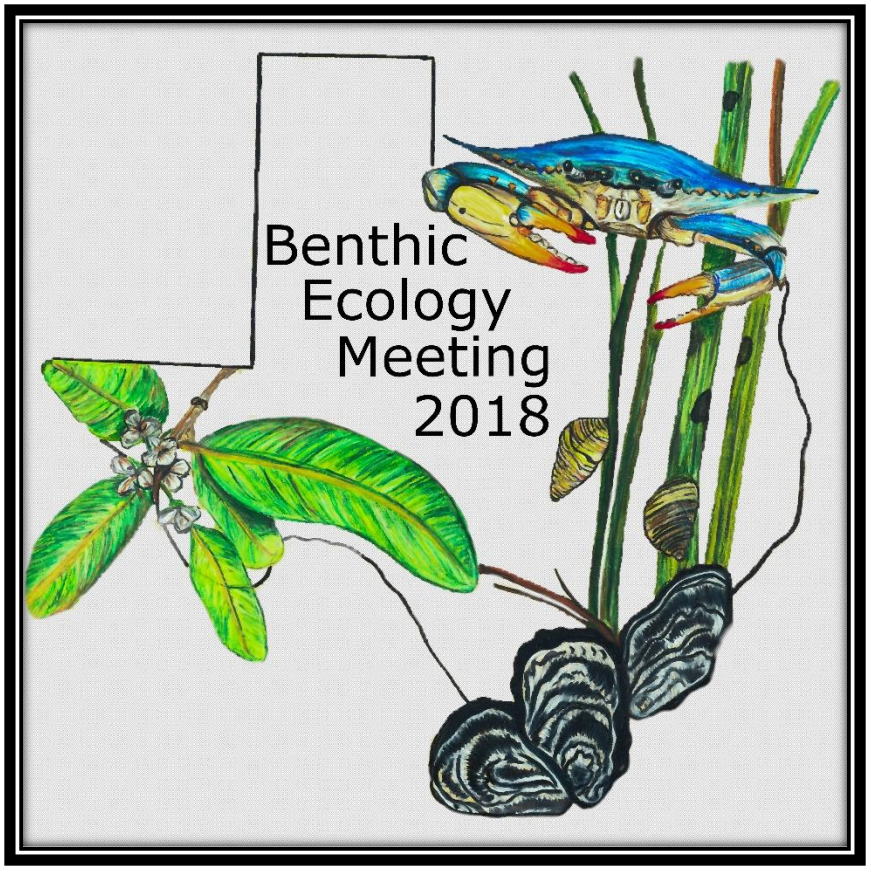

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ABSTRACT BOOK

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ABSTRACTS

Nonnative doesn't always mean negative: effects of Eurasian watermilfoil on nursery habitat quality for estuarine nekton in Louisiana

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Submerged aquatic vegetation (SAV) provides critical habitat for estuarine nekton in the Gulf of Mexico, but habitat quality of SAV beds may change when nonnative species, such as Eurasian watermilfoil (*Myriophyllum spicatum*), become established. We compared the habitat value of *M. spicatum* with another common native SAV (*Ruppia maritima*) by using field collections to document shifts in nekton community structure and a field experiment to compare growth rates of commercially-important juvenile white shrimp (*Litopenaeus setiferus*). Similar communities were collected from both SAV species. The habitat quality provided by *M. spicatum* for white shrimp appeared to meet or exceed that of *R. maritima*, with densities and growth rates of shrimp in *M. spicatum* (2.2 ± 0.47 m^{-2}, 1.0 ± 0.07 mm TL d^{-1}, 28.2 ± 2.83 mg d^{-1}) higher than in *Ruppia* (1.0 ± 0.36 m^{-2}, 0.6 ± 0.09 mm TL d^{-1}, 14.1 ± 2.51 mg d^{-1}). Though differences were detected between SAV species, other factors, such as hypoxia and interspecific competition, may have contributed to differences in shrimp densities and growth. This study indicates that nonnative habitat-forming species can provide productive alternatives to native habitat and, contrary to paradigm, may not always have negative impacts in the invaded ecosystem.

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Microgeographic adaptations and acclimation in shell morphology of a Hawaiian limpet

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Hawaiian limpets (*Cellana exarata*) inhabiting sun-exposed rocks experience higher temperatures and greater desiccation risk when compared to those in shaded crevices. Shell dimensions that minimize the surface to volume ratio confer the greatest resistance to these stressors. It is expected that through either acclimation or adaptation, shell shapes will differ between these microhabitats due to differential selective pressures. We compared the shell morphology of C. *exarata* collected from sun-exposed and protected areas on three islands (the Big Island of Hawai‘i, O‘ahu, and Kaua‘i) and concluded that there was not parallel morphological differentiation between microhabitats across islands. However, there was morphological differentiation among islands and between microhabitats on Kaua‘i. Shells on exposed rocks on Kaua‘i had a lower ratio of surface area to volume than the other limpets sampled and were more likely to be a light color. Genetic analyses with SNPs indicate that there is significant genetic structure between the microhabitats on Kaua‘i, suggesting that selection and adaptation are involved in maintaining the morphological differences. This was particularly surprising because despite extensive population genetic studies with allozymes, mtDNA, and microsatellites, this genetic structure had not been previously detected, and suggests the presence of a newly discovered lineage.

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Environmentally-friendly alternatives to bulkheads for resilient and healthy shorelines: evaluation and implementation of two living shoreline designs

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Living shorelines are a soft-armoring technique used to prevent erosion and provide ecosystem services to coastal regions. However, in areas like Mobile Bay, bulkheads are the most common solution to deteriorating shorelines. These solid vertical walls tend to increase erosion on either side and behind them by reflecting wave energy instead of absorbing it. The goal of this project is to determine the effectiveness of a new living shoreline design in which gabion baskets are attached to bulkheads and then planted in. This will be compared to the success of bulkheads alone, as well as the traditional planted living shoreline used on eroding beaches, in providing protection and ecosystem services to the surrounding environment. Effectiveness will be determined by marsh plant cover, shoreline stabilization, sediment accretion, and creation of habitat. This project is still in its beginning stages of conducting baseline measurements. However, a trial shoreline built to corroborate this experiment suggests that the living shoreline attached to a bulkhead can help reduce erosion and creates a habitat similar to that of a traditional living shoreline. This study will create a new direction for researchers and stakeholders who wish to limit anthropogenic impacts in a world that is already armored.

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Defining the biogeographic assemblage regions of reef fish along the Florida Reef Tract

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Understanding the biogeography of reef fish assemblages is paramount to reef conservation, management, and conducting appropriate population survey designs. Reef fish assemblages are a multispecies complex of reef-associated fish shaped by multiple environmental and biological factors (e.g. temperature, depth, benthic habitat, and topographic relief). The Florida Reef Tract (FRT) extends for 595 km from the Dry Tortugas in the south-west to Martin County in the north, crossing a sub-tropical to temperate climate transition. This study investigates the biogeography of reef fish assemblages throughout the FRT to determine if they correspond to previous regional delineations based on coastal geomorphology. Multivariate density analyses of depth, benthic habitat, relief and latitudinal region show four main ecoregions: Dry Tortugas (DT), Florida Keys (FK), Southeast mainland (SE), and Bahamas Fracture Zone (BF). These four ecoregions subsequently split into sixteen assemblages that represent the current composition of reef fish based on the four factors. The final reef fish assemblage regions were associated with previous benthic habitat maps in order to view their spatial extent. Having a map of current biogeographic reef fish assemblages serves as a baseline and allows more accurate management and monitoring of future reef fish populations.

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

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The capacity of coastal wetlands to stabilize shorelines and reduce erosion is a critical ecosystem service. Gulf of Mexico coastal wetlands are transitional from marshes – dominated by low-stature grasses and forbs – to mangroves. Does the taller, woody mangrove vegetation provide better shoreline protection than salt marsh vegetation during major storm events? Hurricane Harvey provided a unique opportunity to address this question. Harvey came ashore near Port Aransas, Texas as a Category 4 storm in August 2017, passing directly over a mangrove removal experiment that we had initiated in 2012. The experiment consists of ten large (1008 m^2) plots ranging from 0-100% mangrove cover, allowing a direct comparison of shoreline protection provided by mangrove and marsh vegetation during the hurricane event. Mangrove cover decreased by 25-40% after the storm, regardless of initial cover, whereas marsh plants were relatively resistant to hurricane effects. Plots with >33% mangrove cover had less shoreline erosion, but accretion was higher within patches of marsh vegetation. Mangrove cover did not affect the amount of debris deposited in the study area. In general, mangroves reduced shoreline erosion, but were also more damaged by wind and surge, which may reduce their shoreline protection capacity on a longer time scale.

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Nocturnal homing in habitat-specialized reef shrimp – a function of morphological and chemical cues

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Habitat selection is a critical process for animals throughout their life. Adult organisms that travel to forage or mate must re-select habitat frequently, and this movement can impact material transport, nutrient fluxes, and ecosystem dynamics. On coral reefs, competition for space has led to a high proportion of habitat specialists. Habitat selection is especially vital for organisms that require specialized habitat; however research investigating specialized habitat selection has primarily focused on the initial choice made during the juvenile stage. This study assesses the habitat selection process of the adult sponge-dwelling reef shrimp, *Lysmata pederseni* using a mark-and-recapture technique, belt transects, patch reefs, and cue isolation experiments. Adult *L. pederseni* diurnally re-select habitat, and a natural preference exists for specific sponge species and shapes. This natural preference is a function of chemical and morphological cues as well as sponge distribution. Morphologically, shrimp prefer tall, narrow sponges. Chemically, a preference hierarchy exists, with *Callyspongia vaginalis* being the most preferred sponge, followed by *Callyspongia plicifera* and *Niphates digitalis*. As habitat specialists can drive biodiversity, understanding the mechanisms behind habitat selection can inform research and management practices.

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Incorporating intraspecific variation and metabolic theory into our understanding of consumer-plant interactions

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Within southeastern US salt marshes, the marsh periwinkle, *Littoraria irrorata*, utilizes saltmarsh cordgrass, *Spartina alterniflora*, as both a climbing substrate and a potential food source. At high densities, *Littoraria* can denude expansive swaths of cordgrass, destroying associated ecosystem services. Previous research in a Georgia saltmarsh demonstrated that the strength of *Littoraria-Spartina* interaction strength can be predicted based upon the total metabolic demands of the *Littoraria* population (i.e., as determined by both size-structure and density). However, relating geographic variation in *Littoraria* biomass and the resulting *Littoraria-Spartina* interactions has yet to be attempted. We therefore quantified naturally occurring spatial variation in *Littoraria* populations and *Littoraria-Spartina* interactions in salt marshes spanning Florida to Virginia. *Littoraria* body size increased with latitude, although density was greatest at intermediate latitudes. As a result, metabolic biomass and the strength of *Littoraria-Spartina* interactions also was greatest at intermediate latitudes. However, the majority of sites exhibited neutral interaction strengths. Comparisons of field surveys and experimental results suggest that *Littoraria* populations are rarely abundant enough to invoke deleterious effects on *Spartina*. Future work should address how *Littoraria* mobility, microhabitat use and diet combine to create locally variable densities that can initiate strong top-down effects.

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Distribution of lancelets, *Branchiostoma virginiae*, relative to sediments and community structure offshore from Cape Canaveral, Florida.

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Lancelets, *Branchiostoma virginiae* (Chordata: Cephalochordata) are among the most abundant benthic filter-feeding organisms in shallow coastal areas along the east coast of Florida, USA. We used a Young grab (benthic grab) to sample shoals associated with sand mining sites offshore from Cape Canaveral, Florida from 2013 to 2016. Our methods efficiently sampled only mid-size and adult classes of lancelets, so data analyses were based on those classes. Peak lancelet density recorded (out of 432 samples) was $2840 \cdot m^{-2}$, although $300\text{-}1200 \cdot m^{-2}$ were more typical high densities. Distribution was highly discontinuous, however, with most samples containing no lancelets. Lancelets were most common in coarse sand/shell sediments with a low organic content, although sediment grain size alone was not always a reliable predictor of relative abundance. Sampling challenges and errors associated with lancelets will also be discussed.

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Micromechanical comparison of Antarctic king crabs versus jonah crabs

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Ocean temperature is predicted to increase by 2-4°C by the year 2100. Elevated ocean temperatures have allowed shell-crushing predators to migrate towards the Antarctic shelf where they were previously excluded by near-freezing temperatures. However, the Antarctic shelf maintains a low-saturation state of high-Mg calcite, which is thought to be essential for calcifying shell-crushing structures. We compared mechanical properties of the Antarctic king crab, *Paralomis birsteini*, to the temperate-water Jonah crab, *Cancer borealis*, to determine if low calcite saturation state would lead to diminished micromechanical properties of the exoskeleton in king crabs. Samples from the carapace and claw dactyl were dissected, embedded, and tested for microhardness. Contrary to our prediction, microhardness of the carapace did not differ significantly between species, and microhardness of the claw was significantly greater (by ~17%) in king crabs as compared to Jonah crabs. Despite the low calcite saturation state of Antarctic waters, king crabs are able to produce calcified structures with mechanical properties equivalent to or greater than those of a temperate water crab, suggesting that saturation state plays a limited role in crab calcification. Low predation pressures on Antarctic crabs may enable them to allocate resources to predatory rather than to defensive structures.

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Investigation on the grazing habits of blue crabs in temperate and sub-tropical seagrasses located on the North Carolina coast

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Seagrasses provide critical ecosystem services to coastal areas, including nursery habitat for economically important fish taxa, a food source for grazers, improvement of local water quality conditions, and sediment stabilization. In response to climate change, tropical seagrasses are expected to move poleward into temperate environments. North Carolina is located at the transition zone between temperate and sub-tropical seagrass habitats where *Zostera marina*, a temperate seagrass, is at its southern boundary and *Halodule wrightii*, a tropical seagrass, is at its northern limit. As water temperatures rise in North Carolina the distribution, density, and biomass of *Z. marina* are expected to decline while *H. wrightii* may increase resulting in tropicalization of temperate meadows. Shifts in seagrass species distributions in tropical systems have shown that transitions between tropical seagrass species results in significant changes to their associated faunal communities, yet it's unknown if the ecosystem services differ between temperate and subtropical meadows. The research described here will quantify the current status of the tropicalization of NC seagrass meadows, quantify resilience metrics (e.g. species specific growth rates) between temperate and sub-tropical species, and outline future research to measure changes in the grazing habits of profitable fisheries species caused by tropicalization on seagrass ecosystem function.

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Dimensionless indices of habitat complexity: 20 years of results

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I presented new indices of habitat complexity at a BEM 20 years ago. The indices can be used in any habitat with structures, and may be useful for measuring the refuge value of a habitat for prey. The indices are: 1) the amount of cover within an area, for prey to hide behind and 2) the average width of the spaces within the habitat compared with either the width of the predator or prey, which influences the ability of fauna to move through the habitat. I also proposed shapes of the relationships between prey survivorship and these indices: prey survivorship should increase rapidly at first with increasing cover, but then should reach a plateau at high cover levels. Prey survivorship should be low with wide spaces, should be maximal at space sizes that are barely wider than the prey and should decrease again once space sizes are too small for prey to use. Increased habitat complexity may also influence community species richness: high complexity habitats may exclude larger species, but may also provide better refuge for smaller species. I will review the results of studies conducted with marine, freshwater and terrestrial fauna that support some of these hypotheses.

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Does reef state alter coral chemical defense and microbiomes?

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Coral reefs are declining due to multiple anthropogenic stressors, which often allow macroalgae to thrive. Macroalgae are hypothesized to hinder reef recovery by shifting the composition of reef microbiomes towards microbes that are harmful to corals. Macroalgae may also reduce coral chemical defense against pathogens via altered host physiology or altered coral microbiomes. We assessed coral microbial communities of *Porites cylindrica*, *Pocillopora damicornis,* and *Acropora millepora* between three pairs of coral-dominated no-take marine protected areas (MPAs) and adjacent macroalgae-dominated fished reefs in the Indo-Pacific. We also tested for antibiotic effects of coral extracts against a thermally-regulated coral bleaching pathogen, *Vibrio coralliilyticus,* at 28°C. *A. millepora* from MPAs exhibited significantly higher inhibition of *V. coralliilyticus* and lower microbiome variability compared to *A. millepora* from adjacent fished areas. We did not detect differences in *P. cylindrica* or *P. damicornis* chemical defense or microbiomes between MPAs or fished areas. Upon reciprocally transplanting *A. millepora* between MPAs and fished areas, we found that chemical defense is upregulated within 28 days after planting coral into MPAs. This indicates that reef state can alter *A. millepora* chemical defense and establishment of MPAs may promote coral health during warming events that allow *V. coralliilyticus* to thrive.

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What toll does PaV1 exact from the Caribbean spiny lobster population?

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By their very nature, pathogens take a toll on their hosts. Of course, scientists and managers strive to know how much of a host population is lost to a pathogen, but that information can be elusive. Hence, mortality from pathogens is typically lumped together with other sources of natural mortality in population models. For pathogens without a measurable impact on their host or those that impact inaccessible life stages, there is little recourse, but for those that cause direct and measurable host mortality the situation may be different. With the Caribbean spiny lobster, we have a tractable system where we can access all life stages from pueruli to adults, all of which are susceptible to the pathogenic virus PaV1. We quantified the impact of PaV1 on the metamorphosis and survival of pueruli, and the survival of benthic juveniles of incremental size classes. We also determined the proportion of the juvenile population with subclinical infections (via qPCR) that eventually develop clinical and lethal infections, relative to those that remain subclinical indefinitely. Ultimately, these results will be tested in the Florida stock assessment model for the *P. argus* fishery to evaluate the effect of PaV1 on the stock assessment results.

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Changes in crab zoeae composition and timing in a southeastern estuary 1982-2017: responses to climate change and seasonal variability

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Larval recruitment is a fundamental driver of population dynamics, yet our knowledge of how different larval species respond to environmental changes remains limited. Here, I investigated long-term trends between several guilds of crab zoea and the physical environment to assess the influence of climate change and seasonal variability on larval abundance and recruitment. Biweekly sample collections (156 µm) from 1982 – 2017 were characterized by strong seasonal patterns and large abundance fluctuations between years. Preliminary analyses indicate that crab abundances were best explained by the lowest temperatures and salinities observed over the two weeks prior to sampling. However, the strength of these relationships varied as pea crabs exhibited relatively strong positive relationships between temperature and salinity while mud crabs exhibited the weakest relationships. Species composition underwent modest changes over the 35 years as *Uca* and *Sesarma* decreased in numbers whereas the appearance of stone crabs increased. Additionally, the first annual appearance of zoeae occurred slightly earlier over the decades as the timing of zoeae significantly depended on average temperatures for the prior month. These results suggest that regular water temperature readings may help predict the occurrence of larval release and demonstrate that zoea responses to climate variability are highly species dependent.

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Community-managed, voluntary "Rest Areas" result in increased abundance of a Hawaiian shellfish

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Many fisheries world-wide are in decline due to overharvesting, habitat loss, and pollution. Harvest records indicate that the Hawaiian limpet (ʻopihi) fishery crashed in the early 1900's and has not recovered since the onset of management in 1978. ʻOpihi (*Cellana* spp.) are endemic to the Hawaiian Archipelago and are culturally, ecologically, and economically important. In 2014, two Maui communities delineated voluntary "rest areas", where ʻopihi were not harvested, in an effort to reverse their decline in abundance. Surveys of abundance were conducted 2-4 times per year for three years both within and outside of the rest areas using a hybrid protocol informed by both traditional Hawaiian and scientific knowledge. The protocol promotes both participation by minimally-trained surveyors and statistical rigor. ʻOpihi abundance increased both within and down-current from the Rest Areas, but not up-current. These results indicate that (1) the voluntary community-based action affected compliance without the benefit of enforcement. This compliance led to both (2) increased population density within the rest area and (3) larval subsidy and increased population density in freely-harvested areas. Overall, community-based management is a promising avenue for effective marine fisheries management, particularly in the Hawaiian Islands.
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Zooplankton community structure from two New Jersey estuaries

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Zooplankton community structure was assessed in two New Jersey estuaries during the summer of 2016. The numerically dominant organisms included Calanoid copepods (112.4 m^{-3}), Brachyuran crab larvae (21.8 m^{-3}), and Carridean shrimp larvae (1.9 m^{-3}), which had significantly greater densities in Barnegat Bay compared to the Shrewsbury River estuary. Additionally, cladocerans (1.1 m^{-3}) and fish eggs (18.0 m^{-3}) were significantly greater from Barnegat Bay. The only organism to show significantly greater densities in the Shrewsbury was the sea nettle (*Chrysaora chesapeakei*) and these data suggest that this jellyfish exerts substantial top down pressure on the zooplankton community. Some other characteristics include the larval recruitment of *Hydrobia* spp. (1.9 m^{-3}) in the Shrewsbury and the presence of Ostracods (0.5 m^{-3}) in Barnegat Bay. Our results indicate these two estuaries differ substantially in their zooplankton community structure and these differences are potentially related to predator intensity, as well as abiotic factors.
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Lessons learned from a decade of oyster reef restoration in the Gulf of Mexico

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Habitat restoration has become an important tool to ameliorate the effects of habitat loss. Yet, there is an ongoing need to share stories of successful approaches as well as restoration challenges to improve efficiency and efficacy of future projects. The goal of this talk is to share personal stories of successes (and failures) encountered while restoring and monitoring over 70 acres of subtidal oyster reef in Texas over the past 10 years. Drawing on examples from ecological monitoring and estimates of ecosystem service provisioning, we offer insights on what has been learned, what is missing, and what types of information are urgently needed. We will provide examples of how the results from our efforts have been used to develop meaningful success criteria and to provide science-based information to our conservation and management partners. Involving stakeholder feedback in habitat restoration efforts facilitates translation of research results into management-relevant resources to assist with decision-making.

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Origins of a fourth lineage in the adaptive radiation of Hawaiian 'opihi

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Selection is believed by many to have played a major role in the generation of marine biodiversity, but connectivity among marine populations can limit selectively-driven diversification. Previous research focused on endemic Hawaiian 'opihi (*Cellana exarata*, *C. sandwicensis*, and *C. talcosa*) indicated that the 'opihi had adaptively radiated and were among the only marine species in Hawaii to have done so. More recent work in preparation has revealed a fourth lineage of 'opihi that is very closely related to *C. exarata*. This fourth lineage was originally named *C. melanostoma*, but was superficially genetically indistinguishable from *C. exarata*. Microgeographic sampling and SNP analysis reveals that the *C. melanostoma* and *C. exarata* lineages are partitioning habitat on Kaua'i, with *C. melanostoma* being more abundant on sun-exposed calcium carbonate rocks and *C. exarata* being more abundant on basalt and shaded calcium carbonate crevices. *C. melanstoma* is morphologically distinguished from *C. exarata* by a buff colored shell with a smaller ratio of surface area to volume. Preliminarily, the two lineages exhibit a parapatric distribution, with overlap occurring on at least Kaua'i and O'ahu. It seems likely that disruptive selection in combination with a reduction in gene flow among islands resulted in lineage bifurcation.

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Parasites and invasions: a case study of parasite spread in two Newfoundland bays

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Non-indigenous species are increasingly influential in community interactions, e.g. parasites. Invaders may acquire and/or introduce parasites in novel regions. Such host-switching could either enhance or dilute parasite transmission/spread among species utilized in parasite life cycles. We investigated invasion influence on microphallid trematode parasitism in two Newfoundland bays, one with an invasive crab, *Carcinus maenas* (*CM*), and one without. We additionally assessed infection prevalence and intensity of microphallid trematodes in native *Cancer irroratus* (*CI*) crabs and trematode prevalence in native periwinkle (*Littorina obtusata, L. saxatilis*) snails to determine any influence of *CM* in the region. We used DNA barcoding to compare trematode identities across species in the region. We found higher microphallid prevalence but lower intensity in *CI* where both crabs co-occur, versus where *CM* is absent. Additionally, *CM* had higher intensity than *CI*, and for both crabs, males had higher intensity than females. For snails, there was little difference in prevalence between the two bays. Sequencing data detected three genetically divergent trematode clades: 1 found across all species, and 2 others dominant in *CI*, suggesting a native origin for these trematodes which now also utilize *CM*. Altogether, our results demonstrate the complexity of parasite infection in systems with prominent invasions.

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Lessons learned from Alabama's living shorelines.

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Substantial funds have been invested in living shoreline projects to restore coastal habitats, protect shorelines and enhance resiliency of coastal communities. While a variety of techniques have been implemented, we don't yet have a firm understanding of the degree of success of different reef technologies and project designs. In this study, we synthesized data from 12 living shoreline projects implemented in Alabama over the past decade to evaluate project success. All projects involved the construction of oyster reef breakwaters but were done using a variety of technologies (e.g., bagged shell, reef balls, reefBLKS). Bagged shell reefs supported the highest oyster densities. Abundance of finfish and mobile invertebrates was highly variable by site, reef type, and taxon. Shoreline protection has been highly variable by site, reef type and year. Preliminary results suggest bagged shell reefs may be the most effective in providing an array of ecosystem services. Next steps include valuation of market and non-market ecosystem services across project types and expected reef lifetimes. Social survey data collected in conjunction with select projects are also being synthesized and evaluated. Our results will help identify the most promising strategies to ensure that future investments in living shorelines maximize ecological and societal benefits.

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Investigating pathogen transmission techniques and genotypic resistance in the staghorn coral, *Acropora cervicornis*

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Unprecedented population losses of *Acropora cervicornis* since the 1970s have been attributed primarily to disease. Due to an anticipated rise in disease outbreak and severity, a recent effort has been made to identify genotypic resistance to disease. However, prior to the present study, there has been no comparison between common pathogen transmission methods used in these studies. We investigated transmission and resistance to disease in 11 different nursery-raised genotypes of *A. cervicornis* by comparing direct contact and water-borne transmission methods. Overall, transmission was highest in our direct contact treatment, though transmission varied greatly by genotype, with only one genotype appearing to be resistant to disease. However, histological analysis revealed that many fragments appeared to be in poor condition upon the start of our study. To determine if acclimation period affected tissue condition, we conducted a subsequent acclimation experiment over a 9-day period. Overall condition of fragments significantly worsened from day 0 to day 2, before significant improvements in surface-body tissue layers were observed at day 9. Our results highlight the importance of selecting an appropriate disease transmission method and acclimation period when investigating genotypic resistance to disease in corals, and can help predict future population success of a local population.

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The role of pathogens in aquatic crustacean invasions

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Invasive non-native species (INNS) damage native ecosystems by competing with and preying upon native species and introducing pathogens. INN Crustacea pose a risk as natural and facilitated invaders, and are the most abundant group of marine and freshwater invertebrate invaders. The study of INN Crustacea has begun to identify that true "invasive" species may not be the only threat to native environments, but non-native species controlled by a cohort of co-invasive pathogens could be the proverbial "dark horse" of invasive species risk. The microbiome of INNS plays a significant role in the level of threat posed to a naïve ecosystem. The diagnosis of disease is often not accounted for in invasion risk assessments. Examples of pathogens introduced by INNS are numerous, and several introduced diseases have been identified to harm native species. Using two model systems from the marine environment (crab: *Carcinus maenas*) and from the freshwater environment (amphipod: *Dikerogammarus haemobaphes*), I outline the importance of researching the co-invasive microbiome of INNS, revealing both a high diversity of microbial species and addressing risk to native and cultured fauna. Data have provided evidence towards invasive species control, aquaculture and fisheries disease risk, and microbial facilitated increase in host invasive potential.

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Effects of Hurricane Irma on staghorn coral (*Acropora cervicornis*) restoration sites and a nearshore sponge community in the Florida Keys

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Hurricane Irma made landfall in the Florida Keys in September 2017. In its aftermath, we conducted a survey of coral restoration sites located along the reef tract and another of a nearshore sponge community in Florida Bay to evaluate the storm's effect on benthic structure. The coral restoration sites consisted of six locations distributed from nearshore patch reef habitat to the offshore bank reef. In 2011, we had translocated hatchery-propagated staghorn coral (*Acropora cervicornis*) onto these sites. We surveyed these sites during the summer of 2017 prior to Hurricane Irma, and again in November 2017. Estimated coral biomass decreased by 90%, and the architectural complexity afforded by the coral colonies had been substantially reduced. In 2014, we conducted a species-specific survey of a sponge community in Florida Bay that had remained unimpacted by periodic algae blooms that have degraded the Bay's sponge communities. Our post-storm survey revealed that the total biomass of the large, structure forming sponges that provide vital nursery habitat for many species of fish and invertebrates had decreased > 95%. These results underscore Irma's effect on the ecological function of these habitats and the challenges of conducting ecological restoration in the face of recurring environmental stressors.

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The Ellis Island Effect: Invasive Species in the Mid-Atlantic

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Global invasions of marine species often follow human migration pathways and primary commerce routes. Exploration, immigration, and commerce to the United States has created hot spots for invasive species to become established. In particular, Ellis Island served as a primary spot for European immigrants over the last century. During the last 3 years, we have documented for the first time four non-native hydrozoans in New Jersey using molecular techniques. *Gonionemus vertens*, *Moerisia inkermanica*, and *Bougainvillia triestina* have origins potentially linked to the Mediterranean indicating a potential group invasion from that region. *Aequorea australis* is a Pacific hydrozoan whose origin pathway is yet unknown, but has now been documented in our region. As the benthic polyp stages of these species are diminutive (<2mm) and pulses of medusae are infrequent, identification of these species was most likely overlooked in species inventories. However, the use of molecular sequencing of COI and 16S on both polyps and medusa have allowed us to identify these species for the first time in New Jersey and the western mid-Atlantic Ocean.

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Latitudinal variation in post-disturbance recovery in a marine system

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Disturbance operates as a structuring process, often increasing niche opportunities for new species. During recovery, diversity and other productivity-enhancing mechanisms can increase recovery rates and affect compositional trajectories. These mechanisms, however, can vary across biogeographic gradients, such as latitude, suggesting that post-disturbance recovery may also hinge on geographic location. Using sessile marine invertebrate communities, we tested whether tropical communities would recover more quickly than at higher latitudes. We further predicted disturbance in the tropics would initiate a shift in community composition. Experiments were conducted in four regions from the tropics to high-temperate zone (8º - 55º N). Communities were disturbed iteratively using randomized biomass removals (0, 20 and 60 percent cover), in early and late succession (3- and 12-months, respectively). Tropical communities recovered faster relative to higher latitudes in term of biomass recovery and space occupation. While similarity indices revealed no consistent compositional differences among disturbance treatments after initial community assembly, different compositional outcomes emerged in developed communities depending on disturbance intensity. Our results suggest that tropical communities can undergo more rapid recovery after disturbance, but recovery may result in different compositional endpoints. Latitudinal variation in recovery dynamics has important implications for our understanding of community stability across biogeographic gradients.

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The application of ultraviolet light to control biofouling

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Ultraviolet light (UV) is utilized by many industries to control the presence and growth of unwanted organisms. Present day ship hull fouling control coatings will often become fouled when the ship is at rest for prolonged periods of time. The concept for this study is that an autonomous underwater vehicle can be deployed with an array of UV lights to traverse a ship's hull at a frequency which will control marine growth. This field test was designed to investigate the effect of UV exposure on three ship hull coatings: a copper ablative coating, a fouling release coating, and an inert epoxy surface control. The experiments were designed to measure the influence of UV exposure frequency (no UV exposure, continuous exposure, one minute per six hours, and one minute per day), and distance of the UV source from the surface (25 mm *vs*. 50 mm). The results demonstrated that continuous exposure to UV light prevented fouling on all surfaces. Fouling was prevented on the copper and fouling release coatings that were subjected to one minute per six hours, but the epoxy became fouled. This demonstrated that intermittent UV exposure of these ship hull coatings can enhance their ability to prevent fouling.

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Biogeography of meiofaunal communities along a 5500km transect of Western Antarctica

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Meiofauna are key components of marine ecosystems and facilitate bentho-pelagic coupling. However, their biogeographic ranges and dispersal abilities are poorly known, especially in Antarctic waters where knowledge is extremely limited. Many Antarctic marine invertebrates are reported to have circumpolar distributions despite lecithotrophic and brooding development being common. Similarly, most meiofauna have developmental stages that are often assumed to have limited dispersal capabilities. To assess Antarctic meiofaunal distribution patterns and diversity, the hypervariable V9 region of the 18S small subunit ribosomal RNA (SSU rRNA) gene was used to metabarcode samples across a 5500km region of Western Antarctica. Some taxa had broad distributions given that 28 operational taxonomic units (OTUs) were present in ever core processed, 74 OTUs were found at every sampling event, and 722 OTUs were present in all major water basins sampled. Among these broadly distributed OTUs, metazoan taxa from 4 phyla, annelids, arthropods, kinorhynchs, and nematodes, were dominate members. As many of these OTUs relate to taxa expected to have limited dispersal capability based on current life history information, these results highlight our limited understanding of how small organisms move around in the deep sea. Additionally, the Antarctic Peninsula hosts a strikingly different and less diverse community then higher latitude regions.

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Serpulid Reef Communities as Critical Habitat for Invertebrate Prey Resources

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Baffin Bay, Texas is a well-known angler's paradise despite seemingly inhospitable conditions for marine life. Salinities in excess of 60 and algal blooms are common in the bay, yet it persists as the top producer of Black Drum (*Pogonias cromis*) in the state. Previous studies indicate that prey resources for these fish are often scarce in the bay's mud-bottom habitat—but the key to Baffin's success may be in its unique 'rocks'. These large structures were formed by colonial Serpulid worms and provide rare hard-substrate habitat. Preliminary exploration of the reefs has shown invertebrate densities 150 times greater than in Baffin's mud-bottom and baseline dietary analysis indicates that these reef-resident organisms could play a large role in the diet of Black Drum. Serpulid reefs are rare world-wide and are only found scattered around the Baffin Bay system along the US Gulf coast. The health of the Baffin Bay system may depend heavily on the success of its rare Serpulid reefs. An understanding of the ecological role of Serpulid reef communities, in particular as a prey resource, will improve fishery resource management and our ability to predict how this system will respond to environmental disturbance.

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Impact of Hurricane Irma on the upper Florida Keys elkhorn coral population

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Elkhorn coral is uniquely adapted to withstand or even proliferate during physical disturbances. However, decreased coral densities and generally degraded reef habitats have likely compromised their ability to tolerate disturbance. Long-term demographic monitoring of *Acropora palmata* conducted in the upper Florida Keys since 2004 provides a unique look into population responses following tropical storms. Over the course of this monitoring, the upper Florida Keys has experienced nine storm events, five of which caused notable loss of coral tissue. The most severe losses were caused by Hurricane Irma which made landfall in the Florida Keys resulting in a loss of one third of *A. palmata* colonies and nearly half of the total live tissue area. Coral tissue loss was attributed to whole colony removal, sediment scouring, fragmentation and subsequent tissue smothering and disease. Although a large number of fragments were generated from this event, the majority were removed from reef spurs and buried among rubble. With each disturbance that has caused substantial losses, the population has not recovered to pre-disturbance levels before the next disturbance occurs. At the present low density, growth and recruitment are unlikely to outpace the frequency of disturbance events without some type of active population enhancement or reef restoration actions.

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Triage following Hurricane Irma most needed at low-wave exposure sites in the Florida Keys

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Tropical storms are among the largest natural contributors to coral-reef mortality. The pulse of energy brought about by a storm can fracture the entire reef framework, dislodge coral heads, and bury coral colonies. Although coral-reef managers can mitigate damage by stabilizing toppled corals in the aftermath of a storm, less can be done to combat sediment burial. In this study, we asked whether sites that could benefit from active restoration, or triage, were spatially predictable. Three weeks after Hurricane Irma passed over the Florida Keys, several management agencies cooperated in a two-week damage assessment throughout the reef tract. We examined the relationship between several variables that quantified damage and a suite of environmental parameters, including depth, slope, roughness, aspect, coral-colony density, and historical wave energy. We found that past wave energy had a significant ($p=0.026$) negative relationship with sites that could benefit from triage. In other words, sites that suffered from the impact of the hurricane were relatively sheltered. We also found that depth was a significant ($p=0.022$) predictor of whether a site was covered in sediments. The other environmental variables showed no relationship with hurricane impact. We therefore suggest that sites that have experienced low historical wave energy should be considered a priority for reconnaissance and triage after the passage of a severe tropical storm.

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The hunger games: how starvation affects attractiveness of live bait lobsters and trap catch in the Florida spiny lobster fishery

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The Florida commercial lobster fishery for *Panulirus argus* predominantly uses traps baited with live, sublegal lobsters. These bait lobsters are often subjected to long periods of starvation within these traps, yet the effects of this long-term confinement and starvation of bait lobsters on bait attractiveness and trap efficiency remains unknown. We used a series of chemical choice experiments to test whether lobsters avoided conspecifics that were starved for 3, 5, or 7 weeks, and a field-based trap experiment to test whether trap catch was reduced when traps were baited with starved lobsters. In chemical choice experiments, focal lobsters were significantly less attracted to lobsters subjected to any length of starvation than to lobsters that were not starved. Furthermore, traps baited with starved lobsters caught 40 % fewer lobsters than traps baited with healthy lobsters. Our findings suggest that the long-term confinement and starvation of lobsters used as live bait in the Florida spiny lobster fishery may indeed reduce the effectiveness of these baits, as well as diminish the catch efficiency of traps. The reduction of the confinement duration of bait lobsters should increase the attraction to conspecific bait lobsters, and thus increase lobster catch in traps baited with healthy lobsters.

