

ABSTRACTS



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The effect of predation and flow exposure on growth and morphology of *Spirobranchus gaymardi* polychaete worms

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The common Christmas tree worm, *Spirobranchus gaymardi*, is a serpulid tube-dwelling polychaete with several morphological features, including branchial crowns for filter feeding and calcareous spines located at their tube entrances. Variation in these features may be influenced, in part, by the intensity of both water flow and predation, but these interactions are not well-studied. The goal of this research was to examine the effects of water flow and predation intensity on the spine length and aperture width, as well as branchial crown and operculum damage. In Mo'orea, French Polynesia, surveys of serpulids across five different sites with a range of low-to-high flow conditions revealed that serpulid size did not vary consistently with flow intensity, although increased spine length was found in medium intensity flow environments. A spine removal experiment, designed to mimic natural predation, revealed that broken spines grew 167% more compared to control (intact spine) treatments, demonstrating the energy investment of serpulids into spine re-growth. However, spine length did not significantly differ between serpulids exposed to or protected from predation. Thus, morphological variation among *S. gaymardi* serpulids is more complex than has previously been appreciated, and the ecological function of serpulid spines has yet to be determined.

Grad, Poster

The Indian River "LaGoonies": Protecting the most biologically diverse estuary in North America.

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Dive under the water with a group of environmental scientists working with the St. Johns River Water Management District (SJRWMD) to experience the everyday restoration and preservation efforts of the Indian River Lagoon (IRL) system.

The Indian River Lagoon system, America's most biologically diverse estuarine system, has been dramatically affected by anthropogenic activities over the years. Seventy-five percent of salt marsh and mangrove wetlands have been lost or altered due to excessive freshwater discharges from Lake Okeechobee and the St. Johns River. Nutrient-laden waste and stormwater runoff have increased suspended solids, color, chlorophyll and turbidity, negatively impacting water quality. Decreased water quality coupled with increased algae growth reduce available light for photosynthesis and greatly inhibit seagrass growth. To restore and preserve the lagoon, Florida's DEP SWIM and the EPA's NEP programs merged in 1996 to create the IRL Program. Under the sponsorship of SJRWMD, the IRL Program works to improve water and sediment quality, monitor seagrass beds, and encourage public awareness of the lagoon's fragile ecosystem.

Fac, Film

Consequences of male rarity: effects of pollen limitation on seed production, recruitment, and progeny vigor in *Phyllospadix torreyi*

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Determining whether seed production is limited by pollen availability has been an area of intensive study; yet little is known regarding the potential for pollen limitation in hydrophilous plants, especially in the marine environment. We examined sex ratio and seed production, recruitment and viability in the marine

angiosperm, *Phyllospadix torreyi* (Torrey's surfgrass) near Santa Barbara, California. Our results indicated reproduction and recruitment of *P. torreyi* occur on a scale generally localized to the parental source (10s of meters). Female reproductive success ratio (RSR), the ratio of viable seed to total ovules, increased with local pollen production. Low RSR at sites with extreme male rarity suggested pollen limitation was occurring within this system. Not surprisingly, low RSR occurred at sites with extreme male rarity, but was also seen across the range of male availability. Seed recruitment was predicted by local (site) seed production and tidal elevation. However, the occurrence of seed production and recruitment at sites with extreme male rarity suggests some dispersal of seed and pollen extending beyond the immediate vicinity of the site. These data provide evidence that female bias is common in *P. torreyi* and that pollination and seed recruitment occur at a more localized scale than previously believed.

Professional, Oral

Developing a method for agarose-based multiple-nutrient enrichment on wave-swept rocky shores.

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As anthropogenic nutrient inputs to aquatic environments have increased, a variety of methods have been developed to test the impacts of enhanced nutrients, both in the field and in the laboratory. It is known that nutrients affect community structure and ecosystem functioning, but the effects of multiple nutrients (e.g., N+P), and their potential to interact, remains unclear. We adapted a technique, previously used in low-flow estuarine habitats, to control the identity of nutrients being added in experimental plots on New England rocky shores. Nitrate (NO_3^-), phosphate (KH_2PO_4^-), or both nutrients together were dissolved in a 3% agarose solution. These solutions were poured into perforated PVC cap fittings and screwed into a base that was bolted to the intertidal reef. Treatments were left in the field for two weeks. Daily water samples were taken adjacent to each dispenser as the incoming tide washed over them in order to track water column enrichment. All water samples were analyzed for NO_3^- and PO_4^- concentrations to determine the effectiveness of this technique. Using these dispensers, we successfully elevated water-column NO_3^- and PO_4^- relative to controls, and further experiments will evaluate effects of N, P, and N+P additions on community and ecosystem structure and function.

Grad, Poster

Spatial dynamics of the blue crab *Callinectes sapidus* fishery in Chesapeake Bay.

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In recent years, overexploitation and habitat degradation have contributed to precipitous declines in the spawning stock and juvenile recruitment of Chesapeake Bay (CB) blue crabs. Fishery managers in Maryland and Virginia have recently coordinated the adoption of strict harvest restrictions across jurisdictions. However, little is known about spatio-temporal dynamics of catch, particularly recreational harvest, which can be a significant component of total catch. Thus, a mark-recapture experiment was conducted in multiple locations in the Maryland portion of CB, during 2007-2009 to estimate: 1) recovery rate; 2) tag-reporting rate; 3) fishery composition. To date, nearly 30% of tags have been reported. Harvest rates were high throughout most of the study period, but comparable with Baywide estimates. Tag-reporting rates were also high for all fishery sectors, indicating a high level of cooperation with most fishers. The recreational catch was a considerable component of overall harvest (~20-35% per year), much larger than previous Baywide estimates. Differences among years were noted, possibly in response to changes in fisher behavior due to newly imposed management regulations. These data provide an important understanding of the complex nature of the CB blue crab fishery.

Fac, Oral

Drift algae impacts on seagrass at selected sites in the Indian River Lagoon: Field experiment design and preliminary results.

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Drift algae is extremely important to the ecology and productivity of the lagoon, often extending the viable habitat beyond the deep edge of the seagrasses. However, prolonged accumulations of drift algae can reduce the light reaching the underlying seagrasses. The results of a pilot study that assessed the impacts of drift algae on seagrass density levels will be presented, along with a follow-up enclosure experiment. The follow-up enclosure experiment is still on-going but preliminary results will be reported. In the pilot study, an extremely high biomass of drift algae was loaded into a pair of enclosures that initially contained about 78% seagrass density. At the end of week 6, the seagrass densities within the algae enclosures averaged 1% and the controls averaged 85%. The follow-up enclosure experiment consisted of 24 plots composed of 1 control and 5 caged treatment levels of drift algae biomass per block (4 blocks). The initial seagrass density for this experiment was 62-72%. In the highest algae treatment plots at week 6, the seagrass density average was 5% compared to an average 85% in the control plots. The treatment cages with the lowest algae load (2 kg wet weight m⁻²) averaged 49% at week 6.

Fac, Oral

Oyster (*Crassostrea virginica*) health and ecosystem function among tidal creek estuaries in Southeast, North Carolina

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Crassostrea virginica is one of the most common organisms identified from intertidal and subtidal environments throughout its range. In Southeastern North Carolina oysters are predominantly intertidal. *C. virginica* are considered ecosystem engineers, influencing and being influenced by local conditions (TSS level, sedimentation rates, background nutrient levels among others...). In New Hanover County, NC there are several tidal creek systems with varying anthropogenic impacts and conditions. Water quality in these systems tends to respond relatively quickly to changes in the local watershed. This study evaluated the change in density, size demography, sex ratios, and condition index of oysters in both the lower and upper regions of the tidal creek systems. Preliminary data show shift in sex ratios and condition between sites in some creeks. Interestingly, size distribution seems fairly consistent among creek systems that vary in measures of anthropogenic impacts. We have also found that oysters serve as substrates for considerable biomass of microalgal primary producers, suggesting potential for interesting interactions with dissolved and particulate materials.

Fac, Oral

Facilitation cascade drives positive relationship between biodiversity and invasion success

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The pervasive impact of invasive species has motivated considerable research to understand how characteristics of invaded communities, such as native species diversity, affect the establishment of invasive species. Efforts to identify general mechanisms that limit invasion success, however, have been frustrated by disagreement between landscape-scale observations that generally find a positive relationship between native diversity and invasibility and smaller scale experiments that consistently

reveal competitive interactions that generate the opposite relationship. Here we experimentally elucidate the mechanism explaining the large-scale positive associations between invasion success and native intertidal diversity revealed in our landscape-scale surveys of New England shorelines. Experimental manipulations revealed this large-scale pattern is driven by a facilitation cascade where ecosystem-engineering species interact nonlinearly to enhance native diversity and invasion success by alleviating thermal stress and substrate instability. Our findings reveal that large-scale diversity-invasion relationships can be explained by small-scale positive interactions that commonly occur across multiple trophic levels and functional groups. We argue that facilitation has played an important but unrecognized role in the invasion of other well studied systems, and will be of increasing importance with anticipated climate change.

Fac, Oral

Patterns of Native and Invasive alpha and beta Diversity in San Francisco Fouling Communities

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Coastal ecosystems represent one of the most invaded systems on the planet, and a high proportion of invasive species have successfully established within fouling communities in bays and estuaries worldwide. We explored patterns of native and non-indigenous α -diversity (diversity within a community), γ -diversity (landscape or regional diversity) and β -diversity (species turnover or change in species composition from site to site; γ/α) in San Francisco Bay marine fouling communities. We surveyed replicate three month old fouling communities (n=20) and identified diversity in ten sites across the bay during multiple summers (2000, 2001). A subset of these sites was re-surveyed intensively in 2006, 2007, and 2008. Results indicate that native α -diversity was consistently lower than non-indigenous α -diversity. In contrast, native β -diversity was high in comparison to non-indigenous β -diversity. This indicates that invasive species are distributed ubiquitously throughout the Bay, but native species are quite patchy. When the effect of dominant species (mostly solitary tunicates such as *Ciona intestinalis*, *Ciona savignyi*, *Styela clava*, and *Ascidia zara*) on diversity was considered, decreases were seen in α -diversity and β -diversity. The effect of dominant species in this system may have a stronger influence on overall community diversity at both local and regional scales.

Grad, Oral

Do native prey recognize invasive lionfish as predators?

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To avoid predation prey need to recognize their predators. Native species are sometimes naive to invasive predators and do not respond to their presence with effective avoidance behavior. Lionfish, a predatory invasive species from the Indo-Pacific, are spreading rapidly throughout the Caribbean. By consuming young reef fish, lionfish appear to negatively affect coral reef fish populations. We used the ongoing invasion of lionfish on the Bahamas to assess prey responses to a novel marine predator. In experimental trials we found that avoidance behavior of prey differed between lionfish and four native predator species (Nassau grouper, red hind, schoolmaster, and yellowtail). Additional field observations showed that small Caribbean fish (<5cm TL) approached lionfish closer than native predators. The lack of recognition of novel predators is the most damaging form of prey naiveté (because it negates most anti-predator responses) and could partially explain the invasion success of lionfish in the Caribbean. The long-term impact of lionfish will partially depend on whether or not native prey can adapt and develop appropriate avoidance behaviors.

Grad, Oral

Chisembe: Shadow Hunters of Malaŵi.

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Mormyrid fishes emit weak electric pulses for object detection and communication. For decades they have served as important neurobiological models for understanding the inner workings of vertebrate brains. Until recently, however, their behaviors in the wild have eluded observation due to their nocturnal activities and turbid habitats. The transparency of Lake Malaŵi provided the first opportunity to capture underwater recordings of any freely-behaving electric fish. Our film provides an intimate view into one night in the life of the mormyrid electric fish known locally as Chisembe (*Mormyrops anguilloides*). In a lake already famous for cichlid fishes, behaviors of this unfamiliar nocturnal predator include electrosensory prey detection, pack hunting, and electrical activity suggestive of communication between pack members. As with many other natural systems used for investigating animal behavior, film contributes to a better understanding of the extraordinary behaviors of *M. anguilloides*. Our reel contains excerpts from a larger body of video data that was analyzed and published in parallel with production of the film (Arnegard and Carlson, 2005. Proc. R. Soc. B 272:1305-1314). Subsequently, the film and paper have been successfully used in conjunction with one another to teach neurobiology and behavior, illustrating the interactive power of science and film.

Settling into an increasingly hostile world: the rapidly closing “recruitment window” for corals.

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Free space is critical for settling larvae in all marine benthic communities. Settling corals, with limited energy to invest in competitive interactions, are particularly vulnerable during settlement into well-developed coral reef communities. This may be exacerbated for corals settling into coral-depauperate reefs where succession in cryptic spaces moves rapidly towards heterotrophic organisms inhospitable to settling corals. To study the effect of benthic organisms (at mm-cm scales) on coral settlement and survivorship we deployed coral settlement tiles at 10 m depth at Carrie Bow Cay, Belize, and monitored them for 38 months. During the second and third years, annual settlement rates declined by over 50% from the previous year. Invertebrate crusts (primarily sponges) were absent at the start of the experiment but increased in abundance annually from 39, 60, to 73% of the plate underside by year three. As succession progressed, substrates upon which spat settled shifted towards organisms inimical to survivorship. Over 50% of spat mortality was caused by overgrowth by sponges alone. This suggests that immediately following disturbances that create primary substrate, a “recruitment window” develops for settling corals. During this time, early succession facilitating-species are present and not yet overgrown by organisms hostile to coral settlement and survivorship.

Grad, oral

EFFECT OF HARD STRUCTURES ON THE SURROUNDING BENTHIC ASSEMBLAGE OF THE SOFT SEDIMENT

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We placed obstacles on unstructured sediment to explain the small-scale difference in benthic assemblages observed close and apart from epibenthic patches (EPs) dominated by barnacles, ascidians and red algae in the White Sea. Previous findings show that five of the ten top abundant macrobenthic taxa (polychaetes *Aricidea nolani*, *Chaetozone setosa*, *Heteromastus filiformis*, *Scoloplos armiger* and oligochaetes) were associated with the cores sampled close to EPs compared to the cores 25-25 cm apart of them (Yakovis et al. 2004). In 2005-2007 we added concrete bricks (30×15×10 cm) to the same habitat

to separate physical and biogenic distant effects of EPs (2 runs × 5 bricks × 2 cores close and apart before and 1 year after manipulations).

Manipulations had no pronounced effect on the whole assemblage of 88 mobile species. Surface deposit-feeding polychaete *Apistobranchus tullbergi* was equally abundant close and apart from natural EPs but responded to the manipulation negatively. This inconsistency might result from artifacts of the manipulation or the difference between experimental bricks and natural EPs. Yet, consistent with the patterns of abundance observed, mobile subsurface deposit-feeders *Heteromastus filiformis* and *Scoloplos armiger* (Polychaeta) were positively affected by the addition of concrete bricks, proving the architectural component of the effect.

Grad, Poster

Assessing an invasive tunicate (*Didemnum vexillum*) epibiont's impact on predator choice and consumption of a native mussel (*Mytilus edulis*).

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Epibiosis is the colonization of one species (basibiont) by another species (epibiont). Such a relationship has been found in several previous studies to affect predation on the basibiont, especially in cases where the epibiont contains, or manufactures, inorganic acids or secondary metabolites. *Didemnum vexillum* is an invasive colonial tunicate in the Gulf of Maine that overgrows many hard-shelled native species, including the common blue mussel *Mytilus edulis*. *D. vexillum* may contain sulfuric acid that it sequesters in great concentrations within its tunic, in addition to producing secondary metabolites. These chemicals are believed to make the tunicate unpalatable to predators. Our study focuses on the prey choice and consumption of overgrown mussels by a common Gulf of Maine predator, *Carcinus maenas*. Using video-taped choice experiments and 24-hour long "free-for-all" feeding studies, we have determined whether *D. vexillum* has any effect on *M. edulis* as prey for *C. maenas*. These results and their ecological implications will be discussed.

Grad, Oral

Using gut content analysis to assess macroalgae importance as a food source for the amphipod community endemic to Western Antarctic Peninsula.

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Recent studies have revealed high abundances and diversities of crustacean mesograzers (especially amphipods) affiliated with benthic macroalgal communities along the Western Antarctic Peninsula. Reported densities have even been estimated as high as 50,000 individuals m⁻² algal tissue, illustrating the important ecological role amphipods may have in mediating mesograzer-algae interactions. Previous experiments have suggested that two amphipod species, *Gondogeneia antarctica* and *Prostebbingia gracilis*, significantly preferred feeding on the red alga *Palmaria decipiens*, while three species (*Desmarestia anceps*, *Desmarestia menziesii*, and *Plocamium cartilagineum*) were unpalatable in feeding assays. In contrast, amphipod density studies have revealed greater abundances of amphipods, including *G. antarctica* and *P. gracilis*, associated with the unpalatable species of algae. It is possible amphipods use unpalatable, and possibly chemically defended, macroalgae as a refuge from predation. Thus, although associations between amphipods and benthic macroalgae are clearly evident, the exact nature of these associations remains in question. Initial gut content analysis of a suite of amphipods collected on the Western Antarctic Peninsula was conducted and revealed a diverse array of prospective prey including diatoms, macroalgae filaments and thalli, bryozoans, sponge spicules, crustacean parts, and other non-diatom epiphytic unicellular algae. Initial results indicate most species have a mixed diet and many

consume macroalgal filaments as a sizable portion of their diet, including some species thought to be strict carnivores. Although diatoms were found throughout the guts of many species, it is still unclear whether the presence of epiphytic material (*i.e.* diatoms) is the result of host material consumption and incidental ingestion of epiphytes or vice versa. It is important to discern key nutritional sources for these amphipods to further understand the processes mediating mesograzer-macroalgae interactions in near-coastal peninsular benthic habitats.

Tracing sewage inputs to coral reefs: an example from the Meso-American barrier reef.

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The Mexican state of Quintana Roo is among the most rapidly developing coastal zones on the planet. With its proximity and dependence on the Meso-American Barrier Reef, it's surprising that little is known about the impacts of development on nearshore reef ecosystems. Specifically, sewage contamination to local aquifers is a critical issue. Sewage treatment systems are rare and generally remove solids while discharging high concentrations of nutrients and bacteria. Wastewater poses a threat to human health and reef corals, arguably the keystone to the tourism industry. Here, we utilize cost-effective monitoring tools (stable isotope analyses and *Enterococcus* assays) to test for the presence of sewage-derived nitrogen in groundwater inputs to coastal marine waters proximal to developed and undeveloped localities in Quintana Roo. $d^{15}N$ values of the sea fan coral *Gorgonia ventalina* sampled from developed coastlines were enriched (up to 3.6 ‰) relative to undeveloped areas. Furthermore, $d^{15}N$ values from corals sampled along a transect parallel to shore were correlated with *Enterococcus* counts, suggesting that the source of nitrogen assimilated by corals was of human origin, and not natural denitrification. We stress that these metrics can connect development to ecosystem decline in regions where traditional water quality monitoring is not feasible.

Fac, Oral

Coupled effect of larval release and physical forcing in the settlement rate of the subtropical acorn barnacle *Chthamalus bisinuatus*.

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Larval settlement has been demonstrated to be a key parameter regulating population dynamics of marine invertebrates. The literature reporting the effect of physical variables in settlement rate is vast, mostly referring to the role of wind-driven currents and tide-related motions, however, biological processes have been largely ignored. We monitored biological and physical variables of putative importance to the larval settlement of the dominant intertidal barnacle, *Chthamalus bisinuatus*, in São Sebastião, Southeastern Brazil. Rhythmic naupliar release, with a period of 11d, is reflected in the temporal pattern of larval supply in the nearshore water column, which lagged 8d ahead. Settlement on artificial plates lacked the same periodic pattern, but was still positively correlated to supply. Positive sea level anomalies were recorded during periods of southwesterly winds, suggesting significant Ekman transport. Nevertheless, larval supply and settlement were not intensified during such events, but positively correlated to easterlies, indicating straight onshore transport. Our study shows that reproductive patterns of local breeding populations may be used to predict settlement of new individuals, which is apparently not restricted to the stochastic effect of physical forcing.

Grad, Poster

The genetic mating systems of sea spiders (Arthropoda: Pycnogonida) in the context of sexual selection

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Taxa in which males alone invest in postzygotic care of offspring are often considered good models for investigating the proffered relationships between parental care, sexual selection and mating systems. In all species of the Class Pycnogonida, males exclusively provide postzygotic care by carrying fertilized eggs until they hatch. The mating systems of pycnogonids, however, remain poorly known. We combine morphometric analysis and DNA microsatellite markers to describe the mating system in natural populations of three rocky intertidal pycnogonids, *Ammothea hilgendorfi*, *Ammothella biunguiculata*, *Pycnogonum stearnsi*. We detected instances of multiple mating by both sexes in all species, indicative of polygynandrous mating systems. Genotypic assays also showed that a) males do not mix eggs from different females in the same clusters; b) eggs from the same female are often partitioned into different clusters carried by the same male and; c) no male could be excluded as the sire of the embryos he carried (i.e. no cuckoldry). Body size measurements revealed that these species exhibit different degrees of sexual size dimorphism. Using a statistical framework based on selection theory and Bateman's principles, we attempt to determine the intensity and direction of sexual selection for the first time in this taxonomic group.

Fac, Oral

Are artificial reefs surrogates of natural coral habitats for corals and fish in Dubai, United Arab Emirates?

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We compared coral and fish communities on two large (>400,000 m³) and mature (>25 yr) breakwater artificial reefs and six natural coral patches. Coral cover was higher on artificial reefs (50%) than in natural habitats (31%), but natural coral patches contained higher species richness (29 versus 20) and coral diversity (H' =2.3 versus 1.8). Multivariate analyses indicated fish communities differed significantly between habitat types in the summer and fall, but converged in the winter and spring. Univariate analysis indicated that species richness and abundance were stable throughout the year on natural coral patches but increased significantly in the summer on artificial reefs compared with the winter and spring. These large artificial reefs support high coral and fish abundance and diversity, but differ structurally and functionally from natural coral habitats, and so should not be considered surrogates for them.

Fac, Oral

Feasibility of widgeon grass restoration in the Caloosahatchee River using enclosures.

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Submersed aquatic vegetation (SAV) coverage has been decreasing in the mainstem Caloosahatchee River for many years. Maximum depth of SAV occurrence is 1.2 meters so light attenuation is part of the problem. Low light levels and low biomass make plants more susceptible to grazing losses. Widgeon grass (*Ruppia maritima*) has the ability to thrive throughout the river when light availability is high, as it is when clear Gulf water encroaches upstream. If large, dense beds were established, the grazers may have more leaves than they can eat, and submersed plants may start reaching the surface and forming canopies that would allow them to capture light during future turbid periods. To test the ability of *Ruppia* to grow while protected from large grazers and bioturbation, we enclosed plots in protected locations

along the length of the estuary, then transplanted and monitored plants inside and outside the enclosures. Despite periods of poor water quality and high fouling, transplants inside enclosures grew better than existing plants or outside transplants and produced seeds.

Predator chemical cues alter mussel self-organizing aggregation rates and patch metrics. But so do non-predator cues!

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Mussels in aggregations are less vulnerable than isolated mussels to thermal stress, desiccation, storm dislodgement, and predation. We tested two hypotheses. H₁: *Mytilus edulis* self-organize into aggregations with lower perimeter per capita, area per capita, and perimeter:area ratios than singletons. H₂: Chemical cues from predators (crab *Carcinus maenas* and snail *Nucella lapillus*) and injured conspecifics induce increased mussel aggregation rates relative to controls, but cues from a non-predator (snail *Littorina littorea*) and intact conspecifics do not. Mussels were placed in a uniform pattern in arenas holding chemical effluent from each treatment. H₁ was supported: mussels immediately began to move into aggregations that displayed the hypothesized patch metrics. H₂ was equivocally supported: aggregation rates were highest in *Carcinus* and *Littorina* treatments, not different from controls in *Nucella* and intact conspecifics treatments, and lowest in the injured conspecifics treatment. The results are the first to demonstrate mussel aggregation in response to cues from non-predators as well as predators. This response may be selectively advantageous in habitats where herbivorous *Littorina* signal the presence of predators such as *Carcinus* because both live in close proximity with mussels. The results do not support the idea that injured mussels emit aggregation cues.

UG, Poster

The transcriptome of the threatened elkhorn coral, *Acropora palmata*.

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Reef-building corals face a multitude of environmental stressors and Caribbean populations have declined precipitously as a consequence. Still, it is expected that standing genetic variation includes genotypes pre-adapted to stressful conditions, specifically increased sea-surface temperatures. Expressed sequence tag (EST) libraries provide a first glimpse of the transcriptional response of corals to temperature stress. Using 454 titanium sequencing technology, we obtained 967,530 high quality reads with an average length of 411 nucleotides. The reads assembled to 32379 contigs of ~34M bp and 49841 singletons of 18Mbp. There are 19161 ISO groups which can be thought of as genes. We compared the *A. palmata* transcriptome to that of its Pacific congener, *A. millepora*. In line with previous analysis, AAT is the most common microsatellite motif in the *A. palmata* transcriptome. Ultimately, a comprehensive microarray will be designed based on the transcriptome to interrogate the temperature response of elkhorn coral larvae.

Fac, Poster

An upside-down look at the vegetative reproduction and regeneration of sediment-dwelling macroalgae

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Rhizophytic green algae that anchor in unconsolidated sediments use fine rhizoids to bind sand to create a bulbous holdfast. These macrophytes are often abundant in and near tropical and subtropical seagrass beds and their holdfasts occupy considerable belowground space while functioning in regenerative and nutrient uptake roles for the plants. In an experiment to examine the colonization of belowground space by rhizophytic algae and regeneration from holdfasts, thirty plots were cleared of above and belowground algal material. Ten plots were left empty (control plots) and were not disturbed over the three week

experiment. Rhizoidal holdfasts of *Penicillus capitatus* and *Halimeda incrassata* were each transplanted in monoculture into ten plots and allowed to regenerate. Ninety-seven percent of *Penicillus* and ninety-four percent of *Halimeda* holdfasts generated new stipe material. We measured the recruitment, holdfast size, and biomass of new individuals of rhizophytic algae in the experimental and control plots. Treatment made no difference with similar numbers (~238 plants/m²) of new plants among plot types. New rhizophytic algal holdfasts bound a mean volume of 668 ml/m². This study provides some of the first field evidence that holdfasts are regenerative structures and that the colonization of belowground space is extremely rapid.

Grad, Oral

Effects of mutualism on population dynamics in anemonefish symbioses.

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Symbioses impact the population dynamics of obligate associates, and may create limitations to the recruitment of guest partners when host populations are saturated. We marked 119 sea anemones and 120 anemonefish on a coral reef in the northern Red Sea in 2008. The 2 major species of host anemones both exhibited a population structure in which abundance declined exponentially with body size, indicating type III survival curves. Resampling in 2009 confirmed that anemone growth and mortality decreased rapidly with size and age. In contrast, anemonefish were equally abundant across all size classes except for a slight decrease in large individuals, suggesting type I survival. Anemonefish recruitment was restricted due to the exclusion of incoming juveniles by resident adults. However, after individuals became established, their probability of survival was high because symbiosis with anemones provided a safe haven that prevented the high mortality experienced by most free-living coral reef fishes. We conclude that strong partner effects alter the demography of guests more than that of hosts in this mutualism. Models that incorporate these disparate partner effects are needed to provide a scientific basis for the sustainable harvest of these popular ornamental organisms for the aquarium trade.

Grad, poster

Restoration of a brackish marsh: construction design influences aquatic community composition

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Wetland loss has been an area of growing concern. Restoration provides an opportunity to mitigate for wetland losses, but efficient and effective protocols for marsh restoration are not yet fully developed. Our objective was to assess the development of aquatic plant and animal communities in brackish tidal marshes constructed using three different restoration designs near Port Arthur, Texas in the northwest Gulf of Mexico. Marshes were constructed in 2008 using three soil sources: (1) excavated adjacent sediment, (2) dredge material, and (3) excavated adjacent sediment surrounded by dredge fill. Within one year of planting, we used throw traps to assess aquatic community composition, including vegetation, fish and invertebrate density and diversity. Total faunal abundance was positively related to the amount of *Myriophyllum spicatum* (Eurasian Watermilfoil) in the summer 2008 and fall 2009 sampling events. Both *Spirogyra spp.* (Filamentous green algae) and *Ruppia maritima* (wideongrass) proliferate seasonally. Each species' percent cover was highest in the reference marsh. *Myriophyllum* grows well in all areas of the marsh but appeared to grow best in the marsh areas where adjacent excavated sediment had been used. These data reveal that marsh design may influence aquatic vegetation assemblages and subsequently dictate associated animal community composition.

Grad, Oral

Long term studies of seagrass beds in Florida: challenging current thinking

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We examined changes in seagrass landscapes in Tampa Bay from 1988 through 2004. We selected a series of study sites that, combined, represented a spatial extent of 6 million square meters and quantified the change in seagrass cover (presence/absence) at the resolution of meters. Within some locations there were clear indications of seagrass loss as well as seagrass expansion. Landscape analyses indicated that overall, the amount of seagrass cover was remarkably consistent within Tampa Bay across all years. Examination of data sets from other west coast of Florida areas show similar trends of localized seagrass decrease/increase but little evidence of marked changes in seagrass cover over the scale of an embayment. Seagrass landscapes in subtropical settings may be dynamic when viewed over small spatial scales but over large spatial scales and long (greater than 5 years) periods of time the landscapes appear to be resilient.

Fac, oral

Geographic variation in fitness and preference on phlorotannin-rich *Fucus vesiculosus* in a generalist herbivore

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Most generalist marine herbivores have large geographic ranges and encounter locally-variable plant communities, yet we have few studies that examine local evolution of herbivore feeding responses. We assessed geographic variation in feeding preference and juvenile performance in the generalist isopod, *Idotea balthica* along the U.S. Atlantic coastline. *Idotea* is often found on phlorotannin-rich seaweed *Fucus vesiculosus* in areas north of Long Island Sound (LIS), but *Fucus* is unavailable in more southerly areas where *Idotea* primarily uses the seagrass *Zostera marina*. Preference assays with the three food choices show that populations north and south of LIS have distinct feeding preferences, where *Idotea* from Rhode Island prefer *Fucus* while those from Virginia prefer *Ulva*. In performance assays, juvenile *Idotea* from Virginia had higher mortality and lower growth rate when isolated on *F. vesiculosus* or *Z. marina* relative to the control seaweed (*Ulva linza*), while Rhode Island juveniles had lower fitness on *Z. marina*, but equivalent fitness on *Fucus* relative to *Ulva*. *Idotea* that occur north versus south of LIS are genetically distinct at a mitochondrial locus, suggesting that variation in tolerance for the phlorotannin-rich *F. vesiculosus* reflects spatially-variable selection or genetic drift or both evolutionary processes within historically-isolated populations.

Fac, Oral

Phytoplankton growth in response to ocean acidification: a meta-analysis

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Concern for the potential effects of ocean acidification is increasing as atmospheric CO₂ levels rise, ocean carbon chemistry is altered, and pH declines. We used meta-analysis to compare phytoplankton growth at baseline ocean pH values in 1930 to growth at predicted pH values in 2035, 2060, and 2100. Our results suggest that significant declines in overall phytoplankton growth are possible by as early as 2060. This decline is largely driven by a reduction in growth of coccolithophores, the only major phytoplankton group that showed an overall response to declines in ocean pH over the next century. Within major phytoplankton groups, at the species-level, we found both negative and positive responses to ocean acidification. While it is impossible to predict community and ecosystem responses from culture experiments, our results highlight the potential for large effects of ocean acidification on primary productivity. Increasing atmospheric CO₂ concentrations are likely to alter phytoplankton abundance and community composition, with bottom-up impacts on open ocean productivity and fisheries yields over the coming century.

Grad, Oral

Meta-analysis of impacts associated with beach nourishment in South Carolina

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Although beach nourishment has become the primary tool for combating beach erosion in the southeast US, the environmental impacts of this practice remain unresolved. We created a library and historical monitoring database for South Carolina and performed a meta-analysis of available sediment and biological data. In beach environments, the data suggested that sediment match was good and that a somewhat altered invertebrate community rapidly recolonized nourished beaches. Following dredging, borrow areas were characterized by finer and more organically-enriched sediments and a biological community with significantly lower number of species and a greater proportion of polychaetes. Due to small sample sizes, inconsistent monitoring study designs and incomplete reporting, examining the causes of significant between-project differences was problematic, but some comparisons were possible. The season during which nourishment or dredging occurred primarily affected biological responses, likely reflecting a combination of interference with local recruitment and recolonization and survival of disturbance-tolerant species. The location of borrow areas relative to estuarine environments primarily affected post-dredging accumulation of fine sediments and organic material, suggesting better management could lead to more sustainable sand sources. Expanding the geographic extent of the database could significantly contribute to our understanding of beach nourishment impacts and improve future management decisions.

Fac, Oral

Latitudinal variance in ecosystem engineering effects and population structure of the tube-building polychaete *Diopatra cuprea* (Polychaeta: Onuphidae)

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Marine infauna are important ecosystem engineers of marine sedimentary habitats worldwide. In the eastern United States, sheltered intertidal and subtidal sediments are commonly structured by *Diopatra cuprea* (Onuphidae), a large tube-building polychaete. By attaching macroalgae to its tube, *D. cuprea* facilitates macroalgal populations in habitats otherwise devoid of attached algae. *D. cuprea* abundance, body size, and ecosystem engineering effects strongly decrease at lower latitudes. In particular, Florida *D. cuprea* attach over 100-fold less algae compared to northern populations. I document these latitudinal patterns and experimentally show that *D. cuprea*'s failure to attach algae at low latitudes is a behavioral shift, rather than the consequence of altered algal availability or enhanced herbivory. In the mid-Atlantic region, *D. cuprea* is facilitating the invasion of the red macroalga *Gracilaria vermiculophylla*. While *G. vermiculophylla* is an adept invader in its own right, it is currently absent or rare in most Florida intertidal habitats, where lack of *D. cuprea* facilitation may be one factor retarding its spread. These patterns demonstrate that the ecosystem-level effects of engineering species can be context-dependent and can vary geographically; such variance is potentially important for conservation and management efforts, and should be incorporated into ecosystem engineering theory.

Fac, Oral

Non-consumptive effects of an invasive predator on macroinfaunal functional feeding groups in a New England salt marsh.

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Although ecologists are increasingly aware of the importance of non-consumptive effects in shaping community dynamics, their role in salt marsh communities has received little attention. Here we present the results of a field experiment that examined how consumptive and non-consumptive interactions

between the invasive green crab (*Carcinus maenas*) and the periwinkle *Littorina littorea* influence benthic macroinfaunal densities. Treatments consisted of 2 caged crabs, 2 bioturbator crabs, or no crab. Bioturbator crabs were able to roam in the enclosures but had banded claws preventing them from consuming the snails, while caged crabs were contained in small cages that prevented them from physically disturbing the sediment. To simulate consumptive predator effects without the confounding effect of crab risk cues, we manually removed snails through time. We sampled and sorted all macroinfaunal organisms at the end of the experiment into functional feeding groups: surface, interstitial, and filter feeders. Our results suggest that both consumptive and non-consumptive predator effects influenced macroinfaunal densities and composition. Furthermore, the crab effect observed was primarily a result of predator risk cues and not bioturbation. Differences in non-consumptive effect strength on functional feeding groups highlight the importance of functional diversity in mediating the effects of predators on community dynamics.

Grad, Oral

Now you see it, now you don't: the effects of salinity and temperature on the transparency of the ghost shrimp, *Palaemonetes pugio*

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The ghost shrimp, *Palaemonetes pugio*, is an important detritivore in estuarine systems. In this study, we examined the effects of rapid, but ecologically relevant, changes in salinity and temperature on the transparency of *P. pugio*, under laboratory conditions. Animals were placed into solutions with salinities of 0, 15, 25 or 30 ppt and temperatures of 12° C, 20° C, or 28° C for 12 hours. We found that at the control conditions of 15 ppt at 20°C (N = 43), 64% ± 2.8% (Mean±SE) of incident light was transmitted through a 2 mm thickness of the tail muscle, whereas at the extremes of 30 ppt at 28° C (N = 10) and 30 ppt at 12° C (N = 29), the light transmission was only 0.03% ± 4.0% and 4.5% ± 2.8%, respectively (ANOVA, F=57.6, p < 0.0001). We believe that this loss of transparency is due to pooling of low index hemolymph between the high index muscle fibers, which increases light scattering. This induced opacification increases the visibility of the animal and thus may increase predation pressure during periods of salinity and temperature change, changing estuarial trophic dynamics and infaunal composition.

Grad, Oral

A rolling stone gathers no coral: an experimental assessment of the requirements for successful coral recruitment

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Substratum stability is critical to the success and survival of live fragments and coral recruits. Restoration efforts employ a host of artificial agents to secure rubble and recreate lost structure to provide stable settlement surfaces; however, agents like concrete are unnatural, and such substrata, though stable, may be unfavorable to coral larvae. Utilizing organisms that naturally stabilize coral rubble to assist reef rejuvenation has largely been overlooked. On two shallow, fringing reefs along Curacao, four treatments – coral rubble alone, rubble seeded with sponges, rubble bound by concrete, and concrete “rubble” bound by concrete - were used to assess: 1) the performance of stabilizing agents; and 2) the influence of binding agent and substratum type (natural vs. artificial) on the recruitment of coral larvae (numbers and identities). The growth rates of sponge species used to stabilize rubble were also measured to evaluate the sustainability of sponge use. At both sites, sponges readily stabilized rubble, and while concrete was superior, rubble piles bound by sponges were significantly taller and tighter in shape than rubble alone. Though the number and identity of corals recruiting to treatments differed between sites, recruitment was generally heaviest to natural substrata and to sponge bound rubble in particular.

Grad, oral

The Effect of the Bosphorus Strait on Gene Flow Between the Black Sea and the Sea of Marmara for the Black Mussel, *Mytilus galloprovincialis*

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The Black Mussel, *Mytilus galloprovincialis*, is a commercially important species with a continuous distribution spanning the eastern Atlantic, the Mediterranean, the Aegean and the Black Sea. Previous genetic research has indicated differentiation between Aegean and Black Sea (Ukraine) populations of this species. Using the CO3 region of mitochondrial DNA and six nuclear microsatellites we investigated at a local scale whether the Bosphorus strait is a barrier to gene flow causing the observed genetic differentiation. A total of 96 mussels representing eight localities extending from the Black Sea to the Sea of Marmara, including the Bosphorus strait, were analyzed. Results for both mitochondrial DNA and microsatellites showed no genetic grouping among geographical regions. Ukrainian samples differed from those analyzed by a single base position. These results suggest that the Bosphorus Strait does not restrict gene flow for this species. Analysis of samples from a greater geographic range, encompassing the Dardanelles Strait, the Aegean, and more northern populations in the Black Sea, is necessary to understand the previously documented genetic break between Black Sea and Aegean black mussels.

Fac, Oral

Fishery independent underwater video capture observations of grouper usage of hard-bottom habitats

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In this pilot project we investigated the use of a stationary video supplemental stock assessment for gag grouper (*Mycteroperca microlepis*). Underwater video techniques were used to document the presence/absence, estimated size, behavioral patterns, and temporal habitat usage of gag grouper on shallow water, hard-bottom habitats on the continental shelf of North Carolina. A comparison between video findings and diver visual surveys of groupers at the same locations was also made. Survey dives (n = 57, 31 h footage) were conducted from June 2008 – January 2009. Comparing equal segments of each usable video (15 minutes) resulted in observations of 760 scamp (*M. phenax*), 115 gag, 33 yellowmouth (*M. interstitialis*), 27 graysby (*Cephalopholis cruentatus*), 13 red grouper (*Epinephelus morio*), nine rock hind (*E. adscensionis*), two goliath grouper (*E. itajara*), and six unidentified serranids in 8.5 hours of recorded video. Comparisons were made at multiple locations, using baited and unbaited camera deployments on ledge and live-bottom habitats. There were no significant differences in the numbers of gag and scamp detected for surveys in which bait was not used, nor were differences detected for scamp between the two habitat types. Gag grouper were more frequently observed on live-bottom habitats ($p < 0.001$).

UG, Poster

Between tide and wave marks: a new unifying model of physical zonation on littoral shores

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The effects of tides on littoral marine habitats are so ubiquitous that shorelines are commonly described as 'intertidal', whereas waves are considered a secondary factor that modifies the intertidal habitat. However mean significant wave height exceeds tidal range at many locations worldwide. Here we construct a simple model of coastal water level based on tidal range and wave height. From this model we derive four shoreline benchmarks: effective high water, effective low water, submerged high water, and submerged low water. We demonstrate that these benchmarks bracket up to three novel physically defined zones, the effective intertidal zone, wave zone, and the submerged intertidal zone, depending on the ratio of wave height to tidal range. On wave dominated shores (wave height \gg tidal range), all three zones exist independently, but on tide-dominated shores (tidal range \gg wave height) the wave zone is absent and the effective and submerged intertidal zones overlap substantially, forming the classic 'intertidal zone'. Each littoral habitat presents biota with differing physical and physiological challenges that will affect species interactions, community composition, and could lead to uniquely adapted species depending on the range of temporal variability in tidal range and wave height. This wave:tide physical zonation model is a unifying framework that can facilitate our understanding of physical conditions on littoral shores and their effects on resident biota, whether tropical, temperate, marine, or lentic.

Cross-habitat impacts of species decline: response of estuarine sediment communities to changing detrital resources

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Food webs of many ecosystems are sustained by organic matter from other habitats. Yet for most ecosystems it is unknown how the taxonomic composition of organic matter influences community composition. Along the coastline of Sydney, Australia the once abundant habitat-forming macroalga, *Phyllospora comosa*, is now locally extinct. Shallow reefs are now primarily occupied by *Sargassum* spp. and, to a lesser extent, the kelp *Ecklonia radiata*. We experimentally manipulated the supply of *P. comosa*, *Sargassum* sp. and *E. radiata* to estuarine sediments to assess responses by macroinvertebrate communities to: (1) changing the identity of the dominant detrital resource; and (2) varying the ratio of input of different macrophytes. Estuarine sediments dosed with *P. comosa* supported greater abundances of macroinvertebrates than sediments receiving *Sargassum* sp. or the kelp *E. radiata*. Communities in sediments receiving detritus comprised of less than one third *P. comosa* were distinctly different to those in sediments with a higher proportion of *P. comosa*. Our study provides evidence that the ecological ramifications of species decline can extend to spatially removed ecosystems, subsidised by allochthonous materials. Even prior to extinction of detrital sources, small changes in their provision of organic matter may alter the structure of subsidised communities.