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Contrasting complexity of adjacent habitats influences the strength of cascading predatory effects

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Although cascading effects of top predators can help structure communities, their influence may vary across habitats that differentially protect prey. Therefore, to understand how and to what degree habitat complexity can affect trophic interactions in adjacent habitats, we used a broad regional-scale survey, manipulative field trials, and an outdoor mesocosm experiment to quantify predator–prey interaction strengths across four trophic levels. Within estuaries of the southeastern USA, bonnethead sharks (*Sphyrna tiburo*) hunt blue crabs on mudflats and adjacent oyster reefs, two habitats with vastly different aboveground structure. Using 12-h tethering trials of blue crabs we quantified habitat-dependent loss rates of 37% on reefs and 78% on mudflats. We hypothesized that the sharks' predatory effects on blue crabs would cascade down to release a lower-level mud crab predator, which subsequently would increase juvenile oyster mortality, but that the cascade strength would be habitat-dependent. We experimentally manipulated predator combinations in split-plot mesocosms containing reef and mudflat habitats, and quantified oyster mortality. Bonnetheads exerted strong consumptive and non-consumptive effects on blue crabs, which ceased eating oysters in the sharks' presence. However, mud crabs, regardless of shark and blue crab presence, continued to consume oysters, especially within the structural refuge of the reef where they kept oyster mortality high. Thus, bonnetheads indirectly boosted oyster survival, but only on the mudflat where mud crabs were less active. Our work demonstrates how structural differences in adjacent habitats can moderate trophic cascades, particularly when mesopredators exhibit differential use of structure and different sensitivities to top predators.

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Halodule wrightii epiphyte microbiome response to fertilization and/or grazer inhibition

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Interactions of seagrass leaves with environment are mediated by poorly understood biofilms of epiphytic algae, bacteria, fungi and invertebrates. Stressor-driven variation in *Halodule wrightii* biofilms may provide a window into community response mechanisms. A short term (28 days) 2x2 factorial fertilization and grazer inhibition experiment simulated environmental pulses of nutrients representative of early eutrophication, decreased grazing pressure representative of top predator loss, and a combination of both. Treatments were hypothesized to increase levels of epiphytic algae and to alter bacterial communities. Both fertilization and grazer inhibition significantly increased algal accumulation measured by fluorescence scanning. Microbiome analysis (V4 16S rRNA) revealed high levels of bacterial alpha diversity which were not significantly changed by the short term treatments. Beta diversity varied more between replicate blocks than for different treatments, which primarily affected taxa of lower abundance. There was a significant positive relationship between alpha diversity and algal epiphyte accumulation, and significant relationships, both positive and negative, were observed between the abundances of specific taxa at the family or genus level, and either algal epiphyte abundance or a fluorescence-based community composition indicator. Some of these taxa are likely related to nutrient cycling or plant- and grazer- specific biotic interaction.

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Marine invasions in the island ecosystem of Macaronesia: current status and its interplay with climate change

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While terrestrial introductions have been well documented on many island ecosystems and continue to be the focus of extensive work in invasion biology, studies on marine invasions on most of the world's islands have been poorly explored. In addition, invasion dynamics are sensitive to global scale changes. New marine invasions have been recorded in increasing numbers along the world's coasts, due, in part, to the global warming of the oceans and the ability of many successful invasive marine species to tolerate a broader thermal range than similar native species. As a response to this recent warming of the oceans, a poleward movement of numerous species has been observed in many biogeographic regions. To expand our understanding of the scale and diversity of fouling marine bioinvasions on insular systems, we have been examining the marine bioinvasions of benthic organisms of Macaronesia, consisting of four archipelagos: Azores, Madeira, Canary Islands and Cape Verde. On a first stage we performed the first extensive literature review of records of fouling non-indigenous species (NIS) in Macaronesia and have complemented this search with data from ongoing field surveys in some of the islands. We recognize 108 NIS in the region and relate these numbers with critical spatial and temporal variables, including latitude, ship traffic, distance to mainland ports and the nature of modern-day vectors that continue to bring non-native species to these island systems. On a second stage, we are investigating a poleward expansion of several subtropical species from Macaronesia into the European theater and how these species can tolerate extreme thermal regimes. Finally, we recently initiated a monitoring campaign in the marinas and harbors of several islands of Macaronesia to examine whether our in site monitoring surveys match our literature search. Preliminary results will be discussed.

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Man-made docks provide a better reproductive habitat than the surrounding saltmarsh for the range-expanding mangrove tree crab (*Aratus pisonii*)

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When a range-shifting species colonizes an ecosystem that it has not previously inhabited, it may experience suboptimal conditions that impact important aspects of its ecology and life history, such as reproduction. However, within the suboptimal colonized ecosystem, the colonizing species may encounter an anthropogenic habitat analogue: an artificial habitat that more closely resembles its historic ecosystem than the surrounding habitat. If conditions provided by such a habitat lead to an increase in reproductive success over the surrounding ecosystem it could play a vital role in the expansion and persistence of the range-shifting species. The reproduction of the mangrove tree crab *Aratus pisonii* was explored in the suboptimal colonized saltmarsh ecosystem and on docks within the saltmarsh, a habitat analogue to its historic mangrove ecosystem. The egg production and larval quality of crabs from the saltmarsh and dock habitats were examined and compared back to a baseline of conspecifics from the historic mangrove. Further, egg quality in each habitat was examined over the course of a breeding season through a full chemical analysis including energy, glycogen, and lipid as well as fatty-acid identification. Crabs found on docks produced more eggs per unit investment than conspecifics in the surrounding saltmarsh. Further, while of lower quality than those produced in the mangrove, larvae originating from docks were of higher quality than those from the surrounding saltmarsh. Ultimately, through increasing reproductive success, docks may allow *A. pisonii* to expand more quickly into, and better persist in, the colonized saltmarsh ecosystem.

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More human pathogenic *Vibrio* spp. found in farmed (aquaculture) vs. wild oysters in North Carolina, USA

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Oysters can be harvested from the wild or grown through a variety of aquaculture systems, which are increasing rapidly in an attempt to meet growing seafood demands. *Vibrio vulnificus* and *Vibrio parahaemolyticus* are both human pathogens that are most often acquired by eating raw or undercooked oysters. These bacteria are at their highest concentrations, and thus consumers are at their greatest risk, during the warmer months of the year. In North Carolina, wild oysters can only be harvested and consumed during the open oyster season (October 15-March 31). However, oysters grown via aquaculture are not restricted by season. In this study, we compared the human pathogenic *Vibrio* concentrations of wild and aquaculture-grown oysters, harvested during the warmest season. The number of *V. vulnificus* and *V. parahaemolyticus* were enumerated after molecular confirmation. We found significantly greater *V. vulnificus* and *V. parahaemolyticus* in farmed aquaculture oysters than wild caught oysters.

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El Niño drives a larval bottleneck for coral reef fish

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Global warming is amplifying the frequency and intensity of the El Niño Southern Oscillation (ENSO), causing unprecedented levels of coral bleaching and mortality during positive ENSO events, known as El Niño. Yet much less is known how extreme water temperatures and declining productivity might impact hyper-diverse assemblages of coral reef fish that depend on a coral foundation for settlement, growth, and reproduction. Most coral reef fish have a bi-phasic life history with an obligatory planktonic larval phase that spends a month or more in the ocean surface layer completing development. Environmental factors that determine the structure of this larval pool can play a critical role in population and community dynamics on benthic reefs. Here we use plankton samples from a 10-year Hawaiian time series and DNA barcoding to show that both diversity and abundance of the larval pool of fishes is strongly correlated to the sign and strength of ENSO events. In warm and less productive El Niño years, diversity declined by 50% and abundance declined by 80% compared to cooler, more productive, La Niña years. These oscillations were only detected in species that use shallow water (< 200 m) as adults, suggesting that the larvae of reef fish and other epipelagic species are more sensitive to the fundamental changes in the water column during El N Niño than deepwater fishes. Our results suggest that the increasing frequency and intensity of ENSO events predicted in the next 100 years will have devastating community wide impacts on tropical marine fishes.

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Is groundwater a potential driver of oyster populations within Georgia creeks?

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Reef building oysters provide numerous ecosystem services to the Georgia coast, although populations have declined. Due to their economic and ecological importance, large investments in oyster restoration efforts have taken place, including in coastal Georgia. Success or failure of these projects is dependent upon a suite of biological and physical factors. One factor that has not received much attention is the presence of high groundwater discharge on oyster populations. Oyster density and groundwater discharge maps of Oyster Creek, a marsh and oyster-lined creek suggests a negative interaction between discharge and oyster populations. Groundwater surveys were conducted along each bank of the creek using radon sampling. Oysters and discrete water samples were collected at 23 survey sites within the creek. Oyster recruitment was monitored at 13 of the sites on each of the banks, while growth was examined at the 5 sites closest to the area of greatest groundwater discharge. The condition index of each oyster was compared to the nutrient availability, turbidity, and pH. Surveys confirmed that oysters were absent from high groundwater discharge locations, although the effects on demographics were less clear. This survey also revealed a potentially confounding variable in this relationship – sedimentation.

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Using GIS to identify SAV and oyster risks in relation to water treatment plants and dead zones within Chesapeake Bay, MD

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Hypoxic/Anoxic conditions caused by algae blooms, water treatment pollutants, and nutrient eutrophication have plagued international and local fisheries for decades. Sustainable efforts have been given to similarly effected ecosystems within Chesapeake Bay, however future efforts can be improved through the use of Geographic Information System (GIS). Using Oyster planting data from 2000-2014, as well as SAV coverage data, maps were constructed using the ArcMap 10.5.1 program to display their risk to dead zones and pollutants. Water treatment plants and dead zones within Chesapeake Bay functioned as high-risk areas to SAV and sustainable oyster planting efforts. Buffering tools within ArcMap 10.5.1 created 2-mile, 4-mile, and 6-mile risk zones surrounding each water treatment plant. Dead zone risk to SAV within areas of equal depth was assessed using Inverse Distance Weighting and a reclassifying tool, creating a raster layer within ArcMap 10.5.1. Locations for future oyster plantings were scouted based on dead zone toxicity, proximity to water treatment plants, and latitude. Resulting maps illustrated the need for more critical examination of oyster planting locations and their proximity to water treatment plants. Additionally, the prevention of dead zone formation within SAV habitats will aid in replenishing shellfish fisheries within Chesapeake Bay.

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Oyster reef restoration effects on estuarine macrobenthos in St. Charles Bay, Texas

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The eastern oyster, *Crassostrea virginica*, is an important ecological species performing numerous ecosystem services along the Texas coast including providing three-dimensional habitats for estuarine species, improving water quality, and providing shoreline protection. Oysters are filter-feeding organisms which can mitigate eutrophication in coastal waters. Through feeding activities, oysters transfer organic matter from the water column to the benthos by removing large amounts of particulate matter from the water column then excreting particles as feces and pseudofeces. Anthropogenic activities have contributed to rapid degradation of oyster reefs. However, oyster reef restoration has shown success in ameliorating some of the effects of habitat loss. Approximately 600 linear meters of oyster reef were restored using recycled oyster shells in St. Charles Bay, TX, in summer of 2017. Monitoring of the restored reef will be conducted before and after restoration to measure restoration efforts on benthic infaunal organisms and water quality. Our hypothesis is that the diversity of benthic infauna on the restored reef will become similar to that of a nearby reference reef over time.

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Underwater acoustic camera surveillance of pile driving associated with navy proposed actions in the Mid-Atlantic region

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There remains uncertainty regarding the biological relevance of behavioral effects on fish and invertebrates beyond a relatively short range to expected injury from high intensity impulsive sound waves. One source of high intensity impulsive sound produced by Navy actions is impact pile driving for training and shore infrastructure maintenance. These projects are often in relatively turbid inshore or nearshore locations where in-situ visual observation is difficult or impossible. The goal of this project is to evaluate the potential behavioral responses of unconfined marine life (particularly benthic fishes and invertebrates) to actual pile driving sounds in the Mid-Atlantic region using an adaptive resolution imaging sonar. To date, the project has acquired two qualifying samples from a training event and pier maintenance project at Naval Station Norfolk. Two additional samples are planned for this year following by a comprehensive analysis. Preliminary results for the first samples collected will be presented at the Benthic Ecology Meeting.

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Money on the move: Managing shifting species through marine protected areas due to climate change

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Marine Protected Areas (MPAs) are widely regarded as beneficial management tools across the oceans of the world. There are numerous questions about the most effective way to structure MPAs that is both beneficial to focal species and allows for economic gain. One major variable in this management problem is the effects climate change will have on economically important marine species, namely the idea that warming ocean temperatures will shift the ranges of many of these species poleward. This can lead to a) negative interactions with existing resident species, and b) new harvest pressures, both of which could inhibit poleward movement and lead to range contraction. We used a strategic, spatially explicit, age-structured model of hypothetical coastlines to investigate how alternative MPA designs would affect these dynamics. Our results suggest that under most conditions, MPA networks composed of many small MPAs would allow for a more successful "invasion" of the transitioning species than a network composed of few larger reserves. This is consistent with the theory that marine protected areas and reserves increase regional invasibility through increased heterogeneity of the region. This presentation is a continuation of work presented at this conference last year.

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Non-additive effects of multiple disturbances and stresses on benthic eelgrass communities

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Coastal ecosystems are facing environmental changes and anthropogenic pressures that may affect communities in terms of both structure and/or function. Disturbances and stresses are commonly co-occurring in nature where their interaction is generally considered additive or synergistic, however this is rarely tested. The response of an eelgrass *Zostera marina* bed and associated community, facing sediment enrichment (slow nutrient diffusion applied once), light reduction (shading for 19 days) and eelgrass plant density reduction (-80%), was studied for 10 weeks in summer 2015. Main and interactive effects on diversity indices and community structure of the associated species were estimated, as well as the density and relative eelgrass growth. Plant density reduction increased the diversity indices values (per g of *Zostera*) and affected the structure of the associated communities. Sediment enrichment decreased abundances, diversity and richness while shading increased diversity and decreased eelgrass density although these effects disappeared after five weeks indicating a fast recovery after a short stress. Dominant and antagonistic cumulated impacts were observed in some community characteristics. Shading and density reduction had opposite and additive effects on eelgrass growth. The inclusion of multiple disturbances and stresses in experiments helps to disentangle the interaction effects and the mechanisms structuring communities following disturbances.

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Wild crabs of the North: Optimal prey selection varies between genetic lineages of the European green crab (*Carcinus maenas)*

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One of the most impactful invasive species in temperate benthic habitats throughout the world is the European green crab *Carcinus maenas*. Green crabs have spread throughout the eastern coast of North America through multiple cryptic invasions – one from Southern Europe establishing in Southern New England, and a more recent invasion from Northern Europe into the Canadian Maritimes. These distinct genetic lineages have different physiological tolerances, but its unknown if genotype is linked to divergent foraging behavior and prey selection. To test this hypothesis, we used a no-choice/choice experimental design to compare feeding behavior between crabs collected from two populations – Nova Scotia (North) and Casco Bay, Maine (South); and these two populations had nearly fixed differences in mitochondrial lineages associated with the two different invasions. Crabs from both populations showed strong positive selection for medium and large mussels compared to null expectations, however Northern crabs preferred larger size classes compared to Southern crabs. These foraging differences between populations may arise from physiological or behavioral differences between the two populations, and are predicted to have different top-down effects in intertidal and subtidal communities

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Do physiological responses to temperature depend on body mass?

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Individual metabolism is known to scale nonlinearly with both body mass and temperature. When assessing the performance of individuals in the context of climate change, researchers often treat body size and temperature as mechanistically independent, despite recent studies demonstrating an interaction between temperature and body size. Because interactions between the salt marsh gastropod, *Littoraria irrorata*, and smooth cordgrass, *Spartina alterniflora*, are likely important in mediating effects of climate change on marsh ecosystems, we examined how respiration rates Littoraria scaled with body mass and evaluated if temperature alters this scaling relationship. Furthermore, we will investigate the potential for this interaction to vary across a naturally occurring temperature gradient (i.e. latitude) by conducting our experiment with three different populations. Although temperature-body size interactions have been examined in several systems, no study has yet addressed variation along a geographic gradient. Our work seeks to determine if population size structure is necessary to understand how temperature change will translate into physiological responses to climate change, and potentially influence species interactions. Experiments are ongoing but we will be reporting on preliminary results and analyses.

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Phylogeographic analysis of the seastar, *Asterias forbesi*, in the Northwest Atlantic

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Previous studies have shown that the Pleistocene glaciations caused the wholesale extinction of obligate rocky intertidal invertebrates in the Gulf of Maine, with subsequent recolonization from areas of glacial refuge. Here, 88 individuals of the common seastar, *Asterias forbesi*, were analyzed from six sampling locations across the species' range from North Carolina to Prince Edward Island using ~650 bp of the Cytochrome Oxidase I gene in the mitochondrial DNA. These sequences were combined with an additional 20 *A. forbesi* COI sequences available in GenBank in phylogeographic analyses. Haplotype network analysis using 95% parsimony indicated two main haplotypes which contained 42 (39%) and 21 (20%) individuals respectively, out of a total of 108 individuals. Of the remaining 16 haplotypes identified, 13 were single mutational differences associated with the largest haplotype. As expected, *A. forbesi* from North Carolina had the highest biodiversity (8 haplotypes), suggesting that this was a glacial refuge. Further, we detected very high levels of gene flow among the populations and a lack of population genetic structure. The very low observed genetic diversity among *Asterias forbesi* across the species range is concerning as it puts this species at high susceptibility to loss by disease.

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Large-scale oyster restoration in Texas: A legislative mandate, and the science behind it

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In June 2017, the Texas Legislature passed a bill which requires Shellfish Dealers to return 30% of oyster shell, by volume, back to the oyster reefs in Texas bays, or pay a fee that allows an equivalent volume to be restored by the State. This Bill has the potential to have a large, positive influence on the oyster resources in Texas, and may result in at least 120 acres of oyster restoration efforts across the upper coast of Texas in the next 5 years. This presentation will highlight the decision process and scientific data that Texas Parks and Wildlife employees have utilized to select restoration sites and proceed with this program, as well as some of the upcoming scientific opportunities associated with this large-scale restoration. This includes a discussion of our criteria for identifying "degraded" reefs within the bays, the use of acoustic surveys to identify restoration sites, and our proposed restoration methods.

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The continuing shift from stony coral to octocoral communities in the Florida Keys

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Long-term monitoring by the Coral Reef Evaluation and Monitoring Project (CREMP) has documented a shift in community structure where stony corals have been replaced by soft corals as the most abundant organisms on reef communities in the Florida Keys. In response to this observation CREMP began monitoring octocoral populations at a subset of eighteen survey sites throughout the Florida Keys in 2011. Keys-wide, from 2011 to 2016 a significant increasing trend in total octocoral abundance was found with total abundance increasing from 12.3 ± 1.5 (SE) colonies/m^2 in 2011 to 14.5 ± 1.6 colonies/m^2 in 2016 with a maximum value of 15.3 ± 1.5 colonies/m^2 in 2015. Conversely, at the site level 3 of the 18 survey sites were found to have an increase in octocoral abundance while 4 sites were found to have a decrease. Decreased abundances at these sites was likely due to thermal stress associated with the extreme warm sea temperatures in 2014 and 2015, while the increase in abundance at two sites of three was correlated with the post disturbance recovery following stony coral mortality due to the extreme low temperatures in winter of 2010.

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White blotch disease impacts on corals in Southeast Florida

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An unprecedented disease outbreak throughout the Florida Reef Tract (FRT) is contributing to the decline of reef building scleractinian corals. This study was designed to track the fate of affected coral colonies and to characterize how this disease is affecting coral physiology. Both infected and healthy colonies of *Montastraea cavernosa* will be analyzed using a combination of population genetic and transcriptomic techniques. Infected colonies will be designated at three locations within the northern portion of the Florida Reef Tract, an area bounded by St. Lucie Reef in the north, and Breakers Reef, off West Palm Beach, in the South. For each diseased colony three locations will be sampled: directly on the disease margin, directly adjacent to the disease margin on apparently unaffected tissue, and on the most distal, unaffected tissue on the colony. RNA-Seq analyses, using a tagseq approach on an Illumina HiSeq platform, will characterize transcriptomic responses to disease and provide information regarding whole-colony responses to this disease. Discovering how colonies are responding, both acutely and chronically, will provide information that could influence future mitigation and management strategies of current and future outbreaks.
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Direct impacts to seagrass ecosystem structure in the wake of Hurricane Harvey

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

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The Deepwater Horizon (DWH) oil spill occurred in 2010 with widespread impacts across the Gulf of Mexico. Subsequent investigation established a deep-sea benthic footprint (Montagna et al. 2013) and classified sites as impact or non-impact based on chemical and ecological metrics. While many studies have focused on DWH impacts on biodiversity, few have focused on biomass or community function. Here, evidence of DWH impacts on deep-sea meiofauna biomass is presented, focusing on the two dominant taxa, Nematoda and Copepoda. In 2010, biomass was significantly different between impact and non-impact stations, largely driven by greater nematode biomass at impact stations. This increase was mainly due to an increase in nematode abundance, as there was no difference between sites in average animal size. Conversely, copepod biomass was lower at impact stations than non-impact similarly due to abundance changes rather than differences in animal size. There was no difference between non-impact stations and pre-spill biomass measurements but impact stations did have a significant increase in biomass post spill. Spatial interpolation suggested a pattern of increased biomass that was similar to modeled surface water oil plumes, rather than deep-water oil plumes, which may suggest post-spill benthic pelagic coupling, that fueled increased meiobenthic community biomass.

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Algal density on rocky shores varies with surfzone width

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The processes controlling the community ecology rocky intertidal are little understood. Surfzone hydrodynamics have been recognized as a determinant of larval subsidies to rocky intertidal zones, influencing community structure. Differing surfzone morphology causes differences in water exchange, with higher exchange on more dissipative shores, (surfzones wider than 50m). This difference may influence settlement of algal propagules, which may benefit from slower exchange. Barnacle settlement and density are higher at more dissipative surfzones, and algal propagules may have to compete for space with benthic invertebrates. The hypothesis was surfzone width and benthic macroalgal density are inversely related. Near-infrared aerial images were used to calculate the normalized difference vegetation index (NDVI) for sites along the Oregon coast, Google Earth was used to measure surfzone, and ground truth was done for each site, collecting quadrats of algae from the infrared locations. The correlation between surfzone width and algal density, as NDVI or grams/m^2, was logarithmic and significant (NDVI: R^2=0.95, $p<0.00003$; g/m_2: R^2=0.85, $p<0.0012$). Flush rate increases at surfzones over 50m in width, where rip currents form, and the logarithmic relationship may support this effect. Although the mechanism is indeterminate, the relationship between surfzone hydrodynamics and macroalgal density on rocky shores is supported.

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The role of individual learning in the consumption of the non-native green porcelain crab by native crab predators.

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The invasive Green Porcelain Crab (*Petrolisthes armatus*) is an abundant potential prey resource for native predators within oyster reef communities along the southeastern coast of the U.S. However, native predators may not readily consume a novel prey. Here, we evaluated how previously learned handling skills in naïve and experienced Atlantic Mud Crabs (*Panopeus herbstii*) and Blue Crabs (*Callinectes sapidus*) affected predators' foraging behavior and consumption of *P. armatus*. Predators were trained on morphologically similar or dissimilar prey and then exposed to *P. armatus* for five consecutive days. Experienced *P. herbstii* consumed more *P. armatus*, were quicker to attack, and had fewer failed attacks on *P. armatus* than naïve individuals. However, the number of failed attacks by both populations of *P. herbstii* on *P. armatus* significantly decreased over time. Furthermore, *P. herbstii* that were trained to consume the dissimilar prey were slower to approach *P. armatus*. Total *P. armatus* consumption was high in both naïve and experienced *C. sapidus* populations, and both populations were faster to attack and had fewer failed attacks over time. Together, this suggests that native predators can learn to consume a novel prey, and that differences between predator species may reflect differences in preference for *P. armatus*.

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Isoscape and stoichioscape patterns in the dominant seagrasses of the lower Laguna Madre, TX.

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Seagrasses function as ecological indicator by reflecting ecosystem health and water quality. As seagrasses assimilate nutrients from the water column and sediment over time, isotopic and nutrient analyses of plant tissues can be used to define system-wide nutrient dynamics and points of nutrient inputs. From 2011-2015, *Halodule wrightii* blade tissues were collected from 285 sites in the Laguna Madre and analyzed for C:N:P nutrient content and carbon and nitrogen stable isotopic composition. Clusters of seagrasses with significantly enriched $\delta^{15}N$ signatures and depleted $\delta^{13}C$ signatures were significantly associated with areas of high population and human activity, resulting in a localized shift in the average isotopic signature. This was supported by a statistically significant linear relationship between $\delta^{15}N$ and $\delta^{13}C$ clusters and distance from outlets draining high population watersheds (r^2 = 0.3637 and 0.3869, respectively). A significant north-to-south gradient in N:P ratios was also detected, indicating an switch in the system from nitrogen limitation to phosphorus limitation across a spatial gradient. These spatial shifts in nutrient dynamics suggest that seagrass tissue nutrient content is being impacted by human activity in the lower Laguna Madre, and may serve as an early indicator of effects on the lagoon in association with development.

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Do Echinoderms Senesce?

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Sea urchins are often proposed as an animal which may not senesce – as with corals and sponges. This study uses the actuarial definition of senescence, where age-specific-mortality rises with age. Sea urchins have been shown to live at least 100 years, but that alone does not qualify as non-senescence if the age-specific-mortality rises with age nonetheless. I examine a range of approaches to estimating patterns of age-specific mortality across many species of sea urchins and of mortality data across Sea Urchins and Starfish.

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Variability in shoal grass (*Halodule wrightii*) dormant seed densities across the northern Gulf of Mexico

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Shoal grass (*Halodule wrightii*) is a common seagrass species in the Gulf of Mexico, Caribbean, and along the southeast coast of the United States. Like all seagrass species, shoal grass has the ability to expand asexually through rhizome elongation and to reproduce sexually through seed. Shoal grass is an early successional species capable of proliferation in disturbed and/or degraded areas; consequently, understanding the contribution of each reproductive mode is important for predicting colonization rates following disturbance events or during restoration efforts. To better understand shoal grass sexual recruitment dynamics in the northern Gulf of Mexico, we investigated seed bank densities at over 650 sites from south Texas to the Florida Panhandle. Shoal grass seed reserves were spatially variable across the studied region. Seed densities were as high as 4,500 seeds m^2, though many sites had few or no seeds. We frequently found intact seed coat halves, potentially reflecting seed germination; however, we also commonly encountered broken seed coat pieces, characteristic of seed predation. Results from this large-scale assessment of the potential for sexual recruitment in shoal grass suggest that although localized populations reproduce sexually through seed, external factors may limit successful recruitment.

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Large-scale movements of spawning female blue crabs in the Gulf of Mexico: a Gulf-wide mark-recapture study

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Blue crabs support valuable commercial fisheries, although many states have seen declines in landings and abundance estimates in recent years. Stock assessment and management efforts have been hindered by a lack of understanding of the stock structure and boundaries of this migratory species. Female blue crabs undertake a seaward spawning migration. The scale, duration, and extent of this migration determines spawning locations and thus connectivity patterns, as dispersal is largely determined by local wind and current movements during the zoeal stages. To better understand the large-scale movements of female blue crabs within and among estuaries and offshore waters of the Gulf of Mexico, we are conducting a Gulf-wide mark-recapture study. This study involves collaboration between university researchers, commercial and recreational crabbers, and multiple state management agencies. To date, over 13,000 mature female blue crabs have been tagged across the five Gulf states, and over 1,700 recaptures have been reported. Crabs have recaptured 1–477 d after being tagged, 0–337.3 km from the tagging location. Tagging will continue through 2018. Results of this study will directly inform future larval transport modeling efforts and determination of stock boundaries in the Gulf of Mexico.

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Benthic community condition trends in the Chesapeake Bay – 30 years and what progress?

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The Chesapeake Bay is the jewel of North America's estuaries in size, secondary productivity, and effort to protect and promote ecosystem services and functioning. Globally, coastal ecosystems continue to be increasingly stressed by population growth and associated drivers and pressures. Nutrient levels, associated eutrophication, increased levels of hypoxia/anoxia, and increased inputs of toxic materials collectively compromise ecosystem functioning. Benthic community condition is also globally prominent in assessing coastal and transitional ecosystem functioning. We present long-term trends concerning benthic community condition and inferentially relate such patterns to broad-scale patterns of nutrients and chlorophyll a. Using the accepted paradigm of nutrient reduction, decreased primary production, and improvement in benthic community condition, there is little support for significant improvement in benthic community condition in the 30plus years of the restoration program for the Chesapeake Bay.

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The response to disturbance by the annual canopy-forming fucoid, *Stephanocystis osmundacea*

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Coastal California waters experience frequent disturbances due to turbulent swells and wave action. These disturbances directly affect subtidal algal communities that provide biogenic habitat along the coast. This habitat shapes faunal communities by providing refuge through structural complexity. In central California, kelps are the most notable structure providers, but, seasonally, a prolific fucoid, *Stephanocystis osmundacea*, adds a considerable amount of habitat into the environment. While diminutive and bushy during the winter, this alga produces canopy-forming reproductive fronds during the spring and summer months that add to the biogenic refuge. The purpose behind this study was to understand how frequent disturbances affect the physiology of *S. osmundacea*. This was accomplished by performing manipulations on the reproductive and vegetative tissues of the alga. Removal of reproductive fronds during spring elicits a dormancy response, while damage to the vegetative tissue slowed down growth possibly due to the overall photosynthetic capacity being altered. These results suggest that spring frond growth is important to the fitness of an individual and removal causes an energetic switch from reproduction to survival. Understanding how these seaweeds respond to biomass loss provides a better perspective of disturbance effects on this species and the ecosystem it helps support.

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Managing for a "Sound Ecological Environment"

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Addressing a sound ecological environment requires study of the total (complete) aquatic ecosystem and emphasizes preservation of habitat. Inflows dedicated to environmental needs is termed environmental flows. Knowledge of how inflows, resources, and estuarine conditions relate enable resource managers to determine optimal freshwater inflows for the management of target and indicator species. Concern over the delivery and quantities of environmental flows prompted Texas Legislature to pass Senate Bill 3 (2007). Senate Bill 3 directed the use of an environmental flow regime in developing flow standards and defined a schedule of flow quantities that reflected seasonal and yearly fluctuations by specific location in a watershed, and were to be adequate to support a sound ecological environment. An adaptive management process was established whereby scientific and stakeholder groups were formed for seven individual river basin systems. These estuary/bay-focused groups independently devised their own strategy for determining the dynamics of recommended inflows for their river basin management system. Final Environmental Flow Recommendation Reports were created by each Science and Stakeholder teams and used to establish rules by the Texas Commission on Environmental Quality (TCEQ). This research proposes a comparative study of the Science Team Reports, the Stakeholder Team Reports, and the TCEQ Rules.

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Assessing the impacts of ocean acidification on adhesion and shell formation in the barnacle *Amphibalanus amphitrite*

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Barnacles are dominant members of intertidal communities. Their success depends on firm attachment provided by their adhesive and protection imparted by calcified shell plates. We assessed if reduction in seawater pH would alter physiology, adhesion, and shell formation in the barnacle *Amphibalanus amphitrite*. Juvenile barnacles were exposed to one of three levels of pH_T, 8.01, 7.78 or 7.50, for 13 weeks. We found that barnacles were robust to reduced pH, with no effect of pH on mortality, tissue mass, or egg presence. Likewise, adhesive strength and morphology were not affected by reduced pH. Shell formation, however, was affected by seawater pH. Shell mass and base plate area were higher in barnacles exposed to reduced pH. Enhanced growth at reduced pH was driven by increased size of calcite crystals that comprise the shell. Despite enhanced growth, barnacles grown at pH_T 7.5 had base plates that broke more easily, suggesting reduced shell toughness. Shell thickness, crystallinity, and atomic disorder were not affected by pH. It is yet to be determined if such changes would alter survival of *A. amphitrite* in the field, but changes in abundance of this ecologically dominant species would undoubtedly affect composition of biofouling communities. Authors acknowledge ONR funding.
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Direct and indirect effects of disturbance and eutrophication on SW Florida seagrasses

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Shallow estuaries and lagoons along the SW coast of Florida have historically supported extensive seagrass beds, but anthropogenic pressures increasingly threaten these vulnerable habitats. This presentation reviews the status of SW Florida seagrass ecosystems, highlighting alarming declines in the Caloosahatchee Estuary and Estero Bay. The causes of these declines are discussed and categorized as: 1) disturbances stemming from the interaction of extreme weather events and altered watershed hydrology, 2) chronic stresses from nutrient loading and water quality degradation, and 3) indirect effects of these stressors mediated by benthic algae, epifauna, infauna, macrograzers, and microbes. We identify gaps and uncertainties in our current understanding of the mechanisms of seagrass decline in the region, and we describe ongoing and anticipated studies investigating these mechanisms.
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Impacts of warming and acidification on predator-prey interactions in oyster reefs

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Predators exert powerful influence on community structure though direct consumption and indirect predation risk that cascade down to lower trophic levels. However, these community interactions must be placed in an environmental context, as global warming and ocean acidification are affecting marine communities (including oyster reefs) on multiple scales. We are investigating the impacts of global warming and ocean acidification on predator-prey interactions in oyster reefs using a tritrophic system of blue crabs (*Callinectes sapidus*), mud crabs (*Panopeus herbstii*), and oysters (*Crassostrea virginica*). We are currently assessing physiological responses (e.g. activity levels) to these stressors in blue crabs and mud crabs, which will provide insights to potential changes in consumptive effects of predator control. Alternatively, behavioral shifts in predator-prey dynamics (i.e. nonconsumptive effects) can result from sensory impairment due to these stressors. We hypothesize that these stressors will interact by targeting different pathways of control (i.e. warming will affect consumptive effects, acidification will affect nonconsumptive effects). These experiments will yield a better understanding of consumptive and nonconsumptive effects as a function of stress in this endangered ecosystem, and will provide useful knowledge that can be applied to the success of conservation and restoration efforts.

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Life history strategy and the evolution of pathogen avoidance in the Atlantic blue crab, *Callinectes sapidus*

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The Atlantic blue crab, *Callinectes sapidus*, has evolved a complex life cycle that involves spawning and larval development at high salinity; larvae then settle in estuaries, migrating upriver to low salinity environments to mature and mate. *Callinectes sapidus* is tolerant of osmotic stress, however many of its known pathogens are not; therefore, distribution of these pathogens may vary along a salinity gradient. Evolution and maintenance of the complex life cycle may be at least partially driven by pathogen avoidance strategies. We will explore this hypothesis by examining relationships between the environment, disease, and behavior in field surveys and laboratory experiments: 1) surveys in Florida spring-fed, coastal rivers with diagnostics to examine pathogen prevalence along a salinity gradient; 2) laboratory experiments to determine how infection affects the behavioral response to a salinity gradient; 3) laboratory experiments to determine how salinity affects pathogen tolerance and virulence under osmotic stress. Implications for the evolution of pathogen avoidance may be relevant to other euryhaline species, e.g. many salmonid species that also support lucrative fisheries. If our hypothesis is supported, increasing frequency and severity of droughts due to global climate change could limit the effectiveness of this life history strategy by limiting freshwater habitat availability.

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Assessing prevalence and severity of seagrass wasting disease in Florida Bay as a function of immune status in the host species, *Thalassia testudinum*

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Recent trends suggest that marine disease outbreaks caused by opportunistic pathogens, such as seagrass wasting disease, are increasing in frequency and severity. Wasting disease is caused by a genus of slime molds known as *Labyrinthula*, and it is suspected that pathogenicity is intimately linked to the ability of the host to initiate defense responses; however, supportive evidence is lacking. This study investigated the roles of host immune status and environmental stressors in dictating an individual's susceptibility to seagrass wasting disease, using *Thalassia testudinum* individuals collected from Florida Bay subpopulations. Pathogen loading in host tissue was quantified using a novel q-PCR-based detection method, providing information on both the prevalence and severity of wasting disease at each site and within tissue of each individual collected. Additionally, an immune status profile for each individual was generated using several stress-related biomarker assays, and a synopsis of prior exposure to local environmental stressors was estimated using historical water quality data from each collection site. The results of this investigation address whether wasting disease susceptibility is driven primarily by variability in the environment or in the host species, and provide valuable insight regarding the extent to which seagrasses possess the capacity for resilience against marine pathogens.

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Contrasting behavioral responses to predatory risk cues in sympatric Caribbean urchins

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Non-consumptive effects (NCEs) of predators on their prey can be an important influence on ecological communities because predators can suppress the ecological function of more prey than they can consume. We tested for NCEs on grazing and movement behaviors of two species of sympatric urchins that have the potential to control phase shifts on Caribbean coral reefs: the diminutive reef urchin *Echinometra viridis* and the larger and longer-spined *Diadema antillarum*. In laboratory grazing assays, cues from a generalist predator, the Caribbean spiny lobster *Panulirus argus*, strongly suppressed grazing by *Diadema* but not *Echinometra*. Conversely, cues produced by simulated predation on conspecific urchins caused reduced grazing by *Echinometra* but not *Diadema*. In field tests for NCEs on movement behavior, we found that *Echinometra* reduced mean movement distances and directed movement away from lobster cues. *Diadema* movement was not affected by the presence of lobsters. The contrasting responses exhibited by these two urchin species suggest that herbivore populations, and their functional roles on reefs, may respond in unexpected ways to human-driven changes to predator assemblages. In this case, herbivore behaviors likely reflect different life history strategies and the degree to which each species recognizes this spiny lobster as a potential predator.

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Assessing coral assemblages inhabiting relict coral banks off the south Texas coast

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Hermatypic corals flourished on reefs in the Gulf of Mexico in the late Pleistocene to early Holocene. Today, many of these relict reefs are at mesophotic depths and have unique coral assemblages that provide critical habitat. Despite their ecological importance, the reefs of the South Texas Banks have not been quantitatively surveyed unlike their northern counterparts. Therefore, Blackfish Ridge and Aransas, Baker, Dream, Harte Banks were surveyed by ROV. Coral taxa densities (individuals m^{-2}) were estimated from discrete 30 s video segments. Coral communities were respectively 58-70% and 49-76% similar among terraces and slopes; however, significant differences were observed among banks and between slope and terrace communities except at Harte Bank, where terrace communities did not significantly differ from slope communities at any bank. Pairwise testing indicated significant differences between all terrace communities and between only some slope communities. Differences in coral communities among banks were highly correlated to geographic and geomorphic features including bank area, rugosity, longitude, and number of site components. Connectivity within the GOM basin occurs but the extent and pathway of these connections requires further investigation.

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Breaking point: population genetics reveal a lack of vertical connectivity of *Montastraea cavernosa* on the Belize Barrier Reef

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With shallow coral ecosystems under threat worldwide, mesophotic coral ecosystems (MCEs; 30–150 m) have been touted as potential refugia for "re-seeding" degraded shallow reefs. Dubbed the Deep Reef Refugia Hypothesis, this theory relies heavily on the assumptions that 1) MCEs will remain insulated from disturbances affecting shallow reefs and 2) that MCEs can supply viable larvae to shallow reefs following disturbances. Microsatellite genotyping was used to assess the genetic connectivity of populations of *Montastraea cavernosa* across a depth gradient on the Belize Barrier Reef (BBR). Samples were collected from four depth zones (10 m, 16 m, 25 m, 35 m) at four sites on the BBR. All sampling sites demonstrated a strong break in connectivity between shallow (10–16 m) and deep (25–35 m) *M. cavernosa* populations. This lack of vertical connectivity suggests that for shallow reefs in the region, local MCEs are likely not feasible refugia. However, regional analyses demonstrated connectivity among BBR populations at 25–35 m to populations in the Dry Tortugas approximately 1,000 km away. These results highlight the importance of tailoring monitoring and management decisions to include both shallow and MCE *M. cavernosa* populations which are likely functioning independently in the BBR system.

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Do small volumes of freshwater inflow make a difference?

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A small change in inflow may affect the fundamental functioning of an estuary, which in turn can have ramifications for the biota and humans dependent on the estuary. Senate Bill 3 allows water rights be purchased and set aside to benefit estuarine health. The aim of this study was to quantify the effects of small changes in inflow on ecosystem health among various sites, to evaluate the environmental benefits the water rights purchases would have in each area. Discharge, water quality, and benthic communities were sampled monthly at five stations in the Guadalupe and Lavaca-Colorado Estuaries. Benthic invertebrate communities were used as biological indicators of estuarine health. The Guadalupe Estuary had a higher mean monthly freshwater inflow discharge than that of the Lavaca-Colorado Estuary, and so a larger flow volume increase is necessary to impact estuarine health in the Guadalupe Estuary. Distinct oligohaline and mesohaline benthic communities were present in both estuaries. There were significant correlations between flow discharge, water quality, and benthic metrics. The positive correlation between a PCA factor representing positive water quality parameters, and benthic metrics indicates a relationship between small flow changes and estuarine health. This analysis links freshwater inflow, estuarine conditions, and ecological health.

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Genomic discovery of ecotype-specific features in *Serratia marcescens* associated with acroporid serratiosis

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Serratia marcescens is an emergent bacterial pathogen of plants, corals, animals and humans. This broad host range reflects the ubiquity and physiological diversity of the species. Outbreaks are commonly associated with the emergence of highly virulent clones; however, the relatedness and plasticity of these clones remains an open question. To explore this, we used a hybrid approach to produce high-quality genome assemblies for six *S. marcescens* isolates associated with acroporid serratiosis (APS) in the reef-building coral *Acropora palmata*. Although these six isolates are clonal, they can be distinguished by the presence of 10,523 SNPs and a modest accessory genome comprising ~8,500 bp. The next step of analysis involves comparing this coral-associated clonal complex with 358 genomes in GenBank, associated with disease in other hosts. This ongoing comparison is expected to reveal 1) diverse physiological capabilities that underlie their ability to occupy a range of environments and hosts and 2) ecotype- and host-specific features that enable the APS-associated complex to outcompete other coral microflora. Preliminary data indicates that more than 180 features are ecotype- or host-specific, including a type I fimbriae for adhesion and invasion of host tissues, and multiple toxin-antitoxin systems that could play a role in the APS phenotype.

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Evaluating responses of benthic macrofauna to artificial reef placement in the Gulf of Mexico

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Benthic infauna (> 500 μm, deemed macrofauna) are marine invertebrates that live below the sediment-water interface and are ubiquitous in soft marine sediments. Macrofauna are important prey items, ecosystem engineers, and can serve as bioindicators. Artificial reef research has long concerned itself with the impacts on fishes (e.g. production vs. attraction) and has tended to overlook less commercially valuable species such as benthic macrofauna. To fill this knowledge gap we assessed changes in macrofaunal communities and sediment characteristics (grain size and carbon/nitrogen content) with distance from three artificial reefs in South Texas using sediment cores taken on scuba. Because of altered hydrodynamics and increased fish presence following the placement of an artificial reef, we expect macrofauna abundances to increase with distance from the reefs, with abundances being lower nearer the reefs as well as a decrease in grain size and carbon/nitrogen content with distance from the reefs.

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Revealing deepwater lobster settlement across thermal gradients in the Gulf of Maine

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In a warming ocean the spatial distribution of the American lobster (*Homarus americanus)* has shifted northward over recent decades. Despite the collapse of the southern New England stock, dramatic increases in the Gulf of Maine (GoM) have elevated the fishery to its current status as the most valuable single species fishery in the US. Unclear is how much recent increases in the GoM are the result of a temperature mediated expansion of suitable nursery habitat into deeper water. Building on long-term coast-wide monitoring of shallow lobster nurseries, here we describe a targeted 2-year harvester-scientist collaboration to evaluate the depth- and temperature-dependence of larval settlement and adult abundance patterns across thermally contrasting sectors of the GoM. We used a randomly stratified, paired sampling approach with passive vessel-deployed collectors to assess larval settlement, and ventless traps to quantify adults. Preliminary results support the hypothesis that depth-wise patterns of settlement are strongly temperature driven, with settlement concentrating above the thermocline in the well stratified southwestern GoM, and spreading more uniformly across depths in the well mixed northeastern GoM. Ventless trap surveys suggest offshore dispersion after settlement. These results have important implications for changes in lobster ground productivity in a dynamic, changing climate.

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Kelp detritus provides high-quality food for sea urchin larvae

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Highly productive kelps release abundant particulate organic matter into the nearshore environment due to their constant fragmentation and erosion by ocean waves. The contribution of kelp detritus to coastal planktonic food webs has not previously been examined. Here, we demonstrate that detritus derived from a dominant kelp in the Northeast Pacific, *Nereocystis luetkeana*, provides high-quality food for planktonic sea urchin larvae. Our findings challenge the paradigm that phytoplankton are the main diet for zooplankton in nearshore regions, with implications for modeling of ocean production. Furthermore, at the benthic adult stage, sea urchins can destructively graze kelps causing the kelp ecosystem to collapse; hence, our results have implications for understanding feedback mechanisms that may determine the resilience of kelp ecosystems.

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The way that we went: biogeography and historical ecology of the ecosystem engineer *Sabellaria alveolata* in Ireland

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Biodiversity loss is one of the greatest challenges of our time. Broad-scale and long-term datasets that can track both spatial and temporal changes in ecological communities are particularly valuable as they yield invaluable information about ecosystem recovery and resilience, thus informing the selection of locations that are suitable for protection and/or rehabilitation. Biogenic reefs are important for habitat provision and coastal protection. Long-term datasets on the distribution and abundance of the reef-forming polychaete *Sabellaria alveolata* (L.) are available from Ireland. Using a combination of data archaeology and broadscale contemporary surveys the aim of this study was to combine historical records and contemporary data to (1) describe spatio-temporal variation in temperatures, (2) document changes in the distribution and abundance of *S. alveolata* and discuss these changes in relation to extreme weather events and recent warming. A total of 916 records spanning were collated revealing disappearances from a number of locations and a disjunct distribution pattern with six identifiable hotspots that remained relatively constant over time. We discuss how the distribution pattern can be largely explained by tidal fronts and summer stratification. We also discuss the importance of historical ecology as an important management tool for conservation.

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Orbicella faveolata coral chimaeras can be visually identified based on morphological differences

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Patterns of larval recruitment will likely have a critical role in coral population replenishment, maintenance, and growth. Dissolved compounds associated with conspecifics, and appropriate substrata have been shown to attract larvae, sometimes resulting in aggregate settlement and the fusion of genetically unique individuals. After fusion, it is unclear if corals maintain their unique genetic identity therefore forming a chimera, and if chimeras can be visually detected. Competent *Orbicella faveolata* larvae were settled on small settlement discs (2.5 cm dia). After 16 months, the discs were overgrown with corals. The colonies on some discs had homogeneous corallite shape and size, coloration, and texture, while other colonies had two to three distinct appearances despite their continuous tissue. We targeted tissue collection in heterogenous areas of seven colonies and collected tissue from opposite sides of three homogeneous colonies to serve as controls. Tissue samples were genotyped using three polymorphic microsatellites. The three homogeneous colonies were composed of one genotype, while each sample from the heterogenous colonies was a unique genotype, *i.e.*, chimera. This suggest that fused recruits maintain their unique genotypes and can be identified visually. The frequency of natural chimera in this species remain unclear, but heterogeneous colonies can now be targeted.

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A synthesis of the marine live bait trade as a vector for species invasions

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A central goal in ecology is understanding factors that allow particular species to successfully invade novel communities. We used the highly tractable vector of the year-round Maine live marine bait trade as a model to explore how seasonal changes in the abundance and diversity of source species can drive patterns of propagule pressure and therefore successful invasions. We sampled wormweed in source (Maine field) and recipient regions (Mid-Atlantic distributors) in spring, summer, and fall, identifying 42,735 live macro-organisms from 56 taxa. The macroinvertebrate community changed seasonally in abundance, richness, and diversity (taxonomic and functional), with highest propagule pressure during spring and summer. Both vector stage and season significantly influenced taxonomic and functional group richness, while abundance and percent organisms alive was driven by vector stage alone. Seasonal changes in communities were not apparent taxonomically, but there were seasonal differences in functional groups in both the field and vector. Therefore, in similar temperate vectors, season can be a strong predictor of the timing of the cumulative richness, diversity, and functional traits that influence the chances of successful invasions. This research highlights the importance of considering both the seasonality of the focal vector as well as species traits in invasion risk scenarios.

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Predation is stronger in the tropics in a nearshore marine ecosystem

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Over a half century ago, biotic interactions were predicted to be stronger at lower latitudes, underlying the origin and maintenance of global biodiversity. Decades later, lively debate on this fundamental hypothesis continues, while large-scale experimental studies remain rare. We tested the hypothesis that predation is stronger at lower latitudes using predator exclusion and exposure experiments on sessile marine invertebrate communities in four coastal regions spanning 47-degrees latitude (7000km) of the eastern Pacific Ocean. During community assembly, predation strongly reduced prey biomass and shaped prey community composition in the tropics, with no observable effect at higher latitudes. After assembling under low-predation conditions, communities that were exposed to predators also showed rapid declines in prey biomass in the tropics, but not at higher latitudes. Through direct observation of the predator guild, we further documented higher predation rates in the tropics. While stronger predation in the tropics could be explained in part by the higher predator diversity that was observed there, observations suggest the potential role of key predators. Therefore, results from several lines of evidence from a marine ecosystem support the hypothesis that predation is stronger at lower latitudes, demonstrating a greater need to integrate macro- and community ecology.

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Microbial symbionts, carbon and nutrient cycling in Caribbean coral reef sponges

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Sponges host complex microbial communities within their tissues and are important filter-feeding members of reef communities, with the collective capacity to overturn the entire water column on shallow Caribbean reefs every day. The sponge loop hypothesis suggests that sponges take-up dissolved organic carbon (DOC) and, via assimilation and shedding of cells, return carbon to the reef ecosystem as particulate organic carbon (POC). To determine if microbial symbiont communities play a role carbon or nutrient cycling within the sponge holobiont, we paired microbial community characterization (16S rRNA analysis, Illumina Mi-Seq platform) with carbon (DOC, POC) and nutrient (PO_4, NO_x, NH_4) flux data (specific filtration rate) for 10 common Caribbean sponge species. Distance-based linear modeling revealed weak relationships overall between symbiont structure and carbon or nutrient flux, suggesting that the observed differences in POC, DOC, PO_4, and NO_x flux among sponges are not caused by variations in the composition of symbiont communities. However, significant correlations between symbiont structure and NH_4 flux occurred consistently across the dataset. These results indicate that microbial community structure is uncoupled from sponge carbon cycling but may impact sponge-mediated nitrogen cycling within Caribbean coral reef communities.

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Developing a qPCR assay to assess the tolerance of *Crassostrea virginica* to temperature and salinity stress

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The eastern oyster, *Crassostrea virginica*, is a crucial part of marsh ecosystems along the Louisiana Gulf Coast. These oysters improve water quality by filtering the water and forming reefs that increase shoreline stability. Oysters tolerate large fluctuations in temperature and salinity, but freshwater diversions from the Mississippi River and increases in the frequency and severity of precipitation events have caused oysters in the Gulf of Mexico to experience extensive loss. Temperature and salinity have synergistic, non-additive effects on the physiology and gene expression of *C. virginica.* To look for potential biomarkers that quantify stress across multiple axes in C. *virginica*, we collected gill tissue samples from three locations along the Louisiana Gulf Coast: Sister Lake, Calcasieu Lake, and Vermillion Bay. The tissue was immediately excised and preserved in RNAlater to ensure an accurate representation of gene expression at the time of capture. Samples were collected from April – July 2017, before and after significant freshwater (or precipitation) events such as Tropical Storm Cindy. We will present results from quantitative real time PCR assays designed to validate genes previously identified to be highly expressed in response to combined temperature and salinity stress. This approach will allow for rapid identification of transcriptional differences that could be used to assess eastern oyster stress.

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Managing disturbance: the response of a dominant intertidal seaweed *Ascophyllum nodosum* to different frequencies and intensities of harvesting

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The rockweed *Ascophyllum nodosum* is a dominant component of intertidal communities across the North Atlantic Ocean, providing both habitat and primary productivity to nearshore ecosystems. Commercial exploitation of this species is widespread and typically involves cutting the distal portion of fronds thereby permitting regrowth by lateral branching and generation of new fronds from the perennial holdfast. Two key management parameters for determining the sustainability of this resource are the cutting height and the recovery period between successive harvests. Here we assess the influence of these two parameters on several indicators of exploitation, including harvested biomass, remaining biomass, annual harvest yield and biomass recovery. Over a 28-year period, treatments of two levels of cutting height (15 and 30 cm) and five levels of recovery period (1, 2, 3, 4 and 5 years) were applied to individual 25-m^2 plots. In general, indicators were lower for shorter recovery periods of 1 and 2 years. Surprisingly, longer recovery periods of 4 and 5 years rarely increased indicators, suggesting that a 3-year recovery period maximizes harvested biomass. Moreover, longer cutting heights did not consistently result in increased indicators, and indeed, the 15-cm cutting height often provided higher values (e.g., annual harvest rates), especially at longer recovery periods. Other impacts of harvesting beyond effects on biomass (e.g., canopy structure, scale of harvested areas) merit further investigation, but our study provides a unique comparison of the long-term impacts of different management scenarios.

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Acoustic backscatter analysis of nekton utilization over restored and non-restored oyster reefs

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In 2014, Texas Parks and Wildlife Department restored 130 acres of oyster reef in East Galveston Bay after Hurricane Ike's storm surge caused sedimentation on nearly 75% of reefs in the bay system. Monitoring was completed to quantify nekton utilization over restored and non-restored portions of three reefs in East Galveston Bay using acoustic techniques. A post-restoration scan of each reef and surrounding non-restored area was acquired using a 420 kHz split-beam DTX EchoSounder. Acoustic backscatter (measured in Sv) was analyzed for nekton biomass by excluding data below the reef bottom and above the upper limit of the water column. The resulting mean Sv for Hanna's, S. Pepper Grove, N. Pepper Grove, and Middle reefs were -51.62 (dB), -51.96 (dB), -50.17 (dB), and -51.98 (dB) respectively. The surrounding non-restored areas had only slightly lower mean Sv values than on the restored reef areas but both area types reported similar substrate depths. These results could be explained by the cultch placement design of the restored reef, since the bulk of the restoration was conducted using flat structures with little variation in vertical relief. Further analysis should be conducted into future restoration designs to allow for greater substrate complexity, vertical relief and heterogeneity.
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The role of larval supply and competition in controlling recruitment of the temperate coral *Oculina arbuscula*

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Oculina arbuscula is a temperate coral common on hard bottom reefs of the South Atlantic Bight. Larvae of this species must settle on substrate densely colonized by sessile benthic invertebrates. To investigate the relative roles of larval supply and competition for space on the recruitment of *O. arbuscula*, settlement and survival to 30x30cm plots were monitored over 5 years on a reef off Georgia, U.S.A. Treatments consisted of 10 replicates of the following: 1) unmanipulated natural substrate, 2) natural substrate initially cleared of encrusting competitors, and 3) artificial substrate composed of concrete tiles. These plots were photographed 3-5 times/year between July 2004 and June 2009. Images showed that *O. arbuscula* recruits throughout the year with a peak in September/October. While recruitment rates were higher than death rates in all treatments, recruitment to artificial substrate far-exceeded that found on natural surfaces. The high recruitment rates on artificial substrate ruled out the possibility that *O. arbuscula* populations are limited by larval supply. Competition with other sessile invertebrates contributed to differences in recruitment among treatments, however, the competition effect was small. Based on these findings, the alternative hypothesis that *O. arbuscula* populations in this system are limited by sedimentation is proposed.
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Effects of mangrove encroachment on fiddler crab diets: an assessment of preference and food quality

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Black mangroves (*Avicennia germinans*) are encroaching upon salt marshes across the Gulf Coast of Texas. It is unknown how this shifting vegetation community may affect coastal wetland food webs. Fiddler crabs (*Uca* spp.) are detritivorous organisms that are important basal species in salt marsh food webs. They serve as prey for organisms at higher trophic levels, and play important roles in nutrient cycling and soil aeration. In order to determine potential bottom-up effects of mangrove encroachment, we observed the behavioral and physiological responses of *Uca* to different diets. Using a combination of mesocosm experiments, feeding arena trials, and food quality assessments, we determined the differential responses of *Uca* to diets of *Spartina alterniflora* (a common marsh plant) and *Avicennia*. *Uca* spent 60% of their time on sediment enriched with *Spartina* and feeding activity was 2.18 times higher there than on *Avicennia* sediment. *Uca* also increased in weight an average of 2% more on a diet of *Spartina*. This indicates a diet of *Spartina* is both more preferred and of higher quality than a diet of *Avicennia*, which may lead to decreased abundance of fiddler crabs in encroached areas and changes in both marsh sediment characteristics and coastal food web structure.

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Effect of black mangroves (*Avicennia germinans)* on the recovery of *Spartina alterniflora* communities

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Wetland functionality is shown to be positively influenced by species diversity. This association implies that ecosystems with increased species diversity would be more resilient to disturbances. However, the relative contribution (e.g. proportion of total productivity) of a single species to the overall recovery can be difficult to quantify and may be affected by community structure. Here, we examine the effect of black mangroves (*Avicennia germinans)* on the productivity of smooth cordgrass (*Spartina alterniflora)* communities in the Chandeleur Islands recovering from the Deepwater Horizon oil spill. Oil exposure maps of the area were used to identify heavily and lightly oiled sites. Percent coverage estimates were then used to delineate *S. alterniflora* dominant and mixed *S.alterniflora/A. germinans* plots at each site. Percent coverage, shoot density, and leaf length were taken in June and September of 2015 and 2016 to estimate aboveground productivity. Concurrently, belowground productivity was quantified using the implanted mass technique. There were differences in *Spartina* density and productivity when comparing monospecific and mixed plots across a gradient of oil exposure. Although not statistically significant, these results suggest that *A. germinans* has a minimal effect on *S. alterniflora* productivity during recovery.

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Microgeographic variation in larval settlement and recruitment in the barnacle *Semibalanus balanoides*

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Larval recruitment in marine ecosystems is highly variable in both time and space. Striking variation in settlement can occur on the same shore or among sites over very small spatial scales despite the fact that settling larvae are likely to have originated from the same localities. We tested the hypothesis that microclimate variation is responsible for a significant component of this variation. We established permanent quadrats that were cleared of barnacles in 2016 and in 2017 quantified the settlement of the barnacle *Semibalanus balanoides* within and among shores in southwest England with respect to the aspect and angle, two variables that drive large variation in the microclimate of rock surfaces. We then compared patterns of larval settlement within a region to settlement patterns at broader geographic scales across the United Kingdom. We found significant variation in larval settlement that was correlated with microclimate. We discuss how this variation may be accounted for in studies of larval recruitment across broader geographic scales.

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Genetic variation in the eastern oyster, *Crassostrea virginica*: analyzing kinship between spat and adults on a fine spatial scale

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Crassostrea virginica, the eastern oyster, has a pelagic larval duration that lasts two to three weeks and is considered to be moderately long compared to other marine organisms. During this pelagic stage, it was previously thought that larvae were well-mixed in the plankton, leading to patterns of genetic homogeneity on both regional and local scales. However, recent studies have shown significant genetic and, importantly, kin structure at the scale of individual oyster reefs, in both adults and newly settled spat. The question then arises as to the primary mechanisms driving these patterns of non-zero relatedness among individuals. Here, we use 22 microsatellite markers to compare the genetic composition of adults and spat from three different sites off the coast of North Carolina. We hypothesized that local retention would be an important factor determining patterns of genetic structure and as such, expected adults and oysters to be more closely related within- rather than between sites. We found mean kinship values to be significantly higher for adult-spat pairs located at the same sites than for pairs located between sites. We also found two adults that produced a significantly greater fraction of spat than all other adults combined, suggesting that sweepstakes reproduction may also be an important mechanism influencing the genetic composition individual oyster reefs.

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Gut feelings about herbivory on coral reefs: is there an influence of diet on gut microbes and visa versa?

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The recovery of coral reefs following coral mortality can be influenced by the behavior of local herbivores. The removal of algae by herbivorous fish may prevent the establishment of algal stands and may slow the positive feedback loop toward macroalgal-dominated reefs. In some vertebrates, investigators have found a link between diet and gut microbiota composition with diet influencing the gut community and the gut microbes, in turn, influencing food choice. We were interested in whether the gut microbiota of herbivorous reef fish can be influenced by diet and whether food choices may be influenced by gut microbe communities. Using a combination of laboratory and field studies, we tested 3 hypotheses: 1) Can diet changes influence the composition of the gut microbiota of a freshwater aquarium fish (*Gambusia affinis*) on short time scales? 2) Do food availability and habitat quality influence the composition of the gut microbiota of reef herbivores (*Sparisoma viridis*)? 3) Do herbivorous fish (*S. viridis*) prefer algae from their own habitat? Although fish do not appear to prefer "local" foods, our results support the idea that fish gut microbe communities can be influenced by diet and that gut microbe communities in *S. viridis* show strong habitat associations.

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The perils of settling on turf: reduced attachment strength of kelps and consequences for holdfast morphology

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Temperate reefs in Southern New England may be experiencing a phase shift from kelp to turf dominance. Comparisons between historical and recent densities of kelp indicate a dramatic reduction of kelp in this region. Kelps that are present can attach to hard substrate or directly to turf macroalgae. In this study, the *in situ* attachment strength of *Saccharina latissima* (Linnaeus) was examined using a modified dynamometer (spring scale) for individuals attached to hard substrate or turf macroalgae at 4.5 m depth at Fort Wetherill State Park, Jamestown, Rhode Island. Additionally, the density, biomass, and stipe and thallus length of kelp were measured at 2 and 6 m depth from kelp attached to turf or hard substrate. Results show that *S. latissima* attached to turf require 4 times less force to dislodge than individuals attached to hard substrate. Also, kelp density decreased but the proportion of kelp attached to turf increased with depth. Kelps attached to turf exhibited a greater % allocation of biomass to the holdfast and had a smaller thallus length than those attached to hard substrate. The results indicate that turf-attached kelps allocate more energy towards attachment; however, they nonetheless likely experience high mortality due to wave dislodgement.

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Two invasive invertebrates: understanding their range limits in Northeastern North America through relative thermal tolerance

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The European green crab (*Carcinus maenas*) and Asian shore crab (*Hemigrapsus sanguineus*) are both invasive in northeastern North America, where they have significant potential and realized impacts on native shellfish and macroalgae. The more recent arrival, *H. sanguineus*, has begun to displace *C. maenas* as the dominant rocky intertidal crustacean where their ranges overlap. In order to better understand the current and potential spread of these species, their relative thermal tolerances were examined where they co-occur in Cape Cod, MA. Time-to-right testing was used to construct thermal performance curves for both species. The thermal windows in which the species were able to right themselves were broad for both species: 4.8-37°C for *C. maenas* and 5.6-39.9°C for *H. sanguineus. Hemigrapsus sanguineus* was significantly more heat tolerant than *C. maenas*, but cold tolerance did not differ between the species. This was unexpected as *H. sanguineus* has a warmer native range distribution, and suggests that the species may have the cold tolerance needed to expand north of its current range limit in central Maine. These data can help to understand the spatial distribution of two high-impact invasive species, and their potential to spread and persist in the northeast.

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Positive interactions and invasion success: A biogeographic test across native and invasive ranges

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Understanding the mechanisms underpinning the higher abundances invaders often obtain in their non-native compared to native range is a central goal of invasion ecology. Despite the clear evidence for changes in negative species interactions (e.g. loss of natural enemies, increased competitive ability) in driving this pattern, native species can also facilitate invasive species via positive interactions. To date, explicit tests of whether changes in positive interactions increase invader abundances in the non-native compared to native range have not been conducted. Abundances of the porcelain crab, *Petrolisthes elongatus,* native to New Zealand but invasive in Tasmania, are closely tied to the amount of rock habitat under which they live, thus increased habitat-availability may explain higher abundances of *P. elongatus* observed in its non-native range. Biogeographic surveys found no differences in any rock habitat characteristic between New Zealand and Tasmania. However, the calcareous tube-forming serpulid worm *Galeolaria caespitosa* which forms complex habitat on the underside of rocks was prevalent on rocks in Tasmania but almost entirely absent in New Zealand. To explicitly test the effects of the structure provided by *Galeolaria* on crab abundance, mimics of rocks that did and didn't have *Galeolaria* structure present were placed at multiple sites in both Tasmania and New Zealand. Importantly, at all sites in both ranges, the mimics with *Galeolaria* structure facilitated higher abundances of crabs. Results provide crucial *in situ* experimental evidence that native species can facilitate invader abundance by providing a novel habitat-structure not present in the invaders native range.

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Polar bear energetics when the benthos gets pulled out from under them

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Climate change increases the frequency and duration of long-distance swims by polar bears (*Ursus maritimus*). The energetic costs of such swims are assumed to be large, however, no estimates of metabolic costs of swimming for polar bears are available. Here I use data on internal body temperature and external ambient temperature for two swimming polar bears, combined with mathematical modeling of heat production and of heat conduction to the surrounding water, to estimate the metabolic rate of swimming. Using this metabolic rate I then examine the relative heat production and heat loss for bears of a range of sizes and body conditions. I show that, when compared at the same movement rate, the cost of transport for swimming is approximately 5X that of walking. I further show that for small bears (less than approx. 145 cm body length or 90 kg) and bears in poor body condition, heat loss while swimming in cold Arctic waters should exceed heat production, and long swims should therefore not be thermodynamically sustainable. Energetic and thermodynamic costs of long swims may be further exacerbated by recent declines in body condition that have been documented due to climate warming.

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Differential responses to ocean acidification between populations of *Balanophyllia elegans* corals from different upwelling environments

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The current rate of ocean acidification may be too fast for most species to keep pace via evolutionary change or physiological acclimation. However, populations that are locally adapted to conditions not predicted in the global ocean until 2100 may be more tolerant to future ocean acidification (OA). This study compares the response to OA for two populations of the coral, *Balanophyllia elegans* that experience distinct upwelling regimes. We measured respiration rates and gene expression in corals from both populations exposed to pCO_2 levels of 750 and 2000 µatm for 29 days. Corals from the low upwelling environment exhibited lower respiration rates at low pH compared to the corals from the greater upwelling site, indicative of a suppressed metabolism. The transcriptome data revealed an overall suppression of metabolic genes on day 29 in both populations in response to low pH. However, corals from the high upwelling environment upregulated genes involved in calcium ion binding and ion transport, most likely related to pH homeostasis and calcification, suggesting resilience to future pH levels. Higher tolerance to low pH conditions in *B. elegans'* populations may provide an evolutionary step towards maintaining important processes of high metabolic demand in the face of future OA.

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Oxygen uptake and branchiae comparison of the bearded fireworm under low oxygen conditions

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The bearded fireworm, *Hermodice carunculata*, is an abundant mobile corallivore subject to numerous environmental changes throughout its widespread distribution. Each segment of this marine annelid contains bright red branching structures called branchia where the majority of respiration and oxygen uptake occur. Branchial filaments were once a way to help determine speciation, but now are suggested as adaptations to an organism's environment. The study presented here, subjected *H. carunculata* to low dissolved oxygen (DO) conditions to investigate the adaptability of oxygen uptake rates. Results suggest lower levels of DO will increase the worm's oxygen uptake rates, but differences in branchiae morphology were not observed to date.

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Influence of human disturbance and marsh vegetation on fiddler crab retreat behavior

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In response to predator presence, fiddler crabs often retreat into nearby burrows. Reemergence time after predator exposure is influenced by crab size, sex, and tidal location. However, it is unclear how this behavior varies with human disturbances and vegetation zones. This pilot study examined these factors at two sites in Savannah, Georgia, USA; one site was frequented by beachgoers while the second was infrequently visited. One-meter plots were temporarily delineated within zones of bare substrate, mixed *Distichlis*/*Salicornia*, and *Spartina alterniflora*. Following the human disturbance of establishing the temporary plot, the time elapsed for crabs to reemerge from the burrows was recorded. At both sites, average return times were shorter in the lower intertidal plots. Crab return time was significantly longer at the infrequently visited site for plots located within the high intertidal bare patches and the *Distichlis*/*Salicornia*, but there was no significant difference in return times between sites for crabs within low intertidal *Spartina alterniflora*. This study further supports that marsh location influences crab behavior. Additional work is needed to determine whether this is due to vegetation type and/or abiotic factors and how this behavior might be modified by human disturbance in upper intertidal zones.

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Burrowing behavior and energy requirements of ghost crabs, *Ocypode quadrata*, under anthropogenic pressure

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Ghost crabs have been widely used as a bioindicator species of human impacts on sandy beaches to collect the biological data required by management for quick response. Previous studies show that ghost crab population densities and individual sizes decline at sites with strong human impacts. Those studies have mostly focused on mortality of this species to explain those reductions in density and size and have ignored the energetic mechanism underlying population-level responses. Here we examine ghost crab burrow fidelity, burrow longevity and energy costs of burrowing behavior at 20 sites in South Carolina that experience various types of human impacts (pristine, lightly visited beaches, heavily visited beaches, heavily visited beaches with vehicles on the beach) to understand the response in terms of burrowing behavior and burrowing energetic costs. We show that burrowing behaviors, such as fidelity and longevity, as well as overall burrowing energy requirements change significantly with increasing human pressure at a beach. Our results demonstrate that ghost crabs spend more energy on burrowing at heavily disturbed sites.

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Follow your heart: using dataloggers to investigate behavior in freely-moving lobsters

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Much of our knowledge about how marine organisms respond to stimuli comes from experiments in small, closed systems, yet responses may differ if animals are able to move freely. The recent proliferation of compact, programmable electronics offers an opportunity to develop and deploy devices capable of monitoring the behavior of freely-moving animals using several sensors simultaneously. We designed, built, and tested a series of Arduino-based dataloggers that include a heart rate monitor, an electronic compass, an accelerometer, and a temperature sensor to track the movements and responses to stimuli of unrestrained American lobsters (*Homarus americanus*) in a large naturalistic tank. Here, we highlight some of the sample outputs and results from these trials and describe some of their further applications.

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Early life history response of reef building coral *Orbicella faveolata* to ocean warming and acidification

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Ocean warming and acidification are two impacts of climate change that are major threats to the livelihood of coral reefs. However, it is unknown how the early life stages of Atlantic corals cope with the combined effects of these two global environmental stressors. This research investigates the effects of these stressors throughout the early, potentially most vulnerable, life stages of the Caribbean coral species, *Orbicella faveolata*. Gametes from *O. faveolata* were subjected to current day and future scenarios of oceanic temperatures and pH predicted by 2050 in order to quantify the effects of changing climate on fertilization, larval survivorship, and settlement. Results indicate that treatment type did not significantly affect fertilization success. However, high temperature stress caused the greatest larval mortality than all other treatments and inhibited all settlement of *O. faveolata*. This effect was significantly mitigated by ocean acidification in the combined treatment. Reduced survival and settlement of *O. faveolata* larvae when subjected to these conditions may weaken the ability of this species to persevere when combined with additional environmental stressors. Although ocean acidification reduces the impact of temperature stress in the early life stages, the well documented effects of ocean acidification on accretion of more mature corals may drive this threatened species further into decline.

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Diel nutrient cycling by tropical sponges

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When abundant, sponges are a vital link in the bentho-pelagic coupling of marine habitats due to their powerful filtration capabilities and ability to consume and release nutrients. In the Florida Keys, high microbial abundance sponges dominate shallow hard-bottom habitats where they offer habitat to other organisms, consume POM and DOM, and alter water chemistry via biogeochemical cycling. However, little is known about diel cycles of sponge filtration. We conducted experiments in mesocosms in which we compared changes in water chemistry caused by three sponge species (*Speciospongia vesparium*, *Ircinia campana*, and *Ircinia sp.*) across three rates of water flow. Water was sampled from the individual mesocosms every four hours over three days to quantify changing concentrations of ammonium, nitrate, nitrite, and phosphate. The greatest change in comparison to controls occurred eight hours after sunrise, whereas the weakest signal was detected seven hours after sunset. There was a strong correlation between the quantity of available nutrients and sponge-related changes in nutrient concentrations. Our results emphasize the importance of sponge identity and water flow on the diel patterns of filtration and biogeochemical cycling that effect water quality in shallow waters of the Florida Keys.

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Bacterial symbionts in the sea anemones *Diadumene lineata* and *Exaiptasia pallida*

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Sea anemones, like corals and other marine organisms, are host to a variety of bacterial populations. These bacteria have been hypothesized to have a variety of useful functions, including nutrient provision, defense from pathogenic bacteria, and adaptation to changing temperatures. In this study we examined the bacterial populations in freshly caught and cultured *Diadumene lineata* using next-generation sequencing, with focus on taxonomic groups and physiological function. In addition, bacteria from the tissues of *Exaiptasia pallida* were cultured, identified, characterized, and used in an inhibition screen against various human pathogens. Our results illustrate a variety of groups and functions for bacteria that could contribute to sea anemone physiology.