Fac, Oral

Population dynamics and spatial distribution of two species of sea cucumber, *Parastichopus californicus* and *P. leukothele*, in deep central CA waters.

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Sea cucumbers are fished around the world. Along the west coast of the U.S., *Parastichopus californicus* is the primary species targeted in both trawl and SCUBA dive fisheries, and *Parastichopus leukothele* is also likely collected in trawls. As most fishery stock assessments target shallow populations of sea cucumbers, deeper populations often go unmonitored. The purpose of this study is to identify the spatial

distribution and dynamics of the deeper (30-300m) populations of *P. californicus* and *P. leukothele* in central CA (Soquel Canyon to Big Creek). Using 2007 *Delta* submersible video footage, individual sea cucumbers of these species were identified and sized, and habitat characteristics including substrate type, slope, and rugosity were recorded. In total, 869 *P. californicus* and 482 *P. leukothele* were identified on transect, ranging in size from 10-45cm and 5-35cm, respectively. *P. californicus* was found from 25-248m (average=77m) and had an overall density of 5.7 cucumbers/1000m² (stdev=35.5). *P. leukothele* was found from 99-317m (average=211m) with an overall density of 3.4 cucumbers/1000m² (stdev=32.9). Individuals were mapped in ArcGIS (ESRI) for further spatial distribution analysis. Results from this study will provide a fishery-independent analysis of understudied deep-water sea cucumber populations that may be helpful in the management of these species.

Grad, Oral

Grazer Diversity Influences Multiple Stressor Impacts in Experimental Seagrass Systems.

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Diverse ecosystems may be more stable in the face of environmental stressors if functionally similar species can compensate for stressor effects on focal species, and/or if species respond differently to stressors. Such diversity effects may be especially important when multiple stressors act simultaneously. Seagrass systems around the globe are increasingly impacted by multiple environmental stressors as a result of climate change, coastal development, overfishing, and other activities. We manipulated experimental seagrass systems (using *Zostera marina*) to examine the impacts of multiple environmental stressors (temperature, salinity, nutrients, light), and whether species richness of crustacean grazers could buffer ecosystem functions in the face of multiple stressors. We found that crustacean grazer species respond differently to stressors, but that these responses differ with each individual stressor. We also found evidence of a positive relationship between epiphytic algal biomass and crustacean grazer biomass, indicating bottom-up control of grazers. Finally, we found evidence that a diverse crustacean grazer community can buffer certain ecosystem properties (such as biomass of epiphytes), and increase resistance to multiple stressors in our experimental systems.

Grad, Oral

Putting parasite escape into perspective: a biogeographic examination of parasites and hosts across their native and introduced range

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Parasites are important members of communities; thus it is critical to understand their influences within and among bioregions. Specifically, understanding how parasite diversity patterns are affected by differing anthropogenic vectors is largely unexplored. We assembled a comparative study of trematode parasite diversity in two introduced snail hosts (*Ilyanassa obsoleta* and *Littorina saxatilis*) with overlapping geographic ranges on both North American coasts (native, east; introduced, west) and highly differentiated invasion histories (IO: oyster transplantation in the early 1900s; LS: live seafood/baitworm trade in the 1990s). While both snail species had significantly lower trematode richness and prevalence in the introduced versus native regions, we found *L. saxatilis* had escaped more parasites than *I. obsoleta*, which we attributed to several potential, non-mutually exclusive mechanisms: time since introduction, introduction vectors, propagule pressure, parasite prevalence in source populations, and available hosts. In both species, but especially *I. obsoleta*, we found close links between native source populations and introduced populations. Finally, host availability and parasite-specific life cycle strategies were found to have important influences on parasite diversity patterns in introduced populations. Our work demonstrates the importance of understanding host invasion histories in order to fully appreciate parasite biogeographic patterns across native and introduced ranges.

Fac, Oral

Studies on the Benthic Biology of Mumford Cove, Groton, CT: Assessing the Extent of Habitat Restoration Following Cessation of Wastewater Discharge

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For approximately 25 years, effluent from a wastewater treatment plant was discharged into Mumford Cove, a shallow, coastal embayment in southeastern Connecticut. In 1987, the discharge into Mumford Cove ceased following an overabundance of the macroalgae, *Ulva* spp choking residential beaches. Since the benthos are often sensitive to a variety of anthropogenic and natural stressors, many environmental indicators and indices to assess the degree and nature of environmental change have been developed based on marine macrobenthic taxa and communities. This study assessed how the benthic communities in Mumford Cove have responded to the cessation of nitrogen inputs. The primary objectives are to: (1) assess the current status of benthic communities in Mumford Cove, (2) compare the communities with those found at the reference habitat (Palmer Cove), (3) compare the communities with those described by Buck (1971; several years prior to the removal of the wastewater discharge) and Applied Science Associates, Inc (1989; several years after the removal of the discharge in order to assess the degree of benthic community recovery in Mumford Cove, (4) assess the current character of benthic macrophyte communities in Mumford Cove and how they have changed since the early 1970's and late 1980's, and (5) examine the utility of using various benthic populations and community metrics for assessing what constitutes a 'restored' benthic ecosystem in coastal Connecticut waters.

Fac, Poster

Emerging interests at the National Oceanographic Data Center for collaboration with benthic ecologists on biodiversity and coastal and marine spatial planning initiatives.

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The National Oceanographic Data Center (NODC) of the United States National Oceanic and Atmospheric Administration (NOAA) serves the oceanographic community as the primary destination of scientific data for long-term preservation. Two recent national initiatives have NODC interested in increasing its involvement with the biological oceanography and benthic ecology scientific communities. First, the Ocean Biogeographic Information System (OBIS) is gaining recognition as the premier data portal for ocean biodiversity research, for example the Census of Marine Life. Negotiations are underway where OBIS-USA will agree to submit data to NODC. NODC is also interested in supplemental submissions from investigators in cases where OBIS-USA maintains only a fraction of the initially contributed data. Second, Coastal and Marine Spatial Planning (CMSP) is an executive branch initiative for the adaptive management of multiple uses in the marine environment of the United States. Scientists will play an important role in CMSP by sharing data and scientific knowledge. Federal entities like the NODC will be the primary conduit providing data to regional planning bodies. Therefore, the NODC is considering new kinds of data and increased collaboration with the scientific community to meet the challenges presented in CMSP.

Fac, Poster

Enhancing reefs through direct plantation of fragments and sexual propagation of *Acropora* spp.

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We investigated survivorship of *Acropora* spp. fragments and sexually propagated juveniles at three reef sites in Palau. *Acropora digitifera* fragments (n=30, mean wet weight 7.2 ± 0.5g) were harvested and transplanted to the same parent reefs. After 16 months, survival of fragments at Lighthouse, Iou Lukes, and Uchul Achei Reefs was 84%, 78%, and 38%, respectively, whereas mean wet weight of the survivors increased by 15.6x, 10.7x, and 7.5x respectively. Additionally, 70-100% of five *Acropora* spp. (n=10 fragments/species) transplanted to natural reefs survived versus 30-40% transplanted on Reef Balls after one year. To test survivorship of sexually propagated juveniles, *Acropora digitifera* larvae were allowed to settle and metamorphose on plastic mounts and then outplanted directly on Reef Balls. After one year, 0.8% of un-caged *Acropora digitifera* recruits (n=363 un-caged; n=90 caged) survived versus 1.1% in cages. In contrast, similarly propagated corals of the same species were held in a hatchery system for six weeks prior to transplantation on Reef Balls (n=322 un-caged; n=106 caged); in this case, 5.6% survived in cages versus 0% un-caged. Finally, sexually propagated *Acropora digitifera* (n=175) and *Acropora hyacinthus* (n=800) juveniles were outplanted and are currently being monitored on natural reef substrates at two sites.

Grad, Oral

Determining when and where the leatherback sea turtles, *Dermochelys coriacea*, nest on North Friar's beach, St.Kitts

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The leatherback sea turtle, *Dermochelys coriacea*, is the largest extant species of sea turtles, yet the least is known about their nesting locality. Females come ashore only to nest, which occurs 8-12 times per season. To properly collect data from each individual, it is crucial that one is present at the right place at the right time. The goal of this project was to determine whether a reason existed for the location and time that the turtles selected for coming ashore to nest. To accomplish this goal, environmental, climatic, and sand data was collected and analyzed. From within each nest, sand pH, conductivity, temperature, moisture content, and grain size was analyzed. Environmental and climatic data were collected during the processes of emergence and egg deposition. Less than 50% cloud coverage over the beach showed to be significant (P < 0.001). My further findings will hopefully help future researchers better predict a turtle emergence site, allowing more data to be collected.

UG, Poster

Eelgrass population genetics and implications for restoration

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Zostera marina (eelgrass) can be found in the North Atlantic on the coast of Europe and on the east and west coasts of North America. Over the last 30 years, this once robust species has been reduced to sparse patchy populations due to disease and anthropogenic effects. In order to better understand the consequences of this devastation on the population genetics of the species, we have analyzed the population structure of western Atlantic *Z. marina*, employing microsatellite DNA polymorphisms. Although high fixation index values suggest moderate genetic differentiation among most of the *Z. marina* sites, population diversity was low. This lack of diversity was supported by a general dearth of

observable heterozygotes in these sites. Inbreeding seems prevalent in these American populations, suggesting possible reproductive fitness problems in the future. There is evidence of demographic bottlenecks and particularly low genetic diversity in Long Island. Northern Maine had the highest effective population size, suggesting a possible use in future restoration projects.

Fac, Oral

Sea level rise and coastal disturbance links to the loss of horseshoe crab spawning habitat

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Sea level rise and coastal development are creating dramatic changes in estuarine geomorphology, particularly affecting the open sandy beaches of lower Delaware Bay, which have been considered to be prime spawning habitat for horseshoe crabs. Current aerial photography matched with images from the 1930's clearly depicts an obvious landward retreat of the shoreline. Using horseshoe crab egg density and viability as indices of habitat suitability, we compared open bay beaches with tidal creek embankments, nearshore sandbars, bulkheaded beaches, and over-wash areas adjacent to peat banks. Lowest egg densities were found on sand starved or erosional habitats. In areas where sand was accreting, such as mini-deltas and embankments along tidal creeks, egg densities were comparable or superior to adjacent open bay beaches. The highest egg densities were found at two widely separated tidal creeks and their associated sandbars. It is well established that migratory shorebirds in Delaware Bay are dependent on the quantity and spatial distribution of horseshoe crab eggs. Continuing sea level rise could potentially create more marginal and disturbed habitats that will become of increasing value to both horseshoe crabs and migratory shorebirds.

Geographic variation in induced *Fucus vesiculosus* resistance to herbivory: northwest Atlantic vs. Baltic Sea

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The seaweed *Fucus vesiculosus* is known to have inducible herbivore deterring properties. In the Baltic Sea, grazing by the periwinkle *Littorina littorea* led to a reduced algal palatability while, however, a similar study on this invasive gastropod in the northwest Atlantic did not find this capacity in local *Fucus* populations. To test whether this potential pattern is consistent across regions, we exposed *Fucus* individuals from the St. Lawrence estuary either to artificial wounding or to periwinkle grazing. We tested for a decreased palatability of algae every third day over a period of 21 days using subsequent choice feeding assays. In the latter, non-manipulated algal material served as a reference. Higher feeding rates of the periwinkles on non-manipulated seaweeds indicated an induced resistance. Macroalgae showed a reduced palatability as a response to artificial wounding but not to grazing by *L. littorea*. Our results corroborate previous evidences that a resistance can be induced in *F. vesiculosus* from the northwest Atlantic but not by *L. littorea*. This finding suggests the presence of consistent geographic variations in inducible defenses in this alga species between North-America and Europe.

Grad, oral

Herbivory in subtropical seagrass ecosystems and implications for seagrass restoration

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Seagrass restoration projects may be designed according to the principle of “compressed succession”. Faster-growing species are transplanted, often in the presence of a fertilizer source, under the assumption that they will colonize and stabilize bare sediments more quickly than slower-growing foundation species. Top-down controls in seagrass ecosystems are typically reported in the context of herbivory on seagrass epiphytes, rather than direct herbivory on seagrasses. However, transplantation success in restoration projects has been variable due to observed planting unit losses attributed to grazing by herbivorous fish.

Faster-growing seagrasses typically have elevated leaf tissue nutrient concentrations, so herbivores may be attracted by the availability of a new palatable food source. Local fish communities may also differ in grazer composition, which may vary further throughout the year. The seagrass species most likely to survive and persist following transplanting may be a site-specific consideration.

This study will investigate seagrass biomass loss to herbivory in Biscayne National Park, and the extent to which documented losses may be explained by differences in location, seagrass species, season, leaf tissue elemental content, and fish community. The results of this study will help elucidate the influence of direct herbivory in subtropical seagrass ecosystems and inform the design of seagrass restoration projects.

Consumers reduce nitrogen use by seaweed assemblages via selective herbivory on high-uptake species.

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Despite a growing awareness that top-down and bottom-up processes interact to determine the structure and dynamics of ecological communities, the effects of consumers on nutrient uptake and availability remain underappreciated. We evaluated the effects of herbivores on seaweed biomass, community structure, and nitrogen uptake in a rocky intertidal community. We experimentally reduced herbivore abundances in experimental plots at two tidal heights. At the end of this 18-month field experiment, we found no effect of herbivores on seaweed richness, evenness, or overall biomass, relative to controls. However, herbivores reduced the biomass of seaweed species with high nitrogen uptake, suggesting selective herbivory. We quantified the effects of tide height and herbivores on both per-gram and per-area nitrate uptake by measuring uptake rates of seaweed assemblages that duplicated those we observed in our field experiment. Herbivores reduced per-gram uptake, but only at higher tidal elevations. Herbivores reduced per-area uptake at both tidal elevations due to the combination of their biomass-specific effects on composition and their overall effects on biomass. The top-down role that herbivores play in mediating bottom-up nutrient availability has important ramifications for intertidal community and ecosystem structure and dynamics.

Fac, Oral

Shoreline Development, Sediment Type, and Predator Abundance Influence Subtidal Benthic Infauna in the Patuxent River, Chesapeake Bay, MD

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Natural coastal habitats throughout Chesapeake Bay are increasingly threatened with shoreline modification, the effects of which have been well-studied with respect to fish assemblages and intertidal communities, particularly in conjunction with larger-scale watershed development. Recently, interest has shifted toward investigation of the effects of shoreline development on subtidal benthic infaunal communities. This study evaluated the direct, local impacts of bulkhead and riprap compared to natural marsh shorelines, as well as the effects of sediment characteristics and predator abundance, on benthic infauna in the Patuxent River, Chesapeake Bay. In an AIC analysis, shoreline type emerged as the best predictor of infaunal diversity and was also an important factor in determining density. Sediment grain size, however, was the best predictor of both density and biomass, with highest densities and lowest biomass associated with higher percentages of sand and gravel. Predator abundance also emerged as a strong predictor of both density and biomass. Given that predator abundance and sediment type strongly affect benthic infauna and that these factors also may vary according to shoreline type, the construction of hardened structures will lead to complex changes in subtidal benthic communities in Chesapeake Bay tributaries and should be minimized to maintain qualities of the natural system.

Grad, Oral

Modeling the dynamics of a natural predator and potential disease vector among diverse coral communities

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As reef decline continues to change the face of Caribbean reef ecosystems, understanding the dynamics of the causal factors behind the decline has become an increasingly important research area. The coral predator *Coralliophila abbreviata* has been implicated in the transmission of mortality-causing diseases among colonies but this gastropod also shows prey preferences that may be dependent on spatially variable coral community dynamics. Understanding how its feeding activity and consequent potential to transfer disease is affected by species distribution and community composition is difficult with field experimentation alone. Here, quantitative estimates from *in situ* observations and experiments in the Florida Keys were used in the parameterization of a spatially-explicit simulation model. This model provides a useful platform for testing hypotheses of community change and potential disease impact driven by the dynamic prey preferences of this natural coral enemy.

Fac, Oral

Hybrid sterility limits introgression between two *Mytilus* species

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In marine systems a majority of speciation research has focused on pre-mating reproductive isolation mechanisms and very seldom have post-mating mechanisms been examined. Marine mussels in the *Mytilus edulis* complex (*M. edulis*, *M. trossulus*, and *M. galloprovincialis*) are emerging as a model system for examining the role of post-mating reproductive isolation in limiting hybridization and introgression. *Mytilus galloprovincialis* and *M. trossulus* are sympatric and hybridize on both coasts of the North Pacific. Hybridization levels differ among geographic locations, but introgression beyond the F₁ generation is always rare or absent. While assessing gender of mussels, we documented a noticeably low ability to determine gender of individuals in both hybrid zones in Hokkaido, Japan. Eighty percent of gender indeterminate individuals utilizing traditional field methods had a hybrid multi-locus genotype. Histological examination of the gonad tissue revealed unusual cell types present in hybrid individuals that appeared to be arrested in a meiotic phase. The arrest of gametogenesis in both male and female individuals results in very low fertility and thus represents a formidable level of post-zygotic reproductive isolation between these species. This is the first report of reduced fertility as a result of hybridization among any species in the blue mussel species complex.

Grad, Oral

The effect of swell-generated physical damage on disease prevalence and asexual reproduction in the coral, *Acropora palmata* (Lamarck)

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The primary objective of this study was to determine trends in disease on damaged and undamaged colonies of *Acropora palmata*, in the US Virgin Islands (USVI), following an episode of heavy swells that caused physical damage. At four sites on St. Thomas and St. John, colonies of *A. palmata* were surveyed monthly for trends in disease following a series of large swells in March 2008. Over the course of one year following the swell event, disease prevalence was 37% higher on damaged colonies than undamaged colonies. However, disease prevalence was significantly greater only during months where the average water temperature exceeded 28°C. Nine months after the storm swells, 48% of *A. palmata*

fragments generated by the swells were still alive, and survivorship was significantly different between size classes ($P < 0.05$). In addition, predation by the corallivorous snail, *Coralliophila abbreviata*, was influenced by damage to the coral. Snail predation was 46% more common on damaged colonies than undamaged colonies. This study shows that storm-generated damage to *A. palmata* may increase negative, indirect impacts, such as disease and snail predation, and that survivorship of fragments are influenced by fragment-size.

Fac, Poster

Submerged Aquatic Vegetation Restoration in a Mid-Atlantic Low Salinity Estuary: Implications for Successful Fisheries Habitat Enhancement.

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Distribution and abundance of submerged aquatic vegetation (SAV) is important to the ecological function and health of coastal bays and sounds. SAV habitat provides refuge and food for marine organisms and migratory waterfowl. As primary producers, SAV oxygenates the water column and contributes organic material to the estuarine food web. Water clarity is enhanced when plants trap particulate matter in the water column and stabilize bottom sediments. Recent decades have seen declines in the distribution and abundance of SAV due to anthropogenic impacts. Historically, SAV restoration research and life history studies have focused on high salinity species. As a result, experiences on how to best restore SAV in oligohaline shallow wind driven mid-Atlantic estuaries are needed. Applying appropriate techniques from the literature to the successful transplantation of SAV in Currituck Sound, North Carolina, is the goal of my research. In June 2009, SAV was transplanted in sediment cores from donor beds to a nearby restoration site. Plant growth and survival was monitored from June through October. Preliminary results presented will assess growth and survival of multispecies plugs versus single species plugs. Research outcomes will be provided to resource managers to support successful restoration and enhancement of SAV in these systems.

FAC, Oral

Genetic diversity and gene flow in *Zostera marina* populations in Great South Bay, New York.

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The dominant species of seagrass in NY, *Zostera marina*, has experienced several historical bottlenecks and is currently under heavy stress due to water quality and other anthropogenic problems. The consequences of these events on the genetic structure of the remaining populations are unknown. This project addressed questions regarding the genetic diversity of extant populations, and whether understanding the population genetics would aid current conservation and restoration efforts. Plant morphometrics and genetic samples of *Zostera marina* were collected at sites across Great South Bay. Each individual was genotyped at 8 different microsatellite loci. Analysis of microsatellite alleles was used to examine the population structure and gene flow between meadows within the bay. Comparisons of genetic characteristics between populations to plant morphometrics, sediment parameters and water quality data were conducted. The importance of understanding the genetic diversity of extant eelgrass populations in NY will be discussed.

Oral

Starving prey and scary predators: resource availability and condition influence prey behavioral responses to predation risk

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Organisms face constant battles to balance predation risk and foraging success. To mechanistically assess how prey manage these often conflicting demands, we observed the foraging decisions of oyster drills (*Stramonita haemastoma*) when presented with varying resource levels while in the presence and absence of the predatory stone crab (*Menippe mercenaria*). Experiments were conducted in mesocosms and drill hunger and the acclimation time of drills with predators were also manipulated in a four-way fully factorial design. Both stone crabs and eastern oysters (*Crassostrea virginica* of varying densities) were placed in the center of an artificial oyster reef and the drills distance from the oysters was measured as an indicator of drill foraging activity. Oyster drill foraging behavior was most strongly influenced by crab presence; the most active foraging behavior was exhibited in the absence of crabs, but this effect disappeared when drills were starved. Resource density secondarily influenced drill foraging and acclimation time had no effect. These results show that while predator presence may represent the principal concern of prey, their behavioral responses can be motivated by both prey condition and resource availability.

Grad, Oral

Cold Temperature Effects on Byssal Thread Production by the Native Mussel *Geukensia demissa* and the Non-Native Mussel *Mytella charruana*

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Invasive species can be detrimental to an existing ecosystem as they compete with native species for resources. The charru mussel, *Mytella charruana*, originates from South America but has recently been found along the southeastern Atlantic coast of the U.S. This is a cause of concern for native species such as the ribbed mussel, *Geukensia demissa*. The production and attachment of byssal threads to a substrate is a vital component to survival in an intertidal area, and can be directly influenced by environmental conditions such as temperature. Here we compare the effects of cold temperature on byssal thread production of these two species. There were 6 tanks per treatment (3 per species) and 4 mussels per tank. Temperature treatments included 10, 13, and 23° C. When final experimental temperatures were reached, all byssal threads were counted and cut for 7 days. Our data indicated that the coldest tested temperature (10° C) negatively affected byssal thread production in both *M. charruana* and *G. demissa*. However, *G. demissa*, unlike *M. charruana*, showed no difference in mean byssal thread production between 13° C and the control (23° C). These results have implications with regard to survival and future spread of *M. charruana*.

UG, Poster

Alpheid shrimp reduce burial time of corkscrew anemones

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The corkscrew anemone *Bartholomea annulata* resides at the sand-hard substrate interface and provides a home for many organisms including species of cleaner shrimps, which may have positive cascade effects on reef fish diversity. This bottom-dwelling anemone is subject to sand burial by burrowing lugworm mounds, as well as by natural sand inundation. Snapping shrimp, *Alpheus armatus*, which are obligate symbionts and excavate burrows near the base of *B. annulata*, have been observed using their pleopods to remove sand from buried anemones. Does this behavior significantly reduce the proportion of host

anemones that remain buried, and the duration of burial? In field experiments, anemones were buried with and without alpheids, and were observed one day later to determine if they remained buried. Laboratory experiments also were conducted in shallow pools, in which anemones were subjected to the same treatments (with and without alpheids), and examined at fifteen-minute intervals. The alpheids did not significantly reduce the proportion of anemones that remained buried under field or laboratory conditions, but they did reduce the duration of burial. The digging behavior of the alpheid shrimp thus may provide substantial benefits to anemone hosts by reducing host burial and contributing to the maintenance of anemone burrows.

UG, Poster

Whose competing with who?

An early evaluation of flow-regulated, chemically-mediated coral-algal competition

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Competitive interactions play a major role in structuring ecological communities. In coral reefs, competitive interactions between coral and algae are integral to structuring the reef environment. Algae have different mechanisms to outcompete coral, which can be either physical (i.e., abrasion) or chemical (i.e., allelopathy or bacterial mediation). The goals of this study were two fold. First, a goal was to quantify the frequency of coral-algal interactions in the backreef of Moorea, French Polynesia. Additionally, the outcomes of interactions on upstream and downstream sides of coral bommies was quantified to elucidate how the effects of abiotic stress might regulate competitive outcomes. On the downstream sides of coral bommies, there were significantly more algal winners in macroalgal-coral interactions. Second, to begin to evaluate chemically-mediated mechanisms of coral-algae competition, bacterial densities were estimated within and outside of zones of interaction. These results will inform which organisms are engaging in competition in Moorea, French Polynesia and will contribute to a larger project that will evaluate the strengths of these different mechanisms depending on abiotic and biotic stressors.

Grad, poster

The effects of temperature and storms on the population dynamics of the hydrocoral *Millepora* in St. John, US Virgin Islands

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Millepora is rare on many reefs, but when found, it can be an aggressive spatial competitor. In this study we examined the dynamics of *Millepora* in St. John, using photoquadrats to sample the benthos yearly from 1992. *Millepora* functions as a hermatype in some locations, but in this study, it occupied <2.0% of the benthos. Nevertheless, it changed strikingly in abundance over 17 years, varying as much as 3-fold between extremes of annual mean cover. Changes in percent cover and colony size were associated with years characterized by large seasonal ranges in temperature and intense storms. 1998 was unusually hot, with two hurricanes passing <100 km from St. John, and mean percent cover and colony size decreased significantly from 0.6% to 0.4%, and 32 to 26 cm² respectively, while colony abundance and branch density increased by 70% and 35% respectively. Decreases in cover were driven by reductions in colony size through fission and shrinkage, although sexual recruits and branch fragments probably contributed to the increase in colony density. While our correlative study cannot identify causal relationships, it is likely that population dynamics of *Millepora* were driven largely by the physiological consequences of high temperature and the physical damage of storms.

Grad, Oral

Tidal and rainfall effects on salinity, dissolved oxygen and pigment concentrations within northeastern SC marine and freshwater swashes

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Regional development in northeastern South Carolina physically has modified swashes; estuarine tidal systems connected to the ocean by across-beach inlets. Consequences from modifications have been a decline in water quality and increase in beach advisories, both attributed to increased storm water runoff. To examine if runoff influences swash water quality, data from an estuarine, Withers, and freshwater swash, Deep Head, were collected before and after multiple rainfall events. Samples also were collected during high-low tides and from two sites within each swash: Ocean closest to the beach, and 17B closest to natural ponds. Salinity, dissolved oxygen and chlorophyll *a* were measured either in the field or lab from field collected samples. As expected salinities consistently were greater within Withers (24.8 ppt) compared to Deep Head (2.2 ppt), but did not vary consistently with rainfall. Chlorophyll *a* levels did not differ between swashes, but did differ between Withers Ocean (9 µg/L) and 17B sites (14µg/L). Dissolved oxygen levels were slightly greater at Deep Head (9.5 mg/L) compared to Withers (8.0 mg/L). Although rain events and tidal patterns did not illustrate effects on swash water quality, differences in dissolved oxygen, chlorophyll *a*, and suggest differences between marine and freshwater swashes.

UG, Poster

Transplantation and subsequent parrotfish predation on small *Siderastrea siderea* colonies offshore southeast Florida USA

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Nearshore habitats offshore southeast Florida are frequently impacted by coastal construction activities which when permitted, require impact minimization and mitigation efforts. This study tested the efficacy of utilizing an abundant nearshore scleractinian coral, *Siderastrea siderea*, in these efforts. Small (<10 cm diameter) *S. siderea* colonies were removed from a nearshore habitat and transplanted to offshore reef areas. Within 2 weeks, 95% of the transplanted colonies exhibited grazing scars caused by parrotfish predation. Grazing extent and survival was compared to non-transplanted colonies as well as newly transplanted colonies subjected to differing transplantation stress levels. Grazing extent was highest on colonies exposed to the greatest degree of stress. Predation pressure subsided after approximately three weeks, which allowed some colonies to fully or partially recover. In terms of survival, this transplantation effort was not highly successful. However, results from this study emphasize the importance of evaluating environmental and biological characteristics between sites prior to transplantation activities and provides resource managers with information on the efficacy of utilizing small *S. siderea* as a transplantation resource.

Grad, oral

Latitudinal variation in size-dependant patch recovery: the importance of *Ascophyllum* canopy characteristics and light penetration.

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Northern and southern Gulf of Maine (GOM) rocky shore communities vary with respect to the distribution and abundance, but not identity, of dominant species. Previous research (Bryson and Trussell, *in preparation*) suggests that variation in the recovery pattern of both small (0.04m²) and large patches (1m²) on low flow rocky shores may account for differences in community structure. Large patches in the northern GOM recovered at a faster rate than small patches. However, southern patches recovered slowly regardless of size. In order to address differences in size-dependant patch recovery, we first documented key characteristics of the *Ascophyllum nodosum* canopy (biomass, maximum length,

holdfast density and number of thalli/holdfast) at northern and southern sites. Based on these observations, we hypothesized that longer *Ascophyllum* reduced light penetration, and consequently recovery, in small patches in the Northern GOM. We tested these predictions by manipulating canopy length at northern and southern sites, measuring light intensity at the substratum, and documenting recovery. Results suggest that a longer canopy impedes recovery regardless of location, but that latitudinal differences in the recovery rate of large patches persist regardless of canopy length.

Grad, Oral

The curious case of *Elachista antarctica*: palatability differences between epiphyte and host, and factors affecting reproductive propagules

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Evaluation of macroalgal communities surrounding Anvers Island, Antarctica indicated that most species are in some way defended against predation, many using chemical defenses. Also, this community is mostly devoid of emergent filamentous epiphytes. However, *Elachista antarctica* is an endo/epiphyte found growing only out of the palatable rhodophyte *Palmaria decipiens*. *E. antarctica* reproductive propagules' swimming behaviors as effected by irradiance and natural products from defended algae, and settling and germination behaviors in the presence of natural products, as well as palatability differences between host and epiphyte to mesograzers will aid in understanding this exclusive epiphytization and indicate whether macroalgal chemical defenses inhibit biofouling by *E. antarctica*. It was hypothesized that *P. decipiens* was more palatable than the epiphyte, therefore the epiphyte will be ignored during grazing of *P. decipiens*. Feeding assays where an amphipod was given either a choice between *E. antarctica* and *P. decipiens*, or each alga individually, showed preferences to the epiphyte in 3 of 4 amphipod species. Positive phototactic swimming behaviors of propagules have been observed at 80 and 200 $\mu\text{mol photons m}^{-2} \text{s}^{-1}$. This information was used during chemotactic analysis of propagule swimming behaviors and settlement and growth experiments in presence of natural products, reported here.

Swimming through a natural aquarium: Video of observations of fishes on the limestone ledges of North Carolina

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This short film records observations of temperate and tropical fish species on the shallow water, hard-bottom habitats of the continental shelf of North Carolina. Target species for this video project were primarily economically important groupers, but a total of 91 fish species were captured during the 30 hours of filming. The short video presentation will cover a few interesting or exceptionally beautiful scenes and moments captured during the project.

Fac, Film

Biodiversity and ecosystem function of shallow bank systems within the Florida Keys National Marine Sanctuary

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Systems of shallow banks, associated with tidal passes, are distinctive benthic features of the Florida Keys National Marine Sanctuary (FKNMS). These "seagrass banks", formed approximately 2000 years ago, as aggregation of *Porites* coral rubble and *Halimeda* sand. Banks provide a mosaic of essential fish habitat; juvenile nurseries, foraging and sheltering grounds for adults, including high densities of economically important reef fishes. Comparison of Red Bay Banks, Bamboo Banks and Channel Key

Banks to their surrounding basins showed that bank fish assemblages consistently resembled assemblages of coral reefs and had higher diversity and biomass than the surrounding basins. As in most reef fish assemblages a high proportion of the biomass of the bank community consists of “homing” species that shelter during the day and forage nocturnally in surrounding habitats. The species composition, high density and diversity of the bank fish assemblage indicate banks provide a key structural component supporting the biodiversity and productivity of the FKNMS and should be considered for Sanctuary Preservation Area (SPA) status.

Pro, Oral

Eastern oyster (*Crassostrea virginica*) recruitment, growth, and survival on alternative reef substrates

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Chesapeake Bay native oyster (*Crassostrea virginica*) restoration efforts have been extensive. Recently restoration has been impeded by substrate limitation due to reduced availability of oyster shell. We experimentally examined performance of oyster shell, broken concrete, and two sizes of granite and limestone marl in the Lynnhaven River, a subestuary of lower Chesapeake Bay. Treatments simulated intertidal oyster reefs, were caged and uncaged, and were placed at three sites (marsh, riprap and oyster shell reef). Granite of both sizes had the highest oyster recruitment (> 1500 m⁻²) and biomass (> 200 g AFDM m⁻²). Absence of significant caging effects indicated that predation by large predators was not important. Many reefs reached a mature state by the third year, when treatments accreted 15-20 L of shell due to three strong year classes. Exterior portions of the reefs maintained > 70% of oyster density, biomass, and oyster shell volume. Large oysters (> 95 mm shell length) had lower intensity of Dermo infections than smaller (60–90 mm) oysters, suggesting that disease tolerance had developed in these high salinity waters. These findings highlight the importance of substrate type and will assist ecological oyster reef restoration.

A biomimetic data logger to estimate soft tissue desiccation in intertidal bivalve mollusks

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Intertidal organisms regularly experience both marine and terrestrial habitats and can be affected by extreme conditions in either habitat. In particular, sessile intertidal organisms, such as bivalve mollusks, that can not actively escape or avoid stressful conditions are considered an indicator species for the effects of climate change on species distribution in the intertidal zone. Previously, biomimetic data loggers created to measure environmental stresses on bivalve mollusks in the intertidal have measured only body temperature. Desiccation is an environmentally induced stress that is not necessarily coupled with ambient or body temperature. We describe the use of miniature electronic humidity sensors to estimate the soft tissue desiccation rate in mussels.

UG, Poster

Abundance of ribbed mussels (*Geukensia demissa*) in micro- and macrotidal salt marshes in Atlantic Canada: a preliminary study.

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A positive interaction between saltwater cord grass (*Spartina alterniflora*) and ribbed mussels (*Geukensia demissa*) has been documented for southern New England; however, this interaction has not been studied in Atlantic Canadian salt marshes. Two geographically close salt marshes, John Lusby in the upper Bay of Fundy (macrotides, turbid water, cold water temperatures in summer) and Cape Jourimain in the Northumberland Strait (microtides, clear water, warm water temperatures in summer), were sampled in early fall 2008 and 2009. A stratified random sampling design was used to determine the densities of

invertebrate and plant species within quadrats. PRIMER analysis (ANOSIM, using presences/absences) detected a significant difference in community structure between the two salt marshes ($R = 0.127-0.182$ for the 2 years, $p < 0.005$). Ribbed mussels contributed ~4% to this difference (assessed using SIMPER). However, no positive correlation was found between densities of ribbed mussels and saltwater cord grass. Intensive sampling in multiple marshes and a manipulative field experiment are planned for the coming field season to determine the ecological role of ribbed mussels within Atlantic Canadian salt marshes.
Grad, Poster

Indirect impacts of distant breakwaters on coral communities in Dubai, United Arab Emirates

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Large areas of coral reef in Dubai have been destroyed by direct burial and by sedimentation associated with coastal construction projects. Such projects may also have indirect impacts by modifying coastal hydrodynamics. I used a BACI design to assess the indirect effects of a 200 m long breakwater by comparing coral communities at a control reef and a reef 700 m to its lee. Each reef was sampled biannually for one year before and after breakwater construction using both haphazard and permanent photoquadrats. On the control reef, coral cover increased significantly over the course of the study, and community structure remained stable. Coral cover on the impacted reef declined from 50% to 18% after breakwater construction, and there were significant declines in the number of live colonies, mean colony size, and community diversity. Community composition changed significantly as well, *Acropora* spp. were eliminated, and faviids and poritiids increased in proportional abundance. There was no change in sedimentation on the control reef, but there was an increase in fine silts following breakwater construction (28% to 53% cover) on the impacted reef. This resulted from reduced wave action rather than sedimentation produced by construction, indicating the importance of indirect effects of coastal developments on reefs.

Fac, Oral

Post injury recovery, reattachment and growth of the giant barrel sponge, *Xestospongia muta*, in Southeast Florida

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The giant barrel sponge, *Xestospongia muta* is a prominent component in southeast Florida reef communities and is often injured from anthropogenic or natural disturbances. The resulting complete or partial shearing of *X. muta* barrels frequently leads to mortality of loose fragments that cannot naturally reattach. This study examines the degree to which sponge size and injury severity affects recovery and growth and explores artificial reattachment success and growth of fragments. In June 2008, 60 sponges were subjected to injury treatments of approximately 50% or 90% barrel removal. A new, simple method was developed to secure these removed barrels (fragments) to the substrate. For 15 months, all injured sponges were monitored for recovery and growth (change in height), and fragments were monitored for reattachment. All injured sponges showed signs of recovery within 1 month. Within 7 months the reattachment method had already proved successful with more than 80% of all fragments (both treatments) becoming attached. After 15 months, the survival rate for injured sponges was 97% and 88% for reattached fragments. Injured sponges were determined to have higher growth rates than fragments. Studies of recovery success for different injury and restoration scenarios will further facilitate restoration decision making by resource managers.

Grad, Oral

Larval trematode that parasitizes snails predicts abundance of elusive vertebrate host

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Digenean trematode parasites require multiple host species to complete their life cycles. Trematode abundance therefore can be tightly coupled with the abundance of host species. Accordingly, we investigated whether trematodes could index the abundance of hard-to-sample host species.

Diamondback terrapins, *Malaclemys terrapin*, are a species of concern along the US eastern and gulf coasts; however, their population sizes are logistically difficult to quantify. *Pleurogonius malaclemys* is a terrapin-specific trematode that lives its larval life stages first inside mud snails (*Ilyanassa obsoleta*), and subsequently as external metacercarial cysts on hard surfaces such as snail opercula. At each of 12 sites along the Georgia coast, we quantified the prevalence of internal trematode infection among the snail population and the prevalence and mean abundance of external trematode cysts. We then correlated those metrics with terrapin abundance estimated from mark-recapture methods. Our results demonstrate that the abundance of external cysts along with salinity predict $\geq 59\%$ of the variability in terrapin abundance.

We suggest that tight linkages in the life cycle stages of multi-host parasites, especially ones requiring trophic interactions for transmission, make them an inherently holistic, ecosystem-based approach to population assessment and valuable predictors of host species that are challenging to quantify directly.

Fac, Oral

Where's the Beef? Predatory snails' foraging behavior responds differently to chemical cues embedded in sediment.

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Hydrodynamics can significantly enhance or diminish the chemosensory ability of organisms. Previous studies have found that slowing moving animals, such as gastropods, are more efficient foragers in more turbulent flows. In this study, we investigated whether the predatory snail, *Stromanita haemastoma*, is capable of detecting odors embedded in the sediment, which may allow these snails to be more effective foragers in turbulent flows where waterborne chemical cues are mixed. Snails were allowed to forage with flow at 4 cm/s on a sandy bottom. Cue was delivered to the flume through saturation tubing buried in the sediment. Snails were given two treatments, the cue treatment of seawater in which oysters had been filtering overnight and a control of pure seawater. When exposed to cue, snails spent 52.8% of their time with their siphon at the sediment-water interface vs. 35.6% of their time under control treatments ($P < .001$). This preliminary study shows an ability of predatory snails to detect cues in the sediment and paves the way for future research to explore the idea that the sediment-water interface provides a more effective foraging habitat than the benthic water column.

Grad, Poster

Population dynamics of the invasive bryozoan *Membranipora membranacea* along subarctic and temperate longitudinal and latitudinal gradients

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The epiphytic bryozoan *Membranipora membranacea* was first observed in the shallow subtidal zone of Newfoundland and Labrador (NL, Canada) in 2002, ca. 15 years after it was introduced to the Gulf of Maine (USA). Studies indicate that settlement, recruitment and growth of larval and adult stages are affected by temperature, suggesting the population dynamics of this kelp-encrusting alien may change as it spreads northward. This research aims to: 1) investigate spatial and temporal variability in recruitment and growth of *M. membranacea* along NL's longitudinal and latitudinal gradients, and 2) examine how this variability relates to changes in sea temperature. The density of *M. membranacea* (settlers and

colonies) on kelp (*Saccharina longicruris*) and recruitment plates was quantified in 2008 and 2009. In 2008, recruitment on kelp at the southerly sites started approximately two months earlier and was more than one order of magnitude greater than at the northerly sites. In 2009, recruitment on plates did not occur at the east coast sites; however, recruitment was observed at west coast sites and was similar to that on local kelp individuals. Recruitment of *M. membranacea* along the coast of NL varies with local temperature regimes, with greatest densities recorded at the warmest sites.

Grad, Oral

Spatial variability of benthic biodiversity at different spatial scales.

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Biodiversity and its conservation are currently an important issue, mostly due to the environmental changes occurring. Several studies have begun to examine the spatial repartition of benthic organisms, focusing on the spatial scale where main processes explaining the distribution should take place. A hierarchical sampling with four spatial scales (ranging from km to cm) was applied in the Laurentian Channel (St. Lawrence estuary, Quebec) and in the Baie des Milles-Vaches (North Coast of St. Lawrence estuary, Quebec). For the deep environment (Laurentian Channel), the scale of maximum variability is the smallest one (cm) where as for the intertidal environment (Baie des Mille-Vaches), this scale varies from cm to 10'cm depending of the diversity descriptor used. These results corroborate those of previous studies showing most of the time that for the overall community, the scale of maximum variability is the smallest taken into account, regardless of the environment.

Grad, Oral

Consequences of an environmentally-mediated algal bleaching disease

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Environmentally-mediated diseases are increasing in frequency and severity as global climate systems undergo rapid change. Diseases often affect important, habitat-forming marine organisms including corals, seagrasses and macroalgae, with potential community and ecosystem level consequences. We monitored the incidence of bleaching disease in the red macroalga *Delisea pulchra* and found that bleaching was seasonal, facilitated by bacterial infection and abiotic stress and suppressed by algal chemical defences (which were depleted in bleached individuals). More than 50% of algae in monitored populations were affected by this disease in peak seasons and the consequences of bleaching were significant. Bleached algae grew significantly less than their healthy conspecifics and often lost biomass during the study. Fecundity in *D. pulchra* was positively correlated with biomass. Furthermore, bleaching increased algal attractiveness as both habitat and a food source to several important herbivores. Thus bleaching in *D. pulchra* strongly affected the performance of individuals and may have consequences at the population-level. Bleaching also altered algal trophic interactions, providing evidence for marine 'tripartite' interactions shifting in response to environmental change.