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How *'Clone'* can you go? Seagrass genotypic diversity at three different sampling scales

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Seagrass beds often form the foundation of coastal marine ecosystems, performing vital tasks such as nutrient cycling and serving as habitat for a variety of marine organisms. Genetic diversity is vital for the long-term survival of a species because it provides the raw, evolutionary material for environmental adaptation. One aspect of genetic diversity, genotypic (clonal) diversity, has been shown to be strongly correlated with seagrass population fitness and recovery from disturbance. We analyzed genotypic diversity in the seagrass *Halodule wrightii* at three different sampling scales from sites along the Texas Gulf of Mexico Coast. Our purpose was two-fold: (1) to determine which scale most efficiently captures the bulk of genotypic diversity at a location, and (2) to determine if *H. wrighttii* clonal expansion occurs using a *phalanx* (monoclonal) or *guerilla* (intermingled, polyclonal) growth strategy. Results showed that the greatest degree of genotypic diversity was captured at the largest scale (2 m apart). While smaller sampling scales (20 cm apart, 10 cm core) detected unique genotypes, most of those found were also represented at the largest scale. They also showed that *H. wrightii* exhibits a *guerilla* growth strategy, which has the potential to increase outcrossing opportunities among adjacent clones.

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Effects of nutrient enrichment on salt marsh production: a field reciprocal transplant experiment with *Spartina alterniflora*

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Nutrient enrichment has been identified as a potentially important driver of global salt marsh decline. However, relatively little is known about the effects of nutrient enrichment on plants in the high marsh relative to plants in the low marsh. We assessed the short- and long-term effects of nutrient enrichment on above- and below-ground production of short-form *Spartina alterniflora*, a dominant plant species in the high marsh. We conducted a two year field reciprocal transplant experiment of *Spartina* genotypes from fertilized and reference creeks in a long-term, whole-ecosystem, nutrient-enrichment experiment in Plum Island, MA. We looked at the effects of transplant location and plant origin (i.e., short- and long-term fertilization, respectively) on performance of *Spartina* genotypes. The effects of nutrient enrichment on primary production in the high marsh were evident after only two years: aboveground biomass of *Spartina* transplants was significantly higher in fertilized than reference gardens. In addition, belowground allocation to root and rhizome biomass varied across gardens. We also found significant differences in production depending on transplant origin: the relative performance of transplants from the fertilized site was strongly reduced in reference gardens, indicating that long-term fertilization may compromise the ability of plants to perform under ambient nutrient conditions.

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Impact of two hurricanes on an in situ *Acropora cervicornis* nursery

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Hurricanes are known to cause damage to coral reefs through dislodgement, substrate destabilization, and mortality. The effects of hurricanes on coral nurseries, however, remains poorly understood. As the number of coral restoration projects grows and projected frequency of hurricanes increases across the Caribbean, understanding this relationship is critical. Here we examined damage caused by two hurricanes (Matthew, October 2016; Irma, September 2017) to an in situ *Acropora cervicornis* nursery. Fragments were grown in the nursery off Fort Lauderdale, Florida on two different structures: 1 m^3 concrete modules and coral trees. Data were collected quarterly, documenting fragmentation, disease, and biological interactions. Increased colony mortality on both structures was observed following each storm for multiple monitoring events, with variability between structures and storms for missing, broken, and diseased colonies. High abundance of missing colonies were reported for both structures following Matthew, but only observed for coral trees following Irma. Additionally, Irma caused widespread physical damage to both nursery structures and disease prevalence was greater. These results indicate hurricanes can cause extensive mortality, disease, and damage throughout nurseries that can linger even after the storm has passed. Practitioners should be prepared for these effects with plans in place prior to an incoming storm.

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Effect of climate on estuarine benthos at regional scales along the Texas coast

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Climate variability plays a key role in estuary structure and function. Freshwater is delivered to the estuaries as inflows driven by precipitation. The amount of precipitation an area receives could be affected by climate change. Precipitation along the Texas coast is variable from year to year and linked to the El Nino Southern Oscillation (ENSO). A previous study demonstrated decreasing long-term trends in benthos abundance and biomass in response to changes in hydrologic conditions in the Lavaca-Colorado Estuary. The purpose of this study is to investigate whether the previous findings are unique to the Lavaca-Colorado Estuary or if these effects are regional in scale. Six stations in the Lavaca-Colorado Estuary, four stations in the Guadalupe Estuary and five stations in the Nueces Estuary, representing a salinity gradient in each estuary, were sampled quarterly for benthic macrofauna and hydrography from 1986-2009. Ocean Nino Index (ONI), North Atlantic Oscillation (NAO) and North Pacific Index (NPI) were analyzed for relationships between estuarine conditions and climate. In all three estuaries ONI was correlated with salinity, NAO and NPI were correlated with dissolved oxygen and temperature. Long-term declining trends in benthos abundance were found in all three estuaries; however, biomass trends varied by bay system.

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Variability in scleractinian and octocoral recruitment along the Florida Reef Tract

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There is consensus that recruitment failure is impeding coral recovery along the Florida Reef Tract (FRT), but how this parameter varies spatially and temporally is unknown. To address this knowledge gap, we quantified scleractinian and octocoral recruitment over two years at 30 Coral Reef Evaluation and Monitoring Project sites throughout the FRT. At each site, 32 pairs of grooved terracotta settlement tiles (15x15cm) were attached to the substrate and retrieved after one year (n = 1,920 total tiles), then replaced with new tiles for year two. Total numbers of scleractinian and octocoral recruits increased from 2016 to 2017, with 13 sites experiencing a 50% or more increase in scleractinian recruitment. Scleractinian recruitment was dominated by brooding species and exceeded octocoral recruitment at most study sites throughout the FRT. Recruitment rates were highly variable, even among sites in close proximity to one another, and there was a latitudinal shift from north to south along the FRT in recruit position on the tiles from upper to lower surfaces. Because of the regional differences in coral recruitment within the FRT, multiple management plans for this ecosystem may need to be implemented.

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Which came first, *Spartina* or the oyster reef: elucidating spatial distribution patterns of two ecosystem engineers

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In an era of rapid environmental change, understanding species limits and their interactions with other species today, are key components in understanding how they could act in the future. Understanding the limits and interactions of ecosystem engineers, can also inform how whole communities will react to environmental change. *Crassostrea virginica* (oyster) and *Spartina alterniflora* (*Spartina*) physically change their environment by stabilizing sediments, improving water quality and providing habitat. Physical drivers such as salinity, current velocity and wave energy play a large roll in the distribution of these two species, although additional factors are at play. For example, oyster reefs shelter the edges of *Spartina* stands, facilitating lateral growth. *Spartina* can also reduce heat stress by shading of upper intertidal oyster reefs, which facilitates their upper growth limit. Here we present terrestrial lidar and drone imagery results. We found that oyster reefs increase the slope of intertidal banks in small to intermediate estuarine channels. *Spartina* grows up to and overlaps with the upper edge of oyster reefs, but when oysters are not present, *Spartina* grows at lower intertidal elevations. Oyster reefs can facilitate the lateral growth of the outer edge of *Spartina* stands, but could hinder the lower vertical limit of *Spartina*.

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Assessing the efficacy of *in situ* nurseries to support sponge community restoration

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Sponge communities are a key component of the Florida Keys and Florida Bay nearshore marine environment, but have been extensively degraded over several decades. The widespread loss of these communities and the ecological function they support has inspired restoration efforts using clonal tissue collected from sponges occurring in healthy habitat and seeding them into degraded areas. Small-scale restoration efforts have demonstrated that this process can enhance the ecological function of such areas. However, conducting sponge community restoration in Florida Bay on an ecologically meaningful scale will require a much larger number of sponges produced in this manner. We are evaluating the efficacy of using *in situ* nurseries to serve as repositories of sponges to support large-scale sponge community restoration. Our results suggest that nurseries could be an effective strategy to propagate and maintain large numbers of sponges that will reduce or eliminate the need to collect biomass from healthy sponge communities. However, these efforts have had to contend with the continued occurrence of cyanobacteria blooms and recently, the effects of Hurricane Irma. Here, we summarize our ongoing efforts to evaluate the efficacy of sponge nurseries to support restoration work and the challenges of conducting large-scale sponge community restoration in the face of recurring environmental stressors.

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Nekton habitat use and habitat-specific production estimates for turtlegrass across the Gulf of Mexico

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Seagrass meadows in the Gulf of Mexico support a diverse assemblage of fish and invertebrates, several of which are commercially and recreationally important, including the blue crab (*Callinectes sapidus*). To date, however, a large-scale study of seagrass habitat use by nekton has not been conducted in this region. In summer 2018, we will conduct a simultaneous Gulf-wide survey at three sites in Florida (Apalachicola, Cedar Key, and Charlotte Harbor), one site in Louisiana (Chandeleur Islands), and two sites in Texas (Lower Laguna Madre and the Texas Coastal Bend) to quantify the use of turtlegrass *(Thalassia testudinum)* as habitat by nekton. We will quantify juvenile and adult nekton abundance and biomass using trawl and epibenthic sled surveys, measure turtlegrass structural complexity using quadrat surveys and core sampling, and quantify blue crab growth and mortality using mesocosm and tethering experiments. From these data, we will use path analysis and hierarchical linear modeling to develop habitat- and state-specific production models for blue crab populations. Our research will provide vital information on the relationship between seagrass structural complexity and fisheries species abundance and growth that will help inform adaptive management strategies to support sustainable fisheries.

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White-plague like disease outbreak and mass stony coral mortality along the Southeast Florida Reef Tract

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Coral reefs have been on the decline due to a multitude of threats and stressors including global climate change, development, pollution and disease. Starting in late 2014, increases in white-plague type disease prevalence and disease related mortality were reported throughout the northern extent of the Florida Reef Tract offshore Southeast Florida. To describe the impact of this disease event a portion (2013-2017) of a long-term reef monitoring dataset collected by the Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP) was analyzed. Regional stony coral disease prevalence increased significantly across study years with 11 of a total 29 species recorded with active white-plague like infections. Regional stony coral live tissue area decreased significantly and average live tissue area per colony decreased by 42% from 2013 to 2017. Shifts in species dominance across the region were observed with significant region-wide declines in *Montastraea cavernosa*, *Meandrina meandrites* and *Dichocoenia stokesii.* This multispecies disease event is temporally and geographically unprecedented, spanning over 3 years and 165 km. The significant loss of corals larger than 10 cm diameter will negatively affect reproduction and inhibit recovery from this event in addition to the loss of dominant species that may fundamentally change the composition of the community.

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Citizen science benefits coral reef restoration activities

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The abundance of corals has declined significantly over past decades, to the point where several reef-building species in the Caribbean are now listed as threatened. Active reef restoration has expanded exponentially to help recover degraded coral populations and the ecological services associated with healthy and complex reefs. While restoration practitioners now grow hundreds of coral genotypes from several species within coral nurseries and thousands of corals are outplanted onto degraded reefs annually, the cost of these activities continues to be a limiting factor. We describe a citizen science program, Rescue a Reef (RAR), which trains participants in reef restoration and provides unique experiential learning opportunities to recover degraded coral reefs by propagating and transplanting threatened coral species. Between 2015-2017, 230 participants outplanted >1,300 staghorn corals, showing that citizen scientists significantly contribute to reef restoration. Most importantly, corals outplanted by RAR participants showed the same survivorship as those outplanted by scientific experts. The direct benefits of using citizen scientists for restoration are enhanced when the educational opportunities offered by these expeditions are considered. Results from our survey showed significant improvements in coral reef ecology and restoration knowledge for RAR participants. Thus, the growing field of reef restoration based on the coral gardening method offers a unique opportunity for participatory public engagement. By participating in these programs, citizen scientists can go beyond data collection to active restoration of degraded resources.

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***Acropora cervicornis* disease transmission assays: a method for testing potential resistance and improving coral restoration practices**

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The Caribbean reef-building staghorn coral, *Acropora cervicornis*, has experienced unprecedented population declines starting in the 1970s primarily due to coral bleaching and disease. Efforts throughout Florida and the Caribbean have been made to grow *Acropora* species in coral nurseries to maintain genetic diversity and outplant nursery grown fragments to depauperate reefs. Previous research indicates that disease-resistant *A. cervicornis* genotypes exist, but this is unknown in Florida Keys populations. We tested the potential for rapid tissue loss (RTL) resistance among 39 *A. cervicornis* genotypes from a Florida Keys nursery by grafting active disease fragments to apparently healthy fragments. Tissue degradation was documented visually based on presence or absence of RTL, and confirmed using histological analysis. In a preliminary disease screening, 7 out of 39 genotypes showed signs of rapid tissue loss transmission. A replicated transmission experiment using 12 genotypes found all showed signs of RTL transmission though susceptibility was highly variable, 40-100% transmission. Although genotype had no significant effect ($p>0.05$) on RTL transmission (presence/absence), this study shows that disease resistance is present in multiple Florida *A. cervicornis* nursery genotypes. These results may provide a glimpse of the potential disease resistance in the natural population and be used to improve restoration techniques.

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Integration of natural selection across the life-cycle stabilizes a marine mussel hybrid zone

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Hybrid zones occur where two genetically distinct populations interbreed producing offspring of mixed ancestry. Hybrid zones may be maintained if selection on hybrids is offset by migration. Detailed analysis of hybrid zones between the mussels *Mytilus edulis* and *M. galloprovincialis* indicate that directional selection is not offset by migration and consequently the hybrid zones observed in southwest England should not be stable. Despite these results these hybrid zones have been maintained for multiple generations suggesting that selection observed among adults is opposed by selection in other portions of the life-cycle. We tested two hypotheses for selection opposing directional selection against *M. edulis* alleles among adults is offset by either differential fecundity among genotypes or directional selection in favor or *M. edulis* alleles during larval development. We found that there are few differences in fecundity among hybrid genotypes but strong directional selection in favor of *M. edulis* alleles occurs during larval development, which counters selection against those alleles among adults. These results emphasize the importance of partitioning selection across the life cycle to understand the maintenance of hybrid zones in marine species.

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Change in Southeast Florida octocoral density following a multi-year disease event

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The Southeast Florida Reef Tract (SEFRT) occurs offshore Southeast Florida, extending from the northern Martin County to the southern Miami-Dade County. In recent years, the SEFRT has experienced unprecedented levels of disease, resulting in a major decrease of stony coral cover. However, less information is available regarding the effects of this event on octocoral populations. To evaluate the status of octocorals in Southeast Florida, a portion (2013-2017) of the Southeast Coral Reef Evaluation and Monitoring Project (SECREMP) data was analyzed. Octocoral density was surveyed at 22 permanent sites along the SEFRT, utilizing four 10 x 1 m belt transects. The data were evaluated to identify any significant population changes resulting from the multi-year disease event. The overall mean regional density of octocorals significantly increased from 2013 to 2017. Specifically, this increase occurred at 18 of the 22 sites. Contrary to the decline of stony coral populations following the disease event, a decline in octocoral populations has not been observed. With a decrease in the role of stony corals and an increase in the role of octocorals on the SEFRT, further evaluation is necessary to determine the effects on the local benthic community and densities indicative of a healthy reef.

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Analysis of the spatial distribution, and recruitment of native and non-native tunicate species on *Zostera marina* in the New Jersey

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Many tunicate species have invaded the Western North Atlantic coast in the last century. These tunicates can have negative impacts on important industries like shellfish aquaculture, but also foul numerous natural and anthropogenic surfaces leading to displacement of native communities. During the summer of 2017, we assessed the spatial distribution and recruitment of tunicate species in *Zostera marina* (Eelgrass) beds in Barnegat Bay, New Jersey. Samples were collected in June, July, and August using $0.25m^2$ quadrats and assessed for tunicate presence, as well as percent coverage of tunicates. *Botrylloides violaceus* was the most common species found and was found at Barnegat Inlet and Ham Island. *Botrylloides schlosseri, Didemnum vexillum,* and *Ascidiella aspersa* were also found, but were less abundant. Tunicate coverage increased substantially at Barnegat Inlet from June to August, but decreased at Ham Island during this period. *Didemnum vexillum* was only found in Ham Island, while *Ascidiella aspersa* was only found in Barnegat Inlet. These results suggest that fouling invasive tunicates could have a negative impact on eelgrass communities by smothering blades and reducing plant viability.

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Determining habitat use in juvenile lionfish: addressing the nursery hypothesis

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Lionfish have recently invaded the Western Atlantic, Caribbean and Gulf of Mexico. Studies in the invaded range have shown that large lionfish adults are typically found on deep fore-reef habitats and juveniles are more commonly observed on in-shore habitats (e.g., sea grass beds, mangrove). This has lead to assumptions that lionfish are using in-shore habitats as a nursery and at some point during ontogeny they migrate out to the fore-reef. The degree to which in-shore habitats act as a nursery for lionfish has not been empirically tested. We collected lionfish adults and juveniles from paired mangrove and reef habitats at Turneffe Atoll in Belize to determine what percentage of adult lionfish used mangrove habitat in their juvenile life-stage. We used otolith microchemistry to determine spatial differences in trace elements from fishes collected in both mangrove and reef habitats. We used a maximum likelihood estimator to assign adults to either reef or mangrove habitats based on their juvenile otolith chemistry. We found that 36% of adult lionfish recruited to mangroves as juveniles, while 64% recruited to reef habitats. It is critical to determine how lionfish are using various reef-associated habitats in order to understand how to most effectively manage invasive populations.

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Variability in juvenile coral and octocoral communities in the Florida Keys

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A number of reefs in the Florida Keys National Marine Sanctuary (FKNMS) are experiencing a shift from scleractinian coral to octocoral dominance. To determine if this community shift can be explained by differences in juvenile abundance, we present results from three years of a study conducted at 18 Coral Reef Evaluation and Monitoring Project sites throughout the FKNMS. Sites were stratified by region (Upper, Middle, and Lower Keys) and habitat type (patch, shallow forereef, deep forereef). At each site for all three years, we surveyed the same 32 0.25m^2 quadrats (n = 576 quadrats total) for scleractinian and octocoral juveniles < 40mm. Octocoral juveniles tended to be more abundant in northern regions of the FKNMS and scleractinian juveniles more common at southwest sites. There was a large increase in octocoral juveniles in 2017 compared to the previous two years. The dominant genera were *Porites* and *Siderastrea* for scleractinians and *Antillogorgia*, *Eunicea*, and *Gorgonia* for octocorals. This study suggests that when it comes to reef recovery, future communities could be different than current communities on the regional, habitat, and even site levels, and it may not be appropriate to apply a single management plan to the entire FKNMS.

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Localized anthropogenic effects on the marine environment at Palmer Station, Antarctica

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Palmer Station is a small US research base (15-40 people) north of the Antarctic Circle (64.8 °S). In 1989, the Argentine supply vessel Bahia Paraiso ran aground and eventually sunk, leaking an estimated half a million liters of diesel and other hydrocarbons. Subsequent impact monitoring from 1989 to 1992 determined that some marine sediments were contaminated, along with bioaccumulation in, and mortality of, intertidal limpets. However, an assessment of local anthropogenic effects on the marine environment had not been conducted since 1992, and benthic macroinvertebrates were not sampled at all. In 2014 and 2015, marine sediments were collected to quantify the extent and effects of any potential contamination on deep (18 to 24 m), soft-sediment benthic macrofauna from both the Bahia Paraiso, and from Palmer Station itself. In this presentation, macrofauna communities are characterized and compared spatially in relation to historically contaminated areas.

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The influence of defensive plasticity and predator patchiness on the distributions of two chthamaloid barnacles

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The barnacles *Chthamalus fissus* and *C. dalli* overlap in distribution between Santa Cruz, CA and San Diego, CA with *C. dalli* dominating north to Alaska and *C. fissus* dominating south to Baja California. *C. fissus* develops either a narrow or bent defensive morph in response to two species of predatory snails that both feed using a shell spine. Narrow and bent morphs occur in the area of overlap of these two species but it is not known if these defended morphs are all *C. fissus* or if, in fact, *C. dalli* also exhibits defensive plasticity. We examined morphological and molecular characteristics of barnacles sampled in the overlap range to determine if defensive plasticity is unique to *C. fissus*. Both the morphological and molecular analyses revealed that, in the overlap range, all narrow and bent morphs sampled were *C. fissus* and all ovals were *C. dalli*. Furthermore, none of the *C. dalli* growing on shells of the predatory snail exhibited the defensive morph while all *C. fissus* growing on predator shells were narrow. We argue that lack of defensive plasticity in *C. dalli* may impact its southern limit, particularly since the predatory snail, *Acanthinucella spirata* increases in abundance from Monterey, CA south to Baja California.

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Temporal and spatial variability of the epibenthic invertebrate communities inhabiting ridge-swale complexes along the South Atlantic Bight

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The South Atlantic Bight offshore of Cape Canaveral, Florida is composed of large bathymetric features termed, ridge-swale (RS) complexes. These features provide important habitat for a multitude of organisms from the benthos to the neuston, some of which support commercial or recreational fisheries. However, these RS complexes are also favored for sand dredging because they are rich in sand of the grain size suitable for beach re-nourishment. The overall aim of this project is (1) to assess the unique functional ecosystem services that a ridge-swale system provides (2) to determine the functional, biological services which may be affected by dredging and determine the degree of impact and, (3) to examine the recovery of the associated invertebrate and fish communities, post-dredging. To do this, we are using a multidisciplinary, experimental approach that uses control (non-dredged) and dredged RS complexes sampled quarterly (day and night) before, and for several years following, a dredging episode. Seasonal samples were taken starting in Fall 2013, prior to dredging, and are still ongoing. Here we describe the spatial and temporal patterns in the species abundance and diversity for epibenthic invertebrates sampled using an otter trawl from Fall 2013 – Fall 2016.

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Carbon storage varies by benthic seagrass habitat and site around St. Thomas, U.S. Virgin Islands

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Seagrass habitats provide the ecosystem service of capturing and storing carbon in the sediment. In the U.S. Virgin Islands no studies to-date quantify sediment carbon content of seagrass beds or test meadow properties (percent cover, shoot height, shoot density) as predictors of sediment carbon. This study measured sediment organic carbon, with loss-on-ignition (LOI) and elemental analysis techniques, from cores (20 cm long) in native seagrasses (*Thalassia testudinum, Syringodium filiforme*), invasive seagrass (*Halophila stipulacea*), and un-vegetated sand, at three sites around St. Thomas. We hypothesized sediment carbon density would increase with rooting depth: *T. testudinum* > *S. filiforme* > *H. stipulacea* > sand. Average sediment carbon density per core was low, 2.56-14.55 mg C cm^3, and a 3-way ANOVA revealed a significant interaction between benthic habitat and site. Sediment organic carbon and LOI were correlated, yet different from published calibration curves for seagrasses. A multiple linear regression revealed seagrass percent cover and average shoot height as significant predictors of carbon density, implying aboveground morphology may influence sediment carbon more than root depth. Findings suggest that easily-measured seagrass characteristics (LOI, percent cover, average shoot height) can be used to estimate sediment carbon density, which may be useful for data-poor or resource-limited locations.

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The potentially amplified expansion of the invasive seagrass *Halophila stipulacea* in the U.S. Virgin Islands because of hurricanes Irma and Maria

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The Caribbean has been recently devastated by two category-five hurricanes, severely impacting ecologically important seagrasses. Coupled with the recent invasion of *Halophila stipulacea*, seagrass diversity in the Caribbean could be changed drastically. *Halophila stipulacea* grows faster than any of the native seagrasses of the Caribbean, suggesting that *Halophila* would recover the fastest. This invasive seagrass also grows deeper than any of the native seagrasses. Increased depths might create a refugia for the invasive seagrass, allowing it to return even faster. On St. Thomas United States Virgin Islands, bays that were surveyed in the summer of 2017 and one day prior to the first storm will be surveyed monthly for shoot density during recovery. Genetic samples of *Halophila* will also be collected to determine the source of upcoming and resistant genotypes. *Halophila* is recovering rapidly while the native species have barely recovered.

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Assessing DNA methylation patterns of the Eastern Oyster (*Crassostrea virginica*) collected across coastal Louisiana

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Populations of eastern oysters (*Crassostrea virginica*) in coastal Louisiana will be challenged by predicted changes in ocean temperature and salinity. As the environment changes, adaptation will play an important role in differential responses among populations. Potential factors dictating the extent of population-specific responses will be a combination of genomic and epigenomic variation. One emerging tool to investigate how epigenomic features such as DNA methylation may lead to differential responses is reduced representation bisulfite sequencing. This method, along with the recent release of the *C. virginica* genome assembly allows us to identify and describe differentially methylated regions (DMRs) between oysters collected from unique environments. For this study, 20 oysters were collected from four sites characterized as either low (5psu), mid-low (12psu), mid (14psu), or high (19psu) salinity levels. Population specific methylation patterns highlighted that the majority of DMRs were associated within gene features (77.2%). Of these DMRs; 51.3% were located along introns, 10.6% were located along exons, and 2.8% were located within gene promoter regions. Assessing these population specific methylation profiles is a key step to identifying genomic regions that may shape differential responses to environmental change, and ultimately future distributions of oyster reefs in the northern Gulf of Mexico.

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Effects of temperature and salinity on the eastern oyster, *Crassostrea virginica*

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Crassostrea virginica, the eastern oyster, forms reefs that provide critical services and benefits to the resiliency of the surrounding ecosystem. As precipitation events increase in frequency and intensity, salinity changes are becoming an important threat to oyster survival. Temperature and salinity independently and synergistically influence gene expression and physiology in marine organisms. Oysters from Sister Lake, Louisiana were exposed to fully crossed temperature (20°C and 30°C) and salinity (25ppt, 15ppt, and 7ppt) treatments. Transcriptome analysis was used to compare variation in gene expression in combination with physiological measurements of clearance rate and respiration. Preliminary analyses show greater fold-change in gene expression in response to salinity changes at warmer temperatures, suggesting warmer waters exacerbate the salinity stress response. The oysters also had a significant increase in respiration rate between 20°C and 30°C but, despite the higher energetic demands the clearance rate did not comparably increase. This suggests that the oysters are functioning at an energetic deficit at warmer temperatures. In June 2017 we collected oyster tissue from locations across the Louisiana Gulf coast for a fine scale comparison of transcriptional differences that can be used to make more accurate predictions of how climate change will differentially impact geographically separate oyster populations.

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Spatiotemporal change in Southeast Florida's coral reef communities in a warming ocean

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The Southeast Florida Reef Tract (SEFRT) benthic community exists toward the northern limit of shallow water coral distribution. Range expansion further north is likely limited by present day hydrographic processes, therefore the impact of ocean warming on the coral reef community in this region is pertinent. Benthic cover, from 2007-2016 was estimated for two long-term projects to assess coral reef community spatiotemporal changes. Along the SEFRT, mean sea surface temperatures have significantly increased over the period with multiple thermal anomalies experienced. Spatiotemporal change in benthic cover composition suggests potential temperature induced shifts, with statistical analysis via generalized linear models (GLM) identifying significant changes in stony coral, macroalgae, octocoral and sponge assemblages. To assess benthic changes on a latitudinal gradient, the SEFRT was separated by defined biogeographic boundaries and major shipping ports into seven coral reef ecosystem regions. Benthic community change has been analyzed in relation to temperature fluctuations by combining in situ and modelled data from the Hybrid Coordinate Ocean Model (HYCOM), to assess the impact of climate change on the SEFRT.

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Sensitivity of benthic invaders to predation and disturbance across a latitudinal gradient

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Current ecological theory suggests that both biotic and abiotic factors—including physical disturbance and predation— may influence the successful establishment of non-indigenous species (NIS) in benthic marine systems. Yet many marine NIS are distributed across a wide range of latitudes, over which predation and disturbance regimes vary widely. This raises the question of whether broadly successful invaders are influenced directly by either factor. We asked how predation and physical disturbance, alone or in tandem, influence the presence and cover of key NIS (including a suite of tunicates, bryozoans, and barnacles) in benthic invertebrate communities, using a factorial experiment replicated at three sites in each of four regions spanning 47° of latitude. We asked whether the invaders are more or less sensitive to predation and/or disturbance than native species in a given locale, and examined patterns in taxa-specific responses to each factor relative to the known geographic extent of their invasions and species' traits, such as reproductive mode and defenses. Results indicate large geographical and trait-based variation in sensitivity among NIS taxa, suggesting that incorporating interactions among biogeographic patterns and functional traits could strengthen emerging theory about factors influencing invasion success.

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Linkage with maladapted alleles restrains evolutionary rescue via gene flow in a tide pool copepod

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As the climate warms, populations of animals and plants that have adapted to historical climates will experience strong selection to adapt to new temperature regimes. In some species, this adaptation may be facilitated gene flow from populations that are locally adapted to current climatic gradients, with warming temperatures favoring alleles from in equatorward populations. However, evolutionary rescue may also be hindered by linkage, if warm adapted alleles arrive in the new population in a genetic background that is not otherwise well-suited to that environment. We tested this scenario using the tide pool copepod *Tigriopus calfornicus* which is locally adapted to temperature, but also exhibits hybrid breakdown in interpopulation crosses due to genomic incompatibilities. We crossed populations that were divergent for heat tolerance and imposed laboratory selection for increased heat tolerance for fifteen generations, followed by whole genome pooled re-sequencing to identify loci under selection. While hybrids evolved increased heat tolerance, they were unable to reach the tolerance of the southern parent, even after 15 generations of selection. Our results suggest that introgression of adaptive alleles was limited by linkage within a maladaptive genetic background, and that this may place a limit on evolutionary rescue via gene flow in the context of climate change.

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Estimating presence and abundance of spawning female blue crabs offshore in the Gulf of Mexico using fishery-independent survey data

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Blue crabs exhibit a migratory life cycle, with females migrating seaward to release their larvae in water that have salinities in excess of 20 ppt. Females are capable of producing multiple clutches of eggs, may continue to spawn for over a year after mating, and are actively migrating seaward during this reproductive period. Fishery-independent trawl surveys have shown actively spawning females as far as 150 km offshore in the Gulf of Mexico. We conducted reproductive analyses on females collected offshore to confirm their viability as contributors to the Gulf of Mexico blue crab spawning stock(s). Females spawning offshore produce full clutches of eggs with high viability. We also present a novel model design using the fishery-independent SEAMAP trawl survey data for the estimation of presence and abundance of female blue crabs occupying the offshore environments of the northern Gulf of Mexico.

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Impacts of climate-mediated mangrove expansion on avian community dynamics

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Climate-mediated changes in community composition can be seen across a large swath of taxa; from vegetative communities to higher-level trophic species. Changing community composition may lead to novel species assemblages, altered ecosystem dynamics, and changes in ecosystem function. Using long-term, standardized avian monitoring data sets (e.g. Audubon Christmas Bird Count) paired with environmental variables, we investigated how climate-mediated land cover change impacts avian communities along the mangrove-salt marsh ecotone throughout the Gulf of Mexico and eastern Florida. In addition to examining changes in bird abundance and species richness, we also examined how temporal beta diversity varies across sites to gain a more complete understanding about rates of community turnover. Results suggest that total avian species richness peaks at latitudes associated with a convergence of temperate and tropical faunal communities. Total avian abundance, however, showed no site-specific response to increasing latitude. Temporal beta diversity exhibited an increase at higher latitudes. These initial results suggest that changes in avian community composition and species richness are sensitive to changes in latitude, consistent with expected species poleward shifts. Changes in wetland foundation species composition and facilitation of northern range shifts of plant and avian species may explain the community responses to this latitudinal gradient.

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Does density-dependent predation on a non-native prey facilitate its escape from natural enemies?

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Native predators have been shown to provide biotic resistance of invasive prey across ecosystems including coastal communities. However, early in the invasion process, native predators may initially ignore an invader when it's rare and only increase consumption once it becomes more abundant. The filter feeding crab *Petrolisthes armatus* has invaded oyster reef communities along the Southeastern US and is readily consumed by many native predators. We used this invasion to test whether a native predator's consumption of an invasive prey is a function of its abundance relative to native prey. We quantified the consumption rate and preference of the native mud crab predator, *Panopeus herbstii*, under varying ratios of invasive to native prey. We found that consumption of invasive prey was higher in treatments where relative abundance of the invader was higher. However, using Bayesian statistics, we found that preference for invasive prey was often lower than the expected ratio within each treatment and native predators always preferred native prey regardless of its relative abundance. Together this suggests that an invader's escape from its natural enemies may be a result of density-dependent predation, along with a preference for native prey.

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Effects of Hurricane Irma on *Diadema antillarum* in the Florida Keys

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The long-spined black sea urchin (*Diadema antillarum*) remains at extremely low densities in the Florida Keys due to multiple disease-induced mass mortality events in the 1980s and 1990s. A shift in coral reef community structure from coral-dominated to algae-dominated states has been attributed to the functional extirpation of this keystone herbivore. Recovery of *D. antillarum* in the Florida Keys to pre-mortality densities is slow compared to other *D. antillarum* populations in the Caribbean, which could be a result of low fertilization success, limited larval supply, high post-settlement mortality, and recurrent disturbance. Here, we examine the effects of a large disturbance event, Hurricane Irma, on the Florida Keys *D. antillarum* population and surrounding coral reef community. *D. antillarum* densities and benthic community composition were assessed approximately 4 weeks before, 10 weeks after, and 16 weeks after Hurricane Irma at 7 sites in the Upper and Middle Keys. *D. antillarum* density decreased overall, although there was variation in the impacts of the hurricane on *D. antillarum* densities and benthic community composition. The resilience of Florida Keys coral reef communities to disturbances such as hurricanes may be compromised by the continuous decline of the local *D. antillarum* population.

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Timing and drivers of symbiont selection in the early life stages of the massive starlet coral *Siderastrea siderea*

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The relationship between corals and *Symbiodinium* dinoflagellates is sensitive to elevated sea-surface temperatures, which are projected to increase 2.6 to 4.8°C by 2100. One mechanism that may allow corals to persist through ocean warming is an association with thermally-tolerant symbionts. During early life stages, coral larvae or juveniles will uptake multiple species of *Symbiodinium*. This diversity is maintained for months or years, but over time, one *Symbiodinium* species becomes dominant. It is unknown at what age or size dominant selection occurs, and whether environmental factors drive this selection. To determine this, tissue samples of *Siderastrea siderea* within the size classes of one to ten polyps will be collected for the field, and the relative abundance of *Symbiodinium* species per juvenile will be genetically determined. We will also assess if the potential selection of different *Symbiodinium* species is associated with local environmental conditions (i.e. temperature, depth, sedimentation). To assess if rising sea-surface temperatures facilitate the selection of thermally-tolerant *Symbiodinium* species, we will conduct experiments in the laboratory where coral juveniles containing multiple *Symbiodinium* species will be exposed to warm conditions for 3 months. These juveniles will then be genetically analyzed to determine if the thermally-tolerant *Symbiodinium* species increased in relative abundance.

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Scenic SCUBA surveys suggest spillover sustains some snails: over-exploited queen conch populations replenished by marine protected area

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The large marine snail, queen conch (*Lobatus gigas*), supports an iconic Caribbean fishery yet populations are in trouble. Here, we provide evidence of a conch population driven into decline by fishing and show that a well-enforced Marine Protected Area (MPA) replenishes nurseries outside its borders. Repeated surveys of Bahamian fishing grounds show population declines and a shift towards smaller sizes over the past decade. Surveys within tidal channels, which naturally consolidate conch and provide some refuge from harvest, provide abundance, size, and age of conch throughout the Exuma Cays and includes a centrally located MPA. Dive survey data shows higher adult abundance within the MPA and higher immature abundance outside the MPA. A biophysical model of larval transport predicts that prevailing flow pulls larvae out of the MPA and delivers them to unprotected channels where we found thriving nurseries. Further, the model predicts that the larval sources to the park are unprotected areas where densities are too low for reproduction. The MPA is sustaining nearby populations, yet its own future is in jeopardy without upstream sources of larvae. Meetings with fishers suggest that the mood is right to create a network of MPAs that exchange larvae for a sustainable future.

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Effects of environmental change in Louisiana salt marshes on habitat use of coastal consumers

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Coastal ecosystems in Louisiana are a major component for the state's economy and culture, as they provide vital habitat for many species important for local fisheries. For the past few decades, Louisiana salt marshes have been experiencing invasion by the black mangrove. Understanding how species depending on marsh habitats use available resources is critical to predict how shifts such as in dominant macrophytes and other environmental changes impact coastal wetland communities and production. We compared resource use and energy content of fiddler crabs (*Minuca longisignalis*) from salt marsh areas with and without mangrove intersection, respectively, around Port Fourchon, LA. Resource use varies greatly between habitat type, while the crabs' caloric content appears similar across habitats. Our results suggest that habitat-shaping macrophytes severely influence on what resources fiddler crab depend, in order to fulfill their energetic requirements. While the trophic niche of the crabs is narrower in salt marsh areas compared to mixed areas, the species' niche seems to be quite plastic, allowing for a successful performance in both habitat types. Findings from this study indicate that rapid habitat changes impact local marsh-dependent food web dynamics by shifting resource use, yet do not necessarily affect energy availability.