Environmentally-mediated diseases and abiotic stressors can have severe consequences, particularly when they affect important habitat-forming organisms like macroalgae.

Grad, oral

The impacts of CO₂ fertilization on the productivity and structure of seagrass communities.

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The *in situ* impact of CO₂ fertilization on the productivity and structure of a nearshore seagrass community was studied during 2009 in the Florida Keys. Clear 'open-top' chambers were utilized to establish three enrichment treatments (CO₂ enrichment within chambers; no CO₂ enrichment within

chambers; and unchambered controls). Carbonate alkalinity and pH were periodically measured to monitor CO₂ levels. Seagrass productivity and community structure were measured monthly utilizing the leaf punch method and individual shoot counts.

For all dates, enriched chambers demonstrated significantly lower pH values and higher CO₂ concentrations as compared to the unenriched chambers and control plots ($p < 0.01$, Kruskal-Wallis). Seagrass productivity was not significantly different between treatments. Enriched chambers displayed an average productivity of $20.0 \pm 3.8 \text{ mg g}^{-1} \text{ d}^{-1}$, while unenriched chambers and control plots displayed average productivities of 18.6 ± 2.4 and $20.4 \pm 2.5 \text{ mg g}^{-1} \text{ d}^{-1}$ respectively. Community composition was significantly shifted towards lower abundances of calcareous algae within the enriched chambers ($p < .01$, Mann-Whitney). Unenriched chambers and control plots displayed no shifts in community composition. Our results suggest that increased CO₂ concentrations within coastal waters may have a greater relative impact on the abundance and calcification of calcareous algae than on the productivity of seagrasses.

Grad, Poster

Integrating succession and functional richness in the local-regional richness relationship – a global scale perspective.

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The shape of the relationship between local and regional richness can determine the contribution of regional processes on local assemblages for different habitats, taxonomic groups or spatial scales. We investigate this relationship in marine fouling assemblages using an expanded and globally replicated approach by incorporating two dimensions of diversity (taxonomic and functional) and different successional stages. In eight different biogeographic regions (Australia, Brazil, Chile, England, Italy, Japan, Portugal and Sweden), 68 polyvinylchloride plates (15 x 15 x 0.3 cm) were deployed for colonization. Communities colonizing plates were analyzed by measuring percent cover at each of the four different successional ages: 2, 4, 6 and 8 months. Local richness was assessed as the average number of species and functional groups per plate and regional richness was evaluated as the estimated asymptote of the sample-accumulation curves for species and functional groups on experimental plates. We found that the shape of the relationship between local and regional richness depended on successional stage and the type of richness considered. This relationship, whether taxonomic or functional richness are considered, frequently displays independence of the two scales, particularly in early and late phases of the successional process.

Fac, Oral

Gender, intraspecific interactions and prey species effects on mud crab foraging on intertidal oyster reefs

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Mud crabs, *Panopeus herbstii*, can have significant, negative effects on bivalve populations. Although foraging can be modified by interspecific interactions, less well known are the effects of gender, intraspecific interactions, and putative prey species on *P. herbstii* foraging. The effects of gender (male/female), size (small, medium, large) and prey type (ribbed mussels, eastern oysters) on crab foraging were tested in a series of controlled experiments. All crabs were collected from oyster reefs in the field and fed either field or aquacultured bivalves in flow-through (Baruch Marine Lab) or closed-system mesocosms (Coastal Carolina University). Feeding rates between similar-sized males and females were not significantly different. Significantly greater numbers of bivalves were consumed by large (27 – 40 mm) compared to medium (18 – 27 mm) compared to small crabs (10 – 18 mm). Crab foraging rates were significantly reduced by intraspecific interactions between large crabs and all other sizes tested.

Large crabs ostensibly caused between a 28 to 100% reduction in feeding. Intraspecific may rival interspecific effects in reducing bivalve survival. Gender and prey species do not appear to affect mud crab foraging, but intraspecific interactions among different sized crabs may significantly reduce the cumulative effects of *P. herbstii* predation on intertidal oyster reefs.

Grad, Oral

Is the coral triangle a species source or sink? Genetic structure and gene flow of pantropical reef species supports the center of accumulation model.

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Species richness reaches a maximum in the Indo-West Pacific, attenuating with increasing distance from the “coral triangle.” Two speciation models seek to explain this biogeographic pattern. The center of origin model posits high speciation in and around the coral triangle, whereas in the center of accumulation model predicts speciation occurs randomly throughout the Indian and Pacific Oceans, but that species tend to migrate towards the coral triangle. We confront these ideas with data, by using microsatellite markers to estimate population structure and migration patterns in two broadly distributed reef species: the parrotfish *Scarus rubroviolaceus*, and the urchin *Tripneustes gratilla*. Assignment and population graph methods indicate that peripheral regions of the Hawaiian Islands, the Eastern Pacific, and the Red Sea have the strongest effects on population structure, while barriers to gene flow across the boundary between the Indian Ocean and Pacific Oceans are weak. Further, coalescent modeling of the *S. rubroviolaceus* data reveals the migration from the Hawaiian Islands and Eastern Pacific to the Central Pacific is 10x higher than in the opposite direction. Our data, combined with high rates of endemism in peripheral regions, suggest that “edge” populations are sources of new biological innovation that can accumulate in sink regions along the western margin of the Pacific basin.

Fac, Oral

Species and sex determination of juvenile fiddler crabs using *Littoraria* shells as a refuge.

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Studies suggest that juvenile fiddler crabs might settle higher in the intertidal zone because these habitats provide access to food and better refuge from predation, cannibalism, desiccation, heat stress, and competition with other juveniles and adults. Juveniles take cover among vegetation, but no studies have examined other possible refuges in the salt marsh. Recently, juvenile fiddler crabs were observed using snail shells as a refuge. Shell use of up to 79% was observed. The present study determined whether shell use varies with species and sex. Six trips were made to four sites off Old Tybee Road, Georgia in the summer of 2009. During each trip, 100 *Littorina irrorata* shells were collected. In the lab, each shell was examined for crabs. Juvenile crabs were sexed and species identification completed using RFLP analysis. Two species of fiddler crabs were found in shells, *Uca pugnax* and *U. pugilator*. *U. pugnax* was the dominant species at all four sites, although differences were not significant at one of the sites. Sex ratios were female biased at all four sites, ranging from 3.6:1 to 5.4:1. These results might reflect juvenile distribution in the high marsh and behavioral differences between the sexes.

Grad, poster

Effects of short-term exposure to elevated pCO₂ on the photosynthetic performance and growth of *Halimeda minima* in Moorea, French Polynesia.

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Increased carbonization of the ocean is predicted to have dramatic consequences for calcifying marine taxa. Calcified algae are major primary producers and contributors to accretion and sediment production on many coral reefs. *Halimeda minima* is one of the most common calcified taxa on Moorea coral reefs where the current aragonite saturation state (Ω_{arg}) is ≈ 4.1 . To quantify the effects of short-term exposure to an approximate doubling of ambient pCO₂ ($\Omega_{\text{arg}} \approx 2.4$) on photosynthesis and growth, we exposed thalli to seawater bubbled with air (380 μatm pCO₂) and seawater bubbled with air with a pCO₂ ≈ 800 μatm for ten days. Buoyant weight, fluorescence yield, and rETR for each individual were measured at the beginning and end of the experiment. Photosynthetic performance was reduced significantly in the elevated pCO₂ treatment with a 45% and 38% reduction in yield and rETR, respectively. Growth also was reduced significantly (28%). Thalli exposed to elevated pCO₂ showed signs of bleaching with scattered white patches on segments. These results are consistent with previous studies demonstrating negative effects of elevated pCO₂ on calcified taxa and suggest that aspects of coral reef community structure and function will be affected significantly by continued ocean acidification.

Fac, Oral

Interacting effects of predator identity and herbivore assemblage indirectly influence biomass of a primary producer

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Direct effects of predator identity on herbivores can indirectly influence the biomass of primary producers via a classic trophic cascade. We used a model marine system of fish (*Cymatogaster aggregata*, *Syngnathus leptorhynchus*, *Lagodon rhomboides*) as the top predators, mesograzers (*Ampithoe valida*, *Caprella drepanochir*) as the herbivores, and eelgrass (*Zostera marina*) as the primary producer, to investigate how interactions between predator identity and different herbivore assemblages in San Francisco Bay affected *Zostera marina* biomass. Predator identity and herbivore assemblage differentially affected final *Z. marina* biomass. *C. aggregata* and *S. leptorhynchus* led to significantly greater eelgrass biomass by reducing mesograzers herbivory in a classic trophic cascade. In contrast, due to omnivory, eelgrass biomass decreased in the *L. rhomboides* treatment and was similar to the no-fish, mesograzers only treatment. In treatments with both mesograzers, *S. leptorhynchus* was not effective at reducing mesograzers abundances, and *Z. marina* biomass decreased similarly to the no-fish, mesograzers only treatment. Thus, direct interactions between predator identity and herbivore assemblages can indirectly influence ecosystem structural and functional properties.

Grad, Oral

Using acoustic telemetry to track snapper and grouper species in particular areas of Gray's Reef National Marine Sanctuary

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NOAA's Gray's Reef National Marine Sanctuary (GRNMS), located 17.5 nautical miles off Sapelo Island, GA, is one of the largest near-shore live-bottom reefs in the southeastern United States. The reef attracts numerous species of benthic and pelagic fish that support recreational fisheries. The purposes of this research are to determine the residence time of several snapper and grouper and to determine whether

residence time is dependent on habitat characteristics or other environmental factors (i.e. wave height, lunar cycle, spring-neap cycle). Fish were tagged with acoustic tags (V13-1L) and are being tracked using VEMCO® receivers (VR2W). Sixteen fish have been tagged in GRNMS: three red snapper *Lutjanus campechanus* (FL 54–60 cm), seven scamp *Mycteroperca phenax* (FL 58–85.5 cm), five gag *Mycteroperca microlepis* (FL 38–87.5 cm), and one red grouper *Epinephelus morio* (FL 72.5 cm). Fourteen acoustic receivers are currently deployed in the sanctuary, which are able to detect tags reliably over a 200 m radius. Several fishes have been daily residents since tagging and daily detection patterns are significantly correlated ($p < 0.05$) between these fishes. However, variations in daily detections do not appear to be related to the lunar cycle, spring-neap cycle, or wave height.

Grad Poster

Recruitment of bay scallops, *Argopecten irradians*, to artificial seagrass near a spawner sanctuary

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Bay scallops once supported a vibrant fishery on Long Island, New York. Populations crashed in the mid 1980s due to a series of disruptive brown tide blooms. Blooms have not occurred within the Peconic Estuary system since 1995, however, scallops have yet to naturally recover. In the last 4 years, a large-scale restoration effort has taken place, with over 1 million scallops being produced yearly for lantern net and free plant spawner sanctuaries, leading to significant increases in the numbers of scallop spat recruiting to collectors in the years post sanctuary. One small embayment, Hallock Bay, received an on-bottom free plant spawner sanctuary in the winter of 2008. Survival of scallops was high, ~30% through the spawning season in 2009. A series of artificial seagrass units (ASUs) were placed in this bay prior to the spawner sanctuary being established. Scallop spat recruitment to these ASUs were monitored by collecting a series of artificial shoots at the edge and interior. There was no difference between patch type or within patch location for recruitment of scallops, however, there was a significant difference between enclosed and exposed shoots, suggesting a high natural mortality rate for post-set seed scallops.

Declining skeletal extension rates in forereef colonies of *Siderastrea siderea* on the Mesoamerican Barrier Reef System, southern Belize

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We investigated century-scale variations in skeletal extension rates for *Siderastrea siderea* colonies inhabiting outer (forereef, backreef) and nearshore reefs of the Mesoamerican Barrier Reef System in southern Belize. Rates of change in annual skeletal extension (\pm SE) for forereef *S. siderea* have declined significantly ($p < 0.05$) by $0.020 (\pm 0.005)$ mm yr⁻² over the past century, while changes in the rate of annual skeletal extension were not significantly different from zero for backreef ($+0.011 \pm 0.006$ mm yr⁻²) and for nearshore (-0.007 ± 0.006 mm yr⁻²) colonies over this interval. However, changes in the rate of annual skeletal extension for forereef and nearshore *S. siderea* colonies were significantly ($p < 0.05$) lower, by $0.031 (\pm 0.006)$ and by $0.018 (\pm 0.006)$ mm yr⁻², respectively, than for backreef colonies. These results are consistent with two end member hypotheses: (1) that environmental stress within these three reef zones is similar and that forereef and nearshore *S. siderea* colonies are simply more susceptible than backreef corals to such environmental stress; (2) or that forereef, nearshore, and backreef colonies are equally susceptible to environmental stress and it is the environmental stress itself that varies across these three reef zones. We are currently evaluating the acceptability of these hypotheses.

Fac, Oral

Foraging ecology of adult females loggerhead turtles (*C. caretta*): a preliminary study using satellite tracking and stable isotope analysis

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Loggerhead turtles are considered generalist carnivores, feeding on a variety of marine organisms. Although they have the potential to have a top-down effect on the marine food web, their foraging ecology is not well studied and their ecological role in the marine ecosystem is not completely understood. Meanwhile, loggerhead nest numbers in Florida (the main rookery in the western hemisphere) have been declining steadily since 1998 and the reasons for such decline are unclear. As population estimates are based on nesting activity, the decline in nest numbers may reflect a decline in the adult nesting population. However, reduction in nest numbers might reflect a change in the relationship between feeding ecology and reproductive output.

We used a combination of satellite tags and stable isotope analysis of multiple tissues to investigate the foraging ecology of reproductively mature loggerheads. To do so, we compared tissue stable isotope profiles with the oceanographic regions demonstrated by satellite tracking and available data on isotopic signatures of prey items. A better understanding of loggerhead feeding ecology could help elucidate factors that impact their populations and lead to improved conservation strategies for this threatened species, while improving our understanding of trophic relationships in the marine environment.

Grad, Poster

Effects of ocean acidification on fertilization and early development in the seagrass-associated sea urchin *Lytechinus variegatus*.

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Increasing levels of anthropogenically-derived atmospheric carbon dioxide are causing acidification of the world's oceans. Recent studies have demonstrated that calcifying marine algae and invertebrates have various life stages that are impacted by ocean acidification. We investigated the impact of near-future ocean acidification levels on fertilization success, early embryonic developmental rates, and echinoplutei morphometrics in the sub-tropical sea urchin *Lytechinus variegatus*. Artificial seawater was acidified by bubbling CO₂ gas. Gametes were exposed to seawater treatments 30 min prior to fertilization and then eggs were distributed among 5 x 1 liter glass beakers for each treatment [pH 8.2 (control), pH 7.8 and 7.4 (experimentals)] and maintained for 5 days under starvation conditions. Our results indicate that while fertilization success is not negatively impacted, rates of embryonic development under nutrient-limiting conditions are significantly delayed at a seawater pH of 7.8 and 7.4 and skeletogenesis during the first four days of larval development is significantly delayed at a pH of 7.4. Reduced rates of embryonic development and delayed skeletal growth could have negative ramifications on recruitment success due to inability to acquire nutrients and/or embryos and larvae spending longer periods of time in the plankton prior to settlement and metamorphosis.

Grad, Poster

Analysis of seagrass density and canopy height changes concomitant with drift algae cover biomass in field experiment enclosures, Indian River Lagoon.

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An enclosure experiment was conducted in the field, consisting of 24 plots divided into 4 blocks. Each block was composed of 1 non-caged control and 5 caged treatment levels of drift algae biomass covering the initial T₀ seagrass density of 62-72%. The treatment levels (16, 8, 4, 2, and 0 kg m⁻² wet weight) were

determined by loading progressively greater amounts of drift algae over a 4π Licor sensor to affect a full range of light exposure at the canopy depth. In treatment cages with algae, the average cover of seagrass declined below 50% by week 2 in the highest algae cage (HAC); by week 3 in the high-moderate algae and moderate algae cages (HMAG and MAC); and by week 7, the low algae cages (LAC) averaged ~40% decline. At week 12, the enclosures were removed. The HAC had no seagrass remaining, the HMAG treatments averaged <5%, and the MAC and LAC were 7% and 32%, respectively. The seagrass in the controls average 75% cover and the cages with no algae averaged 55% cover. Shoot density and canopy height followed similar patterns of reduction. Recovery (starting at week 12) is being monitored and provisional results are reported.

Fac, Oral

Low-frequency flows control on oxygen dynamics near sediment-water interface.

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Diffusional mass transfer between bottom sediments and overlying water constitutes an essential coupling for benthic and pelagic ecosystems. These transfers are controlled by the thickness of the diffusive boundary layer in the water column, which display periodic changes under oscillatory flows. A numerical diffusion-reaction model describing oxygen dynamics under wind waves and sea swell (Chatelain and Guizien, 2009) was extended to low-frequency flows (seiche, inertial wave, tide, etc.). For these flows, diffusion time across the diffusive boundary layer, time granted to this diffusion during a wave cycle, and oxygen consumption time in the sediment have similar order of magnitudes. Simulations show that unsteady properties of the flow are transmitted to the oxygen concentration inside the sediment: diffusive flux, concentration at the interface, and oxic layer thickness exhibit strong fluctuations. Moreover, maximum oxic layer thickness is phase-lagged with the maximum outer flow velocity. We will underline the ecological relevancy of these results, as oxygen dynamics regulates important biological and geochemical processes of organic matter degradation in the upper sediment.

Grad, Oral

Effect of habitat on growth rate of juvenile Atlantic surfclams, *Spisula solidissima*, in annular flumes: shell-hash vs. flat sand bed

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Spisula solidissima is the largest bivalve fishery in New Jersey, however, over the last decade standing stocks have declined by 87%. At the Long-term Ecosystem Observatory (LEO-15), off Tuckerton, NJ divers have found higher densities of adult surfclams in sandy sediments overlaid by shell-hash compared to open sandy areas nearby. This complex habitat may be important for the growth and survival of many shelf species. In annular flumes we examined whether habitat type (shell-hash vs. flat sand bed) influences the growth of juvenile surfclams. Contrary to expectations, the growth rate of clams was significantly higher ($p < 0.0001$, $\alpha = 0.05$) in a flat sand bed than in shell-hash. Habitat type was also more important for smaller clams which had a larger difference in growth rate between these two habitats compared to larger clams. The concentration of chlorophyll *a* and pheophytin in flume sediments was similar between these two habitats. Many clams in the flat sand bed had their siphons outstretched higher in the water column compared to clams in the shell-hash, which burrowed deeper in the sediment. Decreased growth may result from a behavioral response that reduces food uptake in more turbulent flow fields such as shell-hash beds.

UG, Poster

A spatial and temporal analysis of *Diadema antillarum* urchin recovery in the Florida Keys.

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The 1983-84 Caribbean-wide mass mortality of the long-spined sea urchin *Diadema antillarum* was followed by a second mass mortality event in the Florida Keys in 1991. The demise of this reef herbivore is one of many factors that are thought to affect the community structure of Florida reefs. For 14 years after the second mortality event, urchins continued to occur at low densities (< 0.1 per m^2) and were dominated by small (2-3 cm TD) individuals. Over a 10-year period (1999-2009), we examined abundance, size, and distribution patterns of *D. antillarum* and other urchins at over 1,000 sites throughout the Florida Keys. A stratified sampling design was used that incorporated habitat type, geographic region, and management zone. While few pre-1983 data are available, densities as high as 5 individuals/ m^2 were reported in two studies. Surveys since 1999 indicate that current densities remain well below 1 individual per m^2 ; however, a notable increase in the average and range in test diameter of individuals has occurred. Other urchin species continue to exhibit abundance and distribution patterns similar to historical observations and do not appear to have increased in abundance in response to reduced *D. antillarum* densities.

Fac, Oral

Evaluating alternative management strategies for South Carolina blue crabs.

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Blue crabs, *Callinectes sapidus*, have been experiencing severe declines across their entire geographic range. In South Carolina, annual landings show significant correlations with rainfall, river discharge and average salinity. The causal mechanisms for these correlations are not yet known, but one hypothesis is that upriver migration during drought years creates a refuge beyond the legal fishing limit. To evaluate the importance of this variable refuge habitat, I conducted a series of population simulations using the SCBCRABS spatially-explicit individual based model. The relative size of the refuge from fishing was varied along with trap number. Adult crab densities increased with decreasing trap number, but annual landings were unchanged. Increasing refuge size increased adult crab density and decreased landings but not significantly. These results suggests that fisheries management strategies to reduce trap numbers rather than decreasing fishing area will provide the greatest benefit to standing stock biomass with little or no decrease in annual landings.

Fac, Oral

Cryptic species of trematodes in the plicate horn snail (*Cerithidea pliculosa* Menke) in the Galveston Bay marsh.

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Trematodes (Digenea) infect plicate horn snails (*Cerithidea pliculosa* Menke) in the estuarine marsh system of Galveston Bay. Trematode cercariae (larvae) are morphologically identifiable but similar among the species. Individual morphotypes of cercaria may also represent multiple cryptic species, as suggested by previous studies. Cryptic species may be identified by using genetic analysis of COI genes in trematode DNA. Amplification of this gene was successful in 4 out of 14 observed morphotypes in an eight week period. One of the morphotypes, *Phocitremonides ovale*, was represented by two haplotypes within a single snail with 0.4% Kimura 2 Parameter (K2P) distance. Other morphotypes revealed identical sequences between trematodes from different snails, suggesting a lack of genetic differentiation for that morphotype. Due to high K2P distances between 38.67% and 45.69% as well as clade placement, the phylogenetic tree suggests a high variability within the *Acanthoparyphium spinulosum* morphotype. There was a high rate of infection, for 70% of collected snails harbored parasites and 25% of those infected had multiple morphotypes present. The most commonly identified trematode morphotypes were *Levinseniella*, *Acanthoparyphium spinulosum*, *Phocitremonides ovale*, and *Renicola sp.* For future studies,

the method protocols may be altered in order to increase sequencing success, and more data should be collected over a greater time period.

UG, Poster

Social Network of the Nitrogen Cycle

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Network analysis has been applied to systems as divergent as the internet, the Chesapeake Bay's food web, and over-wintering personnel at South Pole Station. Ecological network analysis has been commonly applied to ecosystems, but social network analysis provides an alternative approach. The transformations and transfers associated with the N cycle can be considered analogous to interactions of a social network. Here we present a generalized N cycle in a novel network context using the social network analysis software UCINET. Twelve chemical species make up the nodes of the network with 6 under oxic and 6 under anoxic conditions. We present the network as an interaction matrix; a circular digraph; and an assessment of the centrality of the various states of N. N species within anoxic environments tended to be involved in more interactions and more central to cycling than those forms in oxic environments. N₂ under anoxic conditions was most central to cycling of all species, while N₂O under oxic conditions was least. Quantitative rate information can be incorporated with resultant shifts in position of chemical species. These represent only the beginning of what can be achieved through this application of social network analysis to nutrient cycling.

Oral

Faunal Associations with Black Sea Urchin, *Diadema antillarum*.

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We conducted research into the potential relationships of organisms which are affiliated with the protection offered by the black sea urchin in four bays in St. John's, USVI. Our target species included three crustaceans (Mysid shrimp, spiny lobsters, arrow crabs) and three fish (French grunts, short-nose puffers, and high hats). Additionally, we assessed the potential that mysid shrimp use kairomone signals to assess risk of predation from fish. Our results indicate that differences in species utilization occurred among bays with relatively large numbers of the high hats in Reef Bay. Results from the mysid experiments indicate that mysids have a threshold response to the concentrations of chemicals in the water where they exhibit escape behavior. Under ambient water conditions approximately 75% of mysids showed no reaction, compared to 30% dosed at the 25 and 50% kairomone dosed water and only 12% showed no reaction at 75% and above kairomone dosed water. As such they showed a step reaction to changes in kairomone concentrations. In total, these faunal relationships may have been impacted when the mass die-off of *Diadema antillarum* occurred in the mid 1980s.

UG, Poster

Responses of the marsh periwinkle, *Littoraria irrorata*, to predator (*Callinectes sapidus*) odors: Indications of a trait mediated indirect effect?

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The salt marsh periwinkle, *Littoraria irrorata*, migrates vertically on blades of *Spartina alterniflora* when the marsh is inundated during high tide. This behavior allows the snails to escape predators, such as the blue crab (*Callinectes sapidus*), that invade the marsh at high tide. The snails are able to detect chemical cues released by the crabs. Previous studies have shown that the presence of blue crabs in the water or

water containing the scent of a crab will trigger the snails to migrate higher on the marsh grass. However, it is unknown if this cue is an airborne or a waterborne signal, or if snails from different geographic locations respond similarly to predator odors. We hypothesized that the snails would move higher when they were allowed to access the water containing the blue crabs (or their scents) relative to treatments in which snails were only exposed to volatile components of the odor. Lab assays were performed using snails from both North Carolina and Louisiana. Preliminary analyses show that snails respond to water borne odors, but not to airborne odors. Moreover, Louisiana snails respond differently than North Carolina snails to the similar odor treatments.

UG, Poster

Stage-structured population modeling as a tool for predicting species' responses to climate change

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Temperature increases due to climate change can have a major effect on the survival and growth of individuals and, in turn, alter population growth patterns. Response to temperature increase can be influenced by age, a factor that is relatively unaccounted for in studies of thermal tolerance. In this study we examined the effect of age on thermal tolerance and used a demographic approach to predict impacts of climate change on three of the most common species in the fouling community of Bodega Harbor, California: the tunicates *Botrylloides violaceus* and *Distaplia occidentalis* and the bryozoan *Watersipora subtuorquata*. We used a combination of experimental temperature exposure and population modeling to determine changes in survival, growth, and population growth patterns at ambient and increased temperatures. The effect of temperature on individual survival and growth was species- and age-dependent. Our model revealed that, due to differences in population growth patterns, increased temperatures are likely to favor rapid growth of *Watersipora* but not of *Distaplia* or *Botrylloides*. We highlight stage-structured population modeling as a novel approach to study the impacts of climate change on populations and demonstrate that age needs to be accounted for in studies of thermal tolerance.

Grad, Oral

Effect of the mud snail *Ilyanassa obsoleta* on vital rates and behaviours of the amphipod *Corophium volutator*.

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The two dominant invertebrates on mudflats in the upper Bay of Fundy, Canada, *Ilyanassa obsoleta* and *Corophium volutator*, are negatively correlated. This may be related to exploitation competition, interference competition and/or predation. We examined the effect of snail density on survival, growth and movement of juvenile and adult *C. volutator*, and on fecundity of adults in laboratory and field experiments. Based on results analyzed to date, survival of juveniles decreased significantly with increasing snail density, whereas survival of adults was minimally affected. During behavioural observations, we discovered that snails did prey on *C. volutator*. The probability of a snail attacking an encountered amphipod was variable (partly dependent on the snail's hunger level); however, probability of capture after attack was consistently high (~85%). In the lab, snails did not appear to affect movement patterns, such as immigration into or emigration away from an area, when amphipods were given a choice of areas with and without snails. Mud snails have long been thought to feed primarily on detritus, carrion and biofilm. However, our results indicate that they are also at least opportunistic predators.

Grad, Oral

Effect of Oyster Reef Height on Reef Persistence in Chesapeake Bay: Evidence for Alternative Stable States

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The success of native oyster, *Crassostrea virginica*, restoration efforts in Chesapeake Bay has been limited by several factors, including the loss of constructed reef habitat due to sedimentation. Recent evidence indicates that reef height influences reef success and may lead to alternative stable states. Because reef construction can cost as much as \$16-20,000 per hectare, it is important to optimize the use of resources to ensure reef integrity where sedimentation is problematic. We constructed two sets of reefs of six different heights (0.05, 0.1, 0.2, 0.3, 0.4, and 0.5 m) in the Great Wicomico River and the Lynnhaven River system, two sub-estuaries of Chesapeake Bay. This range of reef heights encompasses the typical heights used in restoration efforts. Reefs were monitored visually using digital ROV imaging. In a period 4-6 weeks post construction, several of the low relief reefs (0.05 and 0.1 m) were completely covered with sediment, whereas taller reefs (0.3-0.5 m) persisted with substantially reduced surface sedimentation. These results are consistent with the existence of alternative stable states, and dictate that taller reef structures (>0.3 m) should be built to ensure that the reefs persist and become self-sustaining.

Grad, Oral

Colonization rates and species interactions influence development of salt marsh and mangrove communities.

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In the Indian River Lagoon (IRL), Florida, salt marsh and mangrove species intermingle because climatic factors allow persistence of tropical species in the estuary. Gaps, such as those created by hurricanes or during site clearing for restoration, are often colonized by salt marsh species which may affect mangrove recruitment. The combination, diversity, and colonization rate of salt marsh species in gaps may influence the rate at which mangrove species colonize and fill forest gaps, potentially affecting gap regeneration and mangrove forest composition. We have been studying two previously defoliated restoration sites for two years. One site had four different salt marsh species (*Spartina alterniflora*, *Spartina patens*, *Sesuvium portulacastrum*, and *Distichlis spicata*) planted in a field experiment, while at the other site, salt marsh vegetation (mainly *S. alterniflora*) colonized naturally by seedling recruitment and clonal growth. We measured natural recruitment by *Rhizophora mangle*, *Avicennia germinans* and *Laguncularia racemosa*. *S. alterniflora* had different clonal expansion rates in the two sites but showed greater area cover increase than other species. The presence of different salt marsh species, combinations of species, and species richness had significant effects on the colonization rates of *Avicennia* and a lesser effect on *Rhizophora*, and *Laguncularia*.

Grad, Oral

Microhabitat and Phylogeographic Analysis of Genetic and Morphological Variation in Sympatric Six-Rayed Sea Stars, genus *Leptasterias*, in Central California

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Species of the six-rayed sea star, genus *Leptasterias*, are found in different habitats throughout the rocky intertidal from Central California to the Aleutian Islands. Previous studies have suggested that sympatric species of *Leptasterias* are partitioned by habitat. Systematic studies based on genetics to date have revealed numerous species distributed from Central California to the Aleutian Islands with at least 2 species in Central California. Although, there have been numerous studies regarding the systematics of *Leptasterias*, few studies have been focused on Central California and their taxonomic status remains unresolved. Here, we characterize in detail both genetic and morphological traits of 158 individuals from

diverse habitats, including cobblestone and rock wall, across 9 sites throughout Central California (from Greyhound Rock, Santa Cruz County to Fort Ross, Sonoma County). An analysis of color and shape variation showed that a stubby ray morphotype is significantly associated with vertical wall habitats, while color patterns only showed suggestive partitioning. Variation in the mitochondrial control region (269 nt of DNA sequence from 143 individuals) does not show an obvious North-South phylogeographic distribution pattern as might be expected for these brooding sea stars with non-planktonic larvae.

UG, Poster

Predator and non-predator chemical cues alter mussel self-organization into power-law clusters.

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Little is known about factors that create power-law spatial structure in Maine soft-bottom *Mytilus edulis* beds. We tested two hypotheses. H₁: Mussels self-organize into aggregations with fractal power-law properties similar to those observed in the field. H₂: This spatial structure is affected by chemical cues from predators (crab *Carcinus maenas* and snail *Nucella lapillus*) and injured conspecifics, but not from a non-predator (snail *Littorina littorea*) and intact conspecifics. Mussels were placed in a uniform pattern in arenas holding chemical effluent from each treatment. Mussels immediately began aggregating. At 24 h, fractal dimension was calculated for each mussel cluster and the entire assemblage of clusters in each arena. H₁ was supported: mussels aggregated into spatial distributions with fractal power-law structure at the scales of individual clusters and entire arenas. Arena-wide fractal dimensions ($D = 1.07-1.78$) were similar to values for field quadrats and entire mussel beds. H₂ was equivocally supported: D values were high in *Carcinus*, *Nucella*, and *Littorina* effluent, but not different from controls in intact and injured conspecifics effluent. The results are the first to demonstrate that local aggregation responses to chemical cues may be one cause of the large-scale power-law spatial structure observed in Maine soft-bottom mussel beds.

UG, Poster

Physiological insight into feeding ecology of the golden grey mullet *Liza aurata*

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Mulletts are thought to forage on benthic microbial resources (i.e., microalgae and bacteria) but it is still unclear to which extent this trophic link structures both energy and material fluxes in marine coastal environment. The poor understanding of the trophic role of mulletts stems largely from the difficulties with assessing their grazing pressure. The use of stable isotopes on pre-labelled microalgae and bacteria has been recently applied to estimate the uptakes by benthic invertebrates. By using a similar approach, we investigate the trophic link between microbial assemblages and mulletts. In 2009, the algal and bacterial uptake of juveniles golden grey mullet *Liza aurata* was estimated at two temperatures and two fish sizes. The experimental method combined the analyses of grazing in mesocosm and the use of ¹⁵N and ¹³C stable isotopes to pre-label bacteria and microalgae, respectively. At each size and temperature, digestive content, liver and blood of *L. aurata* exposed to enrichment treatments were more ¹⁵N and ¹³C enriched than in control individuals. This suggests both an ingestion and an incorporation of the bacterial and microalgal organic matter. Variations of the calculated ingestion rates between temperatures and fish sizes will be discussed in terms of fish energy requirement.

Effects of competitor density on aggression levels between two damselfish species, threespot (*S. planifrons*) and beaugregory (*S. leucostictus*).

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In May 2009 a study was conducted in Discovery Bay, Jamaica in order to determine the levels of aggressive behavior of two species of damselfish, threespot and beaugregory, in interaction with a competitor. Fish of both species were observed for ten-minute intervals per increasing density (1,2 and 3) of *Diadema antillarum*, the long-spined sea urchin, a known competitor of damselfish and one of the reefs most significant grazers. It was predicted that damselfish would decrease their aggressiveness with an increase in competitor density. Tests were completed in two separate locations, the lagoon and the backreef in shallow waters of less than two meters. The number of attacks (“nips”) was recorded for each minute and correlated between species and *Diadema* density to determine average aggressiveness and threat levels. It was found that the threespot damselfish displays higher levels of aggressiveness overall in comparison to the beaugregory but both fish species display an increase in attacks with an increase of competitor density. The relationship between damselfish and *Diadema antillarum* supports the Intermediate Disturbance Hypothesis with regards to damselfish as keystone species, thus maintaining a high biodiversity on the reef.

UG, Oral

Environmental Quality and Oyster Disease

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Perkinsus marinus, causes the disease commonly known as Dermo in oysters. Previous studies within the tidal creek systems of New Hanover County, NC, have found that *P. marinus* exhibits 100% prevalence in oyster populations. The current study was undertaken to examine prevalence and spatial variability of moderate intensity infections based on background measures of pH, temperature, and salinity. Seven sites were sampled, including five intertidal reefs and two subtidal reefs (Pages Creek, Hewlett’s Creek, Howe Creek, New River, intracoastal waterway adjacent to UNCW’s Center for Marine Science, and the Cape Fear River respectively). Thirty randomly selected oysters from each site were dissected, with specific tissues taken for counts to be performed to determine infection rates based on the Mackin Scale. All of the oysters were found to have infections ranging from negative to light/moderate. Abiotic factors did not conclusively relate to the intensity of infection in the differing populations. Further studies should be done to re-examine the health of reefs and monitor the disease.

UG, Poster

Effects of geochemical spatial heterogeneity on the diversity of deep-sea megafauna on the northern margin of Puerto Rico.

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Benthic megafauna (>1-2 cm) contribute significantly to biogeochemical processes in the deep sea, and patchy distribution patterns of the deep seafloor can generally be attributed to mega-epifaunal assemblages and the spatial heterogeneity of the seafloor. In 2006 a five-day cruise was conducted to visually document possible seep sites along the northern Puerto Rico margin. This included a deep-towed camera system (TowCam) equipped with a CTD meter. Photographic transects, along with corresponding CTD data, were used to analyze the spatial relationship between benthic megafaunal assemblages, physical parameters, and local bathymetry. The transects covered water depths from 1800 m to 3500 m and a total of seven camera tows were deployed; two tows in the eastern flank of Mona Canyon, and five tows in the Arecibo Amphitheater. Physical anomalies were correlated with picture frames based on timestamp; positive correlations were observed. According to our findings, geochemical processes could be associated with the frequency of benthic megafaunal assemblages .

UG, Oral

Historical development of Cape Cod salt marshes triggers current runaway herbivory and marsh die-off

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Cordgrass die-offs in Cape Cod (Massachusetts) salt marshes are the result of decades of human disturbance. Our analysis of historical aerial photographs indicates that significant human impacts on Cape Cod salt marshes date back to the 1940s. From the 1940s to 1970s, marsh loss resulted primarily from shoreline conversion to houses, docks, and marinas. Following the 1970s, when shoreline development was more tightly regulated, cordgrass die-off rapidly accelerated and led to continued loss of marsh habitat. Our ongoing experimental field research indicates that overfishing is responsible for marsh die-off by decreasing abundances of predators, increasing densities of the herbivorous crab *Sesarma reticulatum*, and generating runaway consumption of cordgrass. Shoreline development has thus led to catastrophic marsh loss over the past 70 years by two mechanisms: first, directly through outright conversion of marshes to infrastructure that allowed human access, and later, indirectly through die-off triggered by the commercial and recreational overfishing centered on those areas of infrastructure. The momentum of marsh loss that has persisted despite cessation of shoreline conversion can be tracked through time using historical aerial photographs and fishery records, and suggests conservation efforts should consider how direct and indirect causes of habitat loss shift through time.

UG, Oral

Inferring species distributions of Gulf of Mexico vestimentiferans (Polychaeta, Siboglinidae) using mitochondrial and nuclear genes

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To understand connectivity and the influence of depth and distance on species and population distributions of cold seep vestimentiferan tubeworms in the Gulf of Mexico (GoM), we have built a phylogenetic hypothesis using three genes: large ribosomal subunit rDNA(16S), Cytochrome Oxidase I(COI), the first intron of globin A1(globin).

Initial collections identified six morphospecies of vestimentiferans from the GoM: *Lamellibrachia luymesii*, *Seepiophila jonesii*, and *escarpia* sp. from <1000m; *Lamellibrachia* sp. 1, *Lamellibrachia* sp. 2 and *Escarpia laminata* from >1000m.

Both COI and 16S separate the escarpia clade; however, neither gene separates *L. luymesii* (upper slope) and *L. sp. 1* (lower slope), despite their differing depth distribution and morphology. Globin separates *L. luymesii* from *L. sp. 1*, but does not separate *L. sp. 2* (lower slope) from *L. luymesii* or *L. sp. 1*. As previously reported, we find that COI is unable to resolve relationships among *Escarpia laminata*, *Escarpia spicata*(East Pacific), or *Escarpia southwardae*(East Atlantic), which are also morphologically distinguishable. Therefore, our data suggests that 16S, COI, and globin are limited in their ability to clarify the phylogeny of seep vestimentiferans. We are analyzing additional data for Cytochrome B and Elongation Factor 1 α genes to further clarify species boundaries of GoM vestimentiferans.

Grad, Oral

A coevolutionary arms-race between tropical herbivores and seaweeds: tropical urchins are more resistant to lipophilic secondary metabolites

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Tropical seaweeds produce greater diversities and concentrations of lipophilic secondary metabolites than do temperate seaweeds. This latitudinal trend in chemical defenses is paralleled by greater rates of herbivory in tropical regions. If herbivores and seaweeds in tropical habitats are coevolving, these trends

in chemical defenses and herbivory may also indicate that tropical herbivores are more resistance to tropical seaweed defenses. To test this hypothesis, we collected urchins from tropical (*Arbacia punctulata*, *Diadema antillarum*, *Echinometra lucunter*, *E. viridis*) and temperate (*A. punctulata*, *Strongylocentrotus droebachiensis* and *S. purpuratus*) regions and measured their feeding responses to lipophilic extracts of nine species of chemically-rich tropical seaweeds. Individual urchins were offered a pairwise choice between extract-laden and control artificial-foods. A total of 64 feeding assays indicated that on average tropical urchins consumed 20% more of foods with natural concentrations of extract than did temperate urchins. Moreover, a tropical population of *Arbacia punctulata* consumed more *Dictyota spp.* extract-laden foods than did a temperate population. Our data indicate that tropical herbivores have a greater ability to consume lipophilic defenses than do more temperate herbivores and support the notion that tropical herbivores have evolved counter-adaptations (*i.e.* resistance) to lipophilic chemical defenses found within tropical seaweeds.

Grad, Oral

Sublethal Predation: Latitudinal Variation in two Onuphid Polychaetes

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Diopatra cuprea occur in the shallow and intertidal water on the coast of North and South America. *D. cuprea* population density vary latitudinally, with higher densities at higher latitudes. This latitudinal variation may be due in part to greater predation at lower latitudes. *D. cuprea* often experiences loss of antennae and portions of the anterior due to sublethal predation. Because *D. cuprea* are able to regenerate both anteriorly and posteriorly, these predator attacks rarely cause mortality. We quantified and compared sublethal predation rates between sites in Florida and Virginia. Within Florida we compared *D. cuprea* to another tube building polychaete; *Americanuphis magna*. We quantified rates of sublethal predation between the two sites and between the two genera within the Florida site. Observational experiments were also conducted measuring the effects of sublethal predation on activity of *D. cuprea*. Contrary to our hypothesis, we found no significant differences between *D. cuprea* in the two sites, however there was a trend toward lower predation rates in Florida. We also found that *Americanuphis magna* cannot regenerate anteriorly and experiences more frequent antennal loss than *D. cuprea*.

UG, poster

The potential effect of the bopyrid parasite *Probopyrus pandalicola* on the density and behavior of the daggerblade grass shrimp *Palaemonetes pugio*.

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The daggerblade grass shrimp *Palaemonetes pugio* is host to a variety of parasites including the bopyrid *Probopyrus pandalicola*. This parasite has the potential to reduce shrimp densities because hosts no longer reproduce while infected. Mean parasite prevalence ranged from approximately 1-3% in South Carolina and Georgia estuaries and given these values, potential egg production can be reduced by up to 335 eggs/m³. We have found that there is no effect of the parasite on shrimp behavior or swimming endurance. Instead, shrimp activity was affected by size, tidal stage, and time of day. Furthermore, there was no effect of the parasite on the likelihood of shrimp being eaten by the mummichog *Fundulus heteroclitus*. Fish ate more active individuals regardless of parasite presence. Recently our research is focusing on the effect of multistressors (shrimp with parasites plus insecticides or coded wire tags) and we have found differences in predation rates and LC₅₀ values when shrimp are parasitized.

Fac, Oral

Post-capture survival, larval viability, and future reproductive potential of ovigerous blue crabs caught in the central North Carolina pot fishery

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Blue crab fishery regulations in many states require the release of ovigerous crabs. Ovigerous crabs captured in pots often damage their egg mass. We surveyed egg mass damage in crabs caught in the pot fishery as well as crabs caught by hand. Egg mass damage was much more prevalent in pot-caught crabs than in hand-caught crabs. We investigated post-capture survival and reproductive output of crabs caught in the pot fishery with varying amounts of egg mass damage by confining them in the field for the duration of their lifetimes. 81% of crabs survived to release the first clutch and crabs produced up to six clutches. Less than 1% of clutches produced in confinement were damaged. Lipid content, larval size, and larval survival time without food were similar for all clutches and levels of damage. Clutch volume decreased by ~20% per clutch and the percentage of eggs developing normally decreased from ~20% from clutch 1 to clutch 5. Immediate release of ovigerous crabs could be a viable management strategy, but would have severe economic consequences in high-salinity areas. Area closures, combined with subsidies for crabbers during critical times, may be the most viable management strategy until crab populations recover.

Grad, Oral

Lifetime reproductive potential of female blue crabs *Callinectes sapidus* in North Carolina, USA

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We examined lifetime clutch production and size at maturity for blue crabs *Callinectes sapidus* in North Carolina, USA. Female crabs were collected at terminal molt and confined individually in the field for the duration of their lifetime. Crabs were monitored weekly for the presence of eggs. Clutch quality and larval viability were assessed for each clutch. Crabs produced up to 7 clutches over 1 to 2 spawning seasons and survived up to 394 d after the terminal molt. Time to first clutch and time between clutches were positively correlated with carapace width and best described by degree-days, physiological time calculated as a thermal integral. Size at maturity was negatively correlated with water temperature on the day of the terminal molt. Egg lipid content, egg diameter, larval carapace width, and larval survival time without food were similar for all clutches. The percentage of embryos developing normally decreased 40% from clutch 1 to 4, and clutch volume decreased 50% from clutch 1 to 5. Thus, most of a crab's reproductive output is from the first few clutches. Realistic estimates of fecundity and reproductive potential are essential for accurate spawning stock assessment and population modeling.

Fac, Oral

Developing primers and genetic markers of interest for harpacticoid copepods

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The species' range of deep-sea harpacticoid copepods is of interest to understanding benthic deep-sea ecology. Accurate identification of these species is required to determine their ranges. Matching morphological information with genetic data helps to ensure correct species assignment. The use of multiple genes will provide higher confidence in the assignment of individuals to species. Limited genetic

information is available for copepods, so choosing appropriate genetic markers and primers for identifying species requires the evaluation of additional gene regions. To address this issue, I will design primers and determine the effectiveness of the following genetic markers: the complete mitochondrial genome and 18s rRNA, H1, and H3 genes.

UG, poster

Predation on the bivalve *Macoma balthica* at various shoreline types in the Patuxent River, MD, USA.

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Predator-prey interactions and other ecosystem functions are subject to many stressors in the marine environment, including shoreline development. It has been hypothesized that “hardened,” or developed shorelines such as bulkhead and riprap will have a deleterious effect on shoreline ecosystems in comparison to their natural marsh counterparts. To examine this hypothesis, a pilot study with predator exclusion was executed using replicated caged and uncaged plots with transplanted clams in the Patuxent River, Maryland, USA. Caged plots excluded predators such as *Callinectes sapidus* from prey, including ten marked and measured *Macoma balthica*, and were paired with uncaged plots. The replicates of paired caged and uncaged plots were deployed in each of three shoreline types, marsh, riprap, and bulkhead, at three locations, upriver, midriver, and downriver. Data analyses suggest that: 1) ambient clam abundance is similar within a site between caged and uncaged treatment plots, 2) the proportion of marked clams retrieved from uncaged plots is lower than that retrieved from caged plots, and 3) there is no difference in predation pressure on marked clams among the three shoreline types. Future studies could include additional Chesapeake Bay tributary sites and an expanded number of sites of each shoreline type.

Presentation: *Grad, Poster*

The impact of predation on tunicates in the Gulf of Maine.

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Marine coastal construction creates substrate which is colonized by benthic invertebrate species.

Construction provides refuge for fish assemblages which predate upon sessile invertebrates. The aim of this study was to assess the impact of fish predation on the tunicate community colonizing an artificial substrate.

In May 2009 acrylic panels were deployed at the Coast Guard Pier in Portsmouth NH to be colonized by sessile benthic invertebrate species. Three treatments were implemented; panels exposed to fish predation: panels exposed to fish, seastar, and crab predation: caged panels with no large predator access. Blocking fish predation caused a significant increase in the percent cover of *Molgula citrina* (ANOVA $p < 0.001$). Tunicate richness was significantly different between treatments; caged treatments were dominated by *Molgula citrina* while un-caged treatments were dominated by invasive *Botryllus* spp. The impact of disturbance had a positive effect on space utilization by tunicate species; treatments exposed to predation had significantly more hard substrate being utilized by Ascidian species.

In future work, I plan to examine benthic invertebrate community dynamics among varying habitat types.
Grad, Poster

Benthic Habitat Mapping in High Energy Nearshore Environments Using Acoustic Methods.

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Hard bottom and sedimentary habitats in the nearshore are affected by anthropogenic disturbances such as beach nourishment. Currently used monitoring practices rely on visual techniques (aerial and underwater photography) conducted on an annual basis and do not allow rigorous assessment of the effects of man

induced, or even natural events, on the distribution and composition of these habitats. We investigated the use of an acoustic ground discrimination system (RoxAnn) to determine changes in benthic habitats in the nearshore area of northern Indian River County, FL where hard bottom outcrops occur. This area has also been subjected to numerous beach nourishment projects. We determined the precision of the acoustic method and conducted multiple surveys to assess temporal and spatial changes in bottom types. We were able to map the spatial distribution of several sediment types, bare rock surfaces, Sabellarid worm reef, sponge covered rock, and rock covered with two different algal morphologies over large areas under conditions of suboptimal visibility. Short term (monthly) changes in the distribution of rock and sand habitats were detected over a relatively calm summer season suggesting that annual monitoring is insufficient to assess the impacts of episodic disturbances such as beach nourishment on benthic habitats.
Grad, Oral

Mitochondrial and nuclear gene sequences show conflicting patterns of divergence among putative cryptic species in the marine sponge *Callyspongia vaginalis*

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Cryptic species are likely prevalent in the Porifera due to their simple, plastic morphological characters. DNA sequence data from the mitochondrial cytochrome oxidase I (COI) gene of coral reef sponge *Callyspongia vaginalis* sampled from seven Floridian locations revealed three divergent mitochondrial haplotypes separated by an average of 12 mutational steps and an average genetic (uncorrected p) distance of 2.2%. Divergence time estimates indicated the three mitochondrial lineages split at least 12 million years ago. Slow rates of nucleotide substitution in poriferan mitochondrial genes may limit the resolution of COI so nuclear sequence data were collected to test whether the three haplotypic lineages from Florida are cryptic species. Simulated nuclear sequences based on demography suggested by the COI data show reciprocal monophyly among the three putative cryptic lineages. However, empirical data from the nuclear gene elongation factor-1 α showed extensive allele sharing among the three mitochondrial clades. These discordant patterns may be the result of non-neutral forces preventing introgression of genetically divergent mitochondrial haplotypes among individuals of the same species. This study highlights the importance of utilizing multiple markers when attempting to delineate species.
Grad, Oral

Vegetation characteristics of natural and stabilized fringing marshes in coastal NC

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Sea level rise and increasing coastal development make shoreline stabilization a critical concern for waterfront property owners and resource managers. Marsh grass plantings, sometimes combined with stone sills, are often recommended as alternatives to bulkheads in stabilization projects. However, little is known about the vegetation characteristics of natural fringing marshes and the effect of stone sills on plant biomass and distribution. A year-long plant tagging and harvest study determined the annual production of *S. alterniflora* in a fringing Carteret County, NC marsh to be approximately 785 g/m². Estimates of standing peak biomass based on stem height and density captured 65-100% of this yearly production. A multi-year study of four sites with paired natural and stabilized shorelines evaluated the effects of sills on fringing marsh vegetation and elevation. In stabilized and natural marsh study sites, *S. alterniflora* occurred in a wide tidal range, from -0.45 to 0.35 m NAVD88. Over the course of the study, marshes with stone sills showed significant increases in elevation, yet saw a decline in *S. alterniflora* stem density compared to nearby natural marshes.
Fac, Oral

Toxicity of the insecticide etofenprox to three life stages of the grass shrimp, *Palaemonetes pugio*.

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Opportunities for environmental contamination by the insecticide etofenprox are increasing as its uses expand from primarily indoor residential to rice cultivation and mosquito control. To provide toxicity data for sensitive saltwater species, effects of etofenprox were assessed using three life stages of the estuarine grass shrimp, *Palaemonetes pugio*. Adults, larvae and embryos were tested in aqueous exposures, while adults and larval shrimp were also tested in the presence of sediment. In addition, sublethal cellular stress biomarkers, glutathione and lipid peroxidation, were examined. Larval shrimp were the most sensitive life stage with a 96-h median lethal concentration (LC50) of 0.89 µg/L, compared to 1.26 µg/L for adults and 100 µg/L for embryos. The presence of sediment significantly decreased toxicity of etofenprox to both adult and larval shrimp. Etofenprox exposure increased time to hatch in embryos. Lipid peroxidation levels were reduced in adult and larval shrimp after 96h exposure to etofenprox, while no effect on glutathione was detected. The results of this study provide new information on the toxicity of etofenprox to estuarine invertebrates. These data may prove beneficial to the regulation of this pesticide and management of its uses in coastal areas.

Fac, Oral

Is *Stenopus hispidus* a globally distributed species? A test of reproductive isolation in Atlantic and Pacific populations.

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Virtually all decapod species that appear in the Atlantic and Pacific have been demonstrated to be distinct species. *Stenopus hispidus* also is separated by the Panamanian Isthmus, but to date, has not been morphologically demonstrated to be distinct species. While the Atlantic and Indo-Pacific populations of *S. hispidus* have the same ancestry and are morphologically indistinguishable, in the laboratory, reproductive isolation has not been examined. Here, we present data on studies that compare the biological species concept against traditional conventions. For this study we assembled representative from two populations of *S. hispidus* and examined if they would cross-breed. Shrimp were collected from Haiti and Bali because these populations were the furthest isolated. Thus, if interbreeding of these two populations is successful, it would indicate that *S. hispidus* is likely to be a single species throughout its entire range. This poster will present the results of our study to date and provide some interesting data to support the idea that ancient decapods may evolve at slower rates than more recent taxa.

UG, Poster

The Roles of Facilitation, Competition and Predation among the Red Mangrove (*Rhizophora mangle*) and herbaceous salt marsh species.

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Herbaceous salt marsh species can act as both facilitators and competitors of red mangrove (*Rhizophora mangle*) seedlings. In one field experiment, facilitation occurred as the result of an indirect effect, where herbaceous species provided refuge from infestation by the moth *Cydia desotatum*. The percent of seedlings infested was inversely proportional to the rank of vegetation density (ANOVA $P=0.0067$). Of the four marsh species tested, *Distichlis spicata* was the most effective in reducing the influence of the parasite (ANOVA $P=0.0445$). *C. desotatum* infested 33% of the seedlings and caused mortality in 50% of infested seedlings. For seedlings that survived, plant height at 2 years was reduced by 20% and canopy

volume by 50%. In the second experiment, we found that *Spartina alterniflora* can act as a facilitator or competitor depending on the prevailing environmental conditions. Under more stressful environmental conditions, *S. alterniflora* acted as a facilitator, however when environmental conditions were benign, *S. alterniflora* competed with *R. mangle* and both numbers of side stems (ANOVA $P=0.001$) and leaf productivity (ANOVA $P=0.004$) were greater in bare ground plots than in *S. alterniflora* plots after 1 year. These results suggest that mangrove seedling survival, growth, and architecture can be affected by marsh vegetation.

Fac, Oral

A quantitative and qualitative analysis of the SAV and biogeochemistry of Biscayne Bay, Florida
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We conducted a three-month benthic survey of Biscayne Bay, Florida in the summer of 2009 to explore biogeochemical patterns of the benthos and to determine the population demographics of submerged aquatic vegetation within the bay, as well as the reef tract directly east of the bay. We measured relative abundance of all primary producers and morphology of the dominant seagrass species. We also determined sediment nutrient concentrations, and foliar nutrient concentrations of the seagrass species present in the bay. This survey was done as a precursor to a study on the determinants of primary producer community structure within Biscayne Bay and its environs. Our findings will address basic ecological questions of estuarine benthic ecosystem structural dynamics, and provide a framework within which appropriate management strategies can be formulated for ecosystem restoration and protection.

Grad, Poster

Species-Specific Effects of Salt Marsh Ecads on Distribution, Growth and Survival of Epifaunal Organisms

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The physical structure created by species, particularly foundation species, can organize communities into hierarchies' through positive interactions. In these communities, facilitation by foundation species, (e.g., corals, cordgrass) is the primary interaction that allows a suite of species to occupy a given habitat. Secondary factors such as predation, disturbance, competition or recruitment variation further shape the community and account for species coexistence. Within salt marshes two species of ecads (free floating forms of macroalgae that become entangled among *Spartina alterniflora* and *Spartina patens*) form a substantial part of salt marsh biomass, often surpassing that of *S. alterniflora* and *S. patens*. These ecads (*Ascophyllum nodosum* ecad and *Fucus vesiculosus* ecad) are morphologically distinct seaweeds that range in form from small to large size and wide to narrow frond width. *Ascophyllum nodosum* ecad *scorpioides* morphologies vary from having two large fragments, to increasingly proliferous fragments. Unlike *A. nodosum* ecad *scorpioides*, *Fucus vesiculosus* ecad is larger and has wider fronds. Here, we investigated the relative influence of the two ecad species on salt marsh recruitment, growth and survival of epifaunal organisms. Results of our experiments suggest species-specific differences between the two ecad species. *F. vesiculosus* ecad enhances recruitment and growth of snails in marsh systems while *A. nodosum* ecad *scorpioides* provides a better refuge against predation. These studies will enhance our understanding of the relationship between habitat structure and ecosystem function in salt marshes.

Passive sediment shedding ability in the juvenile scleractinian coral, *Oculina arbuscula*.

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Sedimentation is a key factor controlling juvenile survival of many sessile marine invertebrates. In some coral species, recruits exhibiting upward growth soon after settlement may be better suited morphologically to survive high sediment loads. This study investigates passive sediment shedding

efficiencies in various colony morphologies of juvenile *Oculina arbuscula*, a common scleractinian coral in the South Atlantic Bight. Sedimentation rates were determined for 2007-2009 on a hard-bottom reef off the Georgia coast from a series of PVC traps secured to steel rods placed along the ledge where *Oculina arbuscula* occurs. Sedimentation rates varied seasonally and ranged from <0.30 to >350 $\text{mg cm}^{-2}\text{d}^{-1}$. Passive sediment shedding efficiency across a range of juvenile morphologies is being tested in aquaria. Morphology is being quantified as a ratio of projected to total coral surface area and treatments of high (100 mg cm^{-2}), low (20 mg cm^{-2}), or no (control) inorganic sediment are being applied based on coral area. The amount of sediment sloughed from each coral is being quantified as passive sediment shedding ability. It is predicted that juveniles with a lower ratio of projected to total surface area will exhibit higher sediment shedding ability and a higher probability of long-term survival.

Grad. Oral

Oysters as Indicators of Trophic Status in a Highly Flushed Estuary

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With ever-increasing coastal development, a main focus of estuarine research has become predicting the consequences of nutrient enrichment in coastal ecosystems. In this study, two regions within the Guana Tolomato Matanzas National Estuarine Research Reserve (GTMNERR) in northeast Florida were compared to investigate how well-mixed estuaries with strong tidal influence respond to different nutrient load scenarios. Various water quality sampling regimes were utilized to capture spatial and temporal variability in physiochemical parameters. Since traditionally monitored water quality parameters such as nutrient and phytoplankton concentrations often do not provide a clear indication of trophic status in estuaries with short water residence times, response to nutrient enrichment in this system was measured at the level of benthic primary consumers. Oyster population structure was examined within each region using measurements of oyster density, size, and condition. Results were related to regional and seasonal differences in nutrient concentrations and food availability. Nutrient, chlorophyll *a*, and particulate organic carbon concentrations were positively related to oyster biomass, abundance, and condition. This study demonstrates that oysters are promising bioindicators of water quality in highly flushed estuaries.

Grad, Oral

Dietary analysis of juvenile surf-zone fishes *Trachinotus carolinus* and *Menticirrhus littoralis*: Examining the effects of human impact

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The extent of human activities, specifically beach nourishment, on the ocean surf-zone ecosystem remains poorly understood. As the frequency of beach nourishment is expected to increase, it is pertinent to examine the environmental impact on food habits and nursery function of surf-zone fishes. Stomach contents of juvenile Florida pompano (61-120 mm) and gulf kingfish (62-124 mm) collected in 2008 were examined from two sites with and without nourishment on Wrightsville Beach, NC. Percentage by weight (%W), number (%N) and frequency of occurrence (%F_o) were calculated to determine relative importance of each prey type, identified to the lowest possible taxa. Compound indices IRI and %IRI were used to examine contributions of each prey type to variations in diet. At both sites, crustaceans were dominant among kingfish, particularly amphipods, mysids, and mole crabs (Genus *Emerita*). Incidence of parasitic nematoda was found exclusively in kingfish. Evidence suggests pompano are more generalist feeders, feeding from the entire water column. Crustaceans, specifically amphipods and mole crabs, coquina (Genus *Donax*) and insects were the major groups. Future research will attempt to assess predator feeding behavior and preference for specific prey types as a function of availability and sediment size and composition.

UG, Poster

Effect of substrate leveling on the abundance of Brazilian pepper (*Schinus terebinthifolius*) at restored mosquito impoundments in Mosquito Lagoon, FL

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Coastal wetlands in Mosquito Lagoon, FL were impounded for mosquito control in the 1960s by building dikes over one meter above high tide. Less tidal inundation facilitated invasion by non-native Brazilian pepper (*Schinus terebinthifolius*, terrestrial tree species) and relative abundance was over 20%. Restoration began in the 1990s by mechanically leveling substrate to marsh elevations. For one year, seasonal surveys evaluated Brazilian pepper abundance, soil moisture, soil salinity, and elevation at (n=5): restored impoundments, non-restored shorelines, and reference marshes. Additionally, manipulative experiments simultaneously tested effects of three salinities and three inundations on Brazilian pepper germination, growth, and survival. Thirteen Brazilian peppers were found at one restored impoundment and all were located in an area with significantly higher elevation and lower soil salinity and moisture compared to other locations. During growth trials, 9-month seedlings continuously submerged under saltwater survived for one month with minimal leaf loss. In comparison, high water levels and salinity significantly decreased germination of Brazilian pepper seeds, suggesting different life stages may be more tolerant to coastal wetland conditions. Understanding the role of abiotic factors in preventing invasion will assist resource managers by predicting areas vulnerable to invasion and estimating optimal substrate elevations for future restoration projects.

Grad, Oral

Do Marine Reserves Affect Seagrass Communities? Observations and Experiments from Florida.

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Overharvest of large, marine consumers is predicted to alter seagrass food-webs, resulting in less beneficial grazing on epiphytic algae and reduced seagrass growth and production. However, this prediction has rarely been tested in nature. I evaluated seagrass community composition across a marine reserve boundary in Florida's Banana River Lagoon (BRL) to determine if the greater abundance of large, vertebrate consumers in the reserve area was associated with a reduced abundance of small, demersal predators, an increased abundance of epifaunal grazers, and a reduced abundance of algal epiphytes relative to the adjacent non-reserve area. I also performed a consumer-exclusion experiment inside the reserve in order to evaluate consumer effects without the potentially confounding influence of geographic variation in water quality and physical conditions. There were clear differences in seagrass community characteristics across the reserve boundary, over time, and among experimental treatments. Some of these differences, such as increased epiphyte density in consumer-exclusion treatments, supported the predicted effects of large consumer removal. However, other, unexpected results emphasized the inadequacy of assuming cascading interactions among whole trophic levels in a system with a high degree of functional diversity, omnivory, and local habitat heterogeneity.

Fac, Oral

Feeding activity and filtration rate of the tubicolous amphipod *Haploops nirae*.

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Haploops nirae is a gregarious amphipod species that colonizes muddy environments in South Brittany shallow waters. Recent mapping surveys showed unexpected extensions of colonized habitat, reaching over 5 000 ha in several bays, with densities over 10 000 ind.m⁻². As part of a larger project designed to understand the ecological roles played by this species, we first focussed on the place of this species in the trophic web. Using unique troughs connected to a flow-through system, we were able to assess the

filtration rate of this species and investigate the effects of environmental parameters (food concentration, turbidity, flow rate) on the feeding activity. We showed that particles larger than 20 μm are retained with 100% efficiency and that the individual filtration rate is 15 $\text{mL}\cdot\text{h}^{-1}$. Very little is known about filter-feeding amphipod species but our results fall within the ranges of existing values. Both an increase in food concentration and unexpectedly in inorganic matter were shown to have a positive non-linear effect on feeding activity of *H. nira*. Extrapolation of filtration rates from mesocosm to ecosystem-scale revealed that large extensions of *Haploopsis* habitats in muddy environments could have a severe grazing impact on primary production in colonized bays.

Fac, Oral

What would Bucktooths do? Do Bucktooth parrotfish have a turtlegrass (*Thalassia testudinum*) feeding preference?

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While the impacts of leaf nitrogen on seagrass herbivore feeding patterns are widely reported in the literature, the impacts of covarying secondary defense compounds on the foraging patterns of these herbivores remain unstudied. To determine if the presence of these compounds in turtlegrass leaves could affect the feeding preferences of seagrass herbivores, we conducted a field preference test using tethered seagrass blades with and without leaf epiphytes. Comparisons of the tethered leaves used in these preference tests showed that epiphytized leaves contained lower phenol concentrations than did leaves without epiphytes. We found that parrotfish preferred heavily epiphytized leaves over unepiphytized leaves. This preference could not, however, be explained by differences in the leaf nitrogen content of these offered leaves. How bucktooths are able to detect phenol poor leaves is uncertain, but we hypothesize that it is the epiphytes, serving as a visual cue, that signals to these grazers which plants are low in chemical defense compound content.

Grad, Poster

How important is biodiversity to ecosystem functioning? Relative strengths of diversity, predation, and bottom-up effects in an experimental seagrass ecosystem

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Recent syntheses confirm that declining diversity often reduces productivity in a range of systems. But it remains unclear how important such diversity effects are relative to the central drivers of resource supply and predation. We show that effects of herbivore diversity on biomass accumulation and community structure in experimental seagrass food webs were comparable in magnitude to those of changing resource supply, seasons, and predator pressure. Nevertheless, food web structure strongly and consistently influenced expression of biodiversity effects: species richness enhanced herbivore biomass accumulation primarily in the presence of predators, but affected algal biomass and community diversity primarily in the absence of predators. In contrast, effects of changing resources (light) attenuated above the plant level and had little impact on herbivore diversity effects. Herbivore species richness effects were stronger and often qualitatively different during summer than in colder months, suggesting a link between metabolic rate and the strength of biodiversity effects. Finally, increasing herbivore diversity stabilized aggregate herbivore biomass, consistent with the insurance hypothesis, but destabilized biomass of algae. Thus, effects of changing biodiversity on communities and ecosystems can be comparable in magnitude to those of resource flux and predation, and also interact predictably with changing food-web structure.

Fac, Oral

Impacts of the burrowing activities of the chemosymbiotic bivalve *Thyasira sarsi* on sedimentary redox reactions.

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Thyasirid bivalves are poorly-known but widely distributed inhabitants of soft sediments in colder waters; chemosymbiotic thyasirids are often dominant in sediments recovering for organic enrichment.

Chemosymbiotic thyasirids require access to both oxygen (through the inhalant tube) and reduced sulfur, for the metabolism of bacterial symbionts. The mode of reduced sulfur acquisition is unclear, particularly where reduced sulfur is predominantly metal-bound. Symbiotic thyasirids form complex burrow networks using their feet; here, we investigate alterations in sediment redox reactions around pedal tracts using 2D planar optodes to image the temporal changes in the pH distribution surrounding thyasirids and their pedal tracts. Periodic imaging over eight days reveals an overall decrease in pH around the inhalant tube, but an overall increase in pH around thyasirid burrows. Further, circadian patterns in oxidation/reduction around thyasirid pedal tracts suggest the predominance of sulfur oxidation during the day, and sulfur reduction at night. A pattern of metal-bound sulfur uptake related to thyasirid ventilation activities is suggested, and long-term impacts on sediments and associated benthos are considered.

Fac, Oral

Benthic-pelagic coupling: biofilm erosion and resuspension of micro-organisms in the Brouage mudflat (French Atlantic coast)

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With the participation of Martine Br eret, Philippe Catala, Margot De Crignis, Mariel Dumestre, Camille Fontaine, Hans Hartmann, Micka el Karpytchev, Nicolas Lachauss ee, Fran oise Mornet, Caroline N erot, Philippe Pineau, Pierre Richard.

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Sediment resuspension into the water column is affected by bed shear stress depending on the intensity of currents, wind-induced waves and the erodability of the sediment to erosion. Microphytobenthos may play either enhance or reduce sediment erodability in relation to the excreted exopolymeric substances.

The bed erodability results from complex relationships between sediment properties, macrofauna activities and microphytobenthos. The objective of this study is to quantify both the physical conditions for resuspension of sediment biofilms and the resuspension of biofilm microorganisms (virus, heterotrophic prokaryotes, nanoflagellates, ciliates, microphytobenthos) in the water column during field sampling in July 2008 in the Brouage mudflat. The temporal variation of bed erodabilities and microorganisms resuspension fluxes were evaluated with a portable eroding system ERIS. The different erodimetry experiments confirmed a variation of bed erodability. All the microorganisms were resuspended, but with a different current threshold. While virus, free prokaryotes and nanoflagellates were immediately resuspended at low current, the attached prokaryotes and diatoms required larger current speed to be resuspended. Results were compared with field data from eulerian and lagrangien surveys of the water column along the mudflat through rising tide and discussed versus field bed shear stress estimates.

Fac, Oral

North Pacific deep-sea sediment: environmental variables

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We analyzed environmental variables of the upper centimeter of sediment for stations along the 2700-m and 3700-m isobaths off the west coast of the United States. Four pairs of stations were sampled with a multiple corer. Environmental variables included bacterial abundance, carbon and nitrogen fractions, chlorophyll *a* concentration, enzyme hydrolyzable amino acid concentration, and grain-size distribution. Initial evaluation of these variables has revealed that some of the stations differ conspicuously. We will determine whether correlations exist among the environmental variables and whether one or more of these variables can be correlated with observed patterns of harpacticoid species' ranges and meiofauna abundances.

Grad, Poster

Effects of metabolites from harmful algal blooms on benthic filter feeders

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The dinoflagellate *Karenia brevis* produces brevetoxins, which are potent neurotoxins that bioaccumulate in lower trophic level organisms, causing mass mortalities of fish, birds, and marine mammals that consume them. The role of non-bivalve benthic filter feeders in accumulating and vectoring brevetoxin is largely unknown. We will compare the effects of metabolites from *K. brevis* on filtration rates of different taxa of benthic filter feeders and the extent to which they accumulate brevetoxins. In initial tests a sponge (*Adocia tubifera*), a bivalve (*Mercenaria spp.*), a tunicate (*Styela plicata*), and a bryozoan (*Bugula neritina*) were exposed to extracts of *K. brevis* (20 µg type 2 brevetoxin L-1) for 12 hours. A competitive enzyme linked-immunosorbent assay (ELISA) was used to quantify brevetoxin concentrations in tissue and showed the four groups accumulated different amounts, with *S. plicata* accumulating the most (1333 ± 582 ng PbTx-2 g⁻¹) and *A. tubifera* accumulating the least (772 ± 180 ng PbTx-2 g⁻¹). The prevalence of benthic filter feeders in fouling and live bottom communities and their potential to accumulate high concentrations of toxin could represent an unrecognized source for trophic magnification of toxins after harmful algal blooms.

Grad, Oral

Overgrowth rates of a red crustose alga (*Ramicrosta* sp.) and competitive interactions with corals in Bonaire, Netherlands Antilles

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The shallow back reef of Lac Bay, Bonaire is characterized by a complex shallow coral reef and includes large colonies of the endangered species *Acropora palmata* and *A. cervicornis*. Sections of this reef are being overgrown by a red crustose alga of the genus *Ramicrosta*, a member of the *Peyssonneliaceae*.

Currently, samples are being analyzed to determine if the alga is *Ramicrosta textilis*, only first described in 2009 from samples taken in Jamaica, or an undescribed species. The alga is capable of overgrowing at least thirteen species of corals, including the endangered species *Acropora cervicornis*. *Porites* and *Millepora* species are particularly susceptible to overgrowth by *Ramicrosta*. Based on sampling periods ranging from three to eleven weeks, mean *Ramicrosta* overgrowth rates for *Porites porites*, *P. astreoides* and *Millepora complanata* are 0.81 mm wk⁻¹, 0.87 mm wk⁻¹, and 0.28 mm wk⁻¹ respectively. No coral recruits have been observed on substrates overgrown by *Ramicrosta*, indicating that extensive benthic cover of this alga, as observed in Lac, may limit the area of suitable substrate for coral recruitment.

Fac, Oral

Moving on up: behavioral vacancy chain dynamics in the marine hermit crab, *Pagurus longicarpus*
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Vacancy chain theory describes the distribution of discrete, reusable, and limited resources. A single empty gastropod shell, used by hermit crabs for shelter, has the potential to proffer a benefit to many individuals by initiating a sequential chain of shell switches. Hermit crab vacancy chains occur in a social context, with multiple crabs participating either in synchrony or sequence. To test whether chains differ based on shell quality characteristics, we investigated marine hermit crabs, *Pagurus longicarpus*, from two populations (Nahant and Beverly, MA). Crabs from Nahant inhabited shells of poorer quality (more damage and more crowding) compared to Beverly crabs. In laboratory experiments, we tested the prediction that Nahant crabs would more readily participate in vacancy chains and experience more shell switches. Twenty trials from each population were compared. As expected, Nahant crabs (high damage, high crowding) had higher frequencies of shell investigation, likely explained by their motivation to switch. However, regardless of population, vacancy chains were the same in length and were terminated when the vacant shell was highly damaged. This demonstrates that differences in shell choice behavior do not alter the ecological outcome (chain length), and that behaviors are mediated by shell quality even in a social context.

Grad, Oral

The pros and cons of tropical storm forcing on regional blue crab settlement.

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Global climate change is predicted to increase the frequency and magnitude of hurricanes, with little known consequences for recruitment dynamics of marine species that rely on wind-driven larval transport to coastal settlement and nursery habitats. We conducted a large-scale settlement study of the blue crab in North Carolina, during a 10-year period that encompassed 35 tropical storms of varying magnitudes and tracks. The benefits of hurricane-forcing to megalopal settlement was dependent upon storm track and magnitude, with highest settlement events generally associated with “onshore” storm tracks that made landfall from the ocean and tracked southeast to northwest, or “coastal” storms that followed a path roughly parallel to the coastline and were located < 300 km offshore of the coast. Extreme rainfall events had a negative effect on recruitment by reducing salinities to lethal levels. Thus, the generally positive benefits of hurricanes to estuarine blue crab settlement must be tempered by the magnitude of a given hurricane.

Fac, Oral

Modeling the gag grouper population in the Gulf of Mexico: influence of density-dependent sex change on marine reserve effectiveness

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Marine reserves are increasingly employed as a fisheries management tool. However, the anticipated responses by managed populations to reserves are often based on untested assumptions. Simulation modeling can be used to compare different marine reserve designs across a range of presumed patterns while identifying gaps in available scientific knowledge that will help improve design and management. We present the results of a stage-structured model for the gag grouper (*Mycteroperca microlepis*) from the northern Gulf of Mexico. Gag is a species of protogynous grouper currently experiencing overfishing

and possible sperm limitation due to an observed decline in the male to female sex ratio. Two marine reserves were implemented in 2000 in part to increase that sex ratio. We modeled marine reserve performance under a suite of potential changes in fishing effort to evaluate expected changes when the rate of sex change is a function of male density. We found that including density dependent sex change in the model initially predicted a faster increase in population sex ratio. Excluding density dependent sex change from population models of protogynous grouper could lead to an over-estimation of the predicted sex ratio response to marine reserve protection.

Into the Light: How Geomorphology Affects Irradiance and Primary Production in Tidal Rivers

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Coastal plain rivers widen dramatically where tidal influence begins. As river width increases, shading of the river by riparian vegetation decreases and irradiance available for primary production increases. Longitudinal changes in light availability have not been quantified in coastal rivers, but are central to understanding the ecological implications of tides on river ecosystems. This study investigated the spatial and temporal changes in light availability and phytoplankton growth along the riverine-estuarine continuum of two North Carolina rivers. Solar radiation, tree canopy photographs, water column light attenuation, and channel depth were used to calculate water column irradiance. Chlorophyll a was measured as a proxy for phytoplankton biomass, and photosynthetic response to irradiance was quantified in radioisotope uptake experiments. Results showed that the annual peak phytoplankton biomass occurred in both rivers where irradiance increased most dramatically; this location corresponded with a large increase in river channel width. The relatively low irradiance required for photosynthetic saturation allowed for maximum production to occur in this region during peak irradiance in spring and summer. This mechanistic link between tidally-influenced geomorphology and enhanced primary production is a unique feature of the tidal rivers that greatly affects riverine food webs and ecosystem processes.

Grad, Oral

Red mangrove leaves improve with age like fine wine: the relationship between crab feeding, leaf age, and pre-existing herbivore damage.

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This study tested: 1) whether older mangrove (*Rhizophora mangle*) leaves are fed upon more than younger ones by the mangrove tree crab (*Aratus pisonii*), and 2) why such preferences might exist. The study used: 1) multiple-choice feeding assays to assess feeding preferences, and 2) artificial feeding assays, where dried, ground leaves (or chemical extracts) were incorporated into agar-based food to assess the impact of chemistry. This study found that older leaves were preferred, however crude leaf extracts did not explain feeding preferences. Given that leaf age is confounded with the amount of pre-existing damage on leaves, experiments testing how damage influences feeding were conducted while controlling for age. They demonstrated that greater pre-existing damage resulted in greater crab feeding. Examination of leaf damage created during experiments revealed that new damage occurred on or adjacent to old damage for approximately 80% of all leaves examined. Damaged leaf material was less tough than fresh material. Artificial feeding assays, where crabs were offered undamaged, green versus damaged, brown leaf material, revealed that crabs were attracted to damaged leaf material. Thus, feeding preferences for older leaves are likely due to the presence of greater amounts of pre-existing damage, which is chemically and structurally attractive.

Fac, Poster

The relative contributions of salinity, predation, and trait-mediated responses on oyster drill effects on intertidal oyster reefs

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Oyster drills (*Urosalpinx cinerea*) have the capability to effect oyster (*Crassostrea virginica*) numbers and the success of fledgling oyster reef restoration efforts. Previous studies suggest varying salinity levels may affect drill presence/absence on intertidal reefs in South Carolina, USA. Decapod predators including blue crabs (*Callinectes sapidus*) also have the potential to alter drill feeding on reefs either by consuming drills or influencing drill foraging behavior. A series of experiments are planned to examine survival and feeding rates of drills at varying salinity levels, to measure blue crab feeding on drills, and to determine if blue crabs are capable of affecting drill foraging behavior. Results should answer questions about drill effects on oyster reefs including: 1) whether oyster populations experience a refuge from drill predation during years of increased rainfall and reduced nearshore salinities, 2) are blue crabs able to reduce drill numbers and positively affect oyster numbers either through consumption or altering drill behavior. Documenting the relationships between physical, salinity levels, and biological factors, direct or indirect predation effects, will aid in developing effective models for reef restoration site selection and predicting the directions of community change under the influences of global warming and the anticipated increases in rainfall.

Grad, Poster

Nuclear and mitochondrial sequence data reveal and conceal non-equilibrial population genetic processes in Caribbean reef fishes

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The expectation when sampling co-occurring taxa for phylogeographic studies is that shared evolutionary events will produce concordant population genetic patterns. Likewise, sampling multiple loci is expected to provide replicate samples of the same underlying demographic processes within a species. These expectations were tested for two coral reef fishes species, the tube blennies *Acanthemblemaria aspera* and *A. spinosa*. They are closely related, have the same life histories and pelagic larval durations, and co-occur throughout the Caribbean. Sequence data for one mitochondrial and two nuclear markers were collected for individuals from six populations. While both species share a similar pattern of genetic subdivision, as evidenced by pairwise Φ_{ST} values and STRUCTURE plots, *A. spinosa* has 20-25X greater genetic divergence among populations than *A. aspera* at all markers sampled. Substitution rate estimates reveal that mitochondrial *COI* is evolving at 11.2% per million years. This rapid rate has obscured the signal of old population expansions for both species, which can only be inferred using the slower evolving nuclear markers. However, the rapid *COI* rate allows the recovery of a recent expansion in *A. aspera* corresponding to the last glacial maximum.

Grad, Oral

Aggregative feeding behaviour in sea urchins (*Strongylocentrotus droebachiensis*) leading to gap formation and destructive grazing of a kelp bed

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A key determinant of change in kelp bed ecosystems in the Northwest Atlantic is grazing by the sea urchin *Strongylocentrotus droebachiensis*, which drives decadal shifts in alternative community states from productive kelp beds to unproductive barrens. Field observations show shifts to barrens can be preceded by formation of gaps within a kelp bed. A mathematical model predicts sea urchin feeding aggregations produce gaps when density surpasses a threshold of 150 urchins m⁻². To test this model we transplanted 14,000 adult sea urchins from a barrens on the Atlantic coast of Nova Scotia to a kelp bed

within a nearby large embayment where adults were rare. Sea urchins were transplanted at 4 density levels (0, 50, 100, 200 urchins m⁻²), randomly allocated to 32 circular plots (5 m²) spaced 7 m apart at 7-10 m depth. In half of the plots, all kelp was cleared to simulate physical/biological disturbance. We monitored sea urchin density and measured gap formation and kelp loss in and around plots for 9 weeks. Preliminary analyses show a significant effect of sea urchin density on gap production and expansion, most notably in disturbed plots with high density where gap size increased $0.5 \pm 0.06 \text{ m}^2 \text{ wk}^{-1}$.

Grad, Oral

Perturbation in a dynamic system: variable consequences of coastal storms on habitat structure and faunal composition in an exposed beach.

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Exposed sandy beaches harbor a community of organisms assumed to be highly resilient to pulsed, physical perturbations. Observations of sediment disturbance by waves and of burrowing behavior by the resident species suggest that sediment transport does not affect beach infaunal populations. Yet no explicit test of this hypothesis exists. We used changes in beach morphology associated with storms to examine whether subsequent abundances of infauna changed in a manner consistent with individual organisms acting as passive particles. In September 2008 we collected synoptic, quantitative data on wind, hydrodynamic conditions, geomorphology, sediment composition, and beach fauna for several locations on Onslow Beach (NC) before, between, and after the occurrence of two moderate-sized coastal storms (TS Hanna and a nor'easter). Each storm produced different changes in beach morphology that varied spatially along the island. Faunal responses varied by species. Some species demonstrated no changes in density while others increased significantly in density after the storms, likely due to active redistribution along the beach. Species abundances within a given location could not be predicted from changes in beach morphology. Our results indicate that these organisms do move independently of sediment transport capable of producing large physical alterations to a beach.

Fac, Oral

A Non-Invasive Assay for Quantifying Fish Stress Hormones

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The current industry standard method for examining stress hormones in fishes involves extracting cortisol from plasma. This process is itself stressful, which confounds the accurate quantification of stress and inhibits replication. Recent advances in stress physiology studies have included a new, non-invasive method combining solid-phase extraction (SPE) with an enzyme-linked immunosorbent assay (ELISA) to quantify cortisol levels in the ambient water of fish tanks. Though this approach is theoretically sound, it is still in its practical infancy, and few studies have validated water cortisol levels to blood. Furthermore, this method has only been applied to a limited number of species, only a few of which are marine. In this study, we developed a novel experimental set-up optimized for water cortisol and conducted a systematic examination testing multiple controls for multiple marine fish species in multiple stress situations using a repeated measures design. We found clearly defined and reproducible stress responses observed with just 100ml of water collected from a 70-l tank. These validations are important because this non-invasive method can be broadly applied to quantifying fish stress, and will likely become the new lab-based industry standard for assessing stress physiology in fishes.

UG, Poster

Ecological periodic tables for benthic macrofaunal usage of estuarine habitats.

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Southwood (1977: Journal of Animal Ecology 46: 337-365), in his presidential address to the British Ecological Society, compared the situation in ecology to that in chemistry before the development of the chemical periodic table when each fact, for example, the solubility or reactivity of a chemical element, had to be discovered independently and remembered in isolation. Southwood theorized that since ecological strategies evolve from the interaction of the habitat and organisms “a sort of ecological periodic table” might be constructed with a set of habitat characteristics, or “habitat templet,” as the organizing elements. Our research results show that at the whole estuary scale sediment features (sand and mud), the presence of ecosystem engineering species (eelgrass, dwarf eelgrass, mud shrimp, ghost shrimp and oysters), and bathymetry (intertidal and subtidal) are effective habitat classifiers for benthic macrofauna in the US Pacific Northwest. Spatially and temporally recurring (“periodic”) across-habitat patterns of benthic macrofaunal species richness, abundance, biomass and Bray-Curtis similarity indicate that these habitats act as templates (sensu Southwood (1977)) for benthic macrofaunal communities. The demonstration of periodic across-habitat patterns validate the ecological relevance of the habitats and suggest they can serve as elements in ecological periodic tables of benthic macrofaunal usage.