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Impact of biological variables on larval dispersal of bentho-pelagic species

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Applying a biophysical model in Newfoundland and Labrador (Canada) waters, connectivity processes was investigated during the long pelagic larval phase (2-3 months) of the northern shrimp (*Pandalus borealis*) and key drivers of larval dispersal in different environmental conditions. Three years representative of contrasting North Atlantic Oscillation phases were selected, and the impact of the timing of release (yearly and daily), release location, and vertical migration behaviour on shrimp larval dispersal was hierarchically assessed. The role of those biological characteristics for long larval dispersal processes was estimated by comparing dispersal kernels, travelled distances, and connectivity matrices. From these metrics, the variables that require further field and laboratory investigation to enhance our interpretation of connectivity within the area were identified. Specifically, larval release location and vertical migration behaviour were the two most important drivers for larval success and settlement patterns. Inclusion of diel and ontogenic swimming behaviour increased settlement success of larvae released from inshore areas, regardless of study year. This study improves understanding of northern shrimp stock-recruitment relationships and their sensitivity to changing environmental conditions for bentho-pelagic species with a long larval phase.

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Potential flaws of ecosystem services monetary valuation: Case study of intertidal bare mudflats.

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Intertidal bare mudflats are very productive habitats and provide many ecological functions. As a result, they provide a large diversity of ecosystem services related to the four main groups defined in the Millenium Ecosystem Assessment; so the notion of ecosystem services can easily be used to highlight interdependencies between ecosystems and social systems. Ecosystem services thus sound like a promising tool to consider "ordinary" habitats like intertidal bare mudflats, highlighting the services provided by these habitats. Nevertheless, the framework of the ecosystem services can orientate the way how a socio-ecosystem will be managed. In this perspective, the socio-political use of the notion of ecosystem services should be questioned. In this presentation, we will highlight that, beyond epistemological questionings, it is difficult to estimate the monetary value of all the ecosystem services provided by the intertidal bare mudflats. Using this case study, we will show that the evaluation of the functions of a socio-ecosystem should not only be restricted to an assessment of its ecosystem services, as this framework may be more reductive than integrative, and thus potentially risky.

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Diet and temperature interact to affect survival and fecundity of a marine herbivore

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Increasing sea surface temperatures are predicted to alter marine plant-herbivore interactions and thus the structure and function of macroalgal communities. Host plant quality can alter herbivore fitness, therefore an understanding of how temperature may interact with diet quality is necessary. We used a marine amphipod, *Sunampithoe parmerong*, to test how increased temperatures and diet interact to determine herbivore consumption, growth, survival and fecundity in short and long-term assays. In short-term thermal assays, *S. parmerong* was tolerant to the range of temperatures it currently experiences in nature (20-26 °C), with mortality at temperatures >27 °C. During long-term experiments, *S. parmerong* was grown in laboratory conditions under 9 combinations of altered temperature and diet for two generations. Temperature and diet interacted to determine to the total number of the surviving F1 generation and the total potential F2 population. The development of F1 individuals was affected by diet, but not temperature. Consumption per capita was highest at intermediate temperatures, but could not explain patterns in survival. Our results show that predicting the effects of temperature on marine herbivores will be complicated by host plant quality, therefore climate-driven changes to plant availability will affect herbivore performance and thus the strength of plant-herbivore interactions.

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The impact of nutrient loading on nitrate removal in a *Juncus roemerianus* and *Spartina alterniflora* dominated saltmarsh in the northern Gulf of Mexico

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We are conducting a field study in a salt marsh located on Dauphin Island, AL, where we are increasing inputs of nitrogen (N) and phosphorus (P) in plots dominated by *J. roemerianus* and *S. alterniflora* by 20 g N m^{-2} yr^{-1}/ 1.25 g P m^{-2} yr^{-1}, or 40 g N m^{-2} yr^{-1}/2.5 g P m^{-2} yr^{-1}. We are measuring seasonal rates of denitrification, anaerobic ammonium oxidation (ANAMMOX), and dissimilatory nitrate reduction to ammonium (DNRA) alongside CO_2 fluxes to better understand the link between carbon and nitrogen cycling in salt marsh ecosystems. Half way through the 1-year study, *S. alterniflora* plots by ~12 fold (p=0.008). Compared to the ambient plots, DNRA rates nearly doubled in low fertilization plots in *S. alterniflora* (p=0.008), and have nearly tripled in high fertilization plots in *J. roemerianus* plots (p=0.0007). CO_2 fluxes for J. *roemerianus* plots were temporally variable (p=0.006) with no significant differences between treatments. In contrast, CO_2 fluxes in *S. alterniflora* plots were similar temporally and across the treatments. Our results suggest that *S. alterniflora* tend to remove N at higher rates than *J. roemerianus* when introduced to increased nutrient loading, and both species act as net carbon sinks with similar processing rates.

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Diversity of parasites in the Eastern mud snail *Ilyanassa obsoleta* associated with an invasive alga *Gracilaria vermiculophylla*

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The invasive alga *Gracilaria vermiculophylla*, native to the eastern Asia, has been widely sighted along the eastern U.S. coasts. This invasive alga, which can degrade water quality and shellfish recruitment, can also host dense colonies of native macroinvertebrates. Understanding the parasitism in macroinvertebrates is critical because parasites are indicators of water quality, disease prevalence, and overall biodiversity of coastal ecosystems. The eastern mud snail *Ilyanassa obsoleta* preferably deposits eggs on *G. vermiculophylla* over sediments. This snail is a common intermediate host to a wide range of trematode parasites. We conducted a pilot study to see if the parasitic prevalence in *I. obsoleta* change across different biomasses of *G. vermiculophylla*. In North Carolina and Virginia, we found averages of 12.82% and 10.5% parasitism prevalence respectively. In Virginia, the trematode parasitism was higher among *I. obsoleta* associated with patchy *G. vermiculophylla* distribution (18%), and *Himasthla quissitensis* was the most abundant, while in North Carolina the highest trematode parasitism observed was in the site densely colonized by *G. vermiculophylla* (37%), with *Lepocreadium setiferoides* making up most of the trematode diversity. Continued analysis of the parasitism prevalence can enhance our understanding of changing macroinvertebrate parasitism rates with increasing *G. vermiculophylla* proliferation on biogeographic scale.

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Ecosystem production drives trophic niche volume

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A core ecosystem function is the creation and transfer of biomass through trophic relationships in food webs. Efficient exploitation and transfer of primary production through the food web is mediated by organisms operating within their niche space. Therefore, a complete understanding of this function hinges on understanding how niche space varies based on the amount that can be produced by a particular ecosystem. Competing theories predict that as productivity increases, niche size will either increase as species become more generalist consumers, or decrease due to niche segregation. We test these theories using a novel approach to determine trophic niche size in two generalist fish species along a variable productivity regime in a seagrass ecosystem. Using stable isotope analysis, we construct *n*-dimensional niche hypervolumes of these species, based on the amounts of contribution from each primary production channel present in this ecosystem. Niche volume of both species was exponentially related to seagrass productivity, indicating greater diversity in resource use with decreasing productivity. This pattern provides insight into the relationship between ecosystem production and niche dynamics, and an ecological explanation for the resource maximization behaviors commonly observed in nature.

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Sex on a patch of hot sand: phylogenetic background, biogeography, biomechanical function and thermal-hydric stress

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Thanks to the comprehensive high standards set by the great Jocelyn Crane, many researchers have sought to understand the ecology and evolution of about 100 species of semi-terrestrial fiddler crabs, spread throughout the world tropics. Fixed throughout the genus is a strong sexual dimorphism, which imposes strong selection on males with extraordinary displaying-combat chelae. Molecular evidence suggests that the group arose in the New World, spreading to three major tropical-subtropical realms. Latitudinal diversity gradients are found in all three biogeographic realms, united by a strong relation to summer air temperature. Strong biogeographic interspecies overlap is the norm, likely explained by adaptations for strong along-coast dispersal. The large male cheliped used in display and combat functions as expected from a simple biomechanical model. Mechanical advantage decreases with increasing body size, which is unexpected in a system where combat matters. The mass of the claw does not influence escape speed, but does affect endurance. To successfully attract females, males must display on a patch that is poor in food and thermally stressful. This strategy measurably weakens the males, to the point that they must continually retreat to burrows to hydrate, and eventually desert the burrow to retreat to the lower intertidal, perhaps leading to an enigmatic communal breeding system. Thermal adaptations include rapid color change and possible heat exchange between the major claw and the body. Experiments with 3d printed models help to understand the function of the crab's mere shape and heat transfer under thermal stress. Performance considerations allow us to design models of latitudinal differentiation and potential change in the face of climate change.

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DNA extraction of *Halophila stipulacea* plants for genetic variability around the Virgin Islands

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Invasive species, such as the seagrass *Halophila stipulacea*, pose a threat to the ecosystems that they invade by outcompeting native species for resources. The goal of this project is to determine the genetic variability of *H. stipulacea* and to use that information to help create an invasion history model. In order to achieve this goal, we used the 2bRAD method to identify single nucleotide polymorphisms (SNPs), and analyzed genetic structure and clonal diversity. Approximately 8 samples were analyzed from Magen's, John Brewers, and Lindbergh bay on St. Thomas. From this, we noted 3 different genotypes. Samples collected from John Brewers and a Magen's Bay sample were clones, while the Lindbergh and 2nd Magen's Bay samples differed from all other samples. We found the richness of diversity (R) to be 0.28571 over 4 loci. Since this species is known to reproduce clonally outside of its native habitat, this implies that multiple invasions have occurred throughout the Virgin Islands. Currently, we are assessing genetic diversity of 56 additional samples from different bays around St. Thomas, Water Island and St. John, and in the future, we will determine whether environmental factors such as depth are associated with particular clones in Brewers Bay.

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Habitat complexity and species assemblage shape predator-prey interactions in a model estuarine ecosystem

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Prey in estuaries are often threatened by multiple predators, and must respond to a variety of different predator densities and identities. Predation risk of shared prey can then be affected through behavioral interactions between predators. Estuarine organisms also encounter spatial heterogeneity in the habitats available for refuge and foraging, which may alter predation pressures. We conducted a mesocosm experiment to explore habitat-specific predator-prey interactions using two mesopredatory fishes, Red Drum and Spotted Seatrout, and two prey types, Gulf Killifish and Penaeid Shrimp (White and Brown). Predator treatments followed both an additive and substitutive design (one or two individuals, intra- and inter-specific), and were conducted in three levels of habitat complexity (no structure, patchy submerged aquatic vegetation (SAV), and SAV with high-relief artificial structures). A significant interaction emerged between predator and habitat treatments for both prey species, indicating that the effect of the predator combinations on prey survivorship varied among habitats. Survivorship patterns differed between prey species, and in some cases suggested non-additive predation impacts and non-substitutable pressures enacted by each predator species. These results collectively indicate that estuarine predator-prey interactions are context specific, likely resulting in spatially and temporally variable prey regulation.

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Context dependency in a cosmopolitan defensive symbiosis

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Defensive symbiosis, in which a host is protected from predation by a microbial associate, can play a role in structuring benthic communities. Differing biotic and abiotic conditions may influence the benefit of the association, resulting in the presence of both defended and undefended individuals in the same location which can, in turn, affect community structure. The marine bryozoan *Bugula neritina,* found in temperate environments all over the world, hosts a bacterial symbiont that produces defensive natural products, bryostatins. Interestingly, the symbiont is not found in all host colonies. We determined host type and symbiotic status of *B. neritina* colonies along the East coast of the US along with temperature and salinity, and surveyed the presence of benthic invertebrates, potential predators on *B. neritina* larvae. Although temperature and salinity were not significantly correlated with the distribution of symbiotic and symbiont-reduced hosts, latitude was a significant factor. Proportions of anemones and tunicates significantly correlate with symbiotic and symbiont-reduced colonies. These data indicate that both biotic and abiotic factors may influence the distribution of symbiotic and symbiont-reduced hosts, thus increasing the complexity of benthic communities.

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Predation increases functional diversity in the tropics revealing latitudinal variation in community assembly

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Increasing evidence suggests that species interactions serve as biotic filters at low latitudes, contributing to community assembly and the maintenance of contemporary patterns of diversity. Functional diversity measures the distribution of species in trait space such as the level of clustering, or functional divergence, and can help differentiate community assembly processes. Theory predicts that traits will over-disperse and fill more functional space when biotic filters such as predation limit the similarity of traits among species. Therefore, we tested the hypothesis that predation would result in greater functional divergence in the tropics, while predation would have no effect on functional divergence at higher latitudes. To test this hypothesis, we used predator exclusion experiments on sessile marine invertebrate communities in four regions across 47-degrees of latitude. We found that predation increased functional divergence in comparison to communities that assembled in predator exclusions in the tropics, with no difference in functional divergence among treatments observed at higher latitudes. Our results support the prediction that tropical communities assemble under strong biotic filters, shaping patterns of biodiversity.
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Do blue crabs alter eastern oyster feeding?

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Eastern oysters *Crassostrea virginica* are known to change their morphology in the presence of blue crabs *Callinectes sapidus* making them less susceptible to predation. However, it is not known if induced defenses are maintained through adulthood, or if these changes affect feeding in the presence of the predator. To test this, oyster spat (2 weeks post settlement) were raised in the lab either with or without predator cues until they reached a size of approximately 2 inches in length. Feeding behavior in the presence and absence of a predator was then tested using an in-situ feeding study. Oysters were crushed using a hand-held force transducer to assess induced defenses. Experimental day was a significant blocking factor indicating that water composition effects the feeding process and this can vary daily. Predator presence effected filtration, clearance and organic ingestion rates. Oysters reared in the presence of the blue crab were not less effected by the predator. Shells were stronger in animals that were not raised in the presence of the predatory blue crab. Understanding how induced defenses alter oyster growth and behavior has implications for restoration, aquaculture, and fisheries management.
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Effects of ocean acidification on exoskeleton mechanical properties of the snow crab, *Chionoecetes opilio*

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Ocean acidification (OA) is a decrease in seawater pH resulting from increased atmospheric CO_2. OA affects the ability of many calcifying marine organisms to build and maintain mineralized tissue. We investigated the effects of CO_2-acidified water on mechanical properties of the exoskeleton of adult snow crabs, *Chionoecetes opilio*. Cross-sectioned and polished samples from the carapace, both claws, and walking legs were taken from crabs that had been exposed to one of three pH levels (8.00 [ambient], 7.80, or 7.50) for one to two years. Samples were embedded, polished, and tested for microhardness. The effect of pH on exoskeleton hardness varied by body region. In both the carapace and the left claw, pH did not significantly affect hardness of the exo or endocuticle. Endocuticle hardness of the right claw, however, was reduced by 39 and 27% in crabs held at pH 7.8 and 7.5, respectively, as compared to those held at ambient pH. pH did not affect hardness of exocuticle in the right claw. Mechanical testing of the walking legs and assessment of elemental composition of all body regions is ongoing. These results highlight the body-region specific responses in exoskeleton properties to OA that occur in several crab species.

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Fish and invertebrate community assemblages associated with a remnant, unharvested, North American oyster reef in Sabine Lake, Texas

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Oyster reefs that have been allowed to persist and grow without harvest are exceedingly rare along the North American continent. Such a reef exists on the Texas-Louisiana border, spanning the entrance across southern Sabine Lake. Recently, the state of Louisiana has inquired into the feasibility of commercially harvesting oysters (*Crassostrea virginica* – Eastern oyster) from the Louisiana side of Sabine Lake. Because there is a need for quantitative assessments of biological communities associated with virgin reefs this study utilized trawl sampling within stratified areas of the Sabine Lake Estuary to examine community assemblages in relation to reef proximity, and to provide baseline data for proactive management strategies in the event that harvest does occur. Data collected over four seasons suggest that this intact, unharvested oyster reef is a valuable component of a highly productive ecosystem with significantly higher overall diversity, and numerical dominance for all major animal groups at stations sampled near-reef versus non-reef. These data show the ecological value of this rare "un-fished" oyster reef in terms of its importance in promoting a more diverse and abundant fish and invertebrate community and as essential fish habitat.

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Feeding preference and foraging impact of wintering waterfowl on submerged aquatic vegetation in upper Mobile Bay

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While it has been well established that waterfowl consume substantial amounts of submerged aquatic vegetation (SAV) on their wintering grounds, relatively little is known about their effects on SAV in the northern Gulf of Mexico (nGOM). We measured the impact of wintering American coot (*Fulica Americana*) foraging on native wild celery (*Vallisneria Americana*) and exotic Eurasian water milfoil (*Myriophyllum spicatum*) using caging experiments at two locations in upper Mobile Bay during winter 2013-2014. We also determined feeding preferences using tethering experiments, and monitored the location of coots and the feeding behavior of individual birds. Coots were significantly more abundant over Eurasian watermilfoil than native wild celery. Caging experiments showed mostly higher biomasses in exclusion cages, and suggested a relatively larger impact of coots foraging on milfoil than wild celery. Video recordings confirmed that coots were responsible for the SAV losses detected with both caging and tethering experiments, and dietary analyses supported experimental results and highlighted the role of milfoil in the coot's diet (86.9 ± 8.9 %). Surprisingly, some tethering results showed a preference for wild celery over milfoil by the higher nutritional quality of wild celery (19.26 ± 1.21 C:N ratio) compared to the Eurasian milfoil (25.01 ± 2.45 C:N ratio). Overall, our results are similar to those of several seagrass herbivory studies in showing that herbivores do not always feed on their preferred food, presumably because other factors (e.g., proximity of refuges from predators or competition for food resources) are of overriding importance.

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A tidal index of biotic integrity for the Texas Coast

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Tidal streams are aquatic/marine systems where freshwater inflow from rivers meets a tidally influenced body of water. These brackish water systems provide important estuarine habitat for a number of faunal species. In Texas, the health of these streams is influenced by many anthropogenic practices, which in turn influence water quality and biological resources. The objective of this study is to assess the effects of watershed urbanization and agriculturalization on nekton and benthic infauna within tidal streams using a tidal index of biotic integrity (TIBI) developed by the Texas Commission on Environmental Quality. Water quality variables, benthic infauna, and nekton will be measured in spring and summer at both reference and anthropogenically-influenced locations throughout the upper Texas coast. The TIBI will be assessed for its ability to characterize the effects of urbanization and agriculturalization. Results will assist resource managers in assessing and mitigating the effects of human and natural change on tidal stream ecosystems.

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Invasive Eurasian milfoil (*Myriophyllum spicatum*) in northern Gulf of Mexico estuaries: reviewing a decade of research on invasion dynamics and food web effects

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Estuaries of the northern Gulf of Mexico contain an abundance of habitat-forming submerged aquatic vegetation that provide refuge and protection for a variety of freshwater, estuarine, and marine organisms. However, many of these estuaries now contain numerous exotic species, the ultimate impacts of which are unclear. In the Mobile-Tensaw Delta, located in the upper portion of Mobile Bay, AL, Eurasian milfoil (*Myriophyllum spicatum*) is now the most dominant submerged macrophyte. Milfoil is a structurally-complex macrophyte with the potential to dramatically alter estuarine food webs through reduced encounter rates between predators and their prey and other mechanisms. Here, we summarize a decade of research on the effects of milfoil in this estuary. We provide evidence that milfoil gained a foothold in the protected waters to the north of a manmade, earthen causeway that significantly reduces physical wave action. In surveys of faunal communities using throw traps, trawls, and suction sampling we compare milfoil assemblages with other native macrophytes and explore the interactive role of hydrology, diel periodicity, and macrophyte presence in influencing community structure. Finally, we provide preliminary food web analyses to determine if milfoil, due to its high complexity, creates a "trophic dead end" and limits higher trophic level production.

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Diel shifts in fish and invertebrate community structure within Big Bend seagrass habitats

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Seagrasses are productive habitats that support diverse communities of economically and ecologically important fish and macroinvertebrate species. However, the overwhelming majority of assessments documenting faunal communities within seagrasses have been conducted during daylight hours. We documented diel variability in fish and macroinvertebrate communities in seagrass beds near Seahorse Key, Florida. Additionally, because light pollution affects many coastal areas and may influence community structure, we also manipulated nocturnal light levels to determine its impact on community composition. Using seines pulled along 25-m transects during different diel periods (day/night) and in adjacent areas with added light to mimic light pollution (artificial light or no light), we captured and quantified seagrass inhabitants. Results suggest that, while there was no significant difference between total abundance and species richness, community assemblages did change between night and day, with *Lagodon rhomboides* (pinfish) dominating day samples and *Farfantepenaeus duorarum* (pink shrimp) most abundant in night samples. There were no significant differences with the addition of light. This research highlights the role of diel variability in seagrass communities and suggests that diel movement of organisms may represent an important conduit for the transfer of energy among adjacent habitats.

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The effects of a restored oyster reef (*Crassostrea virginica*) on estuarine nekton and infauna

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Eastern oysters (*Crassostrea virginica*) perform numerous important ecological functions, including provision of complex three-dimensional habitat for nekton, enhancement of water quality, and protection of shorelines. Anthropogenic activities have contributed to rapid degradation of oyster reefs however, restoration has shown success in ameliorating effects of habitat loss. In summer of 2017, approximately 600 meters of oyster reef were restored using recycled oyster shells in St. Charles Bay, TX. Ecological monitoring is being conducted to quantify the effects of restoration on water quality, oyster recruitment and health, and faunal community metrics for nekton and infauna. Benthic cores and sampling trays are being used to evaluate species abundance, biomass, and diversity compared to reference areas**.** Mantle tissue is being extracted from sub-market and market-sized oysters to assess the presence and prevalence of Dermo disease (*Perkinsus marinus*). We hypothesize that the restored oyster reef will support higher densities of nekton and infauna as compared to unstructured habitat, and that the density and size of oysters on the restored reef will become more similar to reference reefs over time. Results will help us better understand the ecological influence of restored oyster reefs on reef-associated nekton and soft-sediment benthic communities.

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A proposed study to document bioaccumulation in sea urchins in the Gulf of Mexico

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Sea urchin gonads are a popular food item in many parts of the world. In the last decade, they have gained popularity in the United States where they are readily available. The sea urchin fishery in the Gulf of Mexico is predominantly recreational. Environmental contaminants have been shown to accumulate in sea urchin gonads; consequently, their consumption poses a risk to consumers. Sea urchins are major consumers of seagrass, macroalgae, and detritus on nearshore benthic surfaces, which accumulate contaminants from various natural and anthropogenic sources, such as mining, oil exploration, extraction, and spills, agriculture, and waste water. This study will investigate the connection between trace metal pollution and bioaccumulation in nearshore populations of sea urchins in the Gulf of Mexico. Sea urchins, their food resources, and sediment, will be collected from multiple sites in Florida and Texas. They will be analyzed for cadmium, copper, zinc, nickel, lead, mercury, and polycyclic aromatic hydrocarbons (PAHs). Cadmium, copper, zinc, nickel, and lead will be analyzed by inductively coupled plasma mass spectrometry. PAHs will be analyzed by gas chromatography-mass spectrometry. Methyl mercury will be analyzed by gas chromatography–atomic fluorescence spectrometry.

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Deep sea with no limits? Four new closely related species of *Emertonia* (Copepoda, Harpacticoida) from the deep sea show characters with a world-wide distribution

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The large-scale dispersal of deep-sea harpacticoid copepods is an increasing focus for ecological studies. A fundamental prerequisite for monitoring and explaining their geographical distribution is precise descriptions of their morphology. Four new, closely related species of the family Paramesochridae (Copepoda, Harpacticoida) were found in the deep sea of the Pacific (San Diego Trough, off Chile), the Atlantic Ocean (Porcupine Abyssal Plain, Angola Basin), and the Atlantic and Indian Ocean sectors of the Southern Ocean (Weddell Sea, off Crozet Island). *Emertonia serrata* sp. n., *Emertonia ilse* sp. n., *Emertonia hessleri* sp. n, and *Emertonia berndi* sp. n. can be distinguished from their congeners by the strongly serrated spines on the exopods of their swimming legs and an outward oriented, flexible seta on the exopod of the fifth leg. Thus, leading to the assumption that these two specific characters evolved only once in the genus *Emertonia*. The apparently cosmopolitan distribution of the new characters covers thousands of kilometers and spans all major oceans. The biogeography of the new species may be explained, e.g., by resuspension events followed by passive transport in benthic currents. Discrepancies in dispersal ranges may be a result of changing geological and oceanographic boundaries.

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Reverse development in *Turritopsis dohrnii* (Immortal Jellyfish): Model system for regeneration, cellular plasticity and aging

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Turritopsis dohrnii (Cnidaria, Hydrozoa) undergoes lifecycle reversal to avoid death caused by physical damage, adverse environmental conditions, or aging. *T. dohrnii* exhibits an additional developmental stage to the typical hydrozoan lifecycle that provides a unique paradigm to further understand regeneration, cellular plasticity, and aging. Weakened jellyfish will undergo reverse development into an uncharacterized cyst-like stage, which then metamorphoses back into an earlier lifecycle stage, the polyp. The underlying cellular process that permit its reverse development is called transdifferentiation, a mechanism in which specialized somatic cells can switch into a new cell type of any lineage. The polyp, jellyfish and cyst stage of *T. dohrnii* were sequenced through RNA-sequencing. Transcriptomes were assembled *de novo* and then annotated to create a gene expression profile of each stage. Comparative functional gene enrichment analyses with the cyst as the central stage of comparison reported significant biological pathways that were over-expressed in the cyst as compared to the other stages, such as telomere maintenance and DNA repair, while categories such as mitotic cell division and cellular differentiation were found to be under-expressed. Ultimately, our work produced a foundation to develop an alternative model system to further investigate and understand reverse development and transdifferentiation in metazoans.

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Historical data reveal changing social effects of rapid temperature changes on marine fisheries over the last half century

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While recent climate-driven warming has impacted marine fisheries, similar basin-wide changes have also occurred through time due to natural temperature fluctuations. Here, we document the ways that fishing communities characterized the effects of rapidly changing water temperatures on fisheries along the US east coast during warming (1945-1951) and cooling (1952-1960) phases of the Atlantic Multidecadal Oscillation, which we compare to observations during a recent period of record warming (2000-2017). Historical warming and cooling were described as affecting the abundance of target species, the prevalence of novel and invasive species, and access to fisheries. Cooling waters were viewed more negatively than warming waters, as they were associated with a loss of access, while warming waters were associated with the potential for new fisheries. In contrast, recent warming was viewed as strongly negative, linked to disease, shifts in distribution, and reductions in abundance of target species. This difference in perception of the effects warming waters may be linked to an overall loss of fisheries opportunity over the past 50 years, which is reflected in the diversity of species described over time. Therefore, the combined effect of long-term overfishing and recent warming waters has contributed to a loss of resilience in marine fisheries.

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Another way to close the "loop": emergent sponges do not return detritus to Caribbean reefs

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The sponge-loop hypothesis proposes that sponges convert the dissolved organic matter released by benthic primary producers into particulate detritus available to higher trophic levels. The hypothesis was developed and subsequently supported from studies of cryptic, encrusting sponges; however, it has yet to be considered for massive, emergent sponge species that dominate the surface of Caribbean reefs. We tested the generality of the sponge-loop for emergent sponge fauna by using direct In-Ex methods combined with acoustic Doppler velocimetry and sponge volume calculations to quantify carbon flux for 9 species representing a variety of functional types. The diet of 5 species hosting abundant symbiotic microbes (HMA) primarily consisted of dissolved organic carbon (DOC), while 4 species with low microbial abundances (LMA) primarily consumed detritus and picoplankton. None of the sponge species studied were found to produce significant quantities of detritus. We conclude that, instead of releasing assimilated carbon in the form of detritus, as originally proposed by the sponge-loop for encrusting, cryptic sponges, emergent sponge species likely retain assimilated carbon as biomass. Given the high rates of DOC uptake observed for HMA species, we propose an additional pathway by which the sponge-loop fuels higher trophic levels via predation by spongivores.

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Trophic niche width expansion of coral reef fishes along a primary productivity gradient in the remote central Pacific

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The trophic niche of species can vary spatially due to numerous natural and anthropogenic factors, yet separating these distinct drivers can be difficult due to historical exploitation. We examined the role of natural oceanographic variation on the trophic ecology and dietary niche breadth of eight common coral reef species spanning multiple trophic guilds. These fishes were collected from the Southern Line Islands, a chain of five remote, uninhabited islands spanning a strong primary productivity gradient in the central Pacific. A combination of stomach content and stable isotope analyses were used to elucidate the spatial variability of diet composition, trophic niche width, and degree of individual dietary specialization. Across species, populations tended to be characterized by larger dietary niche widths and increased degree of individual specialization at the more productive islands or follow no consistent pattern of change. At the island level, the trophic niche of the fish community expanded in isotopic space as a function of increasing productivity, reflecting increased multispecies dietary diversity at the most productive islands. Taken together, these results highlight the importance of considering natural oceanographic variability when evaluating the trophic structure of coral reef ecosystems.

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Scientific writing and publishing boot camp

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One of the most difficult things students (and young professors) face is getting it all down on paper and eventually into print. However, this gets much easier over time if you gain experience. So, why not take a short cut and learn from a seasoned pro, who has already made all the mistakes and climbed that steep learning curve. The topics covered will include: 1) getting organized and basic writing principles, 2) tips for preparing figures and tables, 3) advanced tricks for using Microsoft Word, 4) turning a thesis or dissertation into a publishable article, and 5) navigating the science journal landscape and submission process.

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What have we learned from studies of offshore platforms, oil seeps, and oils spills?

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Since the 1970's more than 3 billion dollars has been spent on studies of sediments around oil and gas production platforms, oil seeps, and oil spills. So, what have we learned? In the Gulf of Mexico, nearly all of the sediment contaminants were mobilized during initial drilling activities and they are limited to about 100 m from platforms. No biological effects were found for megafauna or fish. The most sensitive bioindicators were benthic invertebrates. It was found that macrofauna and meiofauna communities changed within 100 m to include increased deposit feeders (worms) relative to surface feeders (crustaceans), a decrease in crustacean populations, and increased abundances, but decreased community and genetic diversity. Platforms however, resemble artificial reefs with fouling organisms and pelagic fish that feed on them. Thus, the platform toxicity effect was confounded by the reef effect. An experiment comparing platforms, artificial reefs, removal sites, and reference sites was performed to test the disturbance versus reef effects. Reduced meiobenthic abundances, altered community structure, and reduced genetic diversity were primarily a function of reef effects, not contaminant effects. Thus, the "habitat effect" is likely a result of complex ecological interactions near platforms. Oil seeps are nothing like oil spills because of the rates and spatial scales effected. There are some species, e.g., Dorvilleidae polychaetes, that are indicators of oil effects. Comparing the effects of the Ixtoc oil spill (1979) with the Deepwater Horizon oil spill (2010) demonstrates that it will likely take 50 – 100 years for the deep sea to recover.

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Growth and survival of *C. virginica* in the Baltimore Inner Harbor

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At one point in Chesapeake Bay history, the Eastern Oyster, *Crassostrea virginica,* was once so plentiful that their reefs defined major river channels and extended near the surface of the water. It was estimated that oysters, at one time, were able to filter all of the water in the Bay in about a week's time, and it now takes the current population almost a year to filter the same amount of water. After decades of damage to the reefs due to oyster harvesting, increased disease, and significant drops in dissolved oxygen levels left the oyster population in the Chesapeake Bay at less than two percent of the historic population. Oyster cages were placed at three different sites and three different depths, in the Baltimore Inner Harbor, adjacent to the National Aquarium. At each site and depth, community species numbers for cages with and without oysters were surveyed. Measurements of dissolved oxygen, temperature, salinity, and conductivity were taken twice a week. The cages at the surface had higher levels of dissolved oxygen and exhibited higher survival rates than those at deeper depths. This experiment will serve as a basis for future projects involving oysters and water quality in urban areas.

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Green invaders: life stages of the European green crab (*Carcinus maenas*) in Southern Maine

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The European green crab (*Carcinus maenas*) is an invasive shore crab established in Maine's coastal estuaries. The proliferation of the green crab is tied to significant declines in Maine's commercial soft-shelled clam fishery – a 15-million-dollar industry. Despite its overwhelming impact on estuaries, little is known about the species' autecology outside of its native range. To better understand the life history of the green crab in southern Maine, a 3-pronged approach was used to target specific aspects of green crab reproduction: size-of-maturity, timing of reproductive events, and survivorship of zoea under low pH conditions. Carapace widths of gravid females from local populations were measured and compiled (average: 52.54 mm). Zoea from an archival timeseries were identified to determine the timing of *Carcinus* hatchings; four spawning events were noted. Zoea were hatched to test acute effects of low pH on mortality and phototaxis; low pH conditions yielded higher survivorship and phototaxic rates than control pH conditions. Overall, preliminary results indicate that local green crabs have an early size of maturity, punctuated spawning events, and larvae that are resilient to low pH. Therefore, green crabs are a continued threat to local and global coastal communities, especially as coastal waters warm and acidify.

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Arctic crustose coralline algae and the effects of salinity on physiology, distribution, and their ecological function

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Crustose coralline algae (CCA) are ecologically important worldwide, however, few studies have focused on the significance of CCAs in the Arctic. On the Alaska Beaufort Sea coast, CCAs are common in Stefansson Sound, an area of glacially deposited boulders and cobbles that support a rich benthic community, including the Arctic endemic kelp Laminaria solidungula. This work explored how patterns of CCA cover decrease with proximity to the Sagavanirktok River mouth in Stefansson Sound. Mesocosm experiments focused on the effects of salinity on the photosynthetic efficiency, pigment composition, and dissolution of CCA. Results indicated that low salinities alone affected CCA physiology, and novel, continuous pH data from the Boulder Patch suggests that salinity is likely the factor driving CCA distribution in Stefansson Sound, not pH. To better quantify the relationship between CCAs and other species, cobbles were collected from two sites (with and without CCA present) and analyzed for algal and invertebrate biomass. Photo quadrats were used to determine kelp densities. When CCA was present, red algal biomass was reduced and kelp densities were three times greater than areas without CCA. Future studies will continue to explore seawater chemistry changes the effects of these changes on CCA presence within Stefansson Sound.

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Tropical reef fish herbivory controls acute outbreaks of a marine fungal pathogen

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Diseases of coral reef organisms are a global threat to reefs and a major cause of ecosystem deterioration. Pathogenic fungal infections in tropical marine environments are little studied compared to other disease vectors. Fungal infection of crustose coralline algae (CCA) can manifest in acute surficial infection and subsequent CCA mortality, a condition called Coralline Fungal Disease (CFD). No CFD control agents other than natural senescence have been identified. We investigate CFD within the perspective of community interactions, specifically with herbivorous fish. We demonstrate preferential grazing on fungal tissue by two families of herbivorous fishes (*Scaridae* and *Acanthuridae*), and show increased fungal lesion growth when lesions are released from grazing pressure. Mychophagy by herbivorous fish may thus be acting to suppress CFD, a previously undescribed mechanism. The widespread depletion of herbivore populations in many coral systems from overfishing may increase the risk of CFD outbreaks, and the control of fungal infection could thus be an additional factor motivating herbivore protection and conservation, supporting the establishment of area closures, directing management policies such as size, species limits or gear limits on harvest, or encouraging active restoration of these species.
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Trophodynamics of fish-parasitic gnathiid isopods on Caribbean coral reefs

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The contribution of parasites to consumptive pathways remains unquantified for most communities and ecosystems. Gnathiid isopods are the most common ectoparasites of marine reef fishes, infecting multiple host species. They are a known food item of cleaner fishes but are also potential prey for non-cleaner fish species. The first aim of this study was to compare nutrient/energy flow from consumption of damselfish biomass by predators with that consumed by gnathiid isopods. The second aim was to further assess what fish species consume gnathiids. To address the first aim, damselfish were tagged and monitored in their territories over a 1-2 month period to estimate predation rates, and daily gnathiid infestation rates were determined. For the second aim, we sampled the gut contents of 436 fish from fifteen families. While parasite infestation varied among sites (ranging from 17.64 parasites/24h to 108.2 parasites/24h), the estimated biomass transfer exceeded that of predation (88% survival, n=131) by a factor of 6. We also found that while diurnal consumption rates of gnathiids is quite low for non-cleaners, certain species are sufficiently abundant to constitute a significant consumptive pathway. We view these results as further evidence that fish-parasitic gnathiid isopods contribute significantly to coral reef trophic dynamics.
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Is There a Relationship Between Sponge and Algal Cover in the Mesophotic Zone of Caribbean Reefs?