Fac, Oral

Effects of epiphyte biomass and diversity on seagrass in the Florida Big Bend

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Epiphytic algae are a known contributor to seagrass loss, yet they are also critical to productivity and trophic interactions in seagrass communities. We examined epiphyte and seagrass distributions, along with other biotic and abiotic factors, across 80 sites in the Big Bend region of Florida. The spatial distribution of seagrass and epiphyte biomass suggested both light and nutrients were important factors. For example, distance from shore was positively correlated with depth and negatively correlated with seagrass biomass, consistent with light limitation. In addition, both seagrass and epiphyte biomass were higher at sites near the Suwannee River, a likely source of nutrient inputs. In addition to these spatial patterns, epiphyte and seagrass biomass were positively correlated, which is expected as seagrasses are hosts for epiphytes. Interestingly, the nature of the relationship between epiphytes and seagrasses differed with epiphyte diversity: epiphyte biomass per seagrass biomass (i.e. epiphyte load) increased with increased epiphyte diversity. The abundances of two potential grazers, *Lagodon rhomboides* and *Toxuma carolinense*, were not correlated with epiphyte or seagrass biomass. Our results are consistent with considerable evidence for the importance of light and nutrients to seagrasses. Further, they indicate that epiphyte diversity, not just epiphyte biomass, influences the epiphyte-seagrass relationship.

Grad, Poster

Filtration rates of the Giant Barrel Sponge, *Xestospongia muta*: Size scaling and geographical variation.

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Sponges are among the most diverse and abundant taxa on Caribbean coral reefs, with numbers of species and biomass equaling or exceeding that of corals and algae. Their success on reefs can be partially attributed to the ability remove small particles (phytoplankton, bacteria, and viruses) from the water column and their ability to permeate the entire three dimensional structure of the reef. Because of these characteristics, sponges represent a major pathway of carbon flux from the water column to the benthos and a mechanistic understanding of sponge filtration rates is needed. The giant barrel sponge, *Xestospongia muta*, comprises up to 60% of sponge biomass on Caribbean reefs with a size range (tissue

volume) that spans six orders of magnitude. To address the effects of sponge size on filtration rates, we've measured pumping rates of healthy *X. muta* across wide range of sizes on reefs in the Bahamas and in Florida. Pumping rates were remarkably constant between years and sites. Resulting volumetric pumping rates scaled linearly with tissue volume and averaged $115 \text{ ml}_{\text{H}_2\text{O}} \text{ h}^{-1} \text{ ml}_{\text{tissue}}^{-1}$.

Fac, Oral

Evaluating potential nursery habitats of juvenile gray snapper (*Lutjanus griseus*) in the northern Gulf of Mexico

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 Rising global temperature over the past few decades is expected to drive worldwide community changes in composition and ecology. One such climate-induced community transition is poleward shifts in the distribution of tropical species. In the northern Gulf of Mexico (nGOM) gray snapper (*Lutjanus griseus*) populations have risen dramatically in association with warmer temperatures. Data on juvenile habitat use in the nGOM is lacking for *L. griseus*, and with growing populations, it is important to understand how gray snapper exploit potential nursery habitats. We selected seagrass meadows, oyster reef, and salt marsh habitats for study since they are the most common and widely recognized nursery habitats in the nGOM. Growth studies of juvenile gray snapper in each of the three habitats were conducted in the field during fall 2009 and will continue in fall 2010. We will also conduct pairwise preference experiments in a lab setting to determine habitat preference both in the presence and absence of a predator. Results will help us understand how juvenile gray snapper choose and utilize these potential nursery habitats as well as help ensure proper management of coastal ecosystems and fish stocks.

Grad, Poster

Source populations in coastal crabs: parameters affecting egg production

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Benthic marine invertebrates may form metapopulations connected via propagule dispersal. Conservation efforts often target potential source coastlines to indirectly benefit areas depending on allochthonous offspring production. We measured population density, adult size structure, sex ratio, brooding frequency and the proportion of breeding individuals for two common rocky shore brachyurans; the grapsid *Pachygrapsus transversus* and the majid *Epialtus brasiliensis*. Measurements encompassed scales of conservation interest, spanning different breeding seasons to test for pattern persistence. Adult density and brooding frequency varied consistently among shores for both species and largely explained the overall spatial trends of egg production. Persistent patterns also included among-shore differences in the size of ovigerous females for the grapsid and between-bay differences in fecundity for the spider crab. Sex ratio was remarkably constant in both. We found no positive or negative correlations between density and brooding ratio to support either the existence of a component Allee effect or an effect of intra-specific competition. Likewise, shore-specific potential growth in *P. transversus* does not negatively correlate with frequency of ovigerous individuals, as expected under a critical balance between these 2 processes. These patterns suggest that bottom-up drivers may best explain spatial trends in the reproductive output of these species.

Fac, Oral

Impact of Climate Change on Red Mangrove Survival and Success

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Conservation organizations predict that mangrove ecosystems will be severely impacted by sea level and extremes in salinity associated with storm events. In this research, we looked at the interaction between

salinity levels (0, 15 and 30 ppt) and water depth (covering all but top leaves, covering up to level of the sediment, and below the sediment level) for 6 month old red mangroves (*Rhizophora mangle*) in Florida. Plants were monitored every other day for 1 month. Mortality, number of leaves, plant height and production of prop roots were compared among all treatment combinations.

Undergrad Poster

Weak reproductive isolation in threatened Caribbean coral species

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The Caribbean corals, *Acropora palmata* and *A. cervicornis*, are abundant in fossil records but have recently undergone drastic declines. *Acropora prolifera*, a hybrid of these species, has no fossil record. Although previously considered rare, hybrids currently have equivalent or greater abundance than the parental species at some sites. Previous molecular studies have demonstrated regional variability in unidirectional introgression of *A. palmata* genes into *A. cervicornis*. Here the strength of reproductive isolation in this threatened genus was examined. Prezygotic barriers to hybridization in *A. palmata* are semipermeable and in *A. cervicornis* are weak, at best. The efficacy of these incomplete prezygotic isolating mechanisms may depend on density. Under low abundances, eggs may remain unfertilized for longer periods, reducing the effectiveness of conspecific sperm precedence and subtle differences in spawning time in isolating these species. In addition, hybrids are as viable as the parental species at a variety of life history stages and are less or equally susceptible to the typical afflictions that have led to their decline. The likelihood of the generic-wide decrease in abundances resulting in increased hybridization and possibly introgression may hinge on their ability to avoid further loss from current biological and environmental stressors.

Grad, Oral

Measuring the role of waves in benthic ecosystems

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Although the role of tidal currents has received detailed study, little has been done to evaluate a dominant factor driving benthic ecology: waves. To meet this challenge, we have developed a user-friendly GIS-based tool (Wave Exposure Model – WEMo) to assist hydrodynamically - challenged ecologists and managers to forecast and hindcast wave energy at the surface and seafloor, all in a geographic context. The model readily calculates the wave energy by taking into account the effects of wind, shoreline shape and local bathymetry. WEMo provides predictions of wave height and energy using a wave ray technique that evaluates the influence of bathymetry on wave growth and decay as a function of fetch based on linear wave theory. WEMo also provides forecasts of benthic shear stress, orbital velocities and sediment motion based on calculated wave height and wave period. Field calibration studies of wave height using pressure transducers indicate highly reliable performance particularly in semi-enclosed water bodies. This product is designed for non-specialists and is available for free download from our website:

<http://www.ccfhr.noaa.gov/stressors/extremeevents/wemo.html>

Determining generalities in insect herbivore responses to induced salt stress with meta-analysis

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This study examined how different insect herbivore feeding guilds react to salt-stressed coastal plants. Stress has been identified as one of the primary factors influencing the structure of food webs, but few conclusions about the effects of stress on community dynamics have emerged. By performing a multiple species examination, we tested whether or not responses to stress were consistent within and between herbivore feeding guilds, allowing for generalizations to be made about stress and herbivore interactions.

Herbivore responses were determined by counts and indirect visual evidence of insects (e.g. galls, stem boring, and leaf mining) on six different plant species. Data were then analyzed with meta-analysis to determine the factors (e.g. herbivore feeding guild, herbivore taxon, plant functional group etc.) that can result in consistent responses to salt stress. Herbivore responses varied by guild. For example, sap suckers and stem borers were positively affected by the salt treatment. However, leaf chewers, rollers, and miners were negatively affected. This study has allowed for a more thorough examination of the effects of salt stress in salt marsh food webs and has supplied data that could ultimately provide information for future management and sustainability of these complex systems.

Grad, Oral

Stealing Scraps from Dolphins: Interactions between birds and strand-feeding dolphins in a South Carolina salt marsh.

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Atlantic bottlenose dolphins (*Tursiops truncatus*) in some salt marshes in the Southeastern United States engage in a foraging technique known as strand-feeding. In a coordinated manner, a group of dolphins pursue fish onto muddy creek banks, where they temporarily strand themselves in order to capture prey. In Bull Creek, near Bluffton, SC, this behavior occurs regularly and was extensively studied by Petricig (1995) in the early 1990s. Several species of wading birds have been observed foraging at strand-feeding events, but no previous study has investigated the importance of this association to the total foraging requirements of the birds. We identified Great Egrets (*Ardea alba*) and Great Blue Herons (*Ardea herodias*) as the primary bird species that associate with strand-feeding dolphins. Bioenergetic models estimate that these birds are able to meet their daily energetic requirements with prey captured during strand-feeding events. We also determined that bird-dolphin interactions are not truly commensal, and may have a negative impact upon the dolphins. This interaction between birds and strand-feeding dolphins is a unique relationship between apex predators.

Grad, Oral (or Poster)

Habitat choice, size distribution, color variance, and feeding behavior of spotted moray eels, *Gymnothorax moringa*, in coastal waters of Bonaire, N.A.

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The spotted moray eel, *Gymnothorax moringa*, is one of the most abundant eels found in Bonaire, N.A. However, little is known concerning its choice of habitat, behavior, and timing of activity. Contradictory evidence has been reported as to whether *Gymnothorax* are nocturnal or diurnal, but the effect of diet or habitat choice on color and size are unknown. This study focused on how size, behavior, and color correlated with reef flat and slope habitats and time of day. Observations of *G. moringa* were conducted on the west coast of Bonaire in the morning and evening. A "U-shaped" search pattern was utilized to locate eels in 5 study areas extending from shore to a depth of ~15m. Once an individual was located behavior, jaw size, and color were recorded. *G. moringa* was found in greater densities on the reef flat in the evening, displaying exposed venting behavior and predominantly white coloration. In the morning *G. moringa* were found to be in greater densities on the reef slope, displaying foraging behavior and predominantly black coloration. Representatives of all size classes were distributed on the reef flat regardless of time, however, small individuals were not observed on the reef slope in the evening.

Undergrad, Poster

Patterns of species diversity in estuarine benthic communities along the US west coast

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Estuaries in the Pacific North West (PNW) were recently classified by whether the estuary is river- or ocean-dominated, the extent of intertidal to subtidal environments, and spatial salinity patterns. We examine whether these characteristics predict patterns of soft-sediment, macrobenthic diversity (number of species per sample) in estuaries along the US west coast. We have compiled data from >4,000 benthic samples from Puget Sound, WA to Northern Mexico collected using a 0.1 m² grab and 1-mm sieve. Preliminary mixed-model analyses, with estuary as a random effect, suggest that species richness varies by ecoregion ($P < 0.001$, $N=1,377$ and 176 estuaries): Oregonian/N. California < S. California < Puget Sound. For PNW estuaries (Oregonian and N. CA ecoregions), ocean-dominated estuaries have about twice as many benthic infaunal species as river-dominated estuaries ($P < 0.001$, $N=418$ and 39 estuaries). Species diversity did not differ among intertidal and subtidal estuarine environments as identified by the National Wetlands Inventory. We are currently compiling data to analyze the relationship between diversity and within estuary salinity patterns. This is a first step towards developing models to predict benthic diversity at the estuarine and regional scale, a goal which is becoming increasingly important for providing criteria for conservation in estuarine environments.

Fac, Oral

Green crabs Down Under: Does evolutionary history influence recognition of *Carcinus maenas*?

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Marine biological invasions bring species into contact that have had no shared evolutionary history. This absence of shared evolutionary history may influence invasive predator impacts, including cascading effects on lower trophic levels that alter prey number (a density-mediated interaction) or prey behavior (a trait-mediated interaction or TMI). In order for TMIs to occur, prey must often recognize waterborne cues from the predator. There are several possible mechanisms for TMIs to occur in the case of invasive predators: native prey may be unable to detect the invasive predator, native prey may detect the invasive predator regardless of previous experience, or the capacity to recognize the invasive predator may develop as an evolved or acquired trait. In this study, we explored the above possibilities using the invasion of the European green crab (*Carcinus maenas*) in Australia. *Carcinus* was introduced to Victoria, Australia over 100 years ago, and has partially invaded Tasmania in the last 20 years. Consequently, some populations of native, intertidal prey have been exposed to *Carcinus* for over 100 years (Victoria), some for 15-20 years (eastern Tasmania), and some have never experienced the crab (western Tasmania). In a series of laboratory experiments we found that native whelks (*Lepsiella vinosa*) collected from each of these three regions reduced foraging in response to waterborne cues from *Carcinus* and the native predatory crab *Paragrapsus* sp. Thus, even whelks that shared no evolutionary history with *Carcinus* recognized the invasive crab's waterborne cues. Furthermore, *Lepsiella* taken from Victoria had significantly thicker shells than conspecifics from Tasmania. These results will be discussed in the context of trait- and density-mediated interactions and *Carcinus*' impacts in other invaded regions.

Fac, Oral

Inputs of symbiont-derived nutrition to host sponges revealed by combining field manipulations with stable isotope analyses

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Although several studies suggest that symbiotic cyanobacteria may provide supplemental nutrition to host sponges, studies supporting both the presence and importance of this exchange are rare. We addressed these questions by combining stable isotope analyses with field-based shading experiments that reduce the input of photosynthetically fixed carbon to the sponges *Aplysina fulva*, *A. cauliformis*, *Neopetrosia subtriangularis*, and *Niphates erecta*. The sponge *N. erecta* lacks cyanobacterial symbionts and had a higher growth rate under shaded conditions, with no difference in chlorophyll *a* concentration across treatments. This sponge appears to obtain a dominant portion of its nutrition from heterotrophic filter-feeding. Sponges hosting cyanobacterial symbionts undergo a drastic reduction in growth rates and chlorophyll *a* concentrations under shaded conditions, suggesting that inputs of photosynthetically-derived nutrition are important to these sponges. We are currently exploring the ability of stable isotope analyses to trace the input of symbiont-derived or heterotrophically derived nutrition to the host sponge. Preliminary data suggest that increased heterotrophic feeding rates under shaded conditions cannot provide adequate nutrition for sponge maintenance and growth. Together, manipulative shading experiments and stable isotope analyses provide strong, direct evidence that the inputs of symbiont-derived nutrition are crucial for sustaining host sponge metabolism.

Grad, Oral

Local ecological knowledge of the Albemarle-Pamlico Sound in the blue crab fishery.

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The 2009 blue crab season in the Albemarle-Pamlico has been slow for the fishers and there is much discussion over whether this year is an anomaly or indication of future stocks. Through participant observation in the jobs of the fishery (fisher, picker, shedder, etc), I have identified common concerns: fishing pressure, water quality, and scale of management. There are many dynamics at play behind each of these issues, of both a social and biophysical nature, and locals hope that the embedded information they have can help form useful interventions. However, there needs to be a leader for real action to take place. Participant observation, interviews with policymakers, and review of task force meeting minutes have shown that historically, these leaders have been the managers of the processing houses. These managers serve as a hub for all the independent fishers and relay knowledge to policymakers in order for intervention to take place. 90 of the 96 processing houses have shut their doors in the last 10-15 years, removing not only a market option for the fishers but their key organizers. The loss of coordination among the fishers may mean less action and protection for the fishery.

Grad, Oral

Morphology of Allorecognition Reactions in Different Color Morphs of *Polyclinum constellatum*

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Polyclinum constellatum (Polyclinidae) a colonial ascidian found in sub-tropical to tropical regions worldwide occurs in many different color morphs. To date, allorecognition (self, non-self recognition) reactions have been studied widely within botryllid ascidians that share a common vascular system connecting all zooids of a colony. Allorecognition experiments using polyclinid ascidians are limited to *Aplidium yamazii*. Because polyclinid ascidians lack a common vascular system allorecognition is thought to be mediated by motile phagocytic tunic cells. Fusion experiments with *A. yamazii* show that phagocytic tunic cells migrate to the fusion juncture when adjacent colonies come in contact. This study explores allorecognition reactions within *Polyclinum constellatum* color morphs and compares fusion reactions in this species to *Aplidium yamazii*. Binary color combinations of colonies were placed in

contact at either the natural, growing edge or an artificially cut edge. Phagocytic tunic cell migration was quantified after fusion.

Grad, Poster

Influence of water flow on bleaching of *Palythoa caribaeorum*.

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Water flow is an important abiotic factor for corals and other cnidarians. This study shows how water flow influences bleaching in *Palythoa caribaeorum*. Colonies were exposed to flow (low= $3\text{cm}\cdot\text{s}^{-1}$, high= $15\text{cm}\cdot\text{s}^{-1}$) in two temperature regimes (low: 26.5°C , which is within natural variability on the reef where specimens were collected; high: 33.5°C , which is 3.5°C above usual summer temperature) in a unidirectional flume for 48 hours. Two sizes (small= $2.3\pm 0.2\text{cm}$, large= $7.3\pm 0.4\text{cm}$ in diameter) were tested in six repeats per flow regime. Bleaching was determined by zooxanthellae count using a hemocytometer and by chlorophyll *a* concentration using fluorometry. Results suggest that onset of bleaching is rapid (within 48 hours) in high temperature. The low-temperature did not cause bleaching. In the high-temperature treatment, *P. caribaeorum* consistently bleached less in high flow. Upstream sides of large colonies bleached less than the downstream sides in both high and low flow. In high flow, small colonies bleached less than large colonies. This suggests that enhanced diffusion of toxic products is important to mitigate bleaching and more easily accomplished in small colonies, which may thus have an advantage during bleaching events, as has been observed in the literature.

Grad, Poster

Effect of a prolonged brown tide (*Aureococcus anophagefferens*) on interannual *Zostera marina* densities within a New York estuary.

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The sensitivity of seagrasses to light attenuation has been well established in the literature and many now contend that alterations in the coastal light environment are contributing significantly to worldwide declines in seagrass depth distribution, density and aerial coverage. Although a host of stressors have been shown capable of affecting such change, phytoplankton-mediated light attenuation generally receives the bulk of critical attention, as several large-scale seagrass meadow contractions have been temporally linked to inshore algal blooms. These include a 40% loss of *Z. marina* coverage within the South Shore Estuary of Long Island (NY) following a series of *A. anophagefferens* blooms or 'brown tide' events during the mid-1980's. A similar event occurred again during a 7-month period beginning in the spring of 2008. Using data from the National Park Service 'Vital Signs Monitoring Program' for water quality and rapid seagrass assessments conducted in 2007 and 2009, we were able to examine the putative effects of brown tide on *Z. marina* within the SSE system. Preliminary results suggest that no significant losses were sustained and modest gains in density were observed throughout the bay. A number of explanatory variables are now being examined for spatial concordance with observed changes in seagrass density.

Grad, Poster

Towards characterizing the ecological importance of rhodolith beds of Newfoundland and Labrador

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Rhodoliths (maërl) are slow growing, long-lived (often >100 years), non-geniculate coralline algae found worldwide, often at high concentrations over large tracts of seabed from the low intertidal zone to depths >150 m. Along the coast of Newfoundland and Labrador (NL, Canada) rhodoliths form extensive beds (aggregations) that harbor diverse invertebrate assemblages. This preliminary research aims to

characterize the invertebrate fauna within NL's rhodolith beds and examine how diversity may relate to rhodolith and bed complexity. The density, weight, and volume of rhodoliths collected during the summer of 2009 in shallow (5 to 15 m deep) beds at two sites located 40 km apart along the east coast of NL were quantified along with the associated epifauna. Mean rhodolith density (938.9 and 854 individuals/m²), weight (38.2 and 30.4 g), and volume (18.6 and 15.1 ml) were similar between sites. However, the density of the dominant invertebrate, the daisy brittle star, *Ophiopholis aculeata*, was nearly 3 times higher at one site than the other (164.8 and 451.1 individuals/m²). Our results suggest rhodolith beds along the coast of NL form both temporary and permanent recruitment grounds for many echinoderm, mollusc, polychaete, and crustacean species. Further research directions are discussed.

Fac, Poster

Prevalence of *Hematodinium* in the blue crab (*Callinectes sapidus*) in the Corpus Christi Bay system and Aransas Bay, Texas, U.S.A.

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Hematodinium, a parasitic dinoflagellate, harms a variety of commercially important crustaceans and has been implicated in population declines of blue crab (*Callinectes sapidus*) on the Atlantic Coast. In Texas, the blue crab fishery has been characterized as senescent but the reasons for its decline are unclear. Incidence and prevalence of *Hematodinium* in Texas bays is not well-known. This study examines the prevalence of *Hematodinium* in blue crabs in two bay systems on the central Texas coast. Blue crabs have been sampled using standard commercial crab traps six times per month between July-November 2009. Overall catch-per-unit-effort has been extremely low, presumably due to a year-long drought and the presence of red tide. To date, only two crabs out of a total 103 were infected with the parasite.

Hematodinium does not appear to be the leading cause for blue crab decline; however, it may be one of many compounding factors that are contributing to low populations. It is possible that recent environmental stressors have fragmented blue crab populations, making it difficult for the parasite to spread.

Grad, Poster

Examining the precision and efficacy of a portable clinical analyzer when examining selected blood acid-base properties in elasmobranch fishes

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The evaluation of the physiological stress response of fishes is useful for understanding the mechanisms underlying conservation issues at the individual and population levels. Portable clinical analyzers enable biologists to examine these properties immediately after a stress event, but few studies have validated blood acid-base values derived by these tools in fishes, and none have done so in elasmobranchs. We examined the relationship in values of selected blood acid-base parameters between a portable clinical analyzer (i-STAT) and traditionally accepted instrumentation (thermostatted to 25°C) when run side-by-side across multiple elasmobranch fishes. As predicted due to temperature differences, the mean variance between the i-STAT and corresponding instrument was significant for each parameter. However, regression results show tight correlations between paired-values generated between the i-STAT and corresponding method ($r^2 > 0.90$) for pH, pO₂, and pCO₂. Moreover, the magnitude of difference between methods was consistent across a wide distribution of values for each parameter. Although future studies must address a wider range of temperature points, this study provides empirically derived equations allowing the conversion of raw i-STAT-generated values to 25°C. At this initial temperature point, the i-STAT appears to be a reliable instrument for determining (non-temperature corrected) blood acid-base properties in elasmobranch fishes.

Grad, Oral

Effects of temperature and latitude on reproduction of an invasive shore crab, *Hemigrapsus sanguineus*

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Hemigrapsus sanguineus, the Asian shore crab, was first discovered along the coast of New Jersey, USA in 1988 and has spread northward since its introduction. These crabs are significantly less common in northern New England than in southern New England. In order to investigate potential latitudinal differences in reproductive activity, sites in northern and southern New England were monitored during 2008 and 2009. Seasonal patterns of brooding and spawning activity were found to differ between these regions. In addition, laboratory experiments were conducted to determine the effects of temperature on both reproduction and growth. Parameters measured included timing of brooding and spawning, total number of broods produced per year, timing of molt events and total seasonal growth.

Grad, Oral

The effects of biotic and abiotic factors on byssal thread production in the blue mussel, *Mytilus edulis*.

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The blue mussel, *Mytilus edulis*, is a bivalve mollusc that is found on rocky shores that are often subjected to high wave action and the resulting hydrodynamic forces of lift and drag. Mussels have adapted to life in the rocky intertidal by secreting collagenous byssal threads by which they become anchored to the substrate. The strength of byssal attachment is altered by water flow conditions, often marked by an increase in the number of threads under high flow rates (Carrington, 2002). Animal and plant epibionts often settle on mussel shells since they provide a hard substrate in the intertidal area, which might affect the growth and survival of the mussel.

Comparative field and laboratory studies were executed to assess the effects of epibionts on *M. edulis* byssal thread production along a range of flow velocities.

Grad, Poster

Differential seagrass fragment success on restored versus reference oyster reefs

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Sexual reproduction in seagrass is considered rare and colonization of new areas is accomplished via vegetative fragments. In Mosquito Lagoon, Florida previous research has shown that fragments of the seagrass *Halodule wrightii* are successful if the fragment contains an apical meristem and is retained on a suitable substrate. The outer edges of natural (reference) oyster reefs could be considered suitable substrate, however *H. wrightii* is rarely encountered there. Meanwhile, *H. wrightii* beds have begun to regularly show up along the outer edges of newly restored oyster reefs. To understand this difference, we ran field experiments with both reef types. Current oyster restoration efforts in Mosquito Lagoon involve fastening oyster shells to plastic mesh mats to provide vertical substrate for larval recruitment. We examined different methods of attachment as well as different lengths of retention between natural and restored reefs. For the attachment/retention trials, testing was done using 120 fragments per treatment on six restored and six reference reefs. On each reef we placed 20 fragments of each of three treatments: (1) fragments haphazardly dropped on reef, (2) fragments woven into mesh/clusters, and (3) fragments twisted to mesh/clusters. Monitoring was done 24 hours post-deployment, and then weekly for four weeks.

Grad, poster

Characterization and spatial distribution of the megabenthic community of the St. Lawrence Estuary

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The St. Lawrence Estuary (Eastern Canada) contains a variety of marine landscape features, a number of which lie within a portion of a protected marine park. Pressure from multiple users (e.g. transportation, fishing, whale-watching, and gas exploration) combined with early signs of eutrophication and pollution (e.g. bottom water hypoxia) increases interest in the description of its benthic communities. This study aims to describe the megabenthic community structure of the St. Lawrence Estuary and examine community links with environmental variables at diverse spatial scales. Using high resolution images from 127 stations (n = 5 each station), epibenthic organisms were identified and counted. A total of 7028 individuals were identified (51 taxa from 11 phyla). Multivariate analyses identified five different assemblages with the two most diverse found in the shallowest upstream zones of the estuary while the deepest zones located in the Laurentian Channel support the most distinctive communities marked by low species richness and a high density of *Ophiura* sp and *Amphiura* sp. Site depth and sediment characteristics partly explain the assemblage structure and diversity measures. The characterization of the benthic community at various scales will provide a valuable base for monitoring the effect of environmental fluctuations and anthropogenic pressures on benthic habitats in the estuary.

Grad, Poster

Searching for Hot Spots Under the Ice

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Climate change is affecting many arctic species, not only polar bears. Decreasing sea ice cover has an impact on the phytoplankton, zooplankton and finally on the species living on the ocean floor, the benthos. Join our group of scientists on board the research icebreaker Amundsen as we sail through the Canadian Arctic, studying critical hot spots of biodiversity on the seafloor. This research is critical to establishing a baseline understanding of these biological communities, against which we can compare future changes and adaptations. Watch us on deck as we sample seafloor organisms down to 600 meters depth. Look over our shoulder during video surveys of the seabed with a remotely-operated vehicle (ROV). Discover live samples in the shipboard lab. The Arctic is one of the last frontiers on Earth for marine research and an environment that will be most affected by climate change.

Grad, Film

Localization and antioxidant activity of flavonoid compounds in *Halophila johnsonii* and *Halophila decipiens*

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The seagrass *Halophila johnsonii* co-occurs subtidally with *Halophila decipiens* but only *H. johnsonii* occurs intertidally. *H. johnsonii* contains 15 UV-absorbing flavonoids while *H. decipiens* apparently lacks UV-absorbing compounds. Previous studies indicate flavonoids in *H. johnsonii* may have physiological roles other than UV protection. Intertidal *H. johnsonii* is exposed to variable environmental conditions compared to subtidal populations. Abiotic stresses may cause overproduction of reactive oxygen species (ROS) in plants, which can lead to cell damage. Flavonoids have been demonstrated to protect plants against increased ROS. We determined both species contain flavonoids in the outer cell wall and/or cuticle, while *H. johnsonii* also contains intracellular flavonoids. Intracellular flavonoids are better situated to perform antioxidant functions *in planta*. Flavonoid concentration and total antioxidant capacity of *H. decipiens* was compared to inter and subtidal *H. johnsonii*. Flavonoid concentration was highest in

subtidal *H. johnsonii* while antioxidant capacity was highest in *H. decipiens*. These results raise new questions regarding the function of flavonoids in these two species.

Grad, Oral

Myths and misconceptions of the shoreline protection value of coastal wetland vegetation

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Coastal wetlands provide many ecosystem services and are often extolled for their protection of coastal property from erosion and storm damage. In recent studies of the role of coastal wetlands in reducing shoreline erosion and tsunami damage, the shoreline protection value of coastal wetlands has come into question. Contrary to this finding, we find overwhelming support that mangrove and salt marsh vegetation afford protection from erosion, storm surge, and potentially even small tsunami waves. In biophysical models, field tests, and natural experiments, the presence of wetlands reduces property damage, human deaths, and wave heights in proportion to the distance of wetland traversed by storm waves. In addition to these direct effects on waves, coastal wetland vegetation modifies shorelines in ways (e.g. accretion and binding of peat and deposition of organic matter) that increase shoreline integrity (e.g. reduce erosion) over longer timescales and thus may help buffer against the threat of increased sea-level rise. We review the evidence of direct and indirect effects of coastal wetland vegetation to refute some misconceptions about wetland shoreline protection services, including Myth 1: Wetland plant structure plays a limited role in reducing wave heights, and Myth 2: Coastal wetlands do not diminish tsunami impacts. Finally, whereas man-made structures, such as jetties, have historically been used as a disruptive alternative to natural shoreline protection by wetlands, we discuss the potential for coupling man-made, nature-mimicking structures, such as oyster domes, with wetlands to enhance shoreline protection services while simultaneously restoring habitat.

Fac, Oral

Sandy shoals: Ecologically important or beach/barrier island filler?

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Sandy shoals within Louisiana's continental shelf are rare, understudied, and targeted for sandmining. Analysis of similarity (ANOSIM) of 2007 macroinfauna from Ship and Trinity/Tiger Shoals suggests unique and distinct assemblages when compared with each other and the surrounding muddy, benthic environment of the Mississippi-Atchafalaya River depositional plain (offshoal). Trinity/Tiger and the offshoal area groupings were significantly more diverse and abundant than Ship, but the biomass and taxonomic distinctiveness of Ship and Trinity/Tiger were significantly greater than the offshoal. K-dominance curves indicate suspension feeding macroinfauna dominate Ship, spring-fall, with the amphioxys (*Branchiostoma floridae*) and the amphipod (*Acanthohaustorius sp. a*) comprising ~80% of the fall community. Trinity/Tiger showed diverse functionality with a seasonal shift of dominant functional groups. Offshoal was dominated by deposit feeders/disturbance specialists, probably due to sediment dynamics and hypoxia. In addition our shoals apparently perform at least four important ecosystem functions: 1) oxygen refuge within the region of bottom water hypoxia "aka the GoM dead zone", 2) stepping stones for macroinfaunal metapopulations of the U.S. GoM continental shelf, 3) blue crab spawning ground hot spots, and 4) prey resources supporting a continuous offshore blue crab spawning cycle, April-October.

Grad, Poster

Habitat heterogeneity in a local salt marsh affects predation pressure on the periwinkle *Littoraria irrorata*

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The salt marsh periwinkle *Littoraria irrorata*, is abundant in the short *Spartina* high marsh along the Southeastern United States and part of the diet of many aquatic and terrestrial predators. The duration of these predator-prey interactions is influenced by the length of time the salt marsh is inundated. Unsuccessful predation attempts lead to scars, chips and holes on periwinkle shells. This study investigated whether the proportion of periwinkles with one or more scars and holes differed at six short *Spartina* salt marsh sites off Catalina Drive and Old Tybee Island road in Georgia. These roads run through the short *Spartina* high marsh and affect the length of time sites remain inundated. Periwinkle density, the frequency of scars and holes on periwinkles, vegetation type and height were estimated by haphazardly placing 5, 50 x 50 cm quadrats at each site. Vegetation height did not vary with type or site but vegetation type varied significantly among sites. Periwinkles with significantly higher frequencies of scars and holes were found at sites located on the side of the road exposed to tidal creeks and open waters and those with lower frequencies of damages on the side away from open waters.

Fac, poster

Restricting prey emigration underestimates trait-mediated indirect effects.

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Predator-prey interactions can be divided into consumptive effects (CE) and non-consumptive effects (NCE). Elucidating the relative importance between these two components, as well as which is more important in affecting the prey's prey (resource), is integral in understanding food web dynamics. To determine the impact of the predator on the resource either from consumption of prey (density mediated indirect effects; DMIE) or through prey anti-predator behavior (trait-mediated indirect effects; TMIE), past research has primarily been conducted in mesocosms. But, mesocosms experiments ignore one of the most basic anti-predator behaviors, emigration away from the predator. This study uses a tri trophic level food chain (toadfish – mud crab – mussel) conducted in mesocosms that did and did not allow prey emigration to measure the importance of prey movement in indirect effects. We found that CE were 4x greater in “closed” vs. “open” mesocosms. This resulted in TMIE and DMIE being equal in “closed” mesocosms but TMIE were 9x greater than DMIE in “open” mesocosms. This study is the first to measure the importance of emigration in indirect effect experiments and highlights how past studies and meta-analyses on the relative importance between TMIE and DMIE are likely underestimating TMIE.

Grad, Oral

Interactions between algae and corals on a sub-tropical reef: Effects of grazing by the sea urchin *Arbacia punctulata*

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Recent phase-shifts from coral to macroalgal dominance on reefs have been attributed to a number of factors, including eutrophication, coral mortality, and herbivore reduction. Both natural and manipulative experiments have demonstrated the importance of herbivory in controlling macroalgal abundance on coral reefs. However, the majority of these studies have been conducted on tropical reefs using a limited number of herbivorous species. The objective of this study is to determine the relationship between the herbivorous sea urchin *Arbacia punctulata*, macroalgae, and the corals *Oculina* spp. and *Astrangia* spp. on a sub-tropical reef, under both natural and experimentally manipulated conditions. For the observational study, we are quantifying urchin density in the field and photographing quadrats of the

benthic community to quantify corals, macroalgae, turf algae, and crustose coralline algae. We are also manipulating both urchin density and algae density and using photographs to classify the benthic community. We expect to find a significant negative relationship between the density of sea urchins and the percent cover of macroalgae, and a significant positive relationship between sea urchin density and the percent cover of corals.

Grad, Poster

Living in 'sympatry': coexistence through microhabitat and temporal niche partitioning

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Species specific mating calls or signals often vary among closely related species living in sympatry. Reproductive displays of bioluminescent ostracods inhabiting the corals reefs throughout the Caribbean are a dramatic example. Up to eight species conduct nightly reproductive displays over a single coral patch. Here we demonstrate how three of the most abundant species within a Caribbean patch reef habitat vary morphologically and in display characteristics, including, the timing of display initiation and the timing of peak display activity. Adult males of each of the three species are morphologically distinct based on carapace length and height, eye size and keel width. In addition to varying in direction, their bioluminescent displays differ in the duration of the pulses, timing between pulses and the interpulse distances. Although displays of the three species do overlap occasionally, each species seems to preferentially display in a separate microhabitat of the patch reef and initial display times and their peak display times are slightly offset.

Fac, Oral

Abundance, Growth, and Diet of Juvenile Summer Flounder (*Paralichthys dentatus*) and Winter Flounder (*Pseudopleuronectes americanus*) In the Seekonk River, RI and the Taunton River, MA.

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Summer flounder, *Paralichthys dentatus*, and winter flounder, *Pseudopleuronectes americanus* utilize estuaries as nursery habitat during their early life history stages. In southern New England estuaries, however, little is known regarding the spatiotemporal overlap and potential biotic interactions between the flounder species. The purpose of this research was to assess the abundance, growth, and dietary habits of juvenile summer and winter flounder to determine if predator-prey and/or competitive relationships exist. From May to September 2009, flounder in the Seekonk River (5 sites) and Taunton River (6 sites) were sampled biweekly using beach seines. Captured flounder were enumerated, measured for total length (mm), and a sub-sample was preserved for subsequent stomach content analysis. Summer flounder abundance (mean = 0.34 fish/m²) decreased significantly over time, but the abundance of winter flounder (mean = 0.15 fish/m²) remained relatively constant during the sampling period. Summer flounder grew significantly faster than winter flounder (growth rates = 0.85 and 0.25 mm/day, respectively), which may be attributed to differences in dietary habits. Decapods and fish were an important component of the summer flounder diet (52% and 4% by volume, respectively), while amphipods and nematodes were favored by winter flounder (both 37% by volume). These data suggest that competition for food resources is minimal between species. Among the identifiable fish prey in summer flounder stomachs, however, there was evidence of predation on winter flounder, albeit to a limited extent. In order to achieve a better understanding of the diets of the two species, future work will analyze fatty acids. Also, otolith studies will make it possible to more accurately determine growth rates.

Population Genetics of a New Introduction: Green Mussels in the Western Hemisphere

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The green mussel, *Perna viridis*, is native to the Indo-Pacific and has been introduced to several locations in the Caribbean and the Southeastern United States in the past two decades. The first observation in the Western Hemisphere was in Trinidad in the early 1990's with populations subsequently being observed in Venezuela, Jamaica, and the Gulf and Atlantic coasts of the United States as far north as South Carolina. Mussels were collected from both native and introduced populations in order to determine: 1) whether the introduced populations all stem from the same source population, and 2) whether introduced populations have less variation than native populations. Approximately 650 bp of the mitochondrial gene cytochrome oxidase subunit I were sequenced and compared among populations. All introduced populations had similar genetic signatures suggesting a single origin of all green mussel populations in the Caribbean and United States. Furthermore, genetic variation in the introduced populations was considerably lower than in the native populations suggesting they suffered a founder effect.

Presentation Preference: Oral

Novel Imaging Technology Provides a Unique View of Long-term Reef Decline

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Underwater landscape mosaic technology uses feature-matching algorithms to combine downward-looking still and video imagery of the reef benthos to create large scale (up to 600m²), spatially-accurate, composite image of the seabed. This survey technology provides a large-scale spatial framework for detection of reef-scale changes (from disturbances such as ship groundings and hurricanes) as well as sub-millimeter benthic resolution for assessment of coral health information (such as coral bleaching, fish predation and sponge competition). The multi-scale, single-survey approach of the mosaic technology provides an unparalleled archive from which changes to reef resources can be assessed. In association with the coral reef monitoring project at the Atlantic Undersea Test and Evaluation Center (AUTECE), landscape mosaic technology has been applied to the Navy's long-term monitoring of 10x10m reef plots at Andros Island, Bahamas. By combining species distribution information from the early 1970's with recent landscape mosaic images, we have created landscape-scale 3-D benthic change maps of Andros coral communities that depict not only the magnitude of recent declines but also spatial patterns of mortality, resilience and resistance of coral communities over the last several decades.

Grad, Oral

What is the source of the waterborne chemicals that allow coral planulae to "smell" reefs?

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In previous studies I showed that coral planulae will swim downward and begin benthic probing when exposed to waterborne chemicals present above reef surfaces. The goal of the present study was to begin identifying the source of these chemicals. Larvae of the brooding coral, *Porites astreoides*, were collected from Admiral Reef off Key Largo in May 2009. The effects of waterborne chemicals on swimming behavior were tested in 500ml graduated cylinders. Treatments consisted of artificial seawater incubated with one of the following: *P. astreoides* adults, *Montastraea faveolata*, macroalgae, coral rubble colonized by crustose corallines, a combination of all of the above, or nothing (control). Approximately 10 larvae were added to each cylinder and the vertical positions of the larvae were determined every 15 minutes for 1 hour. Significantly greater numbers of larvae were at or near the bottom of tubes containing

seawater incubated with coral rubble than any other treatment, including the combination treatment. These results suggest that water soluble chemicals present in the coralline algae-rubble matrix can act to direct coral larvae to suitable settlement surfaces, but that the ability of larvae to cue on these chemicals may be impeded in the presence of other water soluble substances.

Fac, Oral

Biofouling on recreational vessels in Trinidad and Tobago.

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The twin-island state of Trinidad and Tobago has seen a significant growth in the yachting industry over the last 30 years with numbers having increased 10-fold between 1980 to 2000. Being geographically outside of the hurricane belt, the islands offer a prime hurricane shelter in the Caribbean with excellent boating and repair facilities. The Chaguaramas coastline (Trinidad) has 7 anchorages, one of which- the Chaguaramas Bay was the selected study site. 32 recreational vessel were sampled for biofoulers. Overall, hull foulers belonged to 6 major phyla: Plantae (macroalgae), Bryozoa, Porifera, Mollusca, Crustacea, and Annelida. To date, 50 species have been identified: 25 annelids, 14 barnacles and 6 bivalves (including *Perna viridis* a known introduced species). Preliminary identifications suggest that at least 1 new species (*Megabalanus zebra*) may have been introduced to our waters via this pathway. This research has provided the first species list of macrofaunal foulers of recreational boats for Trinidad and Tobago. Additionally, the study has added to our local biodiversity data at the same it attempts to address the issue of introduced species in our waters.

Fac, Poster

Dispersal in benthic Foraminifera and dynamics of the “propagule bank”

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Benthic Foraminifera are well-known for their ability to respond rapidly to changing environments, a trait that underpins their utility in environmental and paleoenvironmental studies. This trait also reflects effective modes of dispersal and colonization. Previous studies showed that Foraminifera disperse via several mechanisms, but primarily as small juveniles (< 50 µm) or “propagules” that are easily entrained in currents and subsequently deposited. The fine sediment fraction of depositional systems therefore can contain a bank of abundant and diverse propagules, derived from both local and distant populations. To examine the dynamics of foraminiferal propagule banks from selected localities, aliquots of the fine fraction (< 53 or 63 µm) of collected sediments were exposed to a range of environmental conditions (temperature, salinity, illumination). The Foraminifera that grew over the course of the experiments included several species that do not occur as adults at the collection sites, suggesting broad patterns of dispersal by some, though not all, benthic foraminiferans. Overall, results show that the propagule bank is more diverse than the corresponding “community” of adult foraminiferans. This in turn may impart significant resilience to benthic foraminiferal associations following environmental change.

Fac, Oral

Bacterial populations in the sea anemone *Aiptasia pallida*.

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Cnidarians such as corals and sea anemones host bacterial populations that can vary when environmental conditions change. Resident bacteria may contribute nutrients, protect the host from pathogens, or otherwise contribute to cnidarian biology. In this study, we examined the bacteria in cultured specimens of the sea anemone *Aiptasia pallida*. DNA harvested from anemone tissue and from bacteria cultured on marine agar was amplified using the 16S rDNA primers 16F and 1542R. Sequence analysis was used to

identify a variety of bacterial populations, several with possible metabolic or defensive roles in anemone biology. These bacteria may play a critical role in allowing corals and anemones to adapt to new pathogens or environmental changes.

Outcome and Strength of Coral-Algal and Algal-Algal Interactions Across a Gradient of Environmental Conditions

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The strength and outcome of coral and algal interactions may be influenced by temperature, flow, and sedimentation, all of which are thought to be affected under projected climate change scenarios. We are interested in examining the fate of coral-algal and algal-algal interactions across taxa and along a gradient of environmental conditions and determining the rates and patterns of algal succession along those gradients. Initial field surveys were conducted along a gradient of sedimentation and along a gradient of both flow and sedimentation on the north shore of Moorea, French Polynesia. Transects were used to identify live coral and any interactions with coral and algae were recorded as well as total surface area and interaction perimeter. Preliminary data suggests that the effects of high sedimentation on corals is mediated by flow such that in areas of both high flow and sedimentation coral-coral interactions are more common than coral-algal, with the exception of crustose corallines. In areas where high sedimentation is not offset by flow, coral-algal and algal-algal interactions are more common as the stress of increased sedimentation reduces live coral cover. Laboratory and field manipulations will further investigate the combined effects of flow, sedimentation, and temperature on coral-algal and algal-algal interactions.

Grad, Poster

A historical and regional perspective of fish predation in the Gulf of Maine

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The extirpation of top consumers has largely altered ecological communities and ecosystem functioning globally. As recently as 20 years ago, scientists documented that top-down forcing was much higher on offshore ledges in the Gulf of Maine than in coastal waters where overfishing has greatly diminished predator populations. We revisited these sites and quantified predator communities and predation rates to evaluate whether this regional dichotomy still exists. Since many of the offshore ledges have been closed to fishing in the past 2 decades, we were also able to evaluate whether these closures are protecting and rebuilding predator populations. Quantifying ecological processes at regional scales is a necessary step towards unraveling how human impacts have altered ecosystem functioning. In addition, this study will provide baseline information that will be of value to ongoing efforts to monitor the impact of marine closures for rebuilding cod and other groundfish species throughout the Gulf of Maine.

Fac, Oral

A comparison of fish assemblages on artificial and natural reefs in the Southern California Bight

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Despite the extensive use of artificial reefs worldwide, there is currently no optimal design for artificial reefs to increase net production of fishes in an area. In order to determine how closely artificial reefs mimic nearby natural reefs, five pairs of artificial and natural reefs off the coast of Southern California were studied. Artificial reefs had greater densities and higher species richness of fishes along the benthos than found on natural reefs, but there was a trend for artificial reefs to have lower densities and lower species richness in the water column than found in the water column of natural reefs. Artificial reefs were found to be more structurally complex and taller than natural reefs; but macroalgae (including giant kelp) were more abundant on natural reefs. These differences in habitat on the two reef types likely explain the patterns of fish density and species richness observed.

Grad, Poster

Predator avoidance initiates trophic cascades in tidepool communities

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The presence of predators in communities can have cascading effects on lower trophic levels, and these cascades are often caused by changes in prey behavior rather than actual consumption of prey (trait-mediated indirect interactions, TMII). To determine if algal communities in tidepools are indirectly affected by the predatory seastar *Leptasterias hexactis* via behavioral modification of the herbivorous snail *Chlorostoma (Tegula) funebris*, we studied the 1) association of *Leptasterias*, *Tegula* and other invertebrate and macroalgal community members, 2) direct effect of *Leptasterias* addition or removal on refuge use by *Tegula* and 3) indirect effects of *Leptasterias* addition and removal on microalgae. We found a strong negative correlation between *Leptasterias* and *Tegula* density. Our manipulative experiment indicates that this relationship is causal. *Tegula* moved to a refuge habitat when *Leptasterias* was added ($p = 0.024$), and the snails colonized pools when *Leptasterias* was removed, but only when conspecifics were added first ($p = 0.008$). Therefore, an aggregative behavior may alter *Tegula* responses to *Leptasterias*, potentially altering the strength of any TMII. *Tegula* removal ($p < 0.001$) and *Leptasterias* addition ($p = 0.001$) resulted in increased diatom biomass, indicating a TMII between *Leptasterias* and microalgae.

Grad, Oral

A new hypothesized mechanism for species replacement of one invasive crab by another: behavior effects, not predation

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Negative interactions between two species of invasive crab, *Carcinus maenas* and *Hemigrapsus sanguineus*, along the US east coast have been abundantly demonstrated. The result of these interactions has been the elimination of *Carcinus* from intertidal habitats in southern portions of the invaded range. Previous work suggests that this species replacement occurred because *Hemigrapsus* consumes settling postlarvae and juvenile *Carcinus*. I demonstrate that a similar species replacement does not seem to be occurring further north within the Gulf of Maine, and that there is no evidence in the Gulf of Maine that *Hemigrapsus* is consuming *Carcinus*. Instead, the two species coexist, though with substantial negative and lopsided consequences. Specifically, *Carcinus* responds to the presence of *Hemigrapsus* by eating fewer mussels and more algae. This diet shift in turn reduces individual growth rates and reproductive effort. I use this information, together with prevailing current patterns along the east coast, to hypothesize why *Hemigrapsus* has replaced *Carcinus* as the dominant crab in Long Island Sound, but not in the Gulf of Maine.

Multiple predators enhance the magnitude and stability of prey consumption in a south eastern salt marsh

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The jury is still out on whether coexistence of multiple predator species enhances or suppresses rates of resource consumption in natural ecosystems. It is well known that interspecific interactions can produce non-additive effects of multiple predators, but such effects have rarely been compared to those resulting from intraspecific interactions, leaving the key question of whether predator species are functionally substitutable largely unanswered. In the salt marshes of Sapelo Island, GA, two species of predatory mud crab coexist and share a common prey species, the marsh periwinkle. The home ranges of both predators and prey can be incorporated within tractable 1m² wire mesh field enclosures, making this an ideal model system. After a four month experiment (using a substitutive design), both predators in combination had consumed 37% more periwinkles than expected, exceeding both monocultures in the process.

Comparisons between low and high density treatments revealed that intraspecific was stronger than interspecific negative density-dependence, helping to explain observed effects. Multiple predators also increased the temporal stability of predation rates - an effect likely underpinned by differential responses to seasonal temperature changes producing temporal complementarity, which we speculate may have contributed to alleviating interspecific competition and generating the observed positive multiple predator effect.

The mud snail, *Ilyanassa obsoleta*, facilitates growth of two bloom forming *Ulva* species through different mechanisms

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Previous studies examining the impact of grazing by the mud snail, *Ilyanassa obsoleta*, on bloom forming *Ulva* in Rhode Island indicated that mud snail grazing facilitates *Ulva* growth by removing epiphytic microalgae. However, new molecular data suggests that there are actually two (not one) morphologically similar blade-forming *Ulva* species in RI (*U. rigida* and *U. compressa*) that form blooms. Therefore, we examined the impact of *I. obsoleta* grazing on these two species to determine if both are positively impacted by *I. obsoleta* grazing, and if they are facilitated by the same mechanism. In non-choice feeding assays, the growth of both species was enhanced by the presence of *I. obsoleta*. To determine the cause of this increased growth, we investigated both *I. obsoleta* fecal nutrient input and grazing of microalgal epiphytes. We found that snail nutrient addition did not enhance *U. rigida* growth but did enhance *U. compressa* growth. In contrast, removal of the epiphytic microalgae via mechanical means resulted in significant increased growth for *U. rigida*, but not *U. compressa*. This indicates that, while the growth of both species is facilitated by *I. obsoleta* presence, the mechanism responsible for this grazing likely varies for different *Ulva* species.

Grad, Oral

Using growth cycles within the spines of the purple sea urchin *Strongylocentrotus purpuratus* to understand resource allocation.

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The cross-sections of purple sea urchin spines exhibit cyclic growth patterns that resemble tree rings. These rings form in response to breakage and repair and indicate relative habitat exposure differences. It has been shown that microhabitat (flat vs. pitted rocks) influences food consumption and allometric growth patterns of the test and demipyrmaid. Whether spine repair is independent of somatic and gonad growth remains unclear. We predicted that clipping spines in a lab setting increases the number of spine rings, but also negatively affects gonad stereological counts. We also predicted that microhabitat would

have no effect on spine rings, but would negatively affect gonad stereological counts. Sea urchins (n=44) were tagged by 24 h submersion in calcein and randomly assigned to treatments in a 2x2 factorial experiment. Clipping: none or once a month; and Microhabitat: flat or pitted sandstone surfaces. After 6 months, five spines from each individual were sectioned and rings counted. Also, one gonad lobe was fixed, mounted, thick sectioned (~5µm), and oocytes, spermatocytes, and nutritive phagocytes were quantified for gonad development. Finally, test shape and demipyramid growth allometry quantified. These results provide insight about resource allocation and life history variations in response to microhabitat differences.

Grad, Oral

Circulation in Pamlico Sound and Predicted Oyster Larval Dispersal and Connectivity.

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A critical component to understanding connectivity of spatially-separated populations of marine organisms is quantifying hydrodynamic paths of dispersal, and strength of these hydrodynamic connections. We mimicked larval dispersal of the Eastern oyster (*Crassostrea virginica*) by replicating wind-driven circulation patterns in Pamlico Sound (PS), NC using a numerical hydrodynamic model (ADCIRC, ADvanced CIRculation) to produce 3-dimensional flow-fields, followed by predicted trajectories of virtual larvae using a particle-tracking model (PTM). Predicted larval trajectories were then used to estimate a larval connectivity matrix for PS. We used velocity observations from two bottom-mounted ADCPs (Acoustic Doppler Current Profiler) to validate velocities predicted from ADCIRC and trajectories from 12 surface drifts to validate the paths of virtual larvae produced by the PTM. Both the 3D ADCIRC model and the PTM produced reliable predictions thereby providing confidence in qualitative predictions of dispersal of virtual larvae, and potential larval connectivity in PS. Potential oyster larval connectivity and potential self-recruitment for a given broodstock sanctuary varied spatially. Thus, when findings from this study are combined with the results of related studies on spatial dynamics of oyster populations in PS, there is strong evidence for an oyster metapopulation and possibly source versus sink population within PS.

Grad, Oral

Scale, Scale, Scale – The multiple levels of scale used to monitor seagrass beds in the Indian River Lagoon, FL

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Lagoon wide seagrass mapping and long-term monitoring of fixed seagrass transects are two important management tools for evaluating the health of seagrass beds in the Indian River Lagoon (IRL). Mapping occurs every 2-3 years since 1986 and semi-annual monitoring (summer-winter) of fixed transects has been ongoing since 1994. Both Lagoon-wide maps and fixed transects have the ability to reliably detect changes in aerial abundance and depth distribution. However, transects can additionally monitor species composition over time along with expansions or contractions of the total transect length -- one of the best indicators of overall bed health. Since 1994, transect lengths have been increasing (47%), with slight fluctuations due to tropical storms and hurricane activity. This upward trend mirrors the increases in total mapped acreage (27%). The percent composition of the seven seagrass species found in the IRL has remained relatively constant. *Halodule wrightii* (69%) is the dominant species, and found lagoon-wide. Other species present include *Syringodium filiforme* (15%), *Ruppia maritima* (0.5%), *Thalassia testudinum* (4%), *Halophila engelmannii* (6%), *Halophila decipiens* (2.5%), and *Halophila johnsonii* (3%).

Fac, Poster

The effects of Tropical Storm Fay on water quality and seagrass in the Indian River Lagoon, Florida.

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Tropical Storm Fay passed through the central Indian River Lagoon (IRL) from August 19 – August 21, 2008, bringing up to 25 inches of rainfall. High stream discharges reduced salinity and secchi measurements concomitant with increased water color and turbidity. Salinity and water transparency declines were prolonged in the Melbourne/Palm Bay (M/PB) region, not returning to pre-storm conditions for 7 months. Although other regions of the IRL (Sebastian and Vero Beach) experienced similar declines in salinity and water transparency, returns to pre-storm conditions were much faster (after one month post storm) due to shorter residence times. The corresponding seagrass bed changes showed a decline in the average transect length, some transects up to 60% loss, followed by an average recovery in M/PB of 50% (to 90% of pre-storm length) by summer 2009. A decline in seagrass density along the transects continues to be a problem, especially in the M/PB region that was hardest hit by both the 2004 tropical systems and 2008 Tropical Storm Fay. Extremes in freshwater inflows to the lagoon, that contribute to prolonged salinity declines, remain a threat to seagrass community structure and density. Management efforts should focus on reducing both the duration and frequency of these extremes.

FAC, Oral

Settlement of *Callinectes sapidus* Rathbun (blue crab) megalopae in the Newport River estuary

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For three months between August and November of 2008 and 2009, the nightly settlement of *C. sapidus* megalopae was monitored using three passive hog's-hair collectors suspended in the Newport River estuary (NC). Settlement was typically low, with peaks in settlement for several days throughout the season. Peaks generally corresponded with quarter-moons, indicating that megalopal ingress was greatest when the nocturnal flood tide is entirely in the dark. Settlement was compared to environmental variables using cross-correlation analysis. In both years, settlement numbers were significantly negatively correlated with tidal amplitude ($r=-0.33$ in 2008 and $r=-0.36$ in 2009). Settlement was also positively correlated with wind stress from 45° in 2008 ($r=0.25, 0.45, 0.47,$ and 0.31 at lags of 0, 1, 2, and 3 days) and from 225° in 2009 ($r=0.36, 0.30$ at lags of 0 and 1 days). The results of the study indicate that nocturnal flood tide transport and wind were important factors in determining the numbers of megalopae transported into the estuary. Total settlement was much lower in 2009 than 2008. Settlement was used to predict the success in catch per unit effort (CPUE) of the North Carolina blue crab fishery in 2010 and 2011.

UG, Poster

Analyzing a two-hundred year old nautical survey to enhance reef management in Bermuda

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Studying the history of an ecosystem provides new insight into features that currently exist and can enable policy-makers to better confront management issues. This study examined the factors that caused degradation to Bermuda's coral reefs over the past two centuries, by comparing aerial photos from 1997 to a nautical survey from 1797. The location of reef features that had been severely modified or degraded was determined by comparing the two charts. Channel dredging led to the removal of 2.24 ha of reef, much of which could have been left intact had the channels followed different paths. Dredging for the construction of the airport resulted in 2.38 km² of reef removal; 2.136 km² more than previously

estimated. A model derived from 30,000 depth markings on the chart resulted in a comprehensive map of the bathymetry of Bermuda that will be useful for 4D modeling of current flow. Despite these events, Bermuda's reefs have remained resilient since 1797. The results of this historical study will enable improved management of the reef environment.

Fac, Oral

Effects of fertilization and grazing on seagrass community structure in South Florida

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The importance of resource supply and herbivory in driving competitive interactions among species has been an important but contentious issue within ecology. These variables exhibit different effects on species competition when manipulated in isolation but interact when manipulated together. We tested the effects of nutrient addition and simulated grazing on the competitive performance of primary producers in a seagrass bed in South Florida. One square meter experimental plots were established in a mixed seagrass meadow in August 2007. The experiment was a 3 x 3 factorial experiment: 3 fertility treatments (control, med NP (0.39 g N m⁻² day⁻¹, 0.06 g P m⁻² day⁻¹) and high NP(0.77 g N m⁻² day⁻¹, 0.12 g P m⁻² day⁻¹) x 3 herbivory levels (0, 25% and 50 % biomass removal (SH)) x 3 replicates for each treatment = 45 plots). Nutrient additions and simulated grazing were done every two months. The percent cover of all primary producers per square meter was measured using a modified Braun-Blanquet method and seagrass shoots were collected and analyzed for CNP content. Initial results suggest that a) nutrient enrichment enhanced the growth of *Thalassia testudinum* and *Syringodium filiforme*, b) grazing reduced the cover of *T. testudinum* and *S. filiforme* but increased the cover of *Halodule wrightii* and c) the combination of enrichment and grazing increased *S. filiforme* and *H. wrightii* cover.

Grad, oral

High resolution temporal patterns of larval settlement: Do settlers avoid their spatial competitors?

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In coastal zones, members of the benthic hard-substrate fouling community can occupy nearly all available space on exposed surfaces. Understanding the population dynamics of these organisms requires, among other things, knowledge of the timing and quantity of settlement along with associated loss terms and interactions between settlers. Settlement plates are used extensively to measure settlement activity. Periodically retrieving these plates provides a view of settlement activity integrated throughout the sampling period. There are, however, potential losses to mortality within the sampling period that remain unaccounted for. In this study, we combined a settlement plate with an underwater camera to obtain high temporal resolution data on settlement activity as well as losses to these settlers. This information presents a more complete picture of the dynamic nature of these benthic communities. Losses to mortality or other settlement failures could be estimated, and on occasion were a substantial proportion of the daily total settlement. Spatial patterns of settlement, for those species settling in sufficient numbers for analysis, did not suggest aggregation or avoidance behavior between individuals of either the same or different species. Newly arriving settlers showed no avoidance of preexisting colonies.

Fac, Oral

Developing a Non-Invasive Technique to Measure Coral Health

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An important aspect of reef restoration is continued monitoring of coral status to ensure that restoration efforts are successful. Coral pigments have been identified as the best indicator of coral status (i.e., health). Currently, coral status is assessed in a variety of ways, however, most of these are either visual, therefore subjective, or highly invasive. There is a need for a technique to quantify coral status rapidly and non-invasively. The use of bio-optical modeling of coral pigments offers a potential solution. Terrestrial pigment literature is replete with indices and pigment ratios to assess plant status. A variety of indices and pigment ratios found in the terrestrial literature will be applied to coral spectra to determine the relationship between coral pigment concentrations and spectral signatures. Because the fundamental concept is the same (i.e., link optical spectra to plant pigment content) these indices can be applied to optimize bio-optical modeling for corals. This is important for monitoring the status of corals pre- and post-transplantations, or in restoration efforts.

Grad, Poster

Use of Least Cost Pathway to determine survivability of silver perch (*Bairdiella chrysoura*) under hypoxic conditions in the lower St. Johns River, Florida.

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The meso/polyhaline portion of the lower St. Johns River (LSJR) in Jacksonville, Florida is a habitat for all life history stages of silver perch, *Bairdiella chrysoura*, and this portion of the river undergoes seasonal hypoxia events in July and August. A multi-criteria relative least-cost path Geographic Information System (GIS) model was developed to determine the survivability of silver perch via escapement during a large scale hypoxic event. The least cost-path predicted a preferential corridor for fish movement based dissolved oxygen levels, depth and current speed. Three starting locations for fish movement were selected within the LSJR near the edge of the hypoxic zone. These starting locations represented regions of silver perch Essential Fish Habitat (EFH). Escape locations were selected outside the hypoxic zone and represented the area a fish would need to reach in order to escape the hypoxic zone. Based on calculated swimming capacities of silver perch, the least-cost path corridor model showed that silver perch had the ability to move from the starting locations to the escape locations under normoxic conditions. However, silver perch could not escape the hypoxic zone under the hypoxic conditions from any of the starting locations. Under a fast moving, large scale hypoxic event, there would be high silver perch mortality.

Using genetic markers to examine population structure of *Blackfordia virginica*

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Invasive species have become one of the leading causes of bio-diversity loss in the past few centuries. Phylogeography is a useful tool in determining movement of invasive populations, as well as in identifying cryptic species. Samples of *Blackfordia*, identified as *B. virginica*, an exotic species of hydromedusae was collected from Virginia (from where it was originally described), Delaware, San Francisco, and Brazil. In addition, *Blackfordia* sp. was found in estuaries around Lake Ponchartrain, Louisiana, where this genus has never been reported before. Mitochondrial 16S and CO1 markers were used to construct phylogenetic trees and networks to investigate population structure and potential phylogenetic divergence. Deep phylogenetic divergences are present in the data, indicating that multiple species of *Blackfordia* have been sampled. In addition, we have identified similar haplotypes from distant localities, suggesting the presence of long-range gene flow, potentially mediated by human activities.

Grad Oral

Mixed temperate and tropical reef fish assemblages on offshore hard-bottom habitats in North Carolina

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North Carolina reef fish communities near Cape Fear were sampled using SCUBA and underwater videography. Sampling spanned a 7 mo period in which 57 video filming dives were completed (30.5 h), and 34 (24.6 h) were chosen for subsequent analysis. In equivalent intervals of video data (15 min video⁻¹; 8.5 h) 68 fish species were tabulated. Rarefaction analysis estimated total species richness at 72.6. Analysis of all usable video data only detected 13 additional records of reef-associated, cryptic or pelagic species. Richness by site ranged from 10 – 26 (n = 34; mean 18.9, SD 4.2). Only *Haemulon aurolineatum* was detected at all sites. Other common species included *H. plumieri* (0.971 frequency of occurrence), *Mycteroperca phenax* (0.941), *Holacanthus bermudensis* (0.882), *Calamus nodosus* (0.794), and *Diplodus holbrookii* (0.765) at hard-bottom sites. Abundance estimates revealed that *Decapterus* spp. (0.528 proportion of total individuals) and *H. aurolineatum* (0.324) made up the majority of the individuals. Mean Bray-Curtis dissimilarity between paired sites was 0.339 (0.219 SD) indicating a substantial overlap in species composition between most sites. Ongoing analyses include diversity comparisons and cluster analyses to illuminate species composition changes associated with differences in video capture methodology and other variables.

UG, Poster

Relationships between oyster species (*Crassostrea virginica* vs. *C. ariakensis*) and habitat utilization by reef-associated fauna in Chesapeake Bay.

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Despite extensive recent consideration of the introduction to Chesapeake Bay of the Suminoe oyster, *Crassostrea ariakensis*, its morphology and reef-forming capability remained poorly described. Previous studies of the Eastern oyster, *Crassostrea virginica*, indicate that reef morphology affects the development of reef-associated communities. If *C. virginica* and *C. ariakensis* differ in reef morphology and habitat complexity, the communities they support may also differ. Triploid oysters (*C. virginica* only; *C. ariakensis* only; 1:1 mix of species) were used to create experimental reefs at four locations surrounding Chesapeake Bay and investigated over a 2-year period to compare habitat complexity and associated faunal assemblages. Reef-associated fauna were evaluated in relation to oyster species, habitat complexity, season, location, and reef maturity. Spatial comparisons revealed that changes in faunal assemblages and habitat complexity were more pronounced between sites than within sites. In comparison to *C. ariakensis* reefs, *C. virginica* reefs supported higher abundances of over 20 species of associated fauna per unit of oyster biomass. Multivariate analyses revealed that reefs containing both oyster species most often supported communities similar to those of *C. ariakensis* reefs, particularly in subtidal areas of higher salinity. Temporally, community structure varied with increasing habitat complexity and reef maturity, independent of season.

Grad, Oral

Adaptive amputation, what is a slug to do?

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Defenses of seaweeds, counter-measures of herbivores, and how these structure seaweed-herbivore interactions are well-studied for interactions involving generalist herbivores, but poorly known for specialist herbivores and their seaweed hosts. The chloroplast sequestering sea slug *Elysia tuca* lives on and feeds from *Halimeda incrassata*. In both lab and field assays it selects this host over others and selects reproductive over vegetative individuals, despite reproductive individuals living for only 36h. The slugs must therefore rapidly find preferred hosts. Bioassay guided separations demonstrate that tracking is chemically-mediated and cued by 4-hydroxybenzoic acid (4-HBA). In the field, slugs tracked to cloths treated with 4-HBA or to individual *H. incrassata* plants treated with additional 4-HBA. Slug feeding harmed hosts. Plants hosting 1-3 slugs grew ~1/2 as fast as those without slugs, suggesting that there should be strong selection to deter these consumers despite their resistance to host chemical defenses. *Halimeda* selectively amputates branches on which slugs are feeding, and slugs selectively emigrate from plants occupied by conspecifics, possibly as a way of minimizing the signals cueing this amputation response. These patterns indicate that even low-density, low-feeding rate specialist herbivores select for the evolution of traits to suppress these consumers.

Fac, Oral

The presence and fate of pharmaceuticals and personal care products (PPCPs) in wastewater and Charleston Harbor, South Carolina.

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PPCPs include over-the-counter, prescription, and veterinary drugs, as well as chemicals found in cosmetics and common household products. These chemicals may be introduced into aquatic environments by non-point and point sources including domestic wastewater treatment plant effluents. Beginning in March 2009, we examined monthly chemical concentrations of 21 PPCPs in influent and effluent collected from two local wastewater treatment facilities, as well as surface water samples collected near treated effluent discharges in Charleston Harbor. The presence of PPCPs in aquatic environments creates possible risks for health impacts on marine organisms; thus, a select number of compounds were used in an acute exposure screen for potential effects on gill tissue respiration of the Eastern oyster (*Crassostrea virginica*). Preliminary results suggest clear differences in PPCP concentrations among influent and effluent samples. Sampling and analysis will continue through March 2010. This study aims to assess overall seasonal and regional trends in presence/concentrations of PPCPs and removal efficiencies of the wastewater treatment process. Upon completion, this study will be critical in understanding the efficacy of wastewater treatment on PPCPs, the local distribution of PPCPs in estuarine waters, and will help to shed light on important environmental questions concerning PPCP distribution in the marine environment.

Grad, Poster

The *Tegula tango*: a co-evolutionary dance of interacting, positively selected sperm and egg proteins

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Reproductive isolation can evolve between free-spawning species when proteins borne on the surface of gametes diverge. Here, I report on patterns of co-evolution between lysin, a sperm protein, and VERL, the egg's Vitelline Envelope Receptor for Lysin. The VERL from *Tegula funebris* (an intertidal gastropod) possesses a single domain of about 150 amino acids at its N-terminus implicated in

interactions with lysin. Interspecific comparisons show that both lysin and the portion of the egg-borne protein VERL to which lysin binds diverge rapidly (at rates up 10 times faster than for mtDNA) via strong positive selection while the ZP domain of VERL (with no recognition role) evolves neutrally. Rates of nonsynonymous substitution are correlated between lysin and the VERL recognition domain, but the relative number of changes to the male and female proteins varies among lineages, ranging from three-fold faster for males in one to near equity in another. Thus, while sexual antagonism appears to drive the interspecific divergence of these gamete recognition proteins, neither sex maintains a fixed lead in this co-evolutionary dance.

Fac, Oral

A Genetic Perspective of Florida's Threatened Staghorn Corals (*Acropora cervicornis*)

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The Caribbean Acroporid corals, which have historically played an important role as reef-builders, have suffered massive declines over the past three decades and are a priority for conservation. Recent genetic research indicates Caribbean-wide population structure in the two major species, *Acropora cervicornis* and *A. palmata*. These sister taxa are known to hybridize and exchange genes unidirectionally, from *A. palmata* to *A. cervicornis*, thus complicating population genetic analyses of *A. cervicornis*. Using an 814bp mtDNA fragment, we evaluated the genetic diversity of 52 *A. cervicornis* individuals from 22 sites in the Florida Keys. We also compared the Florida samples to a Caribbean-wide dataset to understand patterns of genetic connectivity. Results for Florida Keys samples indicate high rates of introgression, low population structure and high genetic diversity. Recruitment of *A. cervicornis* to Florida from elsewhere in the Caribbean appears low, and high regional population structure reveals Caribbean-wide migration rates below 4 individuals/generation. However, shared derived haplotypes between Florida and the Western Caribbean suggest historical gene flow did occur between these populations. Due to low ongoing rates of gene flow between Florida and elsewhere in the Caribbean, conservation efforts should focus on managing populations locally rather than rely on larval input from distant source populations.

Grad, Oral

Blue Crab *Callinectes sapidus* predation on the Bay Scallop *Argopecten irradians concentricus*: effects of predator size, prey size, and habitat complexity

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In laboratory mesocosm experiments, we assessed the survival of bay scallops *Argopecten irradians concentricus* as a function of female blue crab *Callinectes sapidus* predation as it varied among treatments of habitat type (oyster shell, sand, macroalgae), predator size (>140 mm, ≤ 140 mm carapace width) and prey size (10-20 mm, 21-30 mm, 31-40 mm, 41-50 mm shell height). A balanced two-by-three factorial experimental design was used to evaluate the probability of scallop survival. A two-way ANOVA demonstrated a significant difference in the proportion of scallops surviving by habitat treatment and predator size. Large female crabs exerted greater predation pressure on scallops of all size categories compared to smaller females, whereas oyster shell habitat provided the highest degree of structural refuge from crab predation. Differences in predation as a function of predator size may be attributed to differences in claw strength and crushing capabilities of the two size groups. Differences in survival among habitats may be a function of increasing habitat complexity and structural refuge. These results suggest that blue crab predation may be a deterrent to scallop restoration efforts, particularly in habitats without sufficient structural refuge.

Grad, Oral

Structural heterogeneity in source-sink marine communities

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Community ecology focuses on understanding the mechanisms that drive patterns of diversity, with emphasis on conservation efforts that maintain species abundance and distribution. As habitats become fragmented or destroyed, the spatial distribution and physical characteristics of habitats will play an important role in community dynamics. Source-sink relationships are controlled by mechanisms that change based on the dispersal strategies of the individual species. A habitat may become a source or sink population based on the combination of abiotic factors and coexisting species. However, a community does not necessarily behave as a source or a sink for all the species present. The occurrence of multiple dispersal strategies and life histories within a community creates the opportunity for heterogeneity to drive species' abundance patterns and alter species distribution. In the northern Gulf of Mexico, we explored the effects of structural heterogeneity on the diversity of shallow-water benthic species. PVC tiles were used to form 10x10 cm² communities, and we used community age as a surrogate for the establishment of sources and sinks. Tiles were paired in close proximity at different levels of heterogeneity. Here, we report the response of populations' sources and sinks to heterogeneity, and its effect on overall tile diversity.

UG, Oral

Cordgrass die-off in Cape Cod salt marshes leads to loss of important ecosystem services.

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The ecosystem services provided by salt marshes on Cape Cod, Massachusetts are being degraded by consumer-driven salt marsh die-off which results in extensive loss of the foundation species *Spartina alterniflora* (cordgrass). These services include carbon storage, nursery habitat provision, and buffering against storm damage. We conducted ground surveys at fourteen Cape Cod salt marshes to quantify the extent of die-off, cordgrass biomass, and sediment dynamics, and then used aerial images and ArcGIS software to scale these data to site-specific estimates of how die-off is altering the ability of marshes to provide ecosystem services. We found that die-off is present at more than 70% of our study sites, particularly those associated with localized fishing pressure which is triggering marsh die-off. Over 90% of creek banks are affected by die-off in the most severely degraded marshes. This runaway consumption of marsh vegetation has resulted in dramatic biomass loss, lower rates of sediment deposition, and retreat of the shoreline. These results indicate that die-off has not only impeded the ability of marshes to provide critical ecosystem services but has also overwhelmed mechanisms of their resilience.

UG, Oral

Seasonal dynamics of meroplankton assemblages in the Western English Channel

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Zooplankton data from 20 years of weekly sampling were used to determine inter- and intra-annual patterns of meroplankton community change at Station L4, off the coast of Plymouth, UK. From these data, abundances were calculated for five groups; Cirripedia, Decapoda, Polychaeta, Echinodermata, and Lamellibranchiata. This taxonomic level of analysis was chosen to minimise the potential effects of variation in taxonomic expertise over the 20-year period. Despite some annual variability, analyses showed that seasonal variation accounts for the major changes in the meroplanktonic community

composition throughout the time-series. Cirripedia are the most abundant meroplankton in March and April, followed by Echinodermata in August, and Lamellibranchiata in September and October. Abundance is low during the winter period. The average monthly contribution of the meroplankton community as a percentage of the total zooplankton abundance is highest in spring, when meroplankton (predominantly Cirripedia) can account for up to 42.5% following spawning events linked to phytoplankton blooms. Little evidence was found for any major trends of change in the meroplankton community at Station L4 over the 20-year period. Molecular techniques are being used to attempt a higher level of taxonomic discrimination which should allow a finer picture of annual and seasonal variation to be generated.

Evaluating Coral Gardening Success for the Caribbean coral *Acropora cervicornis*.

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For the past 5 years, Counterpart International's Coral Gardens Program has utilized low-tech, cost-effective fragmentation and transplanting methodologies to restore degraded reef ecosystems. As part of a formal evaluation of this program, staghorn coral (*Acropora cervicornis*) nurseries were surveyed in 2009 in Punta Cana, Dominican Republic and Utila, Honduras. A census of each coral nursery site was conducted to determine the number, size, and condition of staghorn fragments/colonies present. In addition, sources of coral mortality, such as nursery frame failure, diseases, predator impacts, macroalgal overgrowth, or anchor and storm damage, were evaluated. Lastly, an outplanting experiment was conducted at each site to evaluate the cost and efficacy of different fragment outplanting methods. The ability of the Coral Gardens sites to sustain vigorous fragment growth with low-tech and cost-efficient methods has been clearly demonstrated by our assessments. Over the past 5 years, the staghorn nurseries at Punta Cana and Utila have provided a consistent source of fragments that have been used effectively to restore staghorn populations on depleted reefs. These assessments provide key information that highlights that coral gardening is a viable and effective methodology for the propagation and restoration of staghorn populations in the Caribbean region.

UG, Oral

Can blue crabs positively affect oyster reef stability? The non-consumptive effects (NCEs) of blue crabs on mud crabs and its implications for reef resilience

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In recent decades, both oyster and blue crab populations have suffered significant declines often attributed to coastal development and overfishing. However, less is known about how biotic species interactions affect the stability and resilience of oyster reef communities. Our research examines how blue crabs and their traits (e.g. size and diet) may positively affect oyster populations by suppressing the foraging activity of mud crabs through NCEs. Predation experiments between mud crabs and blue crabs demonstrate that blue crabs are effective predators on mud crabs and that predation levels are dependent on both predator size and habitat complexity. Additionally, mesocosm experiments with caged blue crabs establish that blue crabs have a non-consumptive effect on mud crabs and suppress both their presence on oyster reefs and their oyster consumption. The magnitude of this effect is a function of blue crab size (large predators produce the largest NCEs), and predator diet, whereby a diet of crushed conspecifics elicits the greatest response from mud crabs. Long term field experiments are examining the effects of both mud crabs and blue crabs on oyster recruitment and survival. The results of these experiments have consequences for understanding both NCEs and reef resilience.

Grad, Oral

Defensive decisions: Trade-offs in physical and chemical defenses of Caribbean non-scleractinian zoantharians

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Trade-offs due to resource allocation play an important role in ecological theory. Evolution should drive resource-limited organisms to spend those resources as efficiently as possible. Non-scleractinian zoantharians (sea anemones, zoanths, and corallimorphs) provide an excellent group for exploring resource allocation trade-offs because of the varying defensive strategies they employ. While many cnidarians rely on cnides (nematocysts) as a physical mechanism for deterring predation, some lack them and rely instead on chemical defenses. The degree to which physical and chemical defenses are employed by non-scleractinian zoantharians remains largely unexplored. Crude organic extracts from tissue samples were tested for chemical defenses using feeding assays with the generalist consumer *Thalassoma bifasciatum*, the bluehead wrasse. Novel behavioral assays were developed that categorize defensive effects of nematocysts on brine shrimp (*Artemia* sp.). Preliminary data indicate that while clear differences have been demonstrated in the defensive effects of nematocysts, most non-scleractinian zoantharians lack chemical defenses. These results suggest that chemical defenses may not vary inversely with nematocyst defenses in these animals.

Grad, Oral

Sedimentary nitrogen removal in the Cape Fear River Estuary: Spatial and temporal variation of Anammox and Denitrification

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The Cape Fear River Estuary (CFRE) is heavily impacted from agricultural and industrial nitrogen inputs. Sedimentary microbial processes are important for N transformations because photosynthetic primary producers are light-limited due to high amounts of CDOM. Anaerobic ammonium oxidation (anammox) and denitrification are two microbial processes capable of removing N by conversion into a gaseous species. Anammox and denitrification are known to occur in anoxic sediments of the CFRE, yet little is known about the spatial and temporal variations of their rates throughout the estuary. In order to address overall N removal capacity of the CFRE, we collected sediments across transects at fifteen stations along the estuary. ¹⁵N stable isotope incubations were conducted *in vitro* and samples were analyzed on an Isotope Ratio Mass Spectrometer. Denitrification was found to be the dominant process in all samples analyzed, with anammox accounting for about 3 to 10% of N removal. In the freshwater end of the estuary, a clear pattern was seen with higher N removal on the banks than in the channel, yet this was not the case throughout the entire estuary. In fact, the sediment samples with the highest activities were collected in the channel at Marker 61, adjacent to the shipyard serving the Port of Wilmington.

Grad, Oral

Nocturnal migration patterns of two Caribbean reef fishes, *Haemulon sciurus* and *Lutjanus apodus*

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Some coral reef associated fishes have been observed making diel migrations between resting and foraging habitats. Additionally, gut content analyses of *Haemulids* and *Lutjanids*, at varying ontogenetic stages have provided evidence that some species forage in seagrass beds near their coral reef refuges. However, studies rarely examine diel movement data with quantitative assessment techniques. In this study, I used manual acoustic telemetry to track adult *Haemulon sciurus* (n=6) and *Lutjanus apodus* (n=6) individuals over 24 hours and used Geographical Information System (GIS) tools to map diurnal activity

spaces (DAS) and nocturnal activity spaces (NAS). I also calculated DAS/NAS areas, distances between DAS and NAS, and percentages of overlap. Results demonstrated that greater than 50% of the *H. sciurus* and *L. apodus* tracked performed nocturnal migrations. Furthermore, DAS and NAS areas were highly variable; nevertheless, NAS were larger than DAS in all but one individual (*H. sciurus*) suggesting diurnal resting and nocturnal foraging. *H. sciurus* and *L. apodus* had individuals that traveled distances greater than 400 m between activity spaces and in some cases both activity spaces overlapped. This study represents the first attempt to quantify migration behaviors of adult *H. sciurus* and *L. apodus* using GIS and acoustic telemetry data.

Grad, Poster

Diel and lunar changes in cryptochrome (*cry1* and *cry2*) transcript abundances in the brooding coral *Favia fragum*

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Diel and lunar illumination cycles provide well-described environmental cues thought to synchronize biologically important events in *scleractinian* corals, including diel tentacle extension/retraction and reproductive cycles timed to specific lunar phases. Recent evidence showed that cryptochrome gene transcripts, which code for blue light-sensing photoreceptors known to play a role in regulation of diel rhythms, were up regulated during a seasonal broadcast spawning event in the coral *Acropora millepora*. This finding suggests that these photoreceptors may play a role in synchronizing coral spawning events with the lunar cycle. We are using QRT-PCR and histological methods to investigate the correlation between cryptochrome transcript abundance and key reproductive events, including gametogenesis and planulation, in the lunar reproductive cycle of the Caribbean stony coral *Favia fragum*. We have confirmed that these corals express two cryptochrome genes (*cry1* and *cry2*) along with other genes involved in regulation of the circadian cycle in other organisms (*clock* and *bm11*). Both *cry1* and *cry2* fluctuated significantly throughout the diel cycle. Understanding how expression of these genes correlates with diel and monthly biological events in *F. fragum* promises to increase our knowledge of the molecular mechanisms that entrain stony corals and other invertebrates to environmental cues.

Grad, Oral

Oceanographic gradients drive predictable spatial variation in recruitment, predation and community structure in southeastern US salt marshes

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Understanding the mechanisms that mediate the distribution, abundance and diversity of species is a central goal of ecology. Variation in recruitment and environmental conditions are known to influence community composition, but have rarely been investigated simultaneously to evaluate their relative importance in generating ecosystem-wide patterns in community structure. Across the Duplin Sound in southeastern Georgia USA, we evaluated the effects of distance from ocean (barrier island, mid-, and inner-estuary) and salt marsh elevation (high and low zones) on recruitment of common invertebrates, and assessed whether habitat quality and predation intensity co-vary with these main factors. Surveys of adult invertebrates and 2- year recruitment study across 32 sites revealed that the density and recruitment of invertebrates are significantly higher on barrier island than mid- and interior estuary marshes, and vary with species identity across zones. Manipulative field experiments indicate predation is similarly high throughout the estuary, but locally elevated in low marsh zones. These findings suggest that recruitment is high enough on barrier islands to outpace predation, resulting in diverse, abundant adult invertebrate communities, but not in mid- or interior estuary sites where local variation in larval delivery, predation, and habitat quality interact to determine community structure.

Grad, Oral

The use of nursery-grown coral transplants as an ecological engineering instrument for coral reef restoration

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Coral reefs are experiencing a worldwide degradation due to anthropogenic activities and human-amplified global changes. Since traditional rehabilitation methods are ineffective, active restoration has now become the prime mean to cope with the rapid degradation. We tested the “gardening coral reefs” concept, a new method inspired from silviculture guidelines. This two step methodology is based on the generation and farming of large stocks of new coral colonies in *in situ* nurseries prior to their transplantation into degraded reefs.

Nursery-grown coral colonies of seven branching forms were transplanted on a degraded zone of Eilat’s Reef (Red Sea, Israel) in three stages (November 2005, May 2007, September 2008). The farmed transplants showed low mortality rates and the new ecological and spatial niches resulting from their autogenic engineering characteristics were immediately colonized by coral-obligatory invertebrates. When monitoring influences on local fish community we witnessed an increase in the habitat’s carrying capacity, reflected by higher fish abundance. Transplanted *S. pistillata* colonies showed improved reproductive efforts >3 years following transplantation, as compared to residing colonies. Thus, the farmed transplants are not only reinforcing the local coral community but are also enhancing natural reef resilience by contributing to the larval pool.