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Sponges are important for carbon and nutrient cycling on Caribbean reefs. It has been proposed that there is a repeatable pattern of increasing sponge biomass to 150 m depth on Caribbean reefs, while alternative patterns have also been documented. To test this "sponge increase" hypothesis, photographs from remote operated underwater vehicle (ROV) transects in Puerto Rico, the Gulf of Mexico, and St. Thomas (USVI) were examined to determine patterns with depth. Photo-quadrat analysis revealed that the cover of macroalgae (encrusting and upright taxa) had a similar trend with sponge biomass and cover at increasing depths. Both benthic taxa declined consistently from approximately 20% at 110 m to zero at 170 m and deeper in some locations. To further investigate this relationship, the correlation between cover of macroalgae and biomass of sponges were examined at increasing sampling scales. Biomass of sponges and cover of macroalgae were not related at the quadrat scale but were positively correlated at greater sampling scales. Interestingly, these data support another hypothesis, the vicious circle. This hypothesis proposes a positive feedback loop between sponges and macroalgae, with sponges providing nutrients to macroalgae, and macroalgae providing dissolved organic carbon (DOC) to sponges.
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Insect herbivores in salt marshes drive geographic variation in the strength of plant-plant competition

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The strength of species interactions often varies geographically with environmental conditions. Consumers may also affect interactions, but geographic variation in their impact is poorly understood. In salt marshes, competition is often stronger in more benign environments, but herbivores may also affect interactions as they can have dramatic effects on communities, even causing die-offs of plants. We tested how abiotic and biotic conditions relate to geographic variation in plant-plant interactions using neighbor-removal experiments in six marshes along the California coast. We found that interaction strength varied among sites but was unrelated to latitude, soil salinity, soil moisture, temperature or precipitation. We then surveyed invertebrate herbivores across these sites, focusing on two common plant species, *Jaumea carnosa* and *Salicornia pacifica*, to determine whether herbivore load related to interaction strength. *S. pacifica* competed most strongly with *J. carnosa* in sites where *J. carnosa* had greater herbivore loads, suggesting that herbivory intensifies the effects of competition. Herbivore load varied among sites but, like plant interactions, was also unassociated with environmental variables. Our findings indicate that invertebrate herbivores can decrease the competitive ability of host plants and that biotic factors may be an important driver of geographic variation in species interaction strength.
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Investigating population transitions from the threatened parental species, *Acropora cervicornis,* to its hybrid in the U.S. Virgin Islands

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Over the past three decades, there has been a marked decline in the reef-building Caribbean corals, *Acropora cervicornis* and *A. palmata,* which has prompted their listing as "threatened" on the U.S. Endangered Species List. Recently, anecdotal evidence in the U.S. Virgin Islands suggest that the hybrid of these threatened species, *A. prolifera,* is now colonizing areas that were once dominated by *A. cervicornis.* No other coral hybridizing system is currently known to exist in the Caribbean, therefore the impacts of this hybridization are unknown. Hybridization could increase biodiversity through the formation of new species or lead to extinction of the parental species via introgressive backcrossing and competition. Tissue samples of each taxa were collected at three sites to compare genotypic richness. We found that the proportion of unique genotypes per sample size for *A. cervicornis*, *A. prolifera* and *A. palmata* was 0.62, 0.68, and 0.64, respectively. This confirms that the hybrid colonization is from multiple sexually derived individuals, not asexual propagation from a rare hybridization event. Additionally, 12 years of photograph transects will be analyzed to compare site-specific population fluctuations. The preliminary results of this study suggest that acroporid hybrids may become the primary habitat building coral of shallow reefs in the U.S. Virgin Islands, filling an important ecological role left void by the loss of the parental species.

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Fish and the decline of kelp in the Gulf of Maine

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In temperate rocky subtidal ecosystems biogenic structure is provided by macroalgae. As in many similar ecosystems globally, kelp abundance in the southern Gulf of Maine has declined in recent decades. In its place a variety of introduced turf-like algae have become dominant. To investigate the effects of this change in the algal community on higher-trophic interactions, we conducted behavioral observations and experimental trials using the residential fish species, *Tautogolabrus adspersus* (cunner). Cunner is a mid-trophic level predatory wrasse which relies on macroalgae for both refuge and foraging grounds. We found that cunner spent more time hiding than feeding, and that they preferentially hid under algae with flat-bladed morphologies. However, algal morphology did not have any significant effect on cunner's ability to consume prey items (isopods) in experimental trials. Our results indicate that replacement of native kelps by introduced turf algae may leave this mid-level predator more vulnerable to predation by larger animals, with uncertain implications for the greater ecosystem. The changes in algal community composition, and the associated alterations in habitat structure, will likely have cascading effects on many other organisms in the Gulf of Maine.

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Development of a molecular assay for Caribbean coral identification

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As coral cover has declined throughout the Caribbean, interest in determining the potential for reefs to recover via natural recruitment processes has increased. Studies of coral recruitment have been hampered by difficulties inherent in identifying early-stage corals because young recruits often lack distinctive morphological characters. In this study, we developed and assessed the utility of a multiplex PCR assay to identify Caribbean coral species using genetic variation of the internal transcribed spacer (ITS) region. To design this assay, a database of ITS sequences was developed for 17 coral species using adult samples of known identity. A set of three genus-specific primers and six species-specific primers were subsequently designed for use in a single-step nested multiplex PCR protocol aimed at facilitating coral identification. This molecular assay was then used to identify coral recruits previously keyed out using only morphological characters. Results demonstrated that recruit identifications to the genus or species level based on morphology were incorrect in 84% of cases. This genetic assay shows promise as an effective method of identifying early-stage corals to the genus or species level, and may become a valuable tool in studies investigating reef recovery.

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An evaluation of local multispecies competition among corals, sponges, and macroalgae on reefs in the U.S. Virgin Islands

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Benthic communities on Caribbean reefs are structured in part by competition among corals, sponges, and macroalgae, yet little is known about multispecies competition among these groups. In this study, local multispecies competition was investigated on fringing reefs in the U.S. Virgin Islands. Sponges (*Desmapsamma anchorata* or *Aplysina cauliformis*) and macroalgae (*Lobophora variegata*) were oriented on 40 colonies of the coral *Porites astreoides* to create treatment quadrants simulating multispecies or pairwise competition. Photogrammetry was used to generate 3D models and measure the percentage change in surface area of corals and sponges in each treatment, and photographs were analyzed to measure linear sponge-coral, macroalgae-coral, and macroalgae-sponge overgrowth. It was hypothesized that sponge-macroalgae interactions would inhibit the ability of each group to overgrow corals – thereby promoting coral coexistence – during local multispecies competition. Contrary to this hypothesis, corals lost more surface area and *D. anchorata* overgrew *P. astreoides* more rapidly in multispecies treatments. Contact with *L. variegata* appeared to confer a competitive advantage to *D. anchorata,* and such local interactions may result in greater loss of coral cover. Better understanding of these competitive dynamics may help clarify the factors impairing coral resilience and more effective means to mitigate loss of corals on Caribbean reefs.

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Seasonal and spatial variation in fishing mortality of the Louisiana blue crab spawning stock

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Blue crabs, *Callinectes sapidus,* support one of our nation's most valuable fisheries and Louisiana has led the national landings for 8 of the last 10 years. Fishery-independent estimates of abundance have declined in recent years and in 2015, the spawning stock biomass reached the lowest point ever recorded in Louisiana. Management efforts are hindered by incomplete knowledge of female migration patterns and fishing mortality during the spawning migration. In March 2016, we began a mark-recapture study to examine these trends in the Terrebonne, Pontchartrain, and Barataria basins, Louisiana. 6000 female blue crabs were tagged in collaboration with local commercial fishermen. Recapture data were obtained from commercial and recreational crabbers and shrimpers, state agencies, and the public. Recapture rates were used to assess spatial and temporal patterns of fishing mortality. Generally, fishing mortality is highest in the upper estuaries, reflecting the proximity of these areas to fishing communities and the greater distance crabs in these areas must travel through heavy fishing pressure before reaching lower-estuary spawning areas and lower fishing pressure. Fishing mortality is highest during winter months, and lowest during summer. This information, combined with movement data, will be directly applicable to Louisiana blue crab management plans and stock assessments.

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A shell of its former self: Investigating drivers of the Texas blue crab fishery decline

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Despite significant reduction in commercial fishing effort for Texas blue crabs, fishery-independent monitoring of blue crabs in Texas coastal waters has tracked declining populations over the past two decades. Here, we examine population vital rates, environmental drivers, and migratory behavior to ascertain causation of the observed population declines and to assess possible management measures to reverse these observed trends. Concurrent with observed population declines has been a slight reduction in the size at maturation of female blue crabs and a reduction in the proportion of female blues crabs in many Texas bays. Additionally, a spatio-temporal analysis of gravid female blue crabs in Texas bays suggests that annual offshore migration of this demographic, driven by salinity and temperature, has shifted from summer (June-July) to early spring (March-April) presumably in response to seasonal shifts in hydrographic conditions. Trophic impacts to blue crabs are also being examined as potential drivers of population dynamics. In response to these findings, Texas Parks and Wildlife Department is reviewing a number of possible management measures for mitigating the observed population and demographic trends. These include further effort reduction, increases in minimum size, increases in crab trap escape ring size, and/or spatio-temporal moratoriums on female harvest.

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Logistical considerations for the use of unmanned aerial vehicles in coastal habitat monitoring: a case study in high-resolution subaquatic vegetation assessment

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In recent years, the technology and regulation surrounding unmanned aerial vehicles (UAVs) has rapidly advanced. This has resulted in the availability of such technology for more common applications. Here we compare manned versus UAV platforms for acquiring high resolution imagery of subaquatic habitat for the purposes of boat propeller scar delineation. We acquired aerial seagrass imagery in three 50-acre plots with a priori designations of low, moderate, and high seagrass scarring intensity. We observed that a smaller amount of scarring was detected in the manned aircraft imagery compared to that collected by the two UAV platforms and that this disparity was much greater for the high scarring intensity plot. The observed differences in scar feature delineations were at least partially related to logistical difference between these two platforms, specifically, the lower altitude flown by the UAVs. Further, the rapid deployment and local operation greatly simplify the logistics of planning imagery acquisition. However, we realize that the current trade-off with regards to altitude is the ability to cover large areas. As technology and regulations evolve, the comparison of imagery products produced from UAV and manned platforms will become increasingly important to managers and researchers looking to make this transition.

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Density and feeding dependence effects on life history of *Sphaerium simile*

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The small freshwater bivalve *Sphaerium simile*, like most "fingernail clams" within the Sphaeriidae, does not have a planktonic larval stage but instead has offspring brooded inside the parent. Hence, this species is generally regarded as reproductively specialized, or leaning towards "K" selected along the r-K continuum. Multiple offspring can develop simultaneously, but brooding siblings are commonly at different developmental stages. An experiment was conducted to evaluate the relative success of brood and adults in different adult densities and feeding regimes. A controlled laboratory experiment examined nine treatment groups, with density and feeding frequency as independent variables. There were three density treatments (0.3, 1 and 1.7 clams per cm) and three feeding treatments (continuous, once each week and twice each week). Results indicate higher numbers of offspring released per capita in treatment groups with higher densities, and more frequent feeding. There was also more mortality among parent subjects at higher densities, with less frequent feeding. These results provide insight into the life history and stress response of *Sphaerium simile*, a brooding bivalve that remains understudied.

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A phylogeographic analysis of black coral (Antipatharia) on artificial and natural reefs in the Northwestern Gulf of Mexico

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Genetic data were used as an indirect means of assessing genetic connectivity of several black coral (Order: *Antipatheria*) species off the coast of Texas. I sequences two DNA regions (16S and ITS) in five Antipatherian species (*Antipathes atlantica, A. furcata, Stichopathes leukeni, S. occendentalis, and Plumapathes pennacea*) collected from natural and artificial reefs. Based on haplotype distributions, I found evidence of genetic subdivision in some species. Antipatherians have a planktonic larval stage for dispersal and can be a proxy for genetic connectivity of other organisms that have a similar larval stage. Determining connectivity, or lack thereof, is crucial to enact effective management plans for marine protected area networks.

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Long-term changes in macrobenthic communities in contaminated sediments and epifauna bioaccumulation adjacent to McMurdo Station, Antarctica

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Marine sediment in the immediate vicinity of McMurdo Station contains some of the most contaminated sediment in Antarctica. Localized contaminated sediments contain high concentrations of PCBs, lead, DDT, petroleum hydrocarbons, organic carbon, and several trace metals. Cold temperatures and stable hydrology mean that the breakdown of these contaminants is slow. Our team have been monitoring the changes in contamination in the marine environment and effects of this contamination on the benthic communities over three depths (12, 24, 36 m) annually from 2000 to 2015. Historic contamination has caused substantial changes to the benthic macrofaunal community composition and these legacy effects remain, despite small recent changes in community composition. Several biotic indicators have been used to distinguish effects of natural and anthropogenic stressors. Some contaminants (e.g. PCBs, lead, PAHs) have been bioaccumulated in some larger epifaunal taxa found in contaminated areas, with PCBs being elevated above the US Food and Drug Administration advisory level for organisms consumed by humans. The occurrence of bioaccumulation in some epifauna gives suspicion of potential impacts further up the food chain, which is of particular concern given that some of these epifauna are mobile (e.g. the fish *Trematomus* sp.).

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Building a barnacle cement protein profile using immunohistochemistry

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Acorn barnacles are able to adhere to a range of surfaces using secreted cement. In the barnacle *Amphibalanus amphitrite*, secretion of proteinaceous cement occurs at the periphery of the basal plate through a complex process where biomineralization and cuticle formation occur. Previously, cured cement was partially solubilized and analyzed where 19, 43 and 114 kDa cement proteins were identified and polyclonal antibodies prepared against them. The purpose of this experiment was to determine where these cement proteins are localized within the barnacle. Transverse sections of barnacle tissue were prepared, beginning just above the cement-substrate interface and continuing to the operculum and exposed to antibodies. No cement proteins were found in exterior muscle bundles or penis. Positive staining against Aacp43 was found within testes and in longitudinal canals, which run through parietal plates of the shell. Staining against Aacp19 was found lining the interior side of mantle tissue, and in granular-like structures in longitudinal canals. Antibody for Aacp114 tended to aggregate, so the staining profile was inconclusive. Overall, we demonstrate positive staining against cement proteins in barnacle sections, indicating their presence in areas other than the region in contact with the underlying interface. Authors acknowledge support from NRL. S.P. acknowledges NREIP.

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Nutrient loads explains spatial checker boarding of oysters and seagrass along the US Gulf of Mexico coastline

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While areas of the eastern United States have experienced large declines in biogenic foundation habitat over the last century, the estuaries of the Gulf Coast have some of the best remaining oyster reef habitat in North America and extensive seagrass beds. Using gulf coast estuaries, federal databases and geospatial information about foundation habitats, infauna, estuary characteristics, climate, nutrient loads, and upstream watershed land use were summarized to build a structural equation model of factors driving biogenic habitat distributions ($P = 0.069$, Chi-Square = 30.666, df = 38). Oysters and seagrass covaried among estuaries due to differential responses to nitrogen loads and air temperature. Effects also cascaded to the density and richness of the infaunal assemblages. Nutrient loads predicted water column chl *a*. Oyster coverage was positively related with chl *a*, possibly because of its food value. In contrast, chl *a* reduced water clarity and was negatively related with seagrass coverage. Temperature effects may be a proxy for hyposaline conditions during summer. Oysters were lower in high salinity, while seagrass were not due to successional turnover from *Thallasia testudinum* to *Halodule wrightii* and *Syringodium filiforme.* These patterns demonstrate a macroscale interaction between nutrient loads, climate, and living resources.

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Acidification slows withdrawal reflex in sea hares (*Aplysia californica*), a potential sub-lethal effect of anthropogenic climate change

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Sea hares (*Aplysia californica*) are shell-less marine mollusks that display a pronounced withdrawal reflex, protecting their gills, siphon and head structures from threatening stimuli. Among its many effects, ocean acidification has the potential to hinder this reflex in sea hares, exposing vital organs to predators for longer periods. This could lead to detrimental consequences for their survival. Two different experiments were performed. First, the sea hares were exposed to three different acidities for 24 hours (pH 7.95, 7.82, and 7.63) and their reaction to a stimulus applied in their head region was recorded. Sea hares are able to survive slight changes in pH, but larger changes increased their reaction time ($r=-0.766$, $N=33$, randomization test $p<0.001$). Subsequently, the recovery of reflex function was tested by putting sea hares in a pH of 8.05, then lowering it to 7.8, and then increasing the pH to 8.1. Again, pH slowed the reflex, but after returning the sea hares to normal pH, they recovered their reflex speed completely. This indicates that although increased ocean acidification might not immediately prove lethal to *Aplysia*, the decrease in function, as exemplified by their lower anti-predator reflex, might lead to decreased survival and a diminished success as an herbivore.

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A review of octocoral distribution in the Northwestern Gulf of Mexico

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Coral reefs are an integral tier of marine ecosystems because they provide habitat as well as foraging opportunities for many reef-dwelling species. With increasing threats facing coral reef communities around the globe, research has been directed toward finding candidate coral reef habitats for marine protected areas (MPAs). Coral reef habitats being considered for MPA designation include mesophotic reefs, those found from 30 to 150 m. One lineage of Cnidaria commonly found on mesophotic reefs are those of subclass Octocorallia. These corals provide three-dimensional structure for reef-dwelling organisms. Furthermore, some octocorals are azooxanthellate, meaning they are not dependent on a symbiotic relationship with photosynthetic zooxanthellae. This characteristic allows several species of octocorals to persist in low-light, turbid, and deep waters of the Gulf of Mexico. Due to a limited understanding of coral reefs in the northwestern Gulf of Mexico, a concise review of previous studies is necessary. This presentation conveys the current state of knowledge regarding octocoral distribution in the northwestern Gulf of Mexico. The compiled data will act as a baseline for future research by cataloging octocoral distributions and providing additional coral metadata for use in ongoing genetic studies assessing the phylogeography of Octocorallia in the Gulf of Mexico.

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Turnabout: bottom-up vs. top-down factors shaping community structure of sponges on Caribbean fore-reefs

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Interest in the ecology of sponges on coral reefs has grown in recent years with mounting evidence that sponges are becoming dominant members of reef communities, particularly in the Caribbean. New estimates of water-column processing by sponge pumping activities combined with discoveries related to carbon and nutrient cycling have led to novel hypotheses about the role of sponges in reef ecosystem function. Among these developments, a debate has emerged about the relative effects of bottom-up (food availability) and top-down (predation) control on the community of sponges on Caribbean fore-reefs. Recent studies that employed different research methods have demonstrated that dissolved organic carbon (DOC) and detritus are the principal sources of food for a growing list of sponge species, challenging the idea that the relative availability of living picoplankton is the sole proxy for sponge growth or abundance. New reports have confirmed earlier findings that reef macroalgae release labile DOC available for sponge nutrition. Evidence for top-down control of sponge community structure by fish predation has been further supported by gut content studies and historical population estimates of hawksbill turtles, which likely had a much greater impact on relative sponge abundances on Caribbean reefs of the past. In summary, unlike most study systems that are controlled by some combination of bottom-up and top-down effects, sponge communities on Caribbean fore-reefs of the past and present are largely structured by predation.

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Seagrass OASiS: Ocean Acidification Sanctuaries and Subsidies

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Growing evidence indicates that seagrasses may modify local water chemistry enough to generate refugia from acidified waters. However, little quantitative field information is available to ascertain the magnitude of this buffering effect. The spatial variability of the water's chemical composition within seagrass patches is unknown, as is the extent to which seagrass-modified water extends beyond seagrass canopies. We assessed the variability in water chemistry across a seascape via continually pumping water from 0.1 m above the sediment into an instrument reservoir measuring p_TH, DO, temperature and pCO_2 as the sampling track was recorded in and out of the seagrass canopy using a Trimble DGPS. Discrete sampling collected every 10 m along the sampling path provided full carbonate chemistry. Utilizing georeferenced drone imagery and overlaying quantified water chemistry (pH, pCO_2, DO and DIC), we determined the impact of seagrass patches on pCO_2 and p_TH. If we are to conserve and manage coastal ecosystems under future conditions, a broader understanding of the dynamic ecosystem services provided by seagrasses, including the interactions between the biogenic habitat services and the multitude of taxa that rely on seagrasses, is essential. The central challenge now is to understand the links between ocean acidification and ecosystem functioning.

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Using low-cost, recreational side-scan sonar and echosounder units to inform oyster reef restoration in Aransas Bay, Texas

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In order to prioritize fine-scale areas for oyster restoration, we surveyed 500 acres of degraded oyster reef habitat in Aransas Bay, Texas, using a recreational side-scan and dual beam sonar unit. This acoustic data was used to produce high-resolution bathymetry and substrate maps that were utilized by resource managers at Texas Parks and Wildlife to facilitate an oyster reef restoration as directed by new state legislation. *In situ* oyster dredge and patent tong samples were collected to aid in map classification and accuracy assessments. We found that the recreational-grade unit produced accurate, high-resolution maps that were comparable to those produced by high-end, scientific scanning equipment. Our findings demonstrate that recreational sonar units have significantly decreased the cost-barrier for fine-scale mapping and are a valuable tool for managing benthic habitats.

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The effects of hard-bottom habitat degradation on the ecology and biology of the Florida stone crab *Menippe mercenaria* from the Florida Keys

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The stone crab *Menippe mercenaria* supports one of the most economically important fisheries in the southeastern United States. Hard-bottom in the Florida Keys is an important habitat for stone crabs and is characterized by limestone substrate covered by sponges, octocorals, and macroalgae. Cyanobacteria blooms have periodically occurred in Florida Bay, resulting in mass sponge mortalities, most notably the loggerhead sponge. Juvenile and young adult *M. mercenaria* are predominantly found residing in loggerhead sponges or solution holes. We examined the potential impacts of sponge loss by comparing stone crab nutritional condition, trophic position, and site fidelity between degraded and non-degraded sites. We also determined whether *M. mercenaria* use chemical cues from sponges to navigate to locate shelter in hard-bottom. Using stable isotope analysis, we found degraded and non-degraded populations to be operating at the same trophic level and be of similar nutritional condition. Interestingly, the carbon source supporting these populations differed. Stone crabs were attracted to chemical cues from loggerhead sponges over seawater alone, indicating that they may indeed use these cues to navigate hard-bottom and reduce the time to locate shelter. Hence, results were equivocal with some pointing to a potential impact from habitat degradation and others not.

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Benthic invertebrate zonation in a Mississippi River deltaic estuary

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In estuaries, fresh water and sea water mix to produce zones of intermediate salinities with distinct benthic invertebrate associations which we term ecozones. This study was conducted to determine ecozones present in the Caernarvon/Breton Sound estuary and environmental factors that control them. Benthic invertebrates were sampled from 20 sites using a petite Ponar dredge. Clams, other large organisms and shells were also sampled with a rake dredge. PRIMER CLUSTER analysis was used to generate a dendrogram in which taxa found in 60 replicate Ponar samples were hierarchically ranked into groups based on a Bray-Curtis similarity matrix. Highly dissimilar groups derived from the cluster analysis; the distribution of large bivalve shells, *Rangia*, oysters and *Mercenaria;* and salinity data from the Lake Pontchartrain Basin Foundation Hydrocoast maps and this study were used to delineate ecozones. Ecozones present were: the *Rangia* ecozone, the oyster/*Mulinia* ecozone, and the hypoxia stressed bivalve ecozone. A BIO-ENV analysis indicated a combination of bottom salinity, sediment % water, and depth were most important in establishing the ecozones. Mississippi River diversions into this estuary enhance marsh habitat and plant species diversity. While they increase benthic invertebrate abundance, due to decreased salinity and eutrophication they also decrease species diversity.

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Population dynamics and reproductive biology in an invasive population of the green porcelain crab, *Petrolisthes armatus*

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In order to better understand the life history of the invasive crab, *Petrolisthes armatus* and its ecological impact on intertidal oyster reef communities, resident crab assemblages were collected bi-weekly over the past year in Charleston, SC. Resident crab abundance, size, sex and ovigery status were examined to document fluctuations in *P. armatus* population size, timing of reproduction, and sex ratio throughout the year. To complement these findings, a laboratory experiment was conducted to determine the length of time females go between producing successive clutches. This part of this species' biology is currently unknown and is important to understanding reproductive output. Male and female *P. armatus* were held in tanks and the ovigery status of individual females was recorded daily over a 30-day period. Female size was a factor in this experiment because it is not known if crab size affects brood production frequency in this species. During the peak spawning period, smaller females averaged three days between broods whereas larger females averaged twice as long. Ovigery rates observed in the field will be examined by female size and compared to experimental results. Together, these studies improve our understanding of factors affecting reproduction in this non-native species in its invasive range.

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Host health as a driver of symbiont uptake in *Exaiptasia-Symbiodinium* symbioses

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Responses to recent mass coral bleaching events emphasize on the health and recovery of reef ecosystems as a response to anthropogenic climate change. The resulting thermal stress responses breakdown the coral-symbiont system and, once conditions stabilize, reestablish the symbiosis. Resilience of healthy coral reef ecosystems in the face of global climate change entails understanding all factors impacting a reef's ability to recover from stress events. The literature currently accepts that successful reinfections of the host system relies on a variety of factors; however, not all influential components in these systems are clearly understood. Benthic composition and host health may significantly impact the rate in which host *Exaiptasia pallida* takes up new symbionts after bleaching. Variable health of host organisms with exposure to different substrates allowed for the control of anemone health throughout the rebrowning process. Additionally, this variation in success influenced the host to exercise different modes of symbiont uptake. In degraded individuals, hosts select zooxanthellae based on a log-linear relationship with available symbionts; however, healthy hosts were able to uptake symbionts with no correlation to availability, suggesting other factors may be driving uptake in healthy organisms.

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Adaptive divergence along depth gradients in the common reef-building corals *Orbicella annularis* and *O. franksi*

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Adaptation along ecological gradients occurs when populations undergo differentiation that results in increased fitness of native individuals relative to their foreign counterparts. Adaptive differentiation allows organisms to increase fitness in response to environmental variation. We investigated adaptive divergence in two common coral species: *Orbicella annularis* and *O. franksi*. We sampled populations of both species across a depth gradient and found adaptive divergence related to their distributions in wild populations. The fitness of *O. annularis*, which is often found in shallow waters, decreases when transplanted to deeper environments. The lower survivorship of *O. annularis* in deep areas is related to the slower photo-acclimation response and microbial community disruption when facing the novel deep habitat. *O. franksi*, however, adjusts to these new conditions more rapidly, maintains a sustainable photosynthesis, keeps a robust microbiome composition, and dies less. These differential photo-acclimation capacities generate predictable depth limits for each species. We also found that these two species are genetically close with extensive shared genetic variation that gradually segregates across depths, creating frequency differences between species. Our results have implications for the management of these ESA threatened corals in that matching the depth profiles of the donor and transplanted sites enhance coral restoration.

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Potential niche partitioning among sponge species in the lower Florida Keys

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The shallow, tidal flats off the islands of the lower Florida Keys represent a harsh environment for sessile marine invertebrates, with high light intensities and high food variability. This habitat is home to three taxonomically distinct sponge species that share similar rope morphologies: *Cliona varians forma varians*, *Ircinia* cf. *variabilis*, and *Neopetrosia subtriangularis*. Despite sharing a habitat, these three species differ in their symbiont regime, with *C. varians* hosting dinoflagellate photosymbionts, and both *I. variabilis*, and *N. subtriangularis* hosting cyanobacterial photosymbionts. To test hypotheses of niche partitioning among these species, we conducted experiments to measure several aspects of their niches. The sponges were all assayed for pumping rates using dye-video analysis, Total Organic Carbon (TOC) content, microbiome composition, and stable carbon isotope ratios. The results indicated that *N. subtriangularis* had a significantly higher pumping rate than the other species. The TOC of *N. subtriangularis* differed significantly between ambient seawater and exhalent seawater, and the microbiomes and carbon stable isotope ratios of the species varied significantly. More work is currently underway to examine the metabolism of these sponges, giving us insight into the unique ecology of this habitat.

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Species richness, diversity and abundance of sponge communities in Broward County, Florida, 2000-2015

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Sponges (Porifera) are a major component of coral reef ecosystems. They outnumber coral species on the Florida Reef Tract and in places account for more living cover. Because coral reefs are a vital part of Florida's economy, it is important to understand how local sponge assemblages vary over time, especially as corals continue to decline. However, long-term observations of sponge assemblages (species richness, diversity and abundance) are lacking. To address this, photoquadrats were analyzed from a series of 25 sites off Broward County between 2000 and 2015 and recorded a total of 94 species. *Spirastrella coccinea* was the most common and was present at 21 sites. Other common species include *Niphates erecta* and *Amphimedon compressa*. Species richness increased with depth, perhaps associated with greater habitat stability. Different habitat types supported significantly different assemblages. Although assemblages at most sites exhibited no significant changes over time, shallow habitats did exhibit significant compositional variations, possibly due to storm events or beach renourishment. Results will be compared with variations in coral assemblages at the same sites and will provide a baseline for future studies.

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Marsh plant identity and diversity affect mangrove recruitment, survival, and growth

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We tested the effects of flooding depth, marsh identity (*Spartina alterniflora* (SA), *S. patens* (SP), *Distichlis spicata* (D), *Sesuvium portulcastrum* (SES)), & diversity (0, 1, 2, 3 & 4 marsh species) on mangroves (*Rhizophora mangle* [RM], *Avicennia germinans* [AG], & *Laguncularia racemosa* [LR]. Marsh morphological attributes (height, stem density, & patch diameter) were also predictors, as was the change in marsh species. Attributes varied by treatment and greater flooding depth produced – effects. The 3 & 4 marsh species combinations had + effects on marsh attributes. However, loss of a species from these higher diversity combinations reduced the effect magnitude. Marsh attributes & changes in number of marsh species affected number of green leaves on a target RM & total leaves produced over 1 year. Target RM in SP, D, & SES treatments experienced increased herbivory. Combined recruitment densities of the 3 mangrove species increased with flooding depth, marsh height & patch diameter, but declined with increases in marsh plant density. SA & SES monocultures, & one 3 species combination had – effects, while, SP & 1 species pair produced + effects. Individually, RM was + affected by SA monocultures while AG was - affected. LR did not respond to SA but was + affected by SP & SES.

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Hydrodynamic physical and sensory stressors affect the relative importance of predator consumptive and non-consumptive effects

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Predators affect communities by influencing prey density and traits via consumptive (CEs) and non-consumptive effects (NCEs). Physically stressful environments diminish CEs by impeding predator foraging abilities. The environment can also affect sensory detection of predators by prey and so change the relative strength of CEs vs NCEs. We found that blue crab (*Callinectes sapidus*) CEs and NCEs on mud crabs (*Panopeus herbstii*) foraging on juvenile oysters (*Crassostrea virginica*) differed across related flow parameters and were regulated uniquely by physical (i.e. current speed) and sensory (i.e. turbulence) stressors. At low physical and sensory stress, oyster survival was enhanced due to strong blue crab indirect NCEs and total blue crab effects were strongest. NCEs were not important at high turbulences due to impaired mud crab perception of blue crab chemical cues. At intermediate current speeds and high turbulence, blue crab indirect CEs had a moderate positive effect on oyster survival. Yet, at the highest current speeds, oyster survival was high because mud crab foraging was severely limited by physical stress and blue crab effects were not detected. Thus, the environment can simultaneously impose physical and sensory stressors that modify the relative importance of direct and indirect CEs and NCEs through separate processes.

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Predation on oysters is inhibited by acutely intense or chronically mild low salinity events

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Environmental stress gradients can affect species distributions and interspecific interactions. Because environmental stress depends on both intensity and duration, understanding its consequences requires experiments that simultaneously manipulate both dimensions. In Apalachicola Bay, Florida (USA) the southern oyster drill (*Stramonita haemastoma*) is a major predator of the eastern oyster (*Crassostrea virginica*). Drill predation appears to be salinity-dependent. Typically, high (> 20) salinities during the dry summer months favor both oysters and the drill; while, periodic freshets can dramatically reduce salinity, which inhibits (or kills) drills, but not oysters. In this study, we investigated the specific combinations of intensity and duration of low-salinity stress that inhibit drill predation. Large (i.e., intense) salinity reduction (–20) inhibited predation regardless of duration. In contrast, a mild reduction in salinity (–5) only reduced predation when the duration of the reduction was ≥ 10 d. Each of these conditions may create a predation refuge for oysters, consistent with field observations. Given that the recent collapse of the Apalachicola Bay oyster population was preceded by several years without low-salinity events to inhibit predation, our results provide a mechanism by which a predator may have helped cause the loss of a historically productive and sustainable fishery.

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Herbivory and nutrient addition affect Dictyota dynamics differently in St. Thomas, USVI

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Caribbean coral reefs are experiencing an unwanted shift from coral to algal domination. Determining the factors leading to algal phase shifts is extremely important for the resilience and survival of Caribbean coral reefs. *Dictyota* spp. is an abundant, brown, fleshy macroalgae found on shallow reefs in St. Thomas, U.S. Virgin Islands. In this study two factors, herbivory and nutrient addition, were manipulated during three experiments at three sites south of St. Thomas. The experiments used herbivore reduction cages and Osmocote^{TM} fertilizer to explore how the two factors affect thallus heights, percent cover and biomass. Experiments 2 and 3 explored *Dictyota* biomass at one site (14 m) exclusively, for 21 days each. The third experiment measured biomass across four levels of fertilizer addition (0, 5, 10, 20 g). Enriched thalli were targeted by herbivores, and the lowest *Dictyota* abundance was observed at the deepest site showing little response to manipulation. Unexpectedly, nutrient addition inhibited *Dictyota* growth and herbivory had an equally reducing effect on growth. *Dictyota* was not nutrient limited at any sites, and was weakly controlled by the herbivore populations. Factors responsible for *Dictyota* abundance on Caribbean reefs may reflect changes altered by overfishing and a reduction in coral cover.

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How does fishing change in response to ecological shifts on a Polynesian coral reef?

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There are potentially important feedbacks between ecological communities and artisanal and recreational fishing on coral reefs. To explore these we combined social and ecological data from Moorea, French Polynesia, documenting how the reef fishery changed from 2007-2015, a period during which a cyclone and an outbreak of crown of thorns sea stars caused substantial ecological change. We conducted 365 household surveys and collected catch data, sampling 18,000 fish. By combining these data with ecological surveys we tested whether ecological shifts correlated with changes in the catch. We found that less than 20% of people reported changing their fishing activities in response to the disturbances, and almost none reported changing what fish they bought or ate. Nevertheless, the taxonomic composition of the catch changed substantially, with a steep decline in unicorn fish and an increase in parrotfish. While the overall fishable biomass changed little, shifts in the relative abundance of key taxa mirrored changes in the catch. This suggests that while the species being harvested changed, there may have been relatively little alteration in the behavior or selectivity of the fishers, which may explain why the perception of change was relatively modest despite changes on the reefs and in the catch.

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Invasive seagrass *Halophila* hides anemone shrimp cleaning stations?

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Halophila stipulacea, a seagrass that is quickly invading the Caribbean, was covering a large proportion of Brewers Bay, St Thomas, VI, by summer 2017. During 2017, *Halophila* had spread to a reef in the middle of the bay, butting up to coral heads on the reef and to patch reefs adjacent to the reef. The population of corkscrew sea anemones *Bartholomea annulata* has been well studied at this reef over the past 10 years. In surveys conducted in September 2017, we measured the sizes of anemones and the number of anemone-associated shrimp and crabs within areas invaded by *Halophila* and adjacent areas that were as yet uninvaded. The fish-cleaning Pederson shrimp *Ancylomenes pedersoni* was twice as abundant on anemones in the uninvaded area than on anemones in the invaded area. Fish use anemones as the initial visual cue for the presence of a shrimp cleaning station. If the invasive grass hids the anemones and fish cannot easily locate the station, cleaners such as *A pedersoni* may be reduced, possibly leading to a cascading reduction in fish health. Additional areas need to be studied and fish visits to anemones need to be compared within and out of the invaded areas.

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The effects of ocean acidification on *Dyspanopeus sayi* predation

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Ocean acidification (OA) has been shown to negatively affect calcifying organisms by reducing their ability to form and maintain $CaCO_3$ structures. The mud crab, *Dyspanopeus sayi*, is an abundant predator in seagrass beds in North Atlantic estuaries. Although crustacean exoskeletons are formed with calcite, the more stable form of $CaCO_3$, changes in the acid-base regulation of the haemolymph may cause metabolic stress expressed through changes in behavior such as predation. We investigated how 1) a sudden decrease in pH and 2) a slow acclimation to future pH regimes for three weeks would affect *D. sayi* predation on the bivalve prey, *Mytilus edulis*. There was no difference in the predation rates under OA conditions ($p=0.35$) or by acclimation period ($p=0.07$) and no effect of the interaction ($p=0.14$). Our results suggest that *D. sayi* may have the physiological capacity to adjust to decreased pH on short-term (days) and longer-term (weeks) periods. Future research should evaluate physiological processes such as molting frequency, respiration rates, predator avoidance, and egg production to determine tradeoffs between growth, survival, and reproduction. Furthermore, increasing temperature may decrease the tolerance of *D. sayi* to OA, so investigations on the combined effects of OA and temperature are needed.

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Are phenotypic-delimitations a viable method of coral species identification in temperate Southeastern reefs?

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Benthic surveys are an efficient, effective and repeatable method to quickly assess diversity, but they rely on the ability of researchers to visually identify organisms to species. At Gray's Reef National Marine Sanctuary (GRNMS), visual identification is problematic for *Telesto* octocorals, which commonly differ visually only in color. The sclerites of each species are distinct but can only be analyzed with electron micrographs. GRNMS is thought to have two *Telesto* species (*T. sanguinea* and *T. fruticulosa*), that have been identified by color, however, these color-based delimitations have not been confirmed with analyses of either sclerites or DNA sequences. We tested whether phenotypic characters (stalk and polyp color) can reliably identify *Telesto* species in the southeastern USA. We combined physical descriptions, sclerite images and genetic analysis to confirm species identifications. This work is particularly important in light of the need to monitor changes in benthic reef diversity following Hurricane Matthew in 2016.

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Spatial and temporal variability in consumption rates underlie stronger predation in the tropics

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Global biodiversity patterns are characterized by increasing species richness from the poles to the tropics. While increased predator diversity and more complex food webs are expected to occur in low compared to high latitudes, exerting a stronger top-down influence on prey in tropical marine communities, the dynamics of the predator community that shape these ecologically important interactions are not well understood. Therefore, we explored how 1) predator communities impact prey community structure across latitude and 2) species-specific predation rates at local scales give rise to strong cumulative effects of predation at regional scales. Using a standardized exposure experiment in nearshore habitats across four biogeographic regions spanning 47 degrees of latitude, we quantified species-specific predation rates on sessile marine invertebrate communities and tested whether predation pressure invoked changes in prey community structure. We found that mid- and high-latitude prey communities experienced low predation pressure and no effect of predators on community structure, while low latitude communities experienced strong predation and striking changes in community structure. Species-specific predation rates suggest interesting spatial and temporal dynamics of predator-prey interactions in the tropics, indicating that key predator taxa, rather than predator diversity *per se*, may exert a greater influence on overall community level effects.

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Morphological and molecular variations in the invasive hydrozoan, *Gonionemus vertens*

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The cryptic nature of hydrozoans often makes detection of these species difficult. The invasive clinging jellyfish, *Gonionemus vertens*, has had at least two documented invasions since 2016, including New Jersey and France. Morphologically, there are differences between individuals within and among populations including the number and symmetry of radial canals. These differences provide key life history characteristics defining *G. vertens* populations along the East Coast of the United States. In addition to the morphological differences among populations, there are molecular variations including differences the in DNA sequences of highly conserved mitochondrial loci. These morphological and molecular differences can be used to help determine the relatedness of populations and potential invasion pathways. The differences in bell diameter suggest that New Jersey populations bloom earlier than northern populations of *G. vertens* along the East Coast and likely reflects abiotic variations in temperature. The differences in bloom times combined with the molecular variations may indicate that the New Jersey *G. vertens* population is the result of a unique invasion or a complex invasive pathway.

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Taxonomic sufficiency and unidentifiable species in multivariate biodiversity assessments of benthic polychaetes from the northern Gulf of Mexico

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Changes in benthic community structure along environmental gradients can be detected with powerful multivariate analyses based on species lists. Taxonomic sufficiency is the concept that hierarchically higher taxonomic units may be viable alternatives for species level analyses, making the identification process much easier and faster. The performance of family level analyses of polychaetes from the northern Gulf of Mexico continental shelf was tested. We compared the results to species level analysis, taking into consideration the effects of unidentifiable specimens. Many benthic organisms may be too damaged or poorly preserved to identify them, and thus need to be excluded. In contrast, polychaete families are usually sufficiently distinct to identify damaged specimens. Several datasets were used to create similarity matrices between sampling stations, based on polychaete species and families. These similarity matrices were compared to assess the effects of taxonomic sufficiency and excluding unidentified specimens, respectively. Family level analyses performed approximately equally well when 55-60% of specimens could be identified to species. At higher rates of species level identification, species level analyses were superior. However, species level analysis performance varied with the percentage of identifiable specimens, whereas family level analysis did not.

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Cloudy with a chance of mesopredator release: sensory interference alleviates top down control in estuaries

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In communities controlled by top-down forces, removal of top predators may lead to proliferation of mesopredators (i.e. intermediate consumers), with significant and often dire consequences for basal trophic levels and entire food webs. Termed mesopredator release, this process is typically attributed to a decline in the abundance of top predators. We investigated the potential for moderate environmental changes to trigger mesopredator release by diminishing the foraging ability of top predators. In estuaries, fishes occupy the upper trophic levels and many species rely on visual cues to forage. We hypothesized that increased turbidity would attenuate fish foraging ability, increase the abundance of crabs and other mesopredators and significantly alter coastal food webs. We investigated the effects of turbidity on oyster reef (*Crassostrea virginica*) community diversity, oyster recruitment, and predation by different trophic levels using exclusion cages. Communities were more diverse and oyster recruitment higher when turbidity was low. Predator exclusion revealed significantly more mesopredators and higher predation by mesopredators in turbid areas as well as significantly fewer oyster recruits. Further, oysters had stronger, thicker shells in turbid areas, a response used to deter crab predators. Thus, environmental changes may trigger mesopredator release, negatively affecting biodiversity and foundation species by attenuating the foraging ability of higher order consumers.

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The effects of the red tide producing algae, *Karenia brevis,* on *Porites astreoides:* a potential regional stressor to coral reefs

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Seasonal red tide events in the Gulf of Mexico occur from blooms of the neurotoxin producing dinoflagellate, *Karenia brevis*. Periodically these blooms make their way into the Gulf Stream where they have negative effects on Atlantic coastal communities in the south eastern United States. While previous research has focused on the effects of *K. brevis* on marine mammals and economically important species, little is understood of their impact on coral. This study investigated the effect of acute exposure of ecologically relevant concentrations of *K. brevis* ($2.5x10^6$cells L^{-1}) or brevetoxins ([0.018ug PbTx-2, 0.0018ug PbTx-3]ml^{-1}) on two life stages of the coral species *Porites astreoides*. Exposure to *K. brevis* or associated brevetoxins resulted in a reduction in photosynthetic efficiency of coral symbionts at 24 and 48 hours in larvae and at 48 hours for adults. Although no impact was observed on larval settlement, larval survival decreased with both *K. brevis* and brevetoxins. Finally, in pairwise choice, pelagic swimming demonstrated avoidance of water contaminated with *K. brevis* or brevetoxins. The results establish the potential of red tide to act as a regional stressor on coral species. These findings merit future investigations in elucidating the extent of these impacts on coral.

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Assessing seagrass responses to reduced optical water quality and other changes in Estero Bay, Florida

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Seagrasses are highly vulnerable to changes in the environment, especially to decreases in optical water quality, which have been implicated in global seagrass declines. In Estero Bay, Florida anecdotal reports suggest that seagrass coverage and optical water quality have seriously declined over recent decades, however, quantitative analyses of seagrass trends have had equivocal results. An integration between existing monitoring data with a new synoptic assessment to clarify the seagrass and water quality trends, and their relationship was performed. The assessment indicates that, despite a benign period from 2006-2011, a progressive degradation of Estero Bay seagrass habitats is underway. Regression analyses found a strong negative correlation between annual seagrass abundance and average annual temperature, meaning warm water years were most harmful. A strong, negative correlation with macroalgae was found as well, which suggests that harmful eutrophication is occurring in the Bay. In 2017, a new monitoring technique, distributed widely across the Bay, was initiated to quantify seagrass health and extent in conjunction with optical water quality. This data will be used to generate more precise, ground-truthed maps of the seagrass beds, and to disentangle the effects of optical water quality variation on seagrass health in Estero Bay.

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Effects of ocean warming, increased sedimentation, and parental genotype on the post-settlement survival and growth of *Acropora cervicornis*

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Ocean warming and increased sedimentation from coastal construction activities are major threats to the persistence of corals. While the singular effects of increased temperature and sedimentation on corals have been extensively studied, their additive effects on early life stages remain poorly understood. This study assessed the effects of increased temperature and sedimentation on the survival and growth of *Acropora cervicornis* recruits, and also determined the potential for parental effects on their survival and growth. Gametes were collected from adult colonies consisting of 8 genotypes and brought back to the laboratory for fertilization and settlement. Newly settled recruits were reared in 2 temperatures (29 and 31°C) and 4 deposited sediment concentrations (0, 30, 60, and 120 mg/cm^2, corresponding to 0, 2.3-4.6, 7.13-11.6, and 18.9-19.9 NTUs) for 3 months. Survival was maximized under ambient conditions in the 30 and 60 mg/cm^2 sediment concentrations, whereas the highest temperature and sediment concentration drastically reduced survival. However, there were no apparent differences in the survival of different genotypic crosses as well as the recruit growth rates between treatments. These outcomes suggest that reducing sedimentation to below 11.6 NTUs during coastal construction events may allow for the persistence of this species under future ocean warming conditions.

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Gastropod and bivalve community assemblage in Louisiana salt marshes three years after the DWH oil spill

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The Deepwater Horizon oil spill in the Gulf of Mexico was the largest oil spill in US waters to date. It is documented that oil affected ~1000 km of Louisiana shoreline. The impact of oil on salt marsh gastropods has been documented at heavily oiled sites. Periwinkle snails (*Littoraria irrorata*), for example, are less abundant and smaller at heavily oiled sites than reference sites. This study extends previous research by examining gastropod and bivalve community structure at sites with various degrees of oiling: "light", "moderate", and "heavy". Quadrat sampling took place in the spring and fall seasons of 2013 at 4 sites in Terrebonne Bay and 9 sites in Barataria Bay. Periwinkle snails (*Littoraria irrorata)*, common marsh snails (*Melampus bidentatus)*, olive snails (*Neritina usnea*), ribbed mussels (*Geukensia demissa*), and Eastern oysters (*Crassostrea virginica*) were dependent upon site location and oiling classification (oiled vs. reference "unoiled" sites). This research demonstrates that abundances may not be directly impacted by oil three years after the spill and indirect effects of oiling may be more important.

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A line in the sand: what's stopping the spread of the introduced species, *Hermundura americana* (Polychaeta:Pilargidae), throughout the Chesapeake Bay?

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In 2009 the pilargid polychaete, *Hermundura americana*, was first recorded at a single location in the Southern Branch of the Elizabeth River, a tributary of the James River. Over the next two years it became well established throughout the Elizabeth River. In 2012, *H. americana* was found at a single location in the James River. By 2014 it had spread to much of the James River from the polyhaline to oligohaline salinity zones. Although it is well established in these two Chesapeake Bay tributaries; *Hermundura americana* has not been found in any other location in the Bay. Past circulation models document that in the lower James River, near its confluence with the mainstem of the Chesapeake Bay, there is eddy-induced horizontal circulation and vertical transport associated with a frontal system. These are important mechanisms for the retention of larval organisms in the James River and produce a strong net upriver transport with depth. Given its establishment over a wide range of salinities in the James River, *H. americana* could become established throughout the Chesapeake Bay.

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Oyster reef restoration results in enhanced fish species richness according to scientific angling results

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Scientific angling techniques were applied at several TPWD oyster restoration sites to attempt to quantify the effect of reef restoration on the recreational fishing experience for anglers. Anglers utilized identical bait and tackle and fished for equal amounts of time at restoration sites, natural reef controls and non-reef controls. Data were analyzed for Catch Per Unit of Effort (CPUE) for individual species, and for various functional groups of interest. Data were also subjected to multivariate analyses to look for patterns in assemblage structure and assess similarity of catch composition between samples from restoration sites, and control sites. Species richness was found to be greater at restoration sites compared to both non-reef controls and natural reef controls. Furthermore, the proportion of the catch represented by the family Ariidae (sea catfishes) was much lower and the proportion of the catch represented by the family Scianidae (drums and seatrouts) was higher on restored sites indicating an enhanced angler experience. Since 2007, TPWD has restored 470 acres of oyster habitat. While monitoring efforts often target the enhancement of the oyster fishery resource, the benefits of reef restoration to finfish are less well studied.

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Juvenile green sea turtle grazing and the tropicalization of the northern Gulf of Mexico

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Poleward range expansions of marine organisms are occurring at a rapid rate in the Gulf of Mexico (GOM). With its connectivity between tropical and temperate water masses, GOM is a prime location to study the impacts of these expansions. Because of warming temperatures and effective conservation, the green sea turtle (*Chelonia mydas*) is becoming more abundant near its northern limits. In the GOM green turtles feed primarily on turtlegrass (*Thalassia testudinum*), and as *C. mydas* expands into the northern GOM, grazing pressure is increasing. In areas where green turtle abundances increased dramatically, such as Bermuda, turtlegrass meadows have been decimated by green turtles. Therefore, we estimated the effects of turtle grazing in the northern GOM by manually clipping turtlegrass leaves and by using exclusion cages to prevent grazing in seagrass meadows of St. Joseph Bay, FL. We found that simulated grazing decreased productivity, and excluding *C. mydas* by caging led to increased shoot density. Also, turtlegrass recovered following the relaxation of simulated grazing pressure. Given the expected increases in the population size of green turtles in the northern GOM, we intend to track the status of these turtlegrass meadows in St Joseph Bay as tropicalization continues.

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Temperature-dependency of intraguild predation between native and invasive crabs

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Environmental factors such as temperature can affect the distribution and abundance of species directly by altering physiological rates, or indirectly by altering the sign and strength of species interactions. In this study, we examined the temperature-dependency of intraguild predation (IGP) between native blue crabs (*Callinectes sapidus*, the IG predator) and invasive green crabs (*Carcinus maenas*, the IG prey) in order to evaluate how the indirect effects of temperature on competitive and predatory rates may influence the spatial distribution of these species. We conducted mesocosm experiments to empirically quantify the competitive and predatory interactions between blue and green crabs at 3 temperatures reflective of those across their range for 2 different size classes of blue crab. We then used parameter values generated from these experiments (temperature- and size-dependent attack rates and handling times) in a size-structured dynamical IGP model in which we varied IGP attack rates, maturation rate of the blue crab from the non-predatory to predatory size class, and resource carrying capacity at each of the 3 temperatures. Relative competitive abilities and IGP rates differed with temperature, and our model results suggest that these interactions may affect coexistence along a temperature gradient. While many factors may play a role in delimiting species ranges, our results suggest that temperature-dependent interactions are worth considering when developing mechanistic species distribution models and evaluating responses to environmental change.

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How quickly will the deep sea ecosystem recover from the 2010 DWH oil spill? Lessons learned from the 1979 Ixtoc-1 oil well blowout event

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Research indicates that benthic meiofauna and macrofauna were impacted directly following the DWH event and remain disturbed at the DWH site. These results prompt a critical question: how long will it take to recover? Answers to this important question can be inferred from a similar sub-surface oil release that occurred in the Bay of Campeche, Mexico: the 1979-1980 Ixtoc-1 blowout. Tracking meio-and macro-faunal changes during and after the Ixtoc-I blowout event will allow us to predict when the Northern Gulf of Mexico deep-sea habitat is likely to recover from DWH. Sediment cores collected from sites surrounding the Ixtoc-I spill have been analyzed for chemistry and benthic macrofauna, and meiofauna. Based on accurate chronologies, chemical and benthic biological signals associated with the Ixtoc-1 oil spill are recorded about 4 cm beneath surface sediments. Because the infauna zone in deep sea sediments is about 10 cm, we estimate that it will take another 40-50 years for the Ixtoc area to recover. This implies that the DWH area will recover when about 10 cm of fresh sediment caps the contaminated sediment in the deep sea.
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Measuring trophic structure in hard-bottom habitats of the Florida Keys to determine the success of sponge community restoration

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Phytoplankton blooms in the Florida Keys have led to the devastation of hard-bottom sponge communities and the migration of many motile animals out of the region. In an attempt to restore these communities, sponge cuttings have been outplanted on sites throughout the Middle Keys to 'jumpstart' the return of sponges and in turn the ecological function of these communities. Each location was assigned four separate site treatments in combinations of two variables, sponge biomass (high or low) and sponge diversity (high or low). One metric we are measuring to gauge the return of ecological function is the trophic structure of the restoration sites. At each site, representative organisms from each trophic level (e.g., primary producers, grazers, detritivores, carnivores) were collected by hand for stable isotope analysis. The distribution of these isotope values will then be compared between the site treatments and controls (unrestored and non-impacted sites). Treatments most similar to the non-impacted sites will be considered most effective. This work is currently in progress but preliminary results will be available by the time of the meeting.
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Avoiding viruses: how does a Caribbean spiny lobster deal with PaV1 and WSSV infected conspecifics

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White Spot Syndrome Virus (WSSV) is a causative agent of disease, which has led to mass mortalities of cultured shrimp populations around the globe. Natural infections in spiny lobster populations has not been documented but artificial transmission of WSSV to three species of spiny lobsters was found to be as lethal as in shrimp populations. *Panulirus argus* Virus 1 (PaV1) is currently the only known virus to infect Caribbean spiny lobsters. *P. argus* is able to mitigate some of the effects of PaV1 though active avoidance of infected individuals. WSSV is traditionally associated with tropical penaeids and infects an unusually large range of hosts therefore the susceptibility of *P. argus* to WSSV should be taken into consideration. The susceptibility of *P. argus* to WSSV was tested by intramuscular injection. WSSV caused mortality in 70% of the inoculated lobsters, and 80% of inoculated lobsters were positive for WSSV using the nested PCR assay. As WSSV can be transmitted to *P. argus* a similar avoidance mechanism could diminish the risk of fisheries loss due to disease mortality. WSSV is still detected intermittently in wild populations of penaeid shrimp in the Gulf of Mexico and Caribbean regions and disease avoidance could mitigate transmission between populations.

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Density dependent effects of a range expanding fiddler crab (*Uca pugnax*) on ecosystem functioning in New England salt marshes

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The burrowing marsh fiddler crab *Uca pugnax* is expanding its range northward. Individuals were found in Scituate, MA in 2003, and the Plum Island Estuary (PIE), MA in 2014, the first documented occurrences north of Cape Cod. In its southern natal range, *U. pugnax* positively affects marsh ecosystem functions such as primary production. However, range expanding species often have negative, density dependent impacts to their novel habitats. Therefore, we asked: 1) what effect does *U. pugnax* have on ecosystem functioning in PIE; 2) how does this compare to established populations south of the Cape (i.e. Nantucket, MA); and 3) are observed effects density dependent? In summer 2017, we installed 0.25m^2 crab inclusion cages in both PIE and Nantucket in a blocked design (n=4 per density six density treatments). Crab density ranged from 0 (caged control) to 20 (ambient density) spread evenly across treatments. After three months, we measured above and belowground biomass of *Spartina alterniflora*, pore water salinity and nutrients, and soil strength. Preliminary analysis shows a slight decline in overall marsh functionality in PIE relative to Nantucket. Therefore, the initial range expansion of *U. pugnax* could be altering a key marsh ecosystem that supports both human and non-human communities.

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Devastating changes to coral populations in the Florida Keys due to an unprecedented coral disease outbreak

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An unprecedented coral disease outbreak is entering its fourth year along the Florida Reef Tract (FRT). White lesions started appearing on multiple species in late 2014 adjacent to Miami-Dade County. The disease quickly spread through the northern reef tract in 2015 and reached the upper Florida Keys in 2016. At the close of 2017, the outbreak had spread to the west end of Marathon, in the middle Florida Keys. It has encompassed >50% of the entire FRT to date. Lesions have been confirmed on >20 species of corals. The rate of tissue loss varies across species, but rapid necrosis occurs on the most vulnerable corals often resulting in complete colony mortality. Preliminary results from the Coral Reef Evaluation & Monitoring Project (CREMP) from the upper Keys indicate the catastrophic losses of coral due to this outbreak. Among the important, hermatypic coral species, active rates of infection were still as high as 50% in 2017. For vulnerable species, or those affected early at the outbreak's onset, proportional declines in abundance have ranged from 66% to 100%. The slow and persistent progression of this outbreak across the FRT will require several more years to fully comprehend its devastation.

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Altered beasts: Changes in biological functioning of predator and prey under ocean acidification

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Carbon dioxide is entering our oceans at an unprecedented rate. For many species, this is having negative physiological consequences on their fitness and resilience to environmental change, but less is known about the ecosystem effects of these changes. In this study, we assess how ocean acidification (OA) conditions predicted for 2100 affects the biological functioning of an important habitat-forming bivalve, *Mytilus* spp. and its susceptibility to predation by a key predator, the dogwhelk *Nucella lapillus*. Change in three physiological parameters in *Mytilus* were assessed: (1) shell thickness and surface area, (2) body mass and (3) feeding rate, as well as predation risk (mortality) to mussels of different size. Shell thickness/area, body mass and feeding rate of *Mytilus* all reduced under OA conditions indicating reductions in individual fitness. Predation risk also increased by ~26% under OA, including large *Mytilus* that are currently at low risk from predation, suggesting increased susceptibility and/or altered predator foraging behaviour. The results suggest OA will impact upon ecosystem structure and functioning and the continued provision of ecosystem services associated with *Mytilus* reefs.

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Assessing the effects of ocean acidification on structure of the snow crab exoskeleton

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Atmospheric CO_2 is predicted to double by the year 2100, resulting in reduced seawater pH and saturation states. We assessed if such changes in seawater chemistry would affect exoskeleton structure in the snow crab, *Chionoecetes opilio*. Male and female crabs were collected from the eastern Bering Sea and exposed to one of three pH levels (ambient [~8.0], 7.8, or 7.5) for 1-2 years. Exoskeleton structure in samples taken from carapace, claws, and walking legs was assessed in cross-section. The majority of the exoskeleton was endocuticle (~82 and 93% for the carapace and claws, respectively) with the balance as exocuticle. Exocuticle thickness was not affected by sex or pH. Both sex and pH affected endocuticle thickness, and the interaction between these factors was significant. Male claw endocuticles were more than twice as thick as females', although carapace endocuticle of males was slightly thinner at ambient pH. In females, reduced pH tended to result in thinner endocuticles in claws but not in the carapace. In males, endocuticle thickness of the claw did not differ among pH levels, whereas reduced pH increased thickness in the carapace. Ocean acidification affects exoskeleton structure in snow crab in a body-region specific manner that could affect functionality.

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Diversity of UV-reflectance among damselfishes (Pomacentridae)

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Although ultraviolet (UV) radiation is not visible to the human eye some animals, including many coral reef fishes, utilize it for communication. Multiple species of damselfishes (Pomacentridae) possess complex ultraviolet facial patterns. In at least one species these ultraviolet facial color patterns are apparently used for territorial aggression and identification of individuals; we call this the Aggression-Identification Hypothesis. Damselfishes are diverse and have evolved a range of social systems and color patterns in visible light. We predicted that UV-reflectance would also vary with social system. A UV-photography system was used to record the UV-reflectance of multiple species and genera of damselfishes. Fish were placed into a small UV-transparent Lexan aquarium for photography. Significant qualitative differences in UV-reflectance were observed among species and age-classes. Some species (e.g., yellowtail damselfish, *Microspathodon chrysurus*) had complex patterns on their faces (i.e., around the eye and preopercular regions) and/or bodies whereas others displayed no UV-reflectance (e.g., blue chromis, *Chromis cyanea*). The UV-reflection patterns of beaugregory, *Stegastes leucostictus*, were more extensive and complex in non-aggressive juveniles than in territorial adults. Therefore, although UV-reflectance was most often associated with territorial and aggressive species and life-stages thereby supporting the Aggression-Identification Hypothesis, there remains some uncertainty in its generality.

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Characterising the ecological assemblages of urban rock pools: implications for ecological engineering

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Intertidal rocky shores are heterogeneous environments and can therefore support diverse communities. However, rocky reefs across the globe are being increasingly replaced by homogeneous built infrastructure. Understanding the fine-scale features of rocky shores (microhabitats) that support biodiversity is important to conserve and potentially mimic these important habitats. We surveyed natural rock pools at locations with differing environmental conditions to investigate whether the overall rock pool size and the type and size of microhabitats within rock pools influence the diversity and abundance of species. Two sites were selected to represent Inner Harbour conditions (urbanised, contaminated), two sites were located in the Outer Harbour (well flushed), and three oceanic sites were located north and south of the Harbour entrance. Overall, we found that an increase in rock pool width and depth increased diversity and abundance of species. Microhabitats however did not influence species richness and abundances of mobile species, but changed species distributions within rock pools. These effects were location- and microhabitat-specific. This suggests that efforts to mimic rock pools and increase overall diversity or abundance should maximise overall rock pool size and carefully consider microhabitats, but that more specific goals will require consideration of local environmental conditions to benefit associated communities.

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Disease on the half-shell: Prevalence and impact of the protistan pathogen *Haplosporidium nelsoni* on oyster population health in the Gulf of Maine

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Oysters are a vital species to the Gulf of Maine. However, they are threatened by numerous diseases including a protistan parasite, *Haplosporidium nelsoni*, that induces a potentially fatal disease, MSX, associated with numerous mass mortality events. This project's aim is to establish a reputable baseline for MSX prevalence and severity in farmed oyster populations in the Gulf of Maine through the quantitative real-time PCR analysis of samples collected over six geographically disparate sites over two years. Results thus far have shown widespread incidence and varying levels of severity. Establishing a baseline is important for understanding current and future trends of MSX movement and for ensuring the safety of wild and aquacultured oyster stocks.

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One fish, ten fish…how many red lionfish colonized the Atlantic?

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Estimating the number of red lionfish (*Pterois volitans*) colonists in the Atlantic is useful for identifying the introduction pathway and informing policies to prevent similar ecologically devastating invasions. It is well established that ≥10 female lionfish were introduced, based on maternally-inherited mitochondrial control region haplotypes. To more rigorously estimate the number of founders, we simulated the invasion across a range of source population sizes and colonist fecundities using a forward-time, Wright-Fisher population genetic model in concert with a demographic, life-history model. Assuming a balanced sex ratio and no Allee effects, simulations indicate the Atlantic population was founded by 118 (54-514, 95% HPD) lionfish from the Indo-Pacific; the Caribbean by 84 (22-328, 95% HPD) lionfish from the Atlantic; and the Gulf of Mexico by at least 114 (no upper bound 95% HPD) lionfish from the Caribbean. In a more realistic scenario with Allee effects reducing colonist fecundity to 50%, the estimate of Atlantic colonists was 272 (106-950, 95% HPD). Such high numbers are consistent with the Atlantic invasion being initiated via the aquarium trade. Efforts to prevent future invasions should focus on education of aquarium trade stakeholders and prohibition of release, with adequate rewards for compliance and penalties for violations.

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Fine-scale microhabitat usage of a putative habitat generalist reef dwelling goby, *Coryphopterus personatus*

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2: Fundación In-Nova

Variability in habitat quality influences species at the population level and the individual level. At the population level habitat quality is a primary driver of metapopulations and dispersal dynamics, affecting the frequency and strength of dispersal polymorphisms. Individually habitat quality affects the growth rate and reproductive output as well as the mortality rate, amongst other processes. As such, defining habitat quality needs to be done at a scale relevant to the species being studied. Using structure-from-motion photogrammetry we characterize fine-scale microhabitat usage across both habitat type and topographical features to determine microhabitat usage of a coral reef goby, *Coryphopterus personatus*. Using a coupled binomial and negative binomial model we find that the presence of shoals and the density of individuals within shoals are significantly influenced by topographic complexity and three-dimensional shape of the reef. Understanding the factors defining habitat quality in a habitat generalist provide the foundation for future studies seeking to understand how variation in habitat quality influence both individual and population scale processes.

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The effect of relocation on hatching success of loggerhead sea turtle nests

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In 1996 the Loggerhead sea turtle *Caretta caretta* was listed as endangered by the IUCN red list. As of 2017, this species has increased in population size and has been reclassified as vulnerable. A major contribution to the increase in population size can be attributed to conservation practices like nest relocation. A multi-decadal data set obtained from Bald Head Island, North Carolina, USA was used to identify and assess differences in reproductive output and whether differences in hatching success varied between nests that had been relocated and those that had not for an individual mother. A group of 50 individuals were identified by having nested at least 3 years and having lain at least 3 nests total. Between 1992 and 2013 20% of all nests laid were relocated. The mean hatching success of natural nests (not relocated) and relocated nests were 70.97% and 68.86% respectively ($P>0.05$), indicating there is no significant difference in hatching success between natural versus relocated nests for an individual mother. If nesting behavior is heritable, relocation practices could be imposing artificial selection of future generations and their ability to find suitable nest locations, potentially increasing the amount of nests requiring relocation in the future.

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The Lyme Bay MPA Case Study: benthic recovery, storm impacts and lessons learnt

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The Lyme Bay reefs (south west UK) have been annually monitored using a flying video array since they were protected from towed demersal fishing in 2008. Following extreme storm events in 2013/2014 additional research was carried out to assess if the benthos within the Marine Protected Area (MPA) were more resilient than the benthos in areas, which remain open to fishing. Increased storminess is predicted under some climate change scenarios; therefore, results of this study have important implications for the future management of comparably located MPAs. While communities in MPAs can be more resilient against natural disturbance, the benthic community in the MPA was significantly affected by the storms. Lessons learnt from this nine-year study including evidence for site vs feature based management will be presented. This study highlights the importance for long-term studies in temperate MPAs as these robust data now provide evidence for informed management measures to be adopted in existing and future MPAs.

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Effects of hard clam (*Mercenaria mercenaria*) grow-out operations on benthic invertebrate community structure in Barnegat Bay, NJ.

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Hard-clam (*Mercenaria mercenaria*) aquaculture operations maintain densities many magnitudes higher than those found naturally during the 2-3 year "grow-out" phase. While there is ample research describing the negative effects of the physical harvesting of the clams, no regional work has investigated the effects of grow-out on the ecology and biodiversity of the associated benthic communities. Though the high densities maintained during grow-out might be expected to detrimentally impact local communities due to locally-increased nutrient input, we instead hypothesize that the increased abundances of this bivalve will provide a net benefit to local communities due to the increase in total filtering capacity. Results indicating enhancement of non-target molluscan biomass and overall associated benthic biodiversity could recommend an increase in permitted hard clam lease acreage in the region as part of an improved management strategy. Plots of three treatment types (industry-standard screens with clams, screens without clams, and control) were installed at Sedge Island, Barnegat Bay, in 2012. Results will be presented from across the 2012-2015 sampling period.

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Relationship between partial mortality and the demography of the threatened coral *Acropora cervicornis*

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The aim of this study was to test the hypothesis that partial mortality impairs the demographic performance of the threatened reef-builder coral *Acropora cervicornis*. We followed the fate (growth and survival) of colonies with varying degree of partial mortality, indicated by tissue loss, for two years at two reefs in Puerto Rico. Our results indicate that coral growth and survival were affected by tissue loss but only when the proportion of dead tissue exceeded 20% of the total colony size. When evaluating the spatiotemporal conditions of *A. cervicornis* colonies, we found that partial mortality was, indeed, a common feature of the studied populations. At the two sites, and during the entire study, the proportion of colonies that lost more than 20% of their living tissue varied between 40% and 50%. Such high proportion of colonies exceeding the 20% threshold level may put at risk the persistence of the studied populations. Taking into consideration the relationship between partial mortality and the demographic fate of *A. cervicornis* can aid in the development of stronger conservation and restoration programs.

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Deepwater Horizon: A mesophotic coral's response to heat stress and oil

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Scleractinian corals responsible for the foundation of most tropical reefs worldwide are facing a significant threat of extermination due to heat stress warming the upper water layers coupled to increases in pollution pressure. The effects of heat stress and oil pollution, however, are much less known on deeper mesophotic corals (i.e. 30 – 150 m). In this study, we compare and contrast the effect of acute (72 hr.) and chronic (480 hr.) heat stress + oil on the mesophotic coral *Montastraea cavernosa* (Linnaeus 1767) at temperatures varying from 27 to 33°C over six hours vs. increases from 27°C at 1.5°C increments every 72 hours until 33°C was reached. Quantitative real-time polymerase chain reaction (qRT-PCR) resulted in two distinct gene expression profiles. Acute exposure resulted in the activation and upregulation of an oxidative protective enzyme, molecular chaperone, and anti-apoptotic protein. Chronic heat exposure only elicited a physiological response at the higher temperatures (i.e. 30°C). Here, we propose 30°C as a heat-stress threshold for mesophotic *M. cavernosa*. In conclusion, mesophotic coral appear equally susceptible to increased ocean temperature and oil pollution and should be regarded as a sensitive ecosystem.

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Oyster aquaculture changes *Zostera marina* epibiont community composition

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Coastal fisheries are in decline worldwide and aquaculture has become an increasingly popular way to meet seafood demand. While finfish aquaculture can have substantial adverse effects on coastal ecosystems, bivalves are well known for their positive ecosystem services. We investigated the effects of long-line *Crassostrea gigas* oyster aquaculture on *Zostera marina* seagrass beds in Akkeshi-ko estuary, Japan. Results yielded no evidence of an effect of aquaculture on the morphology, density, or biomass of *Z. marina*; however, significant differences arose in the epibiont community. Control seagrass beds located away from aquaculture had higher seagrass epiphyte loads and higher abundances of amphipods. Conversely, seagrass beds below aquaculture lines had higher sessile polychaete biomass and higher isopod abundances. One proposed mechanism is that cultured oysters feed on epiphytic diatoms and epiphyte propagules before they can settle on the seagrass, which then influences subsequent faunal settlement. Our results suggest that the presence of oyster aquaculture may have indirect effects on seagrass by changing epibiont community composition and relative abundances of species. In all likelihood, bivalve aquaculture will continue to expand in coming decades. If carefully implemented and monitored, long-line oyster aquaculture may be a sustainable option for meeting global seafood needs.

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Multiple stressor effects on macrobenthic communities in Southeastern Corpus Christi Bay, Texas, U.S.A.

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In the southeastern Corpus Christi Bay, declines in benthic macrofaunal community abundance, biomass, diversity, species richness, and species evenness have largely been attributed to the occurrence of hypoxia, a condition of low dissolved oxygen. At any one moment in nature, organisms are likely being exposed to multiple stressors the effects of which are difficult to separate. Often the effects of environmental stressors are tested individually and field studies focusing on benthic community metrics and structural responses to multiple stressors are not common. Principal component analysis using a thirty year time's series of water quality data, suggested a large variability in our dataset could be summarized by three components. These components appeared to represent a hypoxia index, a nutrient input index, and an acidification index. Components were orthogonally related, thus correlations among components did not exist. When components were correlated to benthic diversity metric data, acquired in conjunction with water quality data, the hypoxia and acidification indexes had inverse relationships to benthic abundance and biomass. In addition, the hypoxia index correlated negatively to benthic species richness. Decreases in dissolved oxygen concentrations as well as pH levels in southeastern Corpus Christi Bay should therefore be followed by a decline in benthic metrics.

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Shifting ranges and interactions: how does saltmarsh wrack affect mangrove establishment and growth?

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Tropical mangrove species are expanding into temperate saltmarshes worldwide, representing a global, climate-driven transition. Along the north Florida coast, black mangrove, *Avicennia germinans*, is rapidly replacing native saltmarshes. The rate of mangrove expansion is influenced by biotic interactions with both live standing marsh cordgrass, *Spartina alterniflora* and with subsidies of dead *Spartina* wrack. Dead *Spartina* wrack and mangrove propagules both get stranded in coastal marshes on high tides, and we were interested in how the co-occurrence of wrack and propagules affects propagule establishment and growth in the field. To examine effects of wrack on mangrove propagules, we performed a field experiment near the northern extent of the mangrove expansion. We planted mangrove propagules at paired saltmarsh only and mixed saltmarsh-mangrove habitats into the following treatments: saltmarsh, saltmarsh with wrack, and in bare plots (trimmed saltmarsh). We measured propagule survival and growth, as well as changes in vegetation stem density in the plots over the course of 9 months. Wrack facilitated propagule establishment by trapping and stabilizing propagules, but over the long term, propagules in the wrack treatment showed stunted growth and development. Wrack can facilitate initial propagule establishment, but can hinder propagule growth and survival over longer time periods.

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Patterns of amphipod feeding and phenolic content in apical and middle portions of invasive *Myriophyllum spicatum* and native *Ceratophyllum demersum*

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Although the factors leading to successful submerged plant invasions are poorly understood, high levels of chemical feeding deterrents in invasive plant species may be partly responsible. However, chemical deterrents are not always uniformly distributed within plant tissues, and little is known about how that may affect herbivore feeding patterns in aquatic and marine systems. To examine the distribution of phenolics within the tissues of invasive *Myriophyllum spicatum* and native *Ceratophyllum demersum*, 2-cm fragments were taken from the apex and middle portions of 10 individuals of each species. Analysis of total phenolic content in these tissues is currently underway. Previous work showed that phenolic content in whole *M. spicatum* plants is 2-3 times higher than in *C. demersum*. A no-choice feeding experiment showed that amphipods, the dominant herbivore at our study site, consumed significantly more middle than apical *C. demersum* tissue and ate very little *M. spicatum*. A choice feeding experiment confirmed that amphipods preferred the low-phenolic native *C. demersum* to the phenolic-rich invasive *M. spicatum*. We expect that apical portions of *C. demersum* will contain more phenolics than middle segments, which may allow *C. demersum* to divert grazing away from meristematic tissue critical for regrowth.