Grad, Oral

Marine habitat structure and predator-prey interactions: using an individual-based, spatially explicit model to quantify seagrass nursery habitat effectiveness

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The effects of habitat fragmentation on ecological processes has been the topic of much study over the past several decades, with most research focusing on terrestrial systems, even though many marine habitats are patchy. Our knowledge of these effects is limited in part by the confounding effects of habitat structure at fine scales (i.e. structural complexity) and structure at landscape scales. Moreover, most of the empirical studies done on predator-prey interactions have been performed with immobilized or sedentary prey that are unable to interact with predators and with habitat structure as they would in a non-experimental setting. In seagrass habitats, juvenile fishes serve as mesopredators that must forage for prey and avoid predators in a structurally variable environment. We used sampling and a suite of laboratory and field behavioral experiments to parameterize an individual-based, spatially explicit model that predicts how seagrass habitat structure at multiple scales influences mesopredator population dynamics. Mesopredator per capita survival and population size depended strongly on the influence of seagrass habitat structure on predator detection and distances moved when fleeing from predators. Because these factors cannot be incorporated into tethering experiments, future studies on predator-prey interactions in seagrass habitat should incorporate behavior at multiple trophic levels.

fac, oral

Shelter choice of adult Asian shore crab *Hemigrapsus sanguineus* in the intertidal zone in Long Island Sound.

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Interspecific and intraspecific species interactions are important for shelter choice of invading decapods. The Asian shore crab, *Hemigrapsus sanguineus*, has been shown to interact with fiddler crabs (*Uca spp.*) in marsh burrows and exhibits considerable site infidelity between tidal cycles. As shelter is important for a myriad of reasons, we investigated the effects of conspecific and heterospecific presence on adult

recruitment over a 24 hour deployment. Findings indicate *H. sanguineus* avoids male conspecifics and both male and female European green crabs, *Carcinus maenas*. Additionally, *C. maenas* was found in higher numbers subtidally, with lesser *H. sanguineus* use of shelter in the subtidal.

Grad, Poster

Importance of multi-level symbioses: sea anemones as visual cues in anemoneshrimp cleaning of fish clients on Caribbean coral reefs

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Cascade effects in multi-level symbioses are poorly understood. Most mutualisms likely involve multiple species rather than the traditional two-species model, and some have effects that radiate out to impact entire communities. On coral reefs, some giant sea anemones host endosymbiotic zooxanthellae, as well as ectosymbiotic shrimps and fishes. Some anemoneshrimps clean parasites off client fishes, making this a symbiotic complex of at least five levels with radiating indirect effects. We examined the importance of the sea anemone host *Bartholomea annulata* to the cleaning mutualism between the anemoneshrimp *Periclimenes pedersoni* and client fishes on Caribbean coral reefs at St. Thomas, USVI. The shrimps cleaned members of at least 14 families of reef fishes, at high daily rates. We conducted a field experiment in which we manipulated the visibility of anemones and shrimps using mesh covers. Fish posed at cleaning stations where shrimps were covered and anemones visible, but not vice versa, indicating that anemones serve as the visual stimulus for fish to pose for cleaning interactions. We thus need to modify the definition of cleaning interactions as two-species symbioses, to include in some cases a third species: the anemone host which serves as the visual stimulus for fish posing behavior.

Grad, Oral

Genotypic diversity and grazer identity interactively influence seagrass and grazer biomass

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Despite experimental evidence that both producer and consumer diversity can impact population and community processes, little is known about how diversity at these multiple trophic levels may interact. We conducted a mesocosm experiment to examine the independent and interactive effects of seagrass (*Zostera marina*) genotypic diversity and grazer species diversity on seagrass, epiphyte, and grazer responses. There were no interactions between seagrass genotypic diversity and grazer species diversity, per se; however, the effects of seagrass genotypic diversity on both seagrass and grazer biomass depended on grazer species identity. In particular, seagrass biomass was higher in genotypic polyculture than in monoculture, but only when the sea hare *Phyllaplysia taylori* was the only grazer present. Seagrass genotypic diversity effects on grazer biomass and fecundity were small and/or idiosyncratic, yet grazer species composition had a large impact on grazer reproductive effort. Only grazer species identity, and not seagrass genotypic diversity or grazer species diversity, affected epiphyte biomass. Our results confirm the effects of seagrass genetic diversity on the plant itself as well as the grazer species that utilize it for both food and habitat. Furthermore, they emphasize the importance of grazers for controlling epiphyte and seagrass biomass.

Fac, Oral

Toxicity of the water-soluble fraction of two-cycle engine oil to post-settlement juvenile stone crabs *Menippe mercenaria*

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The stone crab, *Menippe mercenaria* is a common marine invertebrate predator that supports one of the ten most valuable marine fisheries in the state of Florida. The post-settlement juvenile life stage

(metamorphosis to 10 mm carapace width) of this species is important because the first year of over-wintering occurs in this stage. In our experiment, acute toxicity of the water-soluble fraction (WSF) of two-cycle engine oil to post-settlement juvenile stone crabs (carapace width = 6.1 mm, SD = 0.6) was examined. Crabs were exposed to eight different treatment concentrations [100, 90, 75, 50, 20, 10, 5% of WSF of oil and a 0% (control)]. The crabs were in the test solutions for 96 hours and were inspected every twelve hours throughout that period. Deaths were recorded at each inspection. Highest death of 32%, occurred at 100% of WSF of oil, and the lowest death of 0% occurred at 0% and 5% of WSF of oil. The only poly-nuclear aromatic hydrocarbons detected in the WSF by Gas Chromatography-Mass Spectrometry were 1-Methynaphthalene and 2-Methynaphthalene. Sub-lethal and chronic effects of exposure of post-settlement *M. mercenaria* to two-cycle motor oil WSF are possible future investigations. Fac, oral

Positive effects of shrimp occupancy on sponge growth and mortality

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Sponge-dwelling snapping shrimps (genus *Synalpheus*) are one of the most diverse groups of crustaceans on Caribbean coral reefs, and live primarily in the interior canals of sponges. Sponges provide habitat and food for their shrimp inhabitants, but it is unknown whether shrimp have any effects (positive or negative) on their hosts. In this study, we used laboratory and field experiments to assess the influence of shrimp occupancy (*Synalpheus* spp.) on the growth and mortality of their sponge host (*Lissodendoryx colombiensis*). We experimentally removed shrimp from paired sponge replicates (two pieces of the same individual sponge) and allowed shrimp to recolonize one member of each pair. We grew paired sponge replicates (in the field and laboratory) and also exposed sponge replicates to predation by the seastar *Oreaster reticulatus* (laboratory). Laboratory growth experiments demonstrated that *Synalpheus* occupancy had small (but significant) positive effects on sponge growth, although there were no significant effects of shrimp occupancy on sponge growth in the field. In laboratory predation trials, unoccupied sponge pieces suffered significantly greater mortality from seastar predators than occupied sponges. Our data suggest shrimp occupancy has some positive effects on sponge growth and mortality, with important implications for understanding how this unique relationship evolved.

Fac, oral

New contributions from landscape ecology to improve marine reserve assessment, placement and management

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While studies of habitat heterogeneity at multiple scales are common in terrestrial ecology, comparably few studies of marine systems have considered the interactions between spatial heterogeneity and ecological processes. Here, we use a landscape ecology approach to quantifying multi-scale metrics of habitat configuration, composition, and structure in coral reef habitats. Landscape metrics were measured using a combination of remote sensing, spatial image analysis and *in situ* surveys at over 80 patch reef sites in Glover's Reef Lagoon, Belize, within and outside the boundaries of a no-take marine reserve enforced since 1998. By relating features of reef habitat heterogeneity to distributions and abundances of reef fishes and corals, we demonstrate the application of a landscape framework to: (1) improve our ability to distinguish marine reserve effects from natural variability across the seascape; (2) guide reserve placement and design; and (3) further our understanding of the influences of landscape structure on the coral community.

Grad, Oral

Spatial distribution patterns in echinoderms in nearshore rocky shores

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The existence of large-scale patterns in diversity and abundance of echinoderms was examined. Echinoderms were collected in inter- and subtidal nearshore rocky shores using standardized protocols developed by the NaGISA project within the Census of Marine Life Program. Contrary to typically assumed latitudinal clines in species richness, taxon richness increased with increasing latitude, especially in the intertidal, even though overall correlations were relatively weak. This trend did not extend into the high Arctic or Antarctic. In addition, a slight decline in taxon richness and abundance occurred from western to eastern longitudes. From a set of 16 environmental drivers, latitude, longitude, acidification and sea surface temperature contributed most to explaining echinoderm community patterns. Dominance of various echinoderm classes differed strongly with depth and geographic region. While none of the drivers showed very strong correlation to echinoderm distribution patterns, this is the first study showing any large-scale patterns for this ecologically important group.

Fac, Oral

Guild structure and microhabitat partitioning among shrimps symbiotic with giant sea anemones on Caribbean coral reefs

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Microhabitat partitioning allows guild members to utilize similar resources by reducing overlap and competition, but is not well understood for species that occupy symbiotic hosts. Four obligate shrimps associate with the corkscrew anemone *Bartholomea annulata* on Caribbean coral reefs, and at least one of them, *Periclimenes pedersoni*, serves an important ecological role as a cleaner of fish parasites. We quantified anemone shrimp populations on marked individuals of *B. annulata* at 2 coral reef sites on St. Thomas, USVI, each 3-6 months for 3 years. Consistent patterns emerged of the distribution and abundance of shrimp guild members over space and time. Congeneric shrimps co-occurred less than predicted on individual anemones, and also partitioned microhabitat use: the spotted shrimp *P. yucatanicus* usually occurred in the center of anemone tentacle crowns, while the cleaner shrimp *P. pedersoni* occupied the tentacle tips or areas around the edges of anemones. The pistol shrimp *Alpheus armatus* created sandy burrows at the base of the anemone column, and the mysid shrimp *Heteromysis actinae* formed swarms among the inner tentacles. We conclude that each crustacean associate utilizes a different microhabitat on the body of the host, with little spatial overlap, and that they also may segregate food resources.

Grad, poster

Assessing the synergistic effects of ship noise and structure on cortisol levels in winter flounder, *Pseudopleuronectes americanus*

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Urban oceans are commonplace and unavoidable, yet our understanding of how different urban stressors impact ocean residents is limited. The ocean acoustic environment, for example, may elicit both chronic and acute stress, but to date has been largely ignored with the notable exception of cetacean biology. Offshore Liquid Natural Gas (LNG) terminals are being increasingly established to offset onshore energy demands. LNG ports may provide a benefit to local fish populations if they act as Fish Aggregation Devices and are restricted from fishing activities. However, the presence of LNG tankers may create an

acoustically-stressful environment that may detract from the potential benefit of structure. Here, we explore the synergistic effects of ship noise (SN) and benthic structure (SB) in the Northwestern Atlantic habitat using winter flounder, *Pseudopleuronectes americanus*. We conducted a fully factorial experiment examining the effects and interactions of SB and SN, analyzing plasma cortisol levels with a radioimmunoassay. Results demonstrated a trend of increased cortisol levels in sound treatments with no structure, which was predicted to be the most stressful situation for flounder. Prolonged, chronic increases in cortisol may result in long term energy tradeoffs, where energy must be allocated to stress-management instead of growth or reproduction.

Grad, Oral

Environmental Forcing of American Lobster (*Homarus americanus*) Settlement: Role of temperature and wind

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The past twenty years of data on annual American lobster (*Homarus americanus*) settlement show immense spatial and temporal variability. Temperature and surface winds affect lobster larval transport and supply to inshore nursery grounds. This study statistically tests the link between lobster settlement and environmental variables such as sea surface temperature (SST) and wind. Spatial correlations between annual American lobster settlement at three oceanographically distinct sites and monthly satellite SST averages found over the Gulf of Maine and neighboring shelf areas were negatively time-lagged to include the period of settlement, larval transport and hatching. Results highlight areas that may be oceanographically important to lobster larval supply and transport. We hypothesize that these patterns of spatial correlations may result from processes that regulate the location of egg bearing female lobsters during hatching or the transport of larvae to shallow coastal nurseries. These hypotheses will be tested using state and federal fishery-dependent data on the distribution and abundance of egg-bearing lobsters and available NOAA buoy records of bottom temperature and NASA satellite wind data. The results of this work will contribute to the application of environmental satellite data in a coupled biophysical model of lobster larval transport and population connectivity.

Grad, Oral

Epifaunal assemblages associated with the native *Chondrus crispus* (Stackhouse) and the non-native *Grateloupia turuturu* (Yamada) in eastern Long Island Sound.

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Although the spread of invasive algae is rapidly escalating, relatively little ecological studies have been done to gauge the impacts incurred to native flora and fauna. A reduction in the dominance of a native habitat-forming species due to the replacement by an introduced species can have adverse effects on the associated epifaunal. The non-native red alga *Grateloupia turuturu*, first reported in Rhode Island, USA in 1994, has recently spread into eastern Long Island Sound. This alga, due to its morphology and opportunistic ability has the potential to impact benthic communities by altering the floristic composition important to the associated invertebrates. A comparison of epifaunal assemblages was made during 2006 and 2007 between competing native and non-native algal communities dominated by either *G. turuturu* or the native, *Chondrus crispus*. Results indicate that habitat dominated by the non-native alga had negative impacts on the epifaunal assemblages as a whole by reducing species richness and total abundance of invertebrates as well as decreases in overall biomass of habitat-forming macrophytes at different temporal scales. Seven dominant mesofaunal species were further examined and shown to be greatly affected by the differences in each of the dominant algal species during periods of typical high abundance.

Fac Oral

Costs and benefits of alternative morphologies and population variation in phenotypic plasticity of the barnacle *Chthamalus fissus*

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Chthamalus fissus is a barnacle found in the high intertidal along the coast of Southern California and Northern Baja California. I have previously demonstrated that individuals of this species exposed to the predatory snail *Mexacanthina lugubris* develop either the narrow or bent operculum morphology and that the predator is less successful at consuming these morphs. In this presentation I describe the costs and benefits of the three morphs and explain why the narrow form is most abundant at sites with high predator density. I also describe evidence for variation in the degree of plasticity among barnacle populations and discuss factors that likely influence this variation and implications for northern barnacle populations which have only recently begun to experience predation by *M. lugubris*.

Fac, Oral

Evidence for large-scale recruitment limitation of blue crabs in upper Chesapeake Bay.

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The major, persistent decline in the Chesapeake blue crab population appears to be largely driven by declines in the female spawning stock and subsequent reductions in juvenile recruitment. Herein, we summarize evidence from (i) existing fishery-independent data sets, (ii) large-scale field surveys and experiments within shallow blue crab nurseries throughout Chesapeake Bay, and (iii) small-scale field releases of hatchery-reared juvenile blue crabs in upper Chesapeake Bay, that provide strong indications that many areas of Chesapeake Bay currently suffer from recruitment limitation. Population declines are evident in landings data, fishery-independent surveys, and in independent measures of spawning stock abundance in the lower Bay spawning sanctuary which have declined by 84% since 1991. Field surveys within shallow nursery habitats of Chesapeake Bay clearly show that juvenile blue crab density declines with distance from the Bay mouth. Conversely, survival of blue crab juveniles is highest in up-estuary sites with abundant prey at all sites. Field releases of hatchery juveniles directly augmented local wild stocks and demonstrated that release sites were not limited by prey availability and are below carrying capacity. Overall, our results are consistent with the hypothesis that important nursery habitats are currently recruitment-limited and contributing to the lack of population recovery.

Fac, Oral

Morphological Changes in Growth of Eastern Oysters (*Crassostrea virginica*) in the Presence of Mud Crabs (*Panopeus herbstii*)

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Mud crabs are well known predators of juvenile oysters. Mud crab predation is greater in the absence of higher order consumers that minimize mud crab foraging and abundance. However, non-lethal effects of mud crabs on oysters have not been quantified. The purpose of this research was to measure any nonlethal effects in oyster morphology resulting from exposure to mud crab predators. Our study consisted of placing newly settled oysters in the field in one of three treatments: a control with no mud crabs, a two mud crab treatment, and a six mud crab treatment. The oysters were in the field for 60 days and the predators were fed bivalves once a week. We then compared changes in meat to shell ratios between treatments. A high ratio indicates more allocation of resources to soft tissue instead of shell and resultantly higher fitness. Ratios were significantly greater in control treatments, indicating that mud crabs exert nonlethal effects on newly settled oysters. These effects are in addition the well documented

lethal effects observed in earlier work. Higher order consumers may prevent both lethal and nonlethal effects of mud crabs on oysters via controlling mud crab populations.

Grad, oral

Secondary spread of invasive species: historic patterns and mechanisms of the continuing invasion of the European rockweed *Fucus serratus* in North America.

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Post-establishment spread of invasive species is a major determinant of impact, but spatial patterns and temporal rhythms are often poorly understood. We examined the spread of *Fucus serratus* over 2000 km of shoreline after its initial discovery in Nova Scotia in 1868. Building upon earlier surveys, we document the current distribution and provide a historic analysis of the invasion, including the integration of the recently-detected multiple introductions from Europe. The initial spread was rapid, likely due to natural spread and the extensive regional shipping traffic of the time. Later spread was slower, but included several major jumps (>250 km), undoubtedly due to human-mediated transport. Although the spatial extent of the invasion has increased over time, it has experienced two notable events: a major retraction (100-150 km) along the northwestern limits of its range in the mid 20th century, and stalled invasions at several points and times during its southward progression. Distributional data suggest that this invader is excluding congeners in shallow zones and possibly kelp species in deeper zones, and genetic data have shown hybridization with native *F. distichus*; this and several other reproductive traits likely contribute to the asymmetric outcome of contact between the two species.

Fac, Oral

The effects of echinoid grazing on photosynthetic performance of tropical crustose coralline algae in southern Taiwan and Moorea, French Polynesia.

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Diadematid echinoids are important herbivores in tropical coral reef ecosystems, and are instrumental in influencing phase shifts from coral to macroalgal dominated communities. Crustose coralline algae (CCA) are a fundamental component of reef communities, yet few studies have addressed how CCA are impacted by echinoid grazing. This study elucidated the effects of grazing by *Diadema savignyi* and *Echinothrix calamaris* on photosynthetic performance of the calcified alga *Hydrolithon onkodes* in southern Taiwan. The effects of grazing were quantified as surface area grazed and photosynthetic performance (rETR) of grazed tissues following laboratory grazing assays. Herbivory by both echinoids reduced the overall photosynthetic performance of grazed thalli, but did not differ by echinoid species. The second component of this study determined the capability of *D. savignyi* to graze on two species of CCA in Moorea, French Polynesia. *H. onkodes* occupies exposed habitats that experience frequent grazing by sea urchins, whereas *Sporolithon* sp. is found only in cryptic habitats. *D. savignyi* grazed 79% of the surface area of *Sporolithon* sp., and only 18% of the surface area of *H. onkodes*. These results provide baseline measurements for future experiments that will investigate the impact of ocean acidification on susceptibility of calcified algae to echinoid grazing.

Grad, Oral

Do alternative mating tactics exist in female horseshoe crabs?

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Females of many species attract and mate with multiple males. Such behavior is viewed either as a product of male-male competition and costly to the female or as a way of improving the female's mating

options. Consistent differences among females in their willingness to mate once (monandrous) or multiply (polyandrous) may reveal the existence of alternative female mating tactics. Discrete variation in female alternative reproductive tactics can have implications for sexual selection theory because female choice can shape the evolution of sperm competition and sexual dimorphism. We examine whether alternative tactics exist in female horseshoe crabs (*Limulus polyphemus*), a species in which male alternative reproductive tactics are well known. In this species attached pairs migrate to shore and spawn on high tides; the male fertilizes the female's eggs externally with free-swimming sperm as the eggs are being laid. Unattached males are attracted to pairs by visual and chemical cues and become satellites of some females while ignoring others. Females appear to be consistently monandrous or polyandrous across multiple nestings, suggesting the existence of alternative female mating tactics is possible. We compare nesting patterns, reproductive success, condition and size data, the role of chemical cues and *in vitro* fertilization results.

Fac, Oral

Experimental manipulations of propagule pressure and other predictors of invasibility

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Propagule pressure describes a measure of the number of individuals released into an area to which they are not indigenous. In marine systems this is commonly represented by the release of early life-history stages such as larvae. Despite a long history of research in supply-side ecology, there are few studies that have manipulated invasive propagules in order to gauge community invasibility. We test the invasibility of marine sessile invertebrate communities by exposing them to controlled numbers of mobile larvae. Using this technique we examine the importance of propagule pressure relative to other invasibility predictors. Results of experiments examining interactions between propagule pressure, predation and physical disturbance will be presented.

Fac, Oral

Effects of coral community structure on the dynamics and impact of the corallivorous gastropod, *Coralliophila abbreviata*

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Predation pressure on a focal population may be mitigated by the prevailing neighborhood composition and structure. In the case of rare or threatened species, these interactions can potentially impact the persistence and recovery of local populations. To examine the effects of coral community structure on the impact of the corallivorous gastropod, *Coralliophila abbreviata*, on the threatened coral species, *Acropora cervicornis*, a field experiment was conducted in which the density and composition of neighboring corals surrounding focal *A. cervicornis* colonies were manipulated, as well as the density of *C. abbreviata* at the study site. Focal *A. cervicornis* colonies either had no neighbors (solitary), conspecific neighbors, alternative prey (*Montastraea faveolata*) neighbors, or non-prey (*Porites asteroides*) neighbors. One hundred and fifteen individually tagged snails were added to the study system and monitored for four months to assess patterns of movement and resource use. The results indicate that both the density and identity of neighboring corals is important in determining levels of corallivore damage to focal *A. cervicornis* colonies. The observed patterns appear to be due to a combination of a density dependent numerical response to prey and subsequent resource use within neighborhood plots by *C. abbreviata*.

Grad, Oral

Modeling the Mussels *Mytilus*: climate change, survival, and distribution

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Intertidal ecosystems are physically rigorous habitats which may serve as models for the effects of climate on biogeography. Organisms residing in the intertidal zone are exposed to a suite of stressful abiotic factors, and must be able to cope with both water and aerial conditions. Most organisms have latitudinally discrete biogeographical distributions, and the range limits are set primarily by environmental temperature. Thus, with changing climatic conditions, the biogeographic ranges of organisms are predicted to shift polewards. Within the genus *Mytilus* are three congener species, *M. edulis*, *M. trossulus*, and *M. galloprovincialis*, which have world-wide distributions. They tend to dominate the intertidal zone, and are extremely valuable economically, being the most commonly farmed species of mussels with multi-billion dollar profits. Research conducted on *M. edulis* from the US east coast indicates that the historic southern limit of this species is contracting in a poleward direction as predicted. Increasing air and water temperatures are causing higher rates of mortality, and these changes are predicted to continue as the climate warms. Modeling of future climate scenarios indicates that *M. trossulus* and *M. galloprovincialis* may not respond to climatic warming in the same manner. Considering the economic importance of these species, changes in distributions will have significant management implications.

Grad, Oral

Trait-mediated interactions between octopuses and prey in shallow water reef communities of the Florida Keys.

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Predators have the ability to influence prey density in one of two ways; they may feed directly upon these animals or they may intimidate them, causing a compensatory response. The central dogma of traditional studies concerning predator-prey interactions has assumed direct predation to be the primary driving force. However, recent studies have found trait-mediated interactions (or TMI's) having an equal or greater effect than direct predation. These trait-mediated interactions can range from behavioral shifts in prey species to physiological changes. Our previous research has identified significant effects of octopus predators upon the distribution of crab prey, but left unclear whether to attribute this effect to direct predation or TMI effects. We conducted a tethering study over the course of two years to estimate the direct predation of octopus on crab prey. Although some direct predation did occur on our sites, predator density did not explain the variation we found in prey survival. We found that crab population numbers declined with increasing number of octopus predators, but this may have been due to increased risk effects leading to increased immigration from the site. Future studies should attempt to measure the changes in survival when prey species are displaced by potential predators.

Grad, oral

Activation of AMP-activated protein kinase in response to hypoxia in two crustacean species

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Marine invertebrates are often exposed to patches of hypoxic seawater, causing these animals to rely on anaerobic metabolism. AMP-activated protein kinase (AMPK) acts as a "fuel gauge" and is activated when cellular energy levels drop. We predicted that hypoxia would result in a depletion of cellular energy, and therefore, an increase in AMPK activity in the rock crab, *Cancer irroratus*, and the green crab, *Carcinus maenas*. Crabs were exposed to hypoxia ($DO_2 < 1 \text{mg/L}$) for 0, 20, 40, 60 or 120 minutes (12°C , 35ppt). Heart and hepatopancreas were harvested at each timepoint and analyzed for AMPK activity and heat shock protein (HSP70) levels using western blots. In the heart, AMPK activity peaked after 20 minutes in *Cancer* and 60 minutes in *Carcinus*. HSP70 levels did not increase significantly in

either species. In the hepatopancreas of both species, AMPK activity increased at timepoint 0 and peaked after 20 minutes. HSP70 levels increased after 20 minutes in *Cancer*, but remained low in *Carcinus*. Comparing the stress response in these subtidal and intertidal species shows that despite slight changes in the time course of AMPK activation, AMPK is a tissue specific and more sensitive indicator of low oxygen stress than HSP70 for marine crustaceans.

Fac, Oral

DOES THE SPECIES COMPOSITION OF SYMBIOTIC MICROBIAL COMMUNITIES FOR CORALS AND SPONGES CHANGE WITH TIME AND SPACE?

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The symbiosis of corals and sponges with marine bacteria is uniquely complex and it has been proposed that sponges and corals cannot be studied without accounting for their symbionts, the 'holobiont' concept. Therefore, this holobiont concept will be the foundation for studying the natural variability of the microbial communities. The microbial communities of the holobiont could be different as distance increases between sites and/or with when samples are collected. Combining field samples for temporal and spatial variability will allow a more holistic view of the holobiont and the composition of the microbial communities. Variability will initially be measured as the presence and abundance of bacterial taxa using cultured material as well as molecular techniques. While previous work suggests that microbial communities of coral colonies are species-specific across wide geographic areas, our approach will begin to define overriding seasonal, annual to interannual variability among these communities. The microbial community is thought to act as one line of defense for corals and sponges; therefore, results will provide a baseline for future work to understand the role of the symbiotic microbes for coral or sponge response to environmental stress (*e.g.*, thermal stress, poor water quality, and infectious agents).

Grad, Oral

Boring Sponge Impacts on the Oyster *Crassostrea virginica* and Oyster Reef Development

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The oyster *Crassostrea virginica* is an ecologically and economically important estuarine species. Well developed oyster reefs enhance water clarity, provide critical habitat for important finfish and crustaceans, and stabilize shorelines against erosion and storm damage. Overharvesting, habitat degradation, and disease have severely reduced oyster stocks and lead to substantial reductions in the extent of oyster reefs. Oyster reef accretion is the sum of processes that act to add new oyster biomass to reefs (*i.e.* growth and recruitment) and processes that act to inhibit reef development, such as predation on oysters, disease and the activities of bioeroders that break down oyster shells. To date, relatively little research has focused on the impacts of oyster shell bioeroders, of which Clionid sponges are perhaps the most damaging. Recent versus historical surveys show marked increases in the abundance of boring sponges in NC oyster reefs, with the biomass of sponge likely exceeding that of oysters on some reefs. Rates of oyster and sponge respiration are similar, but lower overall when sponge and oysters occur together. These results indicate that on contemporary reefs, boring sponges can negatively impact reef development and thereby restoration efforts by eroding the substrate and possibly slowing rates of oyster growth.

UG, Oral

Contaminants of emerging concern in sediment and mussel Standard Reference Materials

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In recent decades, concern has intensified over numerous chemical classes, such as perfluorinated compounds (PFCs) and brominated flame retardants (BFRs), that have become globally distributed environmental contaminants. Many accumulate in biota and/or sediments, can be toxic, and are in current use. The National Institute of Standards and Technology has been developing optimal methods to measure these contaminants of emerging concern (CECs) and characterizing Standard Reference Materials (SRMs) for selected CECs. SRMs are large batches of one homogenous material, such as sediment or mussel tissue, that has been well-characterized for particular constituents, like contaminant concentrations. Other laboratories use SRMs to validate their analytical methods and demonstrate their data quality. This presentation will introduce available SRMs that are useful to the benthic ecology research community, primarily sediment SRMs 1941b and 1944 and mussel tissue SRMs 2977 and 2974a, and investigate interesting temporal trends in CEC concentrations. For example, the mussel SRM collected in 2004 had higher BFR concentrations than one collected in the 1996, which is suggestive of a rising trend. Since the impact of CECs to benthic organisms and food chains is important to consider, more projects are beginning to monitor CECs and need SRMs for quality control.

Fac, Poster

Kelp, sea urchins and invaders: effects on community composition 1992-2008

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We documented changes in community composition that occurred with phase shifts in the rocky subtidal ecosystem at Little Duck Island near Lunenburg, Nova Scotia from 1992-2008. At the beginning of our study, a dense aggregation of the green sea urchin (*Strongylocentrotus droebachiensis*) was destructively grazing a kelp bed, leaving coralline-algae dominated barrens in its wake. In subsequent years, the system underwent a series of phase shifts mediated by mass mortality of sea urchins due to amoebic disease, defoliation of kelp by an invasive bryozoan, and invasion of the green alga *Codium fragile* ssp. *tomentosoides*. Using multidimensional scaling (MDS) we found that phase shifts resulted in one of four macroalgal assemblage types (dominated by kelp, coralline algae, *C. fragile*, or a transitional mixture of species), and that associated with each of these was a distinct invertebrate assemblage. Sea stars and kelp-grazing gastropods were associated with kelp-dominated phases; urchins, chitons and scale worms were most abundant in barrens phases; and small bivalves and amphipods were most abundant in the *C. fragile*-dominated phase. Our findings provide a longer-term perspective on the impact of these invasive species on phase shifts and community structure in the rocky subtidal.

Grad, oral

Functional and genetic differences in coral-algal symbiosis during a coral bleaching event in Puerto Morelos, Mexico

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Two massive coral bleaching events were documented in Puerto Morelos, Mexico in 2005 and 2009. During a five-year study, five dominant reef-building coral species (*Montastraea faveolata*, *M. annularis*, *Porites astreoides*, *Agaricia agaricites*, *A. tenuifolia*) were sampled three times a year to investigate how reef building coral and their symbiotic algae, *Symbiodinium* spp., were affected by these events. All five species of coral showed significant decreases in symbiont density and chlorophyll *a* during both bleaching

events. Bleaching resistant *P. astreoides* have homogenous assemblages of *Symbiodinium* clade A, which have enhanced photoprotective pathways. All other sampled corals were found to host homogenous or mixed assemblages of *Symbiodinium* from clades B and C, with the exception of *M. faveolata* that hosted mixed populations of *Symbiodinium* from clades A, B, and C. During bleaching episodes portions of *M. faveolata* colonies were found to retain pigmentation and higher symbiont densities. Further investigation revealed that these patches had populations of *Symbiodinium* clade A, while adjacent bleaching-prone patches within the same colony had *Symbiodinium* clade B or C. We monitored these colonies during recovery and documented a symbiont community shift in *M. faveolata* to predominantly *Symbiodinium* clade A and D, which are known to have higher thermal tolerances.

Grad, Oral

Differential escape from parasites by two competing introduced crabs

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Although introduced species often interact with one another in their novel communities, the role of parasites in these interactions remains less clear. We examined parasite richness and prevalence in 2 invasive shore crab species, *Hemigrapsus sanguineus* and *Carcinus maenas*, with different invasion histories and residency times in an introduced region where their distributions overlap broadly. We used literature and field surveys to evaluate parasitism in both crabs in their native and introduced ranges. We found only 1 parasite species infecting *H. sanguineus* on the US East Coast compared to 6 species in its native range, while *C. maenas* was host to 3 parasite species on the East Coast compared to 10 in its native range. The prevalence of parasite infection was also lower for both crabs in the introduced range compared to their native ranges; however, the difference was almost twice as much for *H. sanguineus* as for *C. maenas*. There are several explanations that could contribute to *C. maenas*' greater parasite diversity than that of *H. sanguineus* on the US East Coast, including: differences in susceptibility, taxonomic isolation, time since and manner of introduction, distance from native range, and potential for parasite identification bias. Our results also suggest prospects for community-wide impacts possibly affecting parasite richness and prevalence in a diverse array of native and non-native East Coast hosts.

Grad, poster

Intraspecific variation in predator avoidance in a sabellid featherduster worm

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Prey species are constrained by fulfilling their basic needs, but at the same time, avoiding predation. In habitats where the risk of predation is low, allocating less time to predator avoidance would be adaptive. Sabellid featherduster worms combine chemical and structural defenses with behavioral escape strategies, by retracting quickly into their tubes in response to disturbances. To examine intraspecific variation in predator avoidance, I investigated *Sabellastarte magnifica*, which is found living on mangrove roots, in sea grass beds, and on coral reefs in the Caribbean. Individuals on reefs were more likely to retract in response to a physical stimulus than those living on mangroves. This was correlated with reef worms exhibiting a higher incidence of partial predation than mangrove worms. When mangrove worms were transplanted to the reef, worms exhibited more partial predation and behaved more like reef worms by retracting more often to a physical stimulus. When reef worms were transplanted to mangroves, they did not exhibit partial predation, and their behavior changed to that more similar to mangrove worms, responding less to a physical stimulus. Thus, predator avoidance behavior is context dependent, and may be modified by risk of predation.

Fac Oral

Successful Recovery of Two *Halodule wrightii* Donor Sites

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Seagrass habitats are recognized as a critical coastal ecosystem, yet losses to these habitats still occur for a wide variety of reasons, including anthropogenic impacts and natural processes. A widely accepted method for restoring injured or disturbed seagrass habitats is to stabilize the impacted sediment by transplanting healthy donor material into the injured area. Shoal grass (*Halodule wrightii*), a fast-growing, pioneering seagrass species, is commonly used as donor material to initially stabilize sediment and aid in natural recovery of impacted seagrass habitat. Although it has not been well documented, it is believed that donor beds will recover rapidly if collection of donor material is dispersed throughout the donor bed. This study documents the full recovery of two *H. wrightii* donor beds 1 year after the removal of donor material. A total of 659 *H. wrightii* cores was removed from two donor sites within Biscayne Bay, Florida for transplantation as part of an in-kind mitigation project. Results from quarterly monitoring surveys show no significant difference in seagrass density and depth between impact sites and reference locations 1 year after removal of donor material.

Fac, Oral

Accommodation of the sex ratio in eastern oysters to variation in growth and mortality across the estuarine salinity gradient in Delaware Bay.

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Eastern oysters are protandric hermaphrodites. We evaluated the sex ratio of eastern oysters over a wide salinity range in Delaware Bay to determine (a) the degree to which salinity-dependent growth and mortality might influence sex ratio and (b) the sex ratio of landings for application to fishery management. Oysters generate a relatively uniform reproductive potential over a wide range of environmental conditions that impose variations in growth rate and life span. The fraction female routinely fell between 0.4 and 0.5, regardless of location in the salinity gradient. About 70% of the population biomass is female over the same salinity range. As a result of the necessary local modulation of the rate of male-to-female conversion to limit the influence of varying growth and life span over the salinity gradient, the number of males always exceeds by a small amount the number of females; thus improving the likelihood of a female having neighboring males, a necessity for an immobile broadcast spawner. As well, gamete production is maintained at an egg:sperm ratio upon spawning that likely yields a desirable mix for fertilization success. However, oysters at the extremes of the estuarine gradient all yielded populations with divergent sex ratios. One consequence of reduced generation time brought about by increased mortality from disease should be selection favoring the switch from male to female at smaller size. The most downestuary population, the site with the longest record of high mortality, manifests such an increase. Marketed animals range from 62% to 69% female.

Fac, Oral

Tides dictate consumptive and non-consumptive top predator effects on intermediate consumers (snails; *Littoraria irrorata*) and plants (*Spartina alterniflora*)

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By revisiting classic examples of trophic cascades, ecologists unequivocally demonstrated that consumptive and non-consumptive effects of predators equally organize experimental communities. However, it remains unclear if certain conditions predictably vary the relative strengths of these predator mechanisms. Because intertidal marine systems contain multiple predators with different foraging strategies and because predator access to intertidal prey is limited by tides, multiple-predator effects and

tides may interactively dictate which predator effect organizes intertidal food-webs. Along a tidal-regime gradient (diurnal to mixed-semi diurnal) in the Gulf of Mexico, the correlation between snail density and smooth cordgrass biomass fluctuates from positive to negative, suggesting that snails are associated with cordgrass losses in some locations. We experimentally demonstrate that this correlation may vary spatially because different tides alter how blue crab (*Callinectes sapidus*) and crown conch (*Melongena corona*) predators impact the density and behavior of snails. As the duration of low tide increases from mixed-semi diurnal to diurnal, consumptive effects of predators fail to benefit cordgrass because lower snail densities enhance snail per-capita consumption of cordgrass. But in the absence of consumptive effects, diurnal tides and predator cues worsen cordgrass losses by causing more snails to climb, remain on, and overgraze cordgrass during low tide.

Fac, oral

The tale of the spotted spiny lobster: innocuous crustacean by day, bane of coral reef recovery by night.

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Caribbean coral reefs have undergone a phase shift from a system dominated by corals to one where algae are pervasive. This shift was precipitated by the loss of herbivores, including the mass mortality of the long spined sea urchin (*Diadema antillarum*), coupled with disease and the recruitment failure of hermatypic corals. Whereas some areas of the Caribbean have experienced recovery of *Diadema* populations and associated reef recovery, the Florida Keys still have *Diadema* populations well below historical levels, likely due to low larval supply coupled with predation on juveniles. As lobsters are sea urchin predators in other systems, we investigated the role of a nocturnal, philopatric carnivore, the spotted spiny lobster (*Panulirus guttatus*), on patch reef communities in the Florida Keys via field and laboratory experiments. We found that *P. guttatus* consumes herbivorous invertebrates including sea urchins and crabs. Additionally, *Diadema* demonstrated increased flight response and consumed significantly less algae in the presence of *P. guttatus*. Lobsters may also directly inhibit coral recruitment by destabilizing rubble substrate they overturn while foraging. Through its negative impact on the abundance and behavior of herbivores as well as substrate stability, high densities of *P. guttatus* potentially contribute to coral-to-algae phase-shifts on coral reefs.

Grad, Oral

Impacts of Beach Nourishment and Development on *Emerita talpoida* in Southeastern North Carolina

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Beach nourishment is employed to protect beaches and property. Wrightsville Beach, North Carolina (USA) has been nourished since 1938. Additionally, sand is placed on the north end of Masonboro Island. *Emerita talpoida* is a major food source of surf-zone fishes and shorebirds. *Emerita* emigrate from the nourishment site during nourishment. Long-term impacts of beach nourishment and development are unknown. We are examining long-term impacts of beach nourishment and development on *Emerita* by comparing mole crab abundance, size, and female reproductive status at nourished versus unnourished and developed versus undeveloped beaches in Southeastern North Carolina. Fifteen sites on Wrightsville Beach, Masonboro Island, and Hutaff Island were sampled monthly from May through September 2009. *Emerita* were collected using a mesh rake (38cm wide with 1.3cm mesh). All crabs were counted and measured. In the laboratory, egg masses were removed and weighed. Sediment type, grain size, beach slope, sand compaction, water temperature, turbidity, and wave height were measured at each site for correlation with *E. talpoida* abundance. Results suggest that *E. talpoida* prefer beaches with less compact sediment and avoid beaches with high sediment compaction. *Emerita* appear less abundant on developed beaches and beaches with steep (>5%) slopes. *Emerita* size appears unaffected.

A comparison of three methods for estimating Macrozoobenthos diversity and abundance in a tropical seagrass meadow

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The intertidal reef flat surrounding the Island Barrang Lompo in the Spermonde Archipelago / Indonesia is covered by an extensive seagrass meadow dominated by *Enhalus acoroides* and *Thalassia hemprichii*. In this study three methods for estimating the diversity and abundance of macrozoobenthic organisms were compared: 18 replicate sediment cores (16 cm diameter, to 30 cm depth) were taken and the content was sieved over a 1 mm screen. All organisms living (partly) on top of the sediment or leaving visible signs of their presence (e. g. burrow openings, sediment expulsion mounds) were counted within three replicate circles of 6 m diameter. Three replicate plastic foils (3 * 4 m) were installed on top of the sediment and their surface covered with a thin layer of sand. Subsequently, all organisms that either lived on the surface or were found emerging under the plastic foil in search of oxygen were collected after 24, 48 and 72 hours. The by far largest number of species (ca. 250) was found using the plastic foil method, followed by the corer (ca. 75) and the counting circles (ca. 30). Estimates for the abundance of small species that live on or near the surface were highest with the corer method. Larger and deep burrowing species were only caught with the plastic foil and their numbers were much higher than estimated from surface signs. It is concluded that the plastic foil method has a high potential to enhance studies of both diversity and abundance, especially regarding large and deep burrowing organisms which have no surface activity, are impossible or very difficult to catch using other methods, and therefore often underreported.

Grad, Oral

Spatial patterns of macroalgal diversity and biomass in rocky nearshore environments

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Latitudinal trends have often been postulated for marine taxa and communities but surprisingly few large-scale analyses have been done to test these gradients. Only one study, based on literature searches, focused on macroalgae (Kerswell 2006). This current research explores the relationship of macroalgal species numbers and their respective biomass with depth strata and with latitude from globally distributed samples collected using a standardized protocol. In addition, this research examines various environmental variables to determine possible drivers of these trends. This study found an overall positive correlation with latitude in both species numbers and biomass from the northern to the southern hemisphere. Within the northern hemisphere, more species and biomass were found in the higher latitudes. No trend was found in the southern hemisphere. When depth strata were analyzed separately, significant latitudinal trends were found in some strata, primarily in the intertidal. The environmental variables that explained most of the trends were latitude, longitude, acidification, and sea surface temperature. While these data have some limitations, this first attempt at describing latitudinal macroalgal trends has opened the door for future investigations.

Fac, Poster

Swash Discharge Time-series and Potential Contributions to Coastal Ocean Water Quality,

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Inner shelf waters of Long Bay, SC off of Myrtle Beach have been experiencing periodic hypoxia and anoxia. The role of coastal discharge of stormwater and intertidal swash systems may influence this water quality issue. To investigate the role of swashes, time series measurements using Dataflow at the mouth of White Point swash in Myrtle Beach South Carolina were collected over a two year period during 2007-2008. Each time series spanned at least 24 hrs and included complete day-night periods and multiple low-high tidal cycles. Results from these measurements which included; water temperature, salinity, pH, dissolved oxygen, CDOM, and *in vivo* chlorophyll a, indicated that swash discharge during dark periods in late spring and summer had prolonged hypoxic periods, high chlorophyll, and significantly higher CDOM compared to discharged light period water. These discrete swash discharge records as well as tidal stage predicted discharge times were reconciled with water quality records at Apache pier in north Myrtle Beach. Results indicate that periodic synching between this highly developed swash discharge and coastal water quality occurs suggesting that some control over shallow inner shelf water quality variability is independent of meteorological events or offshore oceanographic forcing.

Fac, Oral

Does structure increase marine biodiversity?

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The health and resilience of ecological communities depends on their biodiversity. The goal of our creative inquiry research project was to determine if natural and artificial structure increases biodiversity in shallow marine communities of the Florida Keys National Marine Sanctuary. To measure biodiversity, we sampled three 25 x 25 m sites that differed in their abundance of natural and artificial structures. We measured the algal cover, sponge & coral density, and the diversity of crustaceans, mollusks and echinoderms. Species richness was then compared with the number of structural habitats. Although not statistically significant, our results suggest that richness of sessile and mobile invertebrates were positively related to habitat structure, while algal richness was unrelated. Although these results supported our hypothesis that structure increases marine biodiversity, more research is needed to understand the mechanism by which structure benefits each of these diverse species.

UG, Poster

Possible Reproductive Senescence in American Lobsters (*Homarus americanus*).

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American lobsters are unusual among crustaceans because of their longevity (>80 years). Female lobsters continue to reproduce as they age, however it is not known if older females produce eggs of the same quality and quantity as those of younger conspecifics. Using carapace length (CL) as a proxy for age, relationships between female size and egg quantity and quality were evaluated in 528 brooding lobsters sampled between June 2008-December 2009 (CL range: 82.1-191.6mm). Generally, body size scaled positively with both clutch mass volume and total number of eggs produced ($p < 0.001$); however residual analysis indicated that a greater proportion of females with $CL > 160\text{mm}$ (older individuals) had smaller clutches than predicted ($p < 0.001$). Egg lipid content (proxy for quality; $n=82$) also decreased with female size ($p=0.01$; small females $CL < 105\text{mm} = 11.4 \pm 0.7 \text{ wt\%}$; largest females $CL > 160\text{mm} = 8.3 \pm 0.5 \text{ wt\%}$). Similarly, concentrations of 20:5n-3 (EPA; fatty acid important for larval development in other species) were significantly lower (by 11%, $p < 0.001$) in eggs from the largest females compared to smaller females. These declines in egg quality (and, in several cases, quantity) in larger lobsters suggest that

some older females may exhibit reproductive senescence, a phenomenon rarely reported in animals with non-finite oocyte stores.

Fac, Oral

Potential chemical defenses of Antarctic ascidians against fouling by sympatric bacteria

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Benthic marine sessile invertebrates are often subject to fouling by bacteria, protists and macroinvertebrate larvae. Although at times epibiosis can be beneficial to basibionts, for the most part such interactions are harmful. The aims of this study were to assess the antibacterial activity of crude organic extracts from a suite of ascidians from the western Antarctic Peninsula. Twenty sympatric bacterial strains were isolated and cultured from the water-column and from the surfaces of macroinvertebrates. Paper antimicrobial assay disks containing ascidian extract solutions were placed onto inoculated marine agar plates. The plates were incubated in 4°C until bacterial growth was visible and zones of inhibition could be measured. Zones of inhibition were compared to “solvent only” control disks in order to evaluate antimicrobial activity. The lipophilic extract of the colonial ascidian *Distaplia colligans* caused growth inhibition in all bacterial isolates at the 3X tissue-level concentration. While growth in only one bacterial strain was inhibited by the lipophilic extract of *D. colligans* at the 1X concentration, it is likely given the probability of sequestration of antifoulant compounds on the surface of the tunic, that extracts with inhibitory activity at the 3X concentration have ecologically relevant antifoulant implications.

Grad, Poster

Nutrient concentrations from submarine groundwater discharge points in relation to macroalgal species diversity at Discovery Bay, Jamaica

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Submarine groundwater discharge was studied in the backreef lagoon surrounding the Discovery Bay Marine Lab, University of the West Indies, Jamaica, in May 2009. At the two most intensely studied springs the salinity at the head was over 27 ppt, suggesting that mixing occurred between marine waters and fresher groundwaters before discharging into the bay. Water samples were collected at depth and at the surface and field tested for nitrate (NO₃⁻), nitrite (NO₂⁻), and phosphate (PO₄³⁻) using standard HACH methods. Duplicate water samples were collected and returned to Coastal Carolina University for more sensitive nutrient analyses which are in progress. Lab analyses found that concentrations of NO₂⁻, PO₄³⁻, and ammonia (NH₄⁺) were near detection limits or had zero values. Nitrate field values within the spring plumes were as high as 48.4 µM. Macroalgal species richness and relative diversity were measured as identified species and percent cover of algae in m² quadrats randomly set along 10 m transects oriented north, south, east, and west from spring heads. The macroalgal community diversity was not influenced by proximity to the two springs (spring 1, *p* = 0.547; spring 2, *p* = 0.184).

UG, Poster

Grazing and epiphytism alter the ability of kelps to withstand breakage by waves

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Kelp blade breakage in wave-swept environments is driven in part by the strength, flexibility, and elasticity of blades. Grazing and epiphytism have the potential to decrease the ability of kelps to withstand wave forces by altering these properties. We examined the effect of snail grazers and the invasive bryozoan *Membranipora membranacea* on blade breakage of kelps *Laminaria digitata* and *Saccharina longicuris* in Nova Scotia, Canada. *M. membranacea* encrusts blades with a rigid calcium

carbonate layer, and causes tissue deterioration. Grazing by the snails *Lacuna vincta* and *Littorina littorea* creates surficial scars or perforations in blades. Using standard materials testing procedures, we conducted force-to-break tests on kelp blades that were 1) encrusted with *M. membranacea*, 2) damaged by snail grazing, and 3) undamaged and unepiphytized (controls). We found that *M. membranacea* reduces the flexibility of blade material, and decreases the amount of energy stored in kelp tissue before breakage. Samples perforated by snail grazing broke with a markedly lower force application than partially grazed or unaffected samples. These results suggest that grazing and epiphytism lower the ability of kelps to withstand wave forces, thereby increasing rates of blade breakage and detrital production from subtidal kelp beds.

Grad, oral

Determining the size vulnerability of juvenile *Crassostrea virginica* to mud crab predation on Chesapeake Bay oyster reefs

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Two species of mud crab, the flat mud crab (*Eurypanopeus depressus*) and the white fingered mud crab (*Rithropanopeus harrisi*), commonly inhabit oyster reefs. Mud crab predation on juvenile *Crassostrea virginica* (spat) could have important implications on restoration efforts currently occurring in the Chesapeake Bay. Both species were experimentally examined to determine whether a size preference exists in mud crab predation of juvenile spat. Specifically, spat (two to four weeks old; settled on recycled oyster shell) were placed in an experimental tank with one 24-hour starved mud crab for a period of 96 hours. Size preference was quantified for each crab by measuring the number, size, and settlement location of spat consumed every 24 hours. Preliminary results show that the average size eaten was not significantly different between species ($p < .6249$), even though *E. depressus* carapace size is significantly greater than *R. harrisi* ($p < .0001$). Both species consumed an average size of approximately 5.7mm, when they were given spat ranging from 1 to 20mm. The results suggest that both species have a size preference for spat consumed. Restoration efforts could become improved by allowing juvenile oysters to grow beyond the mud crab's spat size preference.

UG, Poster

Demographic model of Thalassinid shrimp in the Eastern North Pacific

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The Thalassinid shrimp *Neotrypaea californiensis* is found on the Western coast of North America. It is an important ecosystem engineer and a pest in the oyster industry. A stage-based population model was created for several estuaries in Oregon and one in Washington using data from the literature. Fecundity was found to be dependent on size and not age, so stages based on carapace length were used. Probability of retention in stage and moving on from a stage were calculated based on Caswell (1989). Some estuaries were population sinks, and others were population sources. The lowest lambda value, 0.89, was found for Willapa Bay, where pesticides are sprayed to control for the shrimp. The two highest values of lambda were found for Siletz Bay, 1.22, and Alsea Bay, 1.23, which have the greatest fecundities of the populations with data available. The model was then used to look at possible affects of increased predation, decreased salinity, and addition of pesticides.

UG Poster

Size Matters! Relationships between echinoid population dynamics and macroalgal community composition on a Mexican Caribbean coral reef.

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Research on the recovering *Diadema antillarum* population has sought to elucidate urchin-macroalgae relationships to determine if coral reef communities can shift from algal to coral-dominated. The objective of this survey was to understand the impact of *D. antillarum* recovery on the resilience of the Mexican Caribbean algal-dominated ecosystem while considering echinoid size classifications. As hypothesized, higher echinoid density areas correlated to higher crustose coralline algae (CCA) cover, a known coral settlement cue. Unexpectedly, these higher echinoid density areas also had significantly more turf algae and TAS (turf algal-sediment) cover, benthic substrates detrimental to coral health. This could be due to the large proportion of small rather than large urchins at the higher density location on the forereef. Smaller urchins may be limited on the amount of algal biomass they can remove and size classification could play an important role in echinoid survey analysis. The skewed distribution of size classes over the backreef and forereef, and the related effects on macroalgal abundance, could have subsequent effects on coral resilience as the higher percent macroalgal cover on the forereef influences space available for coral recruitment. Further work is in progress to evaluate echinoid population dynamics and the feedback on macroalgal community composition.

Grad, Poster

An Analysis of Coral Reef Restoration of Acroporid Corals as a Potential Coral Reef Management Tool: A Caribbean Perspective

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A study was conducted to gather collective knowledge, perceptions and opinions pertaining to the field of coral reef restoration. A large literary database containing approximately 120 references regarding coral reef restoration was developed along with a Caribbean *Acropora* projects database. From the Caribbean *Acropora* projects database, an interactive GIS map containing 69 individual project sites (each accompanied by its own data page) was also developed. Additionally, a coral reef restoration survey instrument was developed, disseminated among various reef restoration practitioners, and the results analyzed. Results of this study include information on the most effective methodologies of reef restoration as well as the most common re-occurring issues that arise in the field. Additionally, results of this study indicate that coral reef restoration can serve as a potential cost-effective coral reef management tool given the right circumstances. This includes the availability of sufficient funding as well as strong coral reef management plans in place in the form of enforced no-take marine protected areas, community-based management/stakeholder involvement, and public participation in the form of heightened awareness and education.

Grad, Oral

Evidence for density-dependent survival in juvenile oysters (*Crassostrea virginica*) from Chesapeake Bay, Maryland.

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In 2009, 20 separate sites in Maryland were planted with over 400 million juvenile *Crassostrea virginica* oysters (spat; ~2mm shell height). Spat survival was monitored 4-8 weeks post-planting on all 20 bars. Mean survival in 2009 was 11.99%. Survival was negatively correlated with the density of spat planted ($R^2 = 0.137$, $P < 0.01$) and the number of spat initially on the shell when it was planted ($R^2 = 0.446$, $P < 0.01$). These trends were not mirrored in 2008 post-planting monitoring spat survival data and may be an anomaly to the 2009 cohort. However, the 2009 trends suggest that spat survival had some element of density dependence in that year. This density-dependence was further supported by a maximum

estimated population of approximately 4 million spat per bar regardless of the amount of spat initially planted. We believe this density-dependence is either predation or nutrient-based and experiments are currently underway to understand the cause of the high spat mortality observed in Maryland in 2009.

Fac, Oral

“In sickness and in health:” rapid assessments of Mesoamerican coral reefs (MAR) reveal the patchwork impacts of acute and chronic perturbations.

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Mesoamerica's reefs have experienced hurricanes for millennia; anthropogenic threats (inappropriate land use practices, overfishing) have been escalating for centuries. Diseases have decimated some key organisms (herbivorous *Diadema*, acroporid corals) in recent decades. Mass bleaching, diseases and Hurricane Mitch (especially in Belize) profoundly impacted MAR reefs in 1998, and their lingering effects were evident in the high prevalence of coral diseases and/or recent mortality during AGRRA assessments off México's Yucatán coast and Belize in 1999 - 2000. Hurricanes further damaged reefs in Belize (2001, 2001) and Honduras (2001). Recent mortality had declined overall during WWF's MAR surveys in 2001, although diseased corals were more common off Honduras and the Yucatán than in Belize. Hurricanes hit northern Yucatán reefs in 2002, 2004 and 2005, but bleaching during the 2005 thermal event caused little mortality anywhere in this ecoregion. Comprehensive AGRRA surveys throughout the MAR by TNC, WWF and partners during 2005 and 2006 revealed that: diseases remained unusually common off Honduras; and *Diadema* is beginning to recover, yet macroalgae have increased as live coral cover continues to decline. Given growing stressors of global warming and ocean acidification, stronger local protection may help shift reefs towards “for better” and minimize further “for worse.”

Fac, Oral

Fish utilization and nursery function of ocean surf-zone habitat: short- and long-term effects of beach renourishment.

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We describe the assemblage structure, seasonality and recruitment patterns of ichthyofauna utilizing shallow surf-zone habitats at Wrightsville Beach, North Carolina. Year-round sampling initiated in May 2004 is performed biweekly (May-September) or monthly (October-April) using a 30x2m bag seine. To date, 561 seine hauls have yielded 119,197 individuals representing 71 species and 30 families of fishes. Numerically-dominant species include *Membras martinica* (35% of total individuals), *Anchoa hepsetus* (28%), *Trachinotus carolinus* (10%), *Menticirrhus littoralis* (6%) and *Engraulis eurystole* (4%). Fish densities, species richness and diversity were positively correlated with water temperature, peaking during summer/early fall and declining during late winter. Surf sites appear to function as nurseries for several commercially-important species, including *T. carolinus* and *M. littoralis* which recruited as small juveniles during May/June and remained until December. Sand renourishment of Wrightsville Beach during April 2006 resulted in high (>150 NTU) turbidities, reduced sediment grain sizes, altered beach profiles and reductions in benthic invertebrate densities. The response of the surf-zone fish assemblage to these disturbances will be discussed.

Fac, Oral

Ecosystem-level interactions within fragmented mussel beds (*Mytilus spp.*)

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Ecologists still have to elucidate the complex feedbacks operating among habitat fragmentation, biodiversity and ecosystem functioning. To address this, a field experiment was conducted to mimic natural mussel bed ecosystems (*Mytilus spp.*) in the Lower Saint-Lawrence Estuary (Quebec, Canada) and partition the effects of their biotic and abiotic components and spatial structure on ecosystem function (e.g. N fluxes) and community dynamics of associated organisms. Results demonstrated that individual mussel growth is negatively affected by the presence of associated organisms and organic sediment. This feedback was shown to be mediated by mussels' metabolic activity: NH⁴⁺ release increased when mussels were alone. Finally, variations in nitrogen fluxes and colonization by associated organisms was modulated by the level of habitat (mussel bed) connectivity. Our study reveals the potential for feedback interactions linking habitat structure, community dynamics and ecosystem function in marine systems. They further stress the importance of adopting a dynamic meta-ecosystem framework to mediate impacts of habitat fragmentation associated with ecosystem engineers such as mussel beds.

Grad, Oral

Patterns in prey anti-predator behavior based upon habitat type and geographic location

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Nucella lapillus is an abundant gastropod in the North Atlantic, ranging from Long Island to Greenland. Within its range, *Nucella* are common in both protected and exposed shorelines. In the presence of predators *Nucella* express behavioral and morphological phenotypic plasticity, yet behavioral response is less understood. On protected shorelines, *Nucella* experience heavy predation from *Carcinus maenas* and develop thicker shells to deter predation. On exposed shorelines, *Carcinus* is not present, predation risk decreases, and *Nucella* grow thinner shells with larger apertures. *Carcinus* is abundant in southern Maine, yet populations near the Bay of Fundy are small and ephemeral. Therefore, based upon predator dispersal and environmental factors, *Nucella* experience a range of predation risk. We compared induced behavioral changes in snails taken from different locations (Northern and Southern Maine), and different habitats within each location (exposed and protected shorelines). After a 45d induction period, we compared changes in behavior from each population to determine how location and habitat type influence *Nucella* behavioral response. Southern populations responded more to predators than Northern populations, and protected populations responded more than exposed populations. Differences in responses were greater between geographic areas (north vs. south) than between habitats (protected vs. exposed) within a geographic area.

Grad, oral

Establishment of an *in situ* *Acropora cervicornis* Nursery in Southeast Florida: an Evaluation of Survivorship and Growth

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In May 2006, *Acropora cervicornis* was one of two Caribbean stony corals listed as a threatened species by the Endangered Species Act. As a listed species, it is important to identify ways to maintain and enhance *Acropora* populations. In response to the current status of this species, an *in situ* coral nursery was established in southeast Florida to examine potential *A. cervicornis* restoration techniques. In December 2007, clippings from seven unique donor colonies were transplanted to the nursery. Each donor colony provided 9- 3 cm replicates to the nursery for a total of 63 fragments; 1/3 of the fragments were transplanted horizontally and 2/3 were transplanted vertically. The nursery was monitored monthly

through November 2008 collecting data on health, survivorship, branching events and growth. Overall survivorship after 12 months was 76%. Vertical fragments had higher survivorship, but horizontal fragments had higher mean growth rates and number of branches per fragment. These results suggest that examining alternative methods for transplanting horizontal fragments may increase survivorship yielding higher net production. Project results will provide guidance for future nursery activities and for potential large-scale *A. cervicornis* restoration and outplanting efforts.

Grad, Oral

The effects of short term salinity exposure on the sublethal stress response of *Vallisneria americana* Michx. (Hydrocharitaceae)

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The aquatic macrophyte *Vallisneria americana* forms dense meadows which provide the basis of highly productive benthic ecosystems. Many environmental factors negatively affect the overall health of this organism; one of which is increased water salinity. While previous studies have investigated the salinity tolerance of *V. americana*, little work has been devoted to the physiological and cellular impacts of short term (24h & 7d) salinity stress. We utilized a multi-parameter screening approach to provide an early detection of cellular damage prior to the onset of organismal death. Plants exposed to salinities of 15 & 20‰ showed a significant increase in cellular respiration after 24h and 7d. Further, a significant decrease in total shoot protein was observed after 7d. Salinity-induced oxidative stress was detected by loading blades with the fluorescent probe DCFH-DA, which is sensitive to reactive oxygen species (ROS). The presence of ROS was clearly visible in shoot tissue in plants exposed to a salinity of 10 ‰ after 24h. Further, the antioxidant enzyme superoxide dismutase was induced for plants exposed to salinities of 15 & 20‰ after 7d. The above methodology could be used to monitor sub lethal stress for populations of *V. americana* threatened by salt water intrusions.

Grad, Poster

Thermal tolerance and the effect of temperature on morphological plasticity of Pacific cod, *Gadus macrocephalus*

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Previous work on the growth of juvenile Pacific cod (*Gadus macrocephalus*) has suggested differences in the thermal reaction norm among cohorts from the same population. These differences are hypothesized to be the result of a non-genetic effect of variable thermal history. This study examines the physiological and morphological variation in response to temperature in early life history stages. The number of vertebrae in samples of juveniles from three cohorts (2006, 2007, 2008) were counted from x-radiographs. Vertebral counts ranged from 51 to 57 and were significantly higher in the 2007 cohort, the cohort born in the coldest year. These results are consistent with Jordan's Rule in describing the influence of temperature on morphological variation. In a separate laboratory experiment, the influence of post-hatch rearing temperature on high temperature tolerance was compared between two treatments. Maximum temperature tolerance of 11 mm larvae was 19°C and did not appear to be influenced by thermal history. While there was no significant difference in thermal sensitivities, variation in vertebral number indicates that environmental conditions during early life history stages do have an influence on morphology and that vertebral number is plastic.

UG, Oral

Color variation in *Carcinus maenas*: What about the females?

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Male green crabs, *Carcinus maenas*, exhibit two color phases, red and green. The red color is hypothesized to develop during prolonged intermolt. Evidence suggests that green phase crabs are growing while red phase crabs are putting their energy into reproduction. The color change comes with a trade-off in that male red phase crabs are less tolerant of physiological stress but are larger, more aggressive and more likely to mate. Little work has been done on the phenomenon in females. Our work documents the color variation phenomenon in female *C. maenas*. Preliminary analysis of several years of data across multiple sites suggests that, like male crabs, female red phase crabs are larger than female green phase crabs, and less physiologically tolerant. Several female crabs which molted in captivity changed color from red to green, and the overwhelming majority of egg-bearing females are red. On the other hand, female red phase crabs are often more common and do not seem to be more aggressive than green phase crabs. Our data suggests that the color change phenomenon exists in females and may be related to intermolt duration but has several important differences from the phenomenon in males.

Faculty, poster

Spatial and temporal patterns of feeding disturbances by a large epibenthic predator on a mudflat

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Historically, studies of disturbances have focused on the non-spatial components such as the intensity and frequency of disturbances and rate of recovery of disturbed patches. Modeling studies of terrestrial systems indicated that spatial and temporal patterns of disturbances may be significant in determining the responses of communities to disturbances. Similarly, the spatial relationships among individual disturbances may be key to understanding how disturbances shape benthic communities. Feeding disturbances caused by epibenthic predators are a common cause of small-scale variability in softsediment communities, but are particularly difficult to observe without causing disturbance to the benthos. Spatial and temporal autocorrelation of feeding disturbances by the Atlantic Horseshoe Crab (*Limulus polyphemus*) on a mudflat was investigated in the summer of 2009 using a novel method. Two 70m cables were suspended 3m above a mudflat, along which a video camera was guided across. This allowed the observation of the mud surface at high temporal and spatial resolution from June to October without disturbing the benthos. The monitored area were divided into contiguous 1.5m×1.5m quadrats and the density of *Limulus* feeding pits found within each quadrat was quantified and analysed to examine the spatial and temporal dependence of *Limulus* feeding disturbance.

Grad, Oral

Successional trajectories of food web reorganizations on Caribbean coral reefs.

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The transition from *Acropora* to *Porites* dominated coral reefs has altered the structural landscape of Caribbean coral reefs. This transition resulted in a loss of morphologically complex corals to structurally simple reefs dominated by *Porites* and macroalgae. Though often discussed, experimental assessments of the impacts of this transition on reef ecosystem function are rare. Our study addressed this gap in knowledge. Since corallivory is rare in the Caribbean, we hypothesized that loss of complex structure, rather than loss of living coral, primarily resulted in the reorganization of Caribbean food webs. Based on comparisons using structurally similar coral surrogates, we discovered that loss of living coral shifted reef

food webs from dominance by habitat specialists to dominance by habitat generalists. Even so, we did not detect an impact on consumer feeding. Unexpectedly, loss of structure increased grazer densities, presumably due to competitive exclusion from elkhorn by damselfishes. Parrotfish accounted for all observed grazing and invertebrate predation in simple habitats. Coupled with prior studies, our results suggest that live coral loss can precipitate shifts in reef fish assemblages regardless of the level of complex structure. Ecosystem processes are not affected until structure degrades, allowing generalist grazers to proliferate.

Grad, oral

Variation in resource allocation strategies across environmental gradients in the intertidal snail *Littorina saxatilis*.

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The herbivorous snail *Littorina saxatilis* is a dominant species throughout rocky intertidal shores along the St. Lawrence estuary. This habitat is characterised by the presence of steep environmental gradients. Life-history traits can be related to habitat characteristics through mortality regime, resource availability and other environmental pressures. Therefore, gradients in the intertidal zone are likely to affect such traits in organisms living there. It has been observed that snails from the lower tidal levels tend to be larger and more fecund than those from the higher levels. However, reciprocal transplant experiments have shown that, when placed in the same tidal level, snails from the higher level tend to grow faster. These differences could be explained by underlying variations in resource allocation strategies. Patterns of growth and reproduction through the intertidal zone were investigated with common garden experiments. These experiments were conducted with snails collected from both high and low levels in the intertidal zone and provided two different food abundance treatments. Under both food treatments, snails from the lower level had a larger reproductive output but a lesser growth. These results suggest that differences in habitat due to gradients in the intertidal zone can create long-lasting effects in resource allocation strategies.

Grad, Oral

Temporal change at deep cold-seep communities in the Gulf of Mexico

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Imagery, collections and Geographic Information Systems (GIS) analyses were used to examine temporal change within deep cold-seep mussel, tubeworm, and urchin aggregations. Over 1 and 15-year intervals, small mussels replaced bacterial mats, and large mussels and tubeworms replaced small mussels, providing evidence for successional patterns similar to those documented in related cold-seep communities. Also, small mussels replaced areas consisting of crushed shells and tubeworms, suggesting that small-scale seepage changes contribute to changes in species distributions. Seep sites dominated by urchins change over shorter time scales, and were studied over 3, 9 and 12-day intervals to establish the extent of urchin movement and bioturbation. Sediment cores from urchin trails, underneath urchins and background sediments were processed to determine meiofauna diversity and abundance. To tease apart the effect of urchin bioturbation and predation on meiofauna, sediment was artificially disturbed and sampled after 9 days. Urchin-bioturbated sediments had higher meiofauna abundance than background or artificially disturbed sediments. Preliminary results indicate that artificially disturbed sediments had the highest genera richness, and urchin activities decrease meiofauna genera richness. These data suggest that urchins may be specialist feeders, or that specific genera recruit to urchin-disturbed sediments, perhaps due to urchin enrichment of the sediment.

Grad, Oral

Mixed messages evolve to induce behavioral assortment in a diffuse mutualism

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The mutualism between Caribbean cleaner gobies and their “client” fishes appears to involve the evolution of traits reducing the costs of interactions with risky individuals. Advertising stripes induce predators to become clients that receive parasite-cleaning services, in turn providing a reliable food source for the gobies. Our results highlight evolution from predator resistance traits (camouflaged colors within aposematic patterns) to tolerance traits (conspicuous advertising stripes and chemically mediated attack reduction). These shifts were most likely driven by the sensory and learning biases of a large suite of piscivorous reef fishes. Stereotypical client posing behavior and attack occurrences varied inversely among control, yellow, and blue striped models in the field, with blues receiving more posing and fewer attacks. In addition, wild caught cleaners deterred predation in feeding trials, surviving more often and for longer with small predatory fishes. Cleaner status was a significant predictor of survival, and blue cleaners were spit out more often than other goby species. We propose *Elacatinus* gobies have evolved with exaptations to deter and reduce the cost of attacks. A dual signal has mediated this shift from conflict to cooperation via tolerance. Similar trajectories of evolution from resistance to tolerance occur in other diffuse mutualisms.

Grad, Poster

Spawning synchrony and temporal reproductive isolation in corals

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Fertilization success of broadcast spawners depends on the distribution, abundance and timing of gamete release of conspecific and heterospecific individuals. The likelihood of fertilization by heterospecific individuals depends on the rate at which eggs are fertilized by conspecific sperm, as well as the availability of heterospecific sperm. Two closely related Caribbean corals, *Montastraea annularis* and *M. franksi* have compatible gametes and both spawn on the same few evenings each year. Adult colonies from both species can be spatially mixed on reefs and reproductive isolation is dependent on the effectiveness of a small gap in spawning times between these two species. We have set up a permanent study site on a reef in Bocas del Toro, Panama where we have tagged and genotyped close to 500 corals and measured patterns of spawning and reproductive success since 2002. Genetic data suggest some level of hybridization correlated with individual specific spawning times and we are examining hypotheses on how spawning abundances can interact with spawning synchrony to influence the likelihood of hybridization versus reproductive isolation in these corals.

Fac, Oral

Influence of zoanthid inhabitants on pumping rates of two Caribbean vase sponges.

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Sponges filter large volumes of seawater, thereby clarifying the water column and contributing to reef carbon and nitrogen cycles. Our lab is currently examining endogenous and exogenous controls of pumping rates of Caribbean sponges. For example, field measurements of pumping by the giant barrel sponge, *Xestospongia muta*, suggest that pumping scales linearly with tissue volume across a size range from 0.1 to 500 L. Many sponges, including *X. muta* and the vase sponge *Niphates digitalis*, can occur with zoanthid (*Parazoanthus spp.*) polyps covering some or most of their inhalant and exhalant surfaces. Do commensal zoanthids have negative consequences for sponge pumping, and potentially feeding and growth? We used acoustic Doppler velocimeters (ADV) at sites in the Bahamas and Florida Keys to measure exhalant currents of infested and zoanthid-free sponges. Preliminary results show that pumping rates normalized for tissue volume of infested *X. muta* are one-third of those of zoanthid-free sponges.

Such a profound decrease in pumping rates could affect the ability of sponges to feed and grow, and may affect water column quality over reefs.

Grad, Oral

Anoxia in the nearshore coastal waters of South Carolina along the Grand Strand.

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Since July 2004, hypoxic conditions have been intermittently observed in the nearshore waters of Long Bay, a coastal embayment that borders the sandy beaches of the Grand Strand. To characterize the temporal and spatial dynamics of dissolved oxygen (DO) in Long Bay, datasondes have been deployed since 2006 at Apache Pier in northern Myrtle Beach, SC in the surface (0.5m) and bottom waters (6.5m). The longest and most intense period of hypoxia observed by these sondes occurred during August and September 2009. Hypoxic conditions were present during 39% and 10% of a 10-day period (8/18-8/28) in the bottom and surface waters, respectively. During 10% of two of these days (8/19-8/20), the bottom waters were anoxic. Another period of hypoxia occurred from 9/16 to 9/19, with hypoxic conditions present in the bottom waters during 41% of this period. Anoxic conditions were present during 33% of two of these days (9/16-9/17). In contrast to the August event, neither hypoxia nor anoxia were observed in the surface waters. Both events occurred during a spring tide and DO concentrations oscillated in synchrony with the semidaily tidal stage. During August, the lowest DO coincided with high tide. This was reversed during the September event. A time series of vertical profiles collected from this and other fishing piers document the geographic spread of low DO throughout Long Bay and the history of stratification in temperature, salinity and DO. The latter provides evidence for the influence of physical drivers including upwelling, inner shelf fronts, and groundwater input.

Fac, Oral

How corals fight diseases: innate immunity in the staghorn coral *Acropora cervicornis*.

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The global rise in disease epidemics due to climate change has severely impacted marine communities. Reef-building corals have been particularly vulnerable, and yet many aspects of the coral host-pathogen interaction still remain unresolved, including how corals respond to disease infection. Corals possess an innate immune system, but we have only a rudimentary understanding of how it functions. Using next generation sequencing data, we have identified the key components of the innate immune pathway in the reef coral *Acropora cervicornis*. By comparing our transcriptome data against model organisms such as *Drosophila melanogaster*, humans and the sea anemone *Nematostella vectensis*, we show that corals have a more well-developed innate immune system than previously described, possessing most of the immune gene families found in bilaterians. These results provide new insights into the early metazoan immune pathways and the basic immunological “tool kit” of the common ancestor of all animals. In an applied context, these results present key genetic information on how corals react to infections. This knowledge is critical to the conservation of threatened reef corals and has direct conservation implications for the endangered Caribbean staghorn coral *A.cervicornis*.

Grad, Oral

Patterns of polymorphism and divergence at M3 and M6 lysin loci, candidate gamete recognition genes in the blue mussel *Mytilus edulis* species complex.

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Many studies of speciation in benthic marine invertebrates focus on gamete recognition proteins, and adaptive evolution of these proteins has often been linked to prezygotic isolation. The blue mussel *Mytilus edulis* species complex is composed of three species that frequently hybridize in nature. *Mytilus*

has three acrosomal proteins (M3, M6 and M7 lysin) that dissolve the egg vitelline envelope, and are thought to control species recognition. Previous studies have found M7 lysin to be under positive selection, suggesting this lysin is responsible for the species specificity of crosses. However, earlier studies in our lab suggest it is not involved in gamete recognition. Here we show data from the other two, previously uncharacterized, lysins (M3 and M6). We have isolated and sequenced multiple full length cDNA copies of both lysins, and analyzed their patterns of polymorphism and divergence. Both M3 and M6 lysins are highly divergent, due to multiple fixed amino acid replacing substitutions between the two species that hybridize in the northwest Atlantic (*M. edulis* and *M. trossulus*), suggesting that both M3 and M6 are good candidate gamete recognition genes. We present a comparative analysis of patterns of molecular evolution and positive selection of these newly characterized lysins.

Grad, Oral

Dinitrogen gas production by dominant sponges on Conch Reef, Florida Keys (USA) measured by underwater Membrane Inlet Mass Spectrometry (MIMS).

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High microbial abundance (HMA) sponges dominate the benthos and are a major control on particulate and dissolved nitrogen fluxes and chemical transformations in many coral reef ecosystems. The microbial communities hosted by HMA sponges *Xestospongia muta* (*Xm*, barrel sponge) and *Ircinia stobilina* (*Is*, stinker sponge), representing over 60% of the erect sponge biomass on Conch Reef off Key Largo, Florida, transform both dissolved ammonium and nitrate (DIN) into dinitrogen gas. Respiration by *Xm* and *Is* generally results in a 5-15% oxygen drawdown in the huge volumes of ambient water they pump through their tissues. Excurrent dissolved carbon dioxide concentrations increase as predicted from Redfield stoichiometry. However, excurrent DIN production is less than half of predicted values. Does dinitrogen gas production account for the missing N? We tested our Missing N hypothesis in situ utilizing a cabled underwater Membrane Inlet Mass Spectrometer (MIMS) capable of continuously monitoring production of dissolved dinitrogen gas as masses 28 and 29, the latter generated in N-15 labeled ammonium and nitrate spiking experiments. The MIMS also continuously measured other dissolved gases including O₂ (32), Ar (40) and CO₂ (44, 45). High rates of mass 29 dinitrogen production were observed using both forms of labeled DIN.

Fac, Oral

Estuarine invertebrates and forage finfish as bio-indicators of environmental mercury levels in the Narragansett Bay (Rhode Island, USA) Jennifer.C.Linehan, David.L.Taylor, Roger Williams

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Environmental mercury (Hg) contamination is of particular concern because Hg bioaccumulates in aquatic food webs and exposure has deleterious effects on biota, including humans. The potential health risks associated with Hg exposure justifies the development of monitoring programs that link environmental and biological Hg contamination. In this study, sediments collected from the Narragansett Bay Estuary (0-2 cm; 54 sites) were analyzed for total Hg concentration and examined relative to site-specific biogeochemical and abiotic conditions. Moreover, the utility of estuarine invertebrates and forage finfish as bio-indicators of environmental Hg pollution were assessed. Sediment Hg concentrations were positively correlated with total organic carbon, and inversely related to bottom salinity and dissolved oxygen. A significant positive correlation between sediment Hg levels and the Hg content of gastropods, bivalves, and zooplankton was also found. Conversely, polychaetes, macrocrustacean, and finfish Hg body burdens were not significantly related to environmental Hg levels.

The effectiveness of estuarine biota as bio-indicators of environmental Hg contamination is taxon-specific, and is likely influenced by feeding ecology, longevity, and site fidelity.

UG, Oral

Fish nursery function of ocean surf-zone habitat: response to a human disturbance gradient

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The ocean surf zone provides essential habitat for a variety of coastal marine fishes. Surf zones are particularly important as juvenile nursery habitat. The nursery function of surf zone habitat may be compromised by human disturbances to adjacent beaches. Although shoreline development and sand renourishment are common practices on barrier island beaches of the southeastern U.S., their impacts on fish nursery function are poorly described. We are investigating the response of fish nursery function to beach disturbance by comparing the assemblage structure, density and nutritional condition of juvenile fishes sampled from beaches selected to represent a human disturbance gradient. Sampling sites include undisturbed (undeveloped and unnourished, n=3), moderately disturbed (developed but unnourished, n=2) and highly disturbed (developed and nourished, n=3) beaches in southeastern North Carolina. Nursery function is indexed based upon the diet and compositional analysis (tissue lipid content, ash content, somatic condition) of two surf-dependent species: Florida pompano (*Trachinotus carolinus*) and Gulf kingfish (*Menticirrhus littoralis*). Preliminary results suggest that highly-disturbed beaches differ significantly in fish species composition compared to undisturbed sites, and that fish nursery function for *T. carolinus* and *M. littoralis* is compromised on highly-disturbed beaches.

UG, Poster

A Coral Gardening Program for the Propagation and Restoration of the Threatened Staghorn Coral, *Acropora cervicornis*, in Florida.

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The staghorn coral, *Acropora cervicornis*, was once a dominant species throughout the Caribbean. Due to hurricanes, disease, and other human and natural stressors, its populations have declined dramatically in the last few decades. In an attempt to propagate this species for local restoration efforts, a coral gardening program was initiated in Florida in 2007. Branches of *A. cervicornis* were clipped from donor adult colonies and cemented onto cinder blocks in an underwater nursery located within Biscayne National Park. Nursery fragments were monitored regularly to evaluate patterns of growth and mortality based on fragment size and parent genotype. Fragment mortality was 17.3% in the first 8 weeks after transplantation, but decreased to <1% in subsequent monitoring intervals. Larger-sized fragments (> 5 cm) grew significantly faster than small (< 3 cm) fragments, but production based on the initial size of the fragment (cm of new tissue per cm of original tissue) was higher for smaller fragments. Based on the limited impacts on the donor stock, low fragment mortality, and fast growth of nursery fragments, we have demonstrated that the coral gardening approach can be an effective method for the propagation of the threatened staghorn coral.

Fac, Oral

Spatial and Temporal Patterns of Microbial Nitrogen Removal Potential (Anammox and Denitrification) in New River Estuary

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Estuaries and coastal areas are extremely important ecosystems with the highest biological productivities on earth. Excess nitrogen loading from anthropogenic activities is one of the greatest threats to the ecological integrity of estuaries. The New River Estuary (NRE), NC consists of a series of shallow lagoons that span over a 1400 km² area. Non point source pollution contributes to nutrient loadings and subsequently eutrophication. In order to estimate N removal capacity of the NRE, we investigated spatial

and temporal variations in anammox and denitrification rates in estuarine sediments along transects of 12 stations in the NRE using ^{15}N isotope incubation tracer techniques. Preliminary results indicate that rate variation occurs spatially and seasonally with activity being highest in the headwaters during the winter months. Denitrification rates range from 0-40 nmol N g⁻¹h⁻¹ and anammox rates range from 0-4 nmol N g⁻¹h⁻¹. Anammox contributes 0-15% of overall N removal in NRE. Additionally, molecular techniques will be used to identify seasonal shifts in community structure of anammox and denitrifying bacteria and ultimately gain insight into N removal processes in the New River Estuary.

Grad, Poster

Habitat Selection of Parrotfish in the Flower Garden Banks National Marine Sanctuary.

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Parrotfish benefit coral reefs by removing macroalgae which would otherwise outcompete the coral. Parrotfish also cause detriment to the reef by feeding directly on corals, however, parrotfish corallivory in the Caribbean is limited mostly to recoverable events. This study aimed to quantify parrotfish feeding dynamics on the Flower Garden Banks National Marine Sanctuary (FGBNMS), a series of coral reefs in the northwestern Gulf of Mexico characterized by high living coral and low macroalgal cover in comparison to Caribbean reefs. Rotary time lapse cameras were used to capture a 360° panorama every 3 hours from which parrotfish (*Scarus vetula*, *Sc. taeniopterus*, *Sparisoma viride* and *Sp. aurofrenum*) abundance was gathered. Cameras were deployed at 9 different sites for 5-20 days. Coral reef species composition was analyzed at each site and correlated to parrotfish abundance in order to create a hierarchy of habitat preference for each species of parrotfish. Overall parrotfish abundance was low at all sites in comparison to Caribbean reefs which may reflect low food choice preference. Comparing grazing selectivity of the same species of parrotfish in different habitat compositions may increase understanding of underlying feeding motivation which leads to the selection of certain coral or macroalgae.

Ciguatera Fish Poisoning in the US Virgin Islands: Seasonal invariability of Gambierdiscus abundance on a widely varying macroalgal population

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Ciguatera fish poisoning (CFP) is the most commonly reported non-bacterial illness associated with the consumption of seafood and causes a range of negative health effects in humans. CFP is caused by gambiertoxins produced by marine benthic dinoflagellates of the genus *Gambierdiscus*, with macroalgae as a preferred substrate. In shallow coral reefs of the US Virgin Islands, *Dictyota* spp. are the most abundant macroalgae, covering up to half the benthic substratum, and can host large populations of *Gambierdiscus*. We hypothesized that populations of *Gambierdiscus* vary with seasonal environmental parameters and *Dictyota* abundance. We analyzed *Gambierdiscus* abundance on *Dictyota* at four coral reefs over a year, while simultaneously measuring benthic composition and environmental parameters. We found the abundance and distribution of *Gambierdiscus* to be seasonally invariable, even with moderate fluctuations in temperature and light, and a large, six-fold change in the benthic cover of *Dictyota*. This suggests that environmental fluctuations and macroalgal abundance are weak predictors at the reefs studied. However, epilithic algae negatively covaried with *Dictyota* and was not sampled. Thus, future efforts should target *Gambierdiscus* abundance on both *Dictyota* and epilithic algae to understand if whole-reef abundances of *Gambierdiscus* exhibit seasonality that may influence the incidence of CFP in humans.

Grad, Poster

Fatal attraction? No, the Caribbean Orange Icing Sponge does not prefer to settle on corals.

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Despite intense competition among benthic sessile organisms on space-limited coral reefs, the commonly observed association between the Caribbean Orange Icing Sponge *Mycale laevis* and scleractinian corals has been hypothesized to be mutualistic. As a result of this putative mutualism, does the sponge specifically settle in response to the presence of live corals? Settlement assays demonstrated that larvae of *M. laevis* did not preferentially metamorphose in the presence of live coral relative to other substrata. Moreover, benthic surveys showed that *M. laevis* occurred on other kinds of substrata, such as dead coral and other species of sponges. Sponge predation is offered as an alternative explanation for the sponge-coral association. Previous experiments have demonstrated that *M. laevis* is readily eaten by sponge-eating fishes on the reef when exposed. The sponge thus gains an obvious advantage from associating with corals- that of a predation refuge, an advantage that is also conferred by other reef substrata. In overfished areas where sponge predator densities are low, the proposed