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Small- and large-scale variation in macroalgae morphology along a latitudinal gradient

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A shift in focus from species-based to trait-based ecology has the potential to transform ecology into a more predictive science. Much of the focus in trait-based ecology has been on understanding how traits vary among species and how traits relate to function. It is increasingly recognised that many traits display high levels of intraspecific variability with functional consequences. Temperate reefs are often dominated by few species of habitat-forming macroalgae that can display very high levels of morphological variability, suggesting much of the variation in important traits that relate to habitat structure is likely to be intraspecific. We conducted a large-scale study aimed at quantifying the morphological variability of dominant subtidal algae in the genus *Sargassum* along the east coast of Australia and tested the hypothesis that habitat structure varies predictably with latitude. Specimens were collected from eight sites (sub-tropical to cool-temperate) covering nearly 6° of latitude and ~900km, using 11 measures of morphology (incl. trait means and variances). We present multivariate analyses quantifying morphological variation at small scales (among individuals within sites) and large scales (among climatic regions). A better understanding of the relationships between functional traits and water temperature can help predict community responses to a warming ocean.

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Body size and competitor identity modulate prey consumption and feeding behaviour in a slow-moving benthic predator (*Asterias rubens*)

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We examined competitive interactions for variably-sized blue mussel, *Mytilus edulis*, between small and large, 3-week starved common sea star, *Aterias rubens*, and large rock crab, *Cancer irroratus*, or green crab, *Carcinus maenas* (in one-on-one sea star versus crab face-offs) from southeastern Newfoundland. Mussel consumption in *A. rubens*, and four components of its natural feeding behaviour, were quantified over 75-h trials in relatively cold (~4 to 6°C) seawater. Results showed that *A. rubens* (1) prioritizes consumption, upon contacting mussel prey, over non-feeding activities such as responding to physical contacts initiated by *C. irroratus* and *C. maenas*; (2) alters consumption and feeding behaviour under prolonged exposure to *C. irroratus*; and (3) perceives *C. maenas* as an incentive to explore habitat instead of a threat. The inclination to explore was greater in large than small *A. rubens*. Overall, findings demonstrate that *A. rubens*' foraging decisions can be based simultaneously on physiological and environmental conditions, while varying ontogenetically and with competitor's identity. Differences in consumption and feeding behaviour between *A. rubens* exposed to familiar (*C. irroratus*) or unfamiliar (*C. maenas*) competitors also suggest alterations to feeding patterns are a learned response affected by the timing and frequency of encounters with competitors.

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Can predator presence influence bioerosion?

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Boring sponges are one of the most prominent agents of calcium carbonate bioerosion in both temperate and tropical reefs. While there have been many studies that suggest bioerosion rates may be influenced by a multitude of environmental parameters including temperature, acidification, and light, there have been no substantial inquiries into whether boring sponges alter bioerosion rates in response to predation. Using the alkalinity anomaly technique, we sought to determine whether the temperate boring sponge *Cliona* sp. altered bioerosion rates of oyster shell in the presence of the known nudibranch predator, *Doriopsilla pharpa*. The results of this study demonstrate that boring sponges may increase chemical erosion in response to predators.

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Assessing population connectivity of the coral species, *Montastraea cavernosa*, across various spatial scales in Cuba and the Tropical Western Atlantic

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Recovery of threatened coral communities is dependent, in part, on successful recruitment of coral larvae sourced from both local and distant populations. Cuba has the largest shelf habitat in the Caribbean and is centrally located within the Tropical Western Atlantic suggesting that it is a likely crossroads for coral reef populations in the region. Based on ocean current patterns and species composition data we hypothesize that Cuba represents an important coral population source for coral communities in the Flower Garden Banks and Florida Keys. Despite its potential significance as a population source, the population structure of Cuba's coral communities has not been well characterized, nor have any previous studies characterized or sampled corals beyond 40 m in depth. Populations of the scleractinian coral, *Montastraea cavernosa*, were sampled from multiple sites in Cuba and were genotyped utilizing nine previously developed microsatellite markers. *M. cavernosa* is widely distributed among the Tropical Western Atlantic and is an extreme depth-generalist (depth range: 1-113 m) making it an ideal model organism to investigate both vertical and horizontal connectivity across regional scales. This research aims to inform cooperative management efforts in the U.S. and Cuba, which have been recently formalized through a Sister-Sanctuary Memorandum of Understanding.

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Modeling blue crab growth

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Blue crab growth is a stage based process dependent on size and temperature. Individual growth follows a logistic trajectory over the course of a typical year and does not conform well to the principles underlying von Bertalanffy styled growth (i.e. an assumed decreasing growth rate with respect to size). This creates a problem when attempting to estimate growth parameters using growth increment models with tag and recapture data. These models will erroneously attempt to fit a linearly declining regression line to derived growth rates using the resulting x-intercept to define the asymptotic carapace width (L_∞). One solution is to use a molt process model to simulate growth and then fit a seasonal von Bertalanffy curve to the simulated output. Using this approach we were able to simulate growth for blue crabs subjected to the average daily temperatures in Galveston Bay and then estimate the growth parameters. Simulations can be run under different scenarios, but a 15mm blue crab entering the Bay at the beginning of a typical year, that does not reach a terminal molt (as is usually the case for males), can be parameterized with the following seasonal growth parameters ($L_\infty = 220$, $k = 1.432$, $t_0 = 0.069$, $C = 0.779$, and $t_s = 0.634$).

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DNA sequence variation of the HIF1A gene in the Gulf killifish, *Fundulus grandis*

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Fundulus grandis, commonly known as the Gulf killifish, is a common baitfish in the warm gulf waters and serves as a model species for physiological tolerance to temperature, salinity, and hypoxia stress. Changes in oxygen levels due to warming waters and dead zones create a threat to marine life, thus there is a need to understand physiological mechanisms of hypoxia tolerance. When the killifish experience oxygen levels too low for survival, they flip over and float ventral side up. Killifish for this experiment were collected from bait wells after being harvested by shrimp boats in Cocodrie, Louisiana. They were then exposed to varying levels of oxygen and collected once they flipped over. Variation among individuals in the level of oxygen that was sustainable before flipping was apparent. A candidate gene for this variation in tolerance is Hypoxia-inducible factor 1-alpha (HIF1A). We will present DNA sequence data collected to test the hypothesis that variation in HIF1A is correlated with variation in hypoxia tolerance. Results from this experiment will have implications for understanding the physiological basis of hypoxia tolerance in this highly stress tolerant species.

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The effects of oil on northern Gulf of Mexico salt marsh nitrogen cycling

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The objectives of our study were to determine (i) the extent to which denitrification and DNRA are affected by oil spills in marshes, and (ii) if the contamination history of sites impact denitrification and DNRA with the addition of new oil. One site was moderately oiled (Chandeleur Islands, LA) following the 2010 *Deepwater Horizon* oil spill, while the other site was not affected (Dauphin Island, AL). Sediments slurries were incubated with and without water accommodated fraction (WAF) of oil and denitrification and DNRA were measured with the isotope pairing technique. Denitrification rates were lower in 100% WAF than in control or 25% WAF at Dauphin Island in July ($p < 0.05$) and lower in 100% WAF than in control in November ($p < 0.05$), but were similar at the Chandeleur Islands in August ($p = 0.528$). In contrast to DNRA, denitrification rates varied spatially and temporally in control samples ($p < 0.05$). DNRA rates were higher in 25% WAF than control or 100% WAF at Dauphin Island in July ($p < 0.05$). These results suggest that the introduction of oil may affect denitrification and DNRA in salt marsh sediments, but sites that were previously oiled appear to be more resilient.

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Beyond the mesophotic: community structure of Caribbean deep-reef fishes

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Mesophotic reefs extend from the lower limits of traditional SCUBA depths (~50 m) down to approximately 150 m. Mesophotic reefs harbor a unique assemblage of reef fishes that differs taxonomically and ecologically from fishes occurring on shallow reefs. The lower depth limits of mesophotic reef-fish communities have yet to investigated, largely due to logistical challenges in deep diving. The present dataset represents the most extensive record of fish communities from 50-300 m, which was obtained using manned submersibles at four localities throughout the Caribbean. Based on more than 12,000 fish observations, reef-fish community structure was compared across sites and along the deep-reef slope. These data suggest that while the taxonomic composition of deep reefs may differ somewhat between sites across the Greater Caribbean, the overall pattern of zonation and the depth at which faunal shifts occur (including the end of the mesophotic zone) are surprisingly similar across sites. Collectively these results serve as a robust baseline for comparing other deep-reef fish communities beyond the Caribbean, and for monitoring ongoing changes to deep-reef fish communities over time.

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The turnover of space in a barnacle dominated intertidal community: the interaction of temperature and predation

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In southwest England the barnacles *Semibalanus balanoides* and *Chthamalus montagui* occupy most of the space in the mid-intertidal of rocky shores. *Semibalanus* is thought to outcompete *Chthamalus* for space but *Semibalanus* is the preferred prey of the dogwhelk *Nucella lapillus*, which may liberate space and contribute to the survival of *Chthamalus*. We removed *Nucella* to determine the rate at which this predator generates space and contributes to the maintenance of *Chthamalus*. We also used thermal microclimates to evaluate whether predation is temperature-dependent. *Nucella* removal led to a significant decrease in *Semibalanus* mortality. For *Nucella* removal sites, the average monthly mortality of *Semibalanus* was 4.37%, whereas sites experiencing *Nucella* predation had an average mortality 13.7%. Surprisingly cooler sites had a higher average predation mortality than warmer sites, which resulted in lower densities of *Semibalanus* in cooler sites, despite the preferential settlement of *Semibalanus* in these microsites. We speculate this may be an indirect effect of temperature because *Nucella* congregates in cooler microsites and thus tends to forage near these sites. We assessed the rate of space turnover due to predation on *Semibalanus* relative to the rate recruitment to estimate the equilibrium abundance of these two barnacle species.

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A next generation approach to understanding diet of the European green crab *Carcinus maenas* in the Gulf of Maine.

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Traditional methods for quantifying diets in omnivorous consumers are limited to food items that can be precisely identified visually after partial digestion. DNA sequencing approaches avoid this limitation, by using the signal of unique DNA barcodes present in all potential food items. Here we apply a next generation sequencing approach to diets of green crabs in Casco Bay, Maine, a region that has been strongly impacted by a recent green crab invasion – including declining eelgrass beds and soft shell clam harvests. Our sampling design includes male and female crabs collected from two different habitats – eelgrass stands vs. mud flats; and spring and midsummer sampling dates to test for impacts of lobstering and lobster bait. We will present results of 96 mutliplexed crab gut samples amplified with algal, invertebrate, vertebrate, and eukaryotic barcoding primers and sequenced on a Illumina NextSeq platform.

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Impacts of ocean acidification on recruits of the temperate coral *Oculina arbuscula*.

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Rocky outcrops projecting from the sandy bottoms of the South Atlantic Bight (SAB) are colonized by sessile invertebrates that provide structural habitat for fish and mobile invertebrates. Long-term monitoring indicates that organisms inhabiting these ledges are subjected to high partial pressures of CO_2 (pCO_2) of ~800 ppm throughout the summer, suggesting that these invertebrates may be well-adapted to counter the corresponding decreases in pH. We investigated this possibility in O. *arbuscula* recruits, a branching coral common on SAB reefs that produces a $CaCO_3$ skeleton. In the laboratory, we exposed small colonies (5-12mm diameter) to 475, 711, and 1270ppm CO_2 for 75 days. Calcification rates and mortality were monitored throughout the experiment, while respiration rates, photosynthetic rates, zooxanthella densities, and soluble protein were determined at the end. As predicted, higher pCO2 did not impact survival, zooxanthella densities, or soluble protein. In contrast, both calcification rates and photosynthesis:respiration (P:R) ratios tended to be lower at higher pCO2. These results suggest that *O. arbuscula* recruits in the SAB may already be experiencing seasonal depressions in growth rate driven by natural fluctuations in oceanic pCO_2 and that these recruits may be vulnerable to longer term pCO_2 increases resulting from continued fossil fuel emissions.

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Benthic meiofauna communities in Weddell Sea, Bransfield Strait and Drake Passage (Antarctic) depend on oceanographic and topographic conditions

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The marine environment of the tip of the Antarctic Peninsula is characterised by three oceanographically distinct regions. The continental-slope meiofaunal patterns and a set of 16 environmental variables were linked on a large scale (100–300 km among ecoregions). Significant differences were detected between the communities of Weddell Sea and those of Bransfield Strait and Drake Passage. The amount of phytopigments in the sediment, their freshness and the silt and clay content were driving factors for this separation. The highest meiofauna abundances were found in the Weddell Sea. Food banks may facilitate the highest copepod percentages ever recorded for the Antarctic and extremely abundant nematodes even in deeper sediment layers. For Bransfield Strait and Drake Passage a sampling scheme of slopes and adjacent troughs was applied. Multivariate non-parametric permutational analysis of variance showed that in Bransfield Strait slope and trough meiofauna communities differed significantly. These differences were explained best by the regionally and topographically distinct characteristics related to sediment grain size, food quantity and quality, water temperature and salinity. Environmental drivers of the benthic habitat are dependent on large-scale oceanographic conditions and are thus sensitive to changes in water mass characteristics, sea-ice cover and the related primary production.

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Antarctic benthic functioning and the role of meiofauna – a question of time?

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For the Southern Ocean little is known about the role of meiofauna (size class 32–1000 µm) in benthic remineralisation processes. Previous studies showed that meiofauna incorporated only small amounts of added food sources. In experiments with sediments from Bransfield Strait or from the Antarctic deep sea nematodes contributed negligibly to carbon remineralisation. As part of the project 'Role of meio- and macrofauna in benthic ecosystem functioning: Testing effects of different ice cover regimes' we investigate 1) the time span meiofauna communities need to incorporate and 2) the response of different meiofauna compartments (copepods vs nematodes) to food input. During the RV Polarstern expedition PS96 we performed an on-board pulse-chase experiment with the longest experimental time span so far. ^{13}C- and ^{15}N-isotopically marked microalgae (*Chaetocystis* sp., 3.3 mg per core) were added to sediments from the high Antarctic Weddell Sea shelf (483 m). Samples were taken after 1, 3, 6, 12 and 18 days. With this experiment we complete a set of stations sampled for natural stable isotope distribution and benthic functioning incubations. The results will enable us to assess whether meiofauna react with a time lag compared to macrofauna and whether they prefer degraded or fresh organic matter.
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The new fad diet: the effect of predator diet on the phenotypic plasticity of bay scallops *(Argopecten irradians)* by the common spider crab *(Libinia emarginata)*

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The phenotypic plasticity of an organism can be influenced by a multitude of factors. In this experimental trial, the phenotype of juvenile bay scallops *(Argopecten irradians)* was examined in the laboratory. For 8 weeks, bay scallops (10-14 mm) were maintained in a shared, flow-through, tank system with spider crabs (*Libinia emarginata*) assigned a specific dietary treatment (scallop-fed, mussel-fed, or starved). The effect of this chemosensory exposure was later determined by measuring changes in phenotypic parameters including growth rate, weight, and shell strength. A significant difference was found in growth rate among all experimental treatments at ~4 weeks. High mortality of bay scallops occurred in some treatments more than halfway through the experiment. At 8 weeks, all remaining individuals were weighed and crushed, however no significant difference were found in shell strength or weight in the surviving groups.
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Influence of sponges on growth, survivorship and skeletal density of nursery-grown staghorn coral *Acropora cervicornis*

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Coral reefs are undergoing a worldwide decline, and such has been the case for the staghorn coral (*Acropora cervicornis*), an important reef-building species of the Caribbean considered as critically endangered by the IUCN. As a way to mitigate its loss, an effort is being put on coral restoration techniques such as coral gardening. Here we report preliminary results from an ongoing study of three staghorn coral nursery treatments with the purpose of determining the possible effects that sponge-derived nutrients, via the trophic 'sponge-loop', might have on growth, survivorship and skeletal density of the coral fragments. Preliminary data shows higher growth rates for the control group consisting of corals nursery frames with only cinderblocks beneath them, followed by the cinderblocks with sponges attached to them (sponge treatment), and lastly by the control group of corals only. We hypothesize that the cinderblocks may increase coral growth by increasing turbulence around the coral fragments, which in turn lowers the boundary layer surrounding the fragments and increases nutrient uptake. Alternatively, fish and invertebrates that colonize the blocks may also have a yet undetermined effect on coral growth through grazing or nutrient deposition. Interestingly, even when accounting for branch number in the analysis, the number of branches on a coral fragment appears to have a positive effect on its growth.
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Oyster reef restoration effects on estuarine productivity in St. Charles Bay, Texas

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Eastern oysters (*Crassostrea virginica*) are an ecologically important species along the Texas Gulf coast that perform several ecosystem services. Oyster reefs provide habitat provision for estuarine species, protection of shorelines, and enhancement of water quality. Oyster reefs can increase local biodiversity by providing complex three-dimensional habitat for fishes and macroinvertebrates. Oysters are directly affected by anthropogenic activities therefore, oyster reef restoration can be beneficial to support estuarine communities. Approximately 600 linear meters of oyster reef were restored using recycled oyster shells in St. Charles Bay, TX, in summer of 2017. Sampling trays were placed on the restored reef and a nearby reference reef. Ecological monitoring has been conducted before and after the placement of trays at each site to compare the effects of restoration efforts. Our hypothesis is that the abundance and size of oysters as well as the abundance, biomass, and diversity of fishes and macroinvertebrates on the restored reef will become more similar to the reference reef over time.
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The Deep-sea ecosystem: assessment of the biodiversity and abundance of deep-water fauna in the Exuma Sound, Eleuthera, Bahamas and the Northeastern Gulf of Mexico.

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The limited knowledge of the deep-sea is a paramount concern, affecting our ability to assess the overall health of the ocean's ecosystem. Technology has made deep-sea fishing more accessible, but management plans cannot be implemented on ecosystems lacking fundamental information of the biology and species within them. Comprehensive ecological studies are needed to identify factors that may influence distribution and abundance of the faunal groups that are becoming commercially relevant. This observational study was conducted over a 3-year period to provide an assessment of physical, environmental, and biological factors that drive benthic and benthopelagic community structure and function in Exuma Sound, the Bahamas. A series of 115 deep-sea traps were sampled from 360 to 1480 meters deep from spring 2014 to spring 2017. During this study two new species were discovered *Booralana maxeyorum* and *Booralana sp. nov*. Crustaceans dominated the catch (98%) with teleosts (1.2%) and elasmobranchs (.1%) contributing the rest. We describe the community structure and assemblages of the deep-sea crustacean fauna, which will provide additional information to the benthic ecosystem of the deep-sea for future management in this area.

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Stinky snails: Chemical cues of *Crepidula fornicata* and their effect on the forging ability of chemosensory predators

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Many aquatic invertebrates rely on chemical cues to survive in their habitats. *Crepidula fornicata* beds represent an important habitat and food source for various species; however, it is largely unknown whether the chemical released by these snails can interfere with the ability of sympatric species to detect predators or prey. Mesocosm, flume, and tethering experiments were conducted to examine whether chemical cues emitted by live *Crepidula* affect the foraging activity of the mud crab (*Dyspanopeus sayi*), a chemosensory predator. In mesocosms, mud crabs foraged for blue mussels (*Mytilus edulis*), in both the presence and absence of cues from live *Crepidula* for 40 hours. In a Y-maze flume study, crabs were given a choice between *Crepidula* or no *Crepidula* treatments, in combination with either bay scallops (*Argopecten irradians*) or mussels. In 24 hour field experiments, scallop survival was compared in a sandy habitat versus a *Crepidula* bed. In both mesocosm and flume experiments, the presence of *Crepidula* chemical cues exerted a significant effect on the predatory activities of mud crabs. In tethering experiments, scallop survival rates were low but no differences were observed between habitats. The potential benefits of *Crepidula* chemical cues as a habitat refuge for sympatric bivalves is discussed.

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The effects of mitochondrial genotype on the behavioral response to temperature stress in European green crabs *Carcinus maenus*

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Mitochondrial and nuclear DNA analysis has clearly demonstrated that the European green crab (*Carcinus* maenas) has spread throughout the eastern coast of North America through multiple cryptic invasions – one from Southern Europe establishing in Southern New England, and a more recent invasion from Northern Europe to the Canadian Maritimes. A previous study which utilized the European source populations of this double invasion showed that Northern European crabs are more cold tolerant and less heat tolerant than Southern European crabs, but genotypic links to stress phenotypes remain poorly understood. Previous work in the Carlon Lab has shown that mitochondrial genotype influences the behavioral response to cold stress, so that mitochondrial lineages from northern populations tolerate colder water compared to mitochondrial lineages from southern populations. Here we compared the behavioral performance of individual crabs of known mitochondrial genotype to both cold and heat stress, to test the hypothesis that there is a trade-off in performance at cold and hot extremes. Behavioral performance was determined by inverting crabs and observing whether they right themselves. To determine mitochondrial genotype, the marker cytochrome oxidase I (CO1), was amplified sequenced using Sanger Sequencing. I will present data from populations collected from the Bay of Fundy, Gulf of Saint Lawrence, and Gulf of Maine, selected for varying frequencies of mitochondrial lineages.

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The ability to describe allometric differences in functional morphology among saltmarsh plant species

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Recognition that a nonlinear regression approach may be more appropriate, comparing allometric relationships among species present statistical challenges. The use of standard allometric methods to compare relationships among two or more species involves logarithmically transforming bivariate data, applying a linear regression model, and statistically comparing parameters among regressions. Statistical comparisons of allometric parameters for nonlinear regressions are challenging because of the complex associations among variables and parameters in the model. To investigate the suitability and value of linear or nonlinear approaches, allometric relationships between C3 (sea oxeye) and C4 (cordgrass) saltmarsh plants are examined. Initial standard allometric analyses suggest species differences exist for size-mass relationships. Additional assessment of data characteristics to determine whether linear or nonlinear approaches should be used and how to analyze (e.g., nonlinear ANCOVA) and interpret parameter differences between species if nonlinear regression is required will be discussed.

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Rates and consequences of sublethal hypoxia exposure for demersal fish in the northern Gulf of Mexico quantified with geochemical markers

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Reconstructing patterns of bottom-water hypoxia exposure in mobile fishes is essential to estimate population responses to this widespread environmental stressor. The chemistry of fish ear stones, or otoliths, offers a unique opportunity to identify sublethal hypoxia exposure using redox-sensitive chemical markers that record lifetime exposure histories for individual fish. This approach was used to quantify the proportion of Atlantic Croaker (*Micropognias undulatus*) exposed to hypoxia in the northern Gulf of Mexico, which experiences widespread summertime hypoxia every year. The proportion of fish with sublethal hypoxia exposure during their first year of life was relatively consistent among sampled geographic regions (32-34%), indicating that exposure was common enough to have important consequences for reproductive sustainability. Young-of-year croaker exposed to hypoxia were smaller in length and mass, but had similar mean relative condition factors to croaker of the same year class experiencing normoxic conditions. Finally, tissue stable isotope measurements were coupled with otolith chemistry to assess whether hypoxia displaces demersal foragers to pelagic food webs, and found evidence for benthic food web displacement in some years. The effects of hypoxia are thus complex, and otolith chemistry offers a novel way to unravel the dynamics of this growing environmental stressor.

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Temporal variation in the recruitment of biofouling organisms at Port Canaveral, Florida

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Biofouling, or the unwanted growth of plants and animals, presents numerous challenges to marine industries and can aid the spread of invasive species. In order to develop targeted solutions, it is important to understand the early stages of biofouling. A study was designed to investigate the relationship between recruitment of fouling organisms to changes in salinity and temperature at Port Canaveral, FL. Every month, six optically clear, polycarbonate panels (20 x 10 x 0.15 cm) were immersed for a period of three months to observe how the community changed through time. Each week, panels were photographed and the backs of the panels scanned on a desktop scanner. Panel scans enable the base of the organisms to be observed through the clear polycarbonate allowing for identification of new recruits and tracking their rate of growth. To test if fouling pressure varied throughout the year, panels were weighed and visually assessed for percent cover by macrofouling organisms. Temperature and salinity at the test site were recorded by a HOBO every half hour. Statistical analyses utilizing multivariate statistics, repeated measures ANOVA and correlation analysis were used to describe the differences in community structure, fouling pressure and relationships to the seawater temperature and salinity.

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Ocean Bitemap: global and local drivers of shallow water predation intensity

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Fundamental constraints on marine primary production are globally resolved through remote sensing, yet we lack a detailed picture of top-down pressure in the sea. Prey consumption translates energy and materials through food webs, and rates of consumption are vital for predicting fisheries production and understanding global gradients of productivity and diversity. Our group of 40 collaborators (co-author list: bitemap.wordpress.com) measured predation on standard prey (dried squid) in paired seagrass and unvegetated habitats at 80 sites in 16 countries across 105 degrees of latitude, and simultaneously censused predator communities. Predation intensity was strongly influenced by thermal context: predation increased with annual and in situ temperature. Predator diversity and biomass were higher in seagrass habitats, but this did not translate to consistent differences in predation intensity between habitat types. Interestingly, the influence of predator diversity varied by habitat: predation intensity tended to decrease with increasing predator diversity in seagrass, but increased at higher predator diversity in unvegetated habitats. These results suggest that predation responds strongly to regional environmental conditions (notably temperature), but is also sensitive to local diversity and functional composition. A major implication of our findings is that climate change can alter both bottom-up and top-down processes in marine ecosystems.

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Predicting benthic foraging habitat for Gulf sturgeon throughout the Gulf of Mexico

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Gulf Sturgeon, *Acipenser oxyrinchus desotoi*, is listed as threatened, with critical habitat identified throughout the northern Gulf of Mexico (GOM). Because not all critical habitat provides equivalent foraging value, reliably identifying areas of relatively high vs. low prey abundances is an important management goal. This study provides an uncommon examination of spatial trends in prey assemblage composition across the Gulf Sturgeon's range and establishes the consistency of correlations between prey composition and physical features of bottom habitat. Gulf Sturgeon prey assemblages differ significantly across the northern GOM, with a dominance of amphipods on the northwest coast of Florida, polychaetes in the central northern GOM, and bivalves in Louisiana and Mississippi Sound. Analyses of sturgeon telemetry data, benthic prey abundances, and corresponding sediment grain size indicate Gulf Sturgeon feed in sandy areas at 2-4 m depths. Management on a scale smaller than the GOM should be considered.

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Estimating enhancement of faunal production resulting from oyster reef restoration

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Crassostrea virginica, the Eastern oyster, can be quite extensive and is found throughout the Western Atlantic and U.S. Gulf of Mexico. Although *C. virginica* reefs are an integral part of marine and estuarine systems throughout their range, they have been severely degraded compared to historic levels. Half Moon Reef is located in Matagorda Bay, TX. This historic *C. virginica* reef was originally 500 acres, but intensive dredging throughout the 1900's destroyed the infrastructure of the reef and led to the collapse of the oyster population. In 2013, The Nature Conservancy restored approximately 60 acres of Half Moon Reef. The purpose of this study is to estimate the enhancement of fish and macroinvertebrate production resulting from the restoration. Field samples have been collected from the reef every 3 months for the past 4 years. We will use these data to calculate the per-unit-area enhancement of production expected from the restoration of oyster habitat. The information gained will be important in the future for stakeholders investing in oyster reef restoration in the region in the future.

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Investigating the connectivity of Florida Caribbean spiny lobster *Panulirus argus* recruits using stable isotope analysis

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The limited information available on the recruitment dynamics of the Caribbean spiny lobster *Panulirus argus* (Latreille, 1804) has long been an issue for biologists, as well as fishery scientists, in the study of this species. The long pelagic larval stage and circulation in the Caribbean Sea has led many researchers to hypothesize that Caribbean lobster stocks are demographically open, implying connectivity among stocks in this region. Multiple approaches have been applied to investigate potential stock connectivity in this species, including bio-physical modeling and genetic markers. Stable isotope analysis has proven to be a useful tool to study the connectivity among the populations, and has been widely applied in studies of both terrestrial and aquatic species. However, this method has never been applied to Caribbean spiny lobster recruits. In this study, we performed carbon and nitrogen stable isotope analyses on four stages of lobster pueruli (the non-feeding clear, semi-pigment and pigment stages, as well as the juvenile feeding stage) that arrived in the Florida Keys from August 2014 to July 2016. Results indicated that values of stable isotope ratios differed between the feeding and non-feeding stages. The $\delta^{13}C$ and $\delta^{15}N$ of the lunar monthly samples displayed huge temporal variation and oscillated during the two-year sampling period. Cluster analyses of the stable isotope values suggested that four clusters could have contributed to the observed Florida recruits. The results of our study reveal the possibility that the Florida spiny lobster stock receives recruits from multiple source populations outside Florida, in addition to self-recruitment.

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Degradation and resilience of seagrass community and food web structure following a direct impact by Hurricane Harvey

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Disturbance is recognized as a major organizing force in marine communities and hurricanes may serve as a natural experiment to examine how different forms of disturbance interact to affect ecosystem structure and function. Hurricane Harvey made landfall August 25, 2017 on San Jose Island, Texas as a Category 4 storm. The intense wind energy and storm surge was a devastating physical force and the extreme rainfall and freshwater run-off created a low salinity event that persisted for months. We documented losses in physical habitat structure of seagrass (*Thalassia testudinum*) meadows and attempted to tease apart effects of multiple stressors associated with the storm on biodiversity and food web structure. Severe but localized losses in seagrass cover resulted in cascading declines in epifaunal and mesograzer abundance and diversity, indicating an extreme shift in the base of the food web. These effects did not appear to propagate to the highest trophic levels, however, as predation rates did not vary between impacted and reference sites. These initial results highlight the complex impacts of the two forms of disturbance on seagrass food webs, with lower trophic levels displaying high vulnerability to loss, while higher trophic level interactions were more resistant to hurricane impacts.

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Testing for local adaptation across short and tall growth forms of *Spartina alterniflora*

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Salt marshes along the US Atlantic coast are characterized by two growth forms of the dominant plant, *Spartina alterniflora*: tall-form plants at low elevations and short-form plants at higher elevations. It remains unclear whether these distinct growth forms result from environmentally induced or genetic differentiation, and thus whether short-form plants will be able to modify their morphology in response to increasing inundation associated with sea-level rise. To test the potential for local adaptation, we conducted both a common garden experiment and field reciprocal transplant experiment and quantified plant survival, growth, and morphology. Our common garden experiment illustrated that tall-form *Spartina* seedlings were taller (~4cm) than short-form *Spartina* seedlings, indicating that phenotypic variation in height has a genetic component. In our field experiment, survivorship in the tall zone was low, regardless of transplant origin. However, of the surviving plants in the tall zone, tall-origin transplants were taller, had higher above-to-belowground biomass, and tended to produce more seeds than short-origin transplants, indicating that local adaptation may occur across tidal elevations. These results suggest that the ability of tall-form *Spartina* to migrate landward is vital to stabilizing the retreating marsh edge.

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A facilitation cascade in seagrass beds enhances community diversity

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Facilitation cascades occur when primary foundations species promote the settlement and survival of a secondary foundation species that further enhances ecosystem functioning or structure. We experimentally tested if a facilitation cascade occurs between eelgrass (*Zostera marina*), pen clams (*Atrina rigida*) and epifaunal diversity in temperate seagrass beds and, in turn, if this sequence of direct positive interactions has feedbacks that affect seagrass productivity, algal biomass, and decomposition. Using a combination of surveys and transplant experiments, we found that pen clam settlement and survivorship was significantly greater in seagrass beds compared to adjacent sandflats. Pen clam establishment in turn facilitated the settlement of fouling organisms, algae, and associated invertebrate fauna thus enhancing biodiversity, the effect of which scaled with increasing pen clam density. We did not detect an impact of pen clam presence or density on seagrass functioning other than provisioning of biodiversity. Our findings add to the growing amount of literature that suggests secondary foundation species, such as pen clams, can enhance the abundance and richness of seagrass communities. Although increased biodiversity did not translate to increased functioning in our experiments, it may under alternative scenarios.

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Black mangrove seedling survival and growth rates in different salt marsh habitats under moderate and hypersaline conditions

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Changing temperatures and precipitation patterns are predicted to alter coastal ecosystems such as black mangroves (*Avicennia germinans*) encroaching into salt marshes. Understanding how interactions with marsh species and multiple stresses affect *Avicennia* seedling growth can provide insight into which coastal habitats may be more vulnerable to encroachment. A reciprocal transplant experiment and an observational field study within different habitats were used to investigate *Avicennia* seedling survival and growth under moderate and hypersaline conditions in south Texas. In the transplant experiment, only 1 seedling of 357 propagules survived after 60 days. Seedlings in the moderate salinity site had higher survival rates than those in the hypersaline site; seedling survivability was similar in succulents and *Avicennia* habitat types. Seedling survival rates were similar between moderate and hypersaline natal sites, suggesting there was no local adaptation. Naturally recruited seedlings in moderate salinity were taller and had a faster growth rate than those in the hypersaline site. Seedling growth rates in hypersaline conditions varied depending on habitat type. Collectively, *Avicennia* seedlings had higher survival and growth rates in the moderate salinity site, suggesting these coastal areas may be more vulnerable to mangrove seedling recruitment, survival, and subsequent mangrove stand encroachment.

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Regional differences in trophic interactions among marsh-associated fishes

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Coastal salt marshes are generally considered valuable nursery habitats for many economically important fishes. However this vital habitat is only accessible to transient marsh visitors when the marsh platform is flooded greater than 5 cm. Along the Gulf and East coasts of the United States, marsh flooding varies greatly due to differences in both astronomical and meteorological tides. These regional differences in tidal amplitude and duration can alter the amount of time transient fishes are able to forage on and immediately adjacent to the marsh platform, having implications for the types and volumes of prey in diets of these mobile fishes. We conducted a literature review of estuarine fish diets and habitat characteristics of salt marshes from Texas to New York. Preliminary results indicate marsh-platform species appear almost completely absent in the diets of transient fish species in the Gulf of Mexico, while along the Atlantic coast marsh-platform species appear regularly in the diets of many estuarine fishes. The trend that no marsh-platform species in the diets of transient fish could have implications for energy flow from marsh habitats or indicate that in the Gulf there are alternative pathways for marsh energy to subsidize secondary consumer biomass in estuarine waters.

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Assessment of eelgrass resilience and recovery following Hurricane Sandy

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Hurricane Sandy in 2012 had devastating impacts to coastal regions of New Jersey and the Mid-Atlantic with damage to infrastructure, homes, and natural ecosystems. In particular, the storm negatively impacted Submerged Aquatic Vegetation (SAV) beds, attributed to storm surge, island breaches, flow acceleration, and erosion. We assessed SAV beds from donor and restoration sites in 2010, 2013, and 2017 to determine initial storm impacts and subsequent recovery post-disturbance. Results from this work indicate that for some sites, spatial coverage was severely to moderately depleted in 2013, but now show signs of recovery. This includes both donor and restoration sites, although trajectories vary among sites. One critical piece of information that needs to be clarified is whether any declines in genetic diversity resulted from this significant stochastic event. New Jersey eelgrass populations, in particular, already showed signs of low genetic diversity and bottlenecking, but how the region recovers genetically is still unknown.

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Effects of extreme freshwater events and *Perkinsus marinus* on *Crassostrea virginica* stress response

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Eastern oyster (*Crassostrea virginica*) community structure depends largely on freshwater inflows and the influence these inflows have on salinity. Increasing salinity, particularly in combination with high temperatures, is known to decrease oyster growth and increase parasitism by the protozoan, *Perkinsus marinus*, the causative agent of Dermo disease. However, the effects of extreme freshwater events on *P. marinus*-*C. virginica* interactions are less well understood. We examined the effects of freshwater events of different magnitudes on stress response of oysters with variable levels of *P. marinus* infection in controlled laboratory experiments using the physiologically based index scope for growth. Oysters were collected from Texas bays and were subjected to one of six salinity treatments (<5, 5, 10, 15, 20, and 25) for five days. Physiological parameters such as oxygen consumption, ammonia excretion, clearance rate, and absorption efficiency were then measured to determine the overall energy available for growth and reproduction. Oysters were then sacrificed to quantify *P. marinus* infection. Results will improve understanding of the role of short-term freshwater inflow events on host-parasite interactions and provide information to guide water and natural resource management decisions.

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Conflicts in scale: temporal and spatial variation in larval settlement and post-settlement growth in marine mussel populations

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Recruitment depends upon adult input, larval success and dispersal, and post-settlement growth and survival, all of which have been poorly studied. We examined larval settlement and post-settlement success in a population of mussels (*Mytilus edulis* and *M. galloprovincialis*) in southwest England. We specifically assess the spatial scale of settlement and post-settlement growth among populations across a region expected to be interconnected by larval dispersal. We identified cohorts of spat, which were used to determine growth rate. We used flow cytometry to determine the concentration of nanoplankton (putative food source for spat). We found that multiple settlement events occurred during the summer season, with the largest events occurring in the spring. There was variation in the timing of settlement and the quantity of recruitment across locations. However, we found growth rates to be similar across all sites which is consistent with the result that nanoplankton concentrations were relatively uniform across sites. We conclude that the spatial scale of processes regulating larval settlement is substantially smaller than the spatial scale of those processes regulating the growth of spat.

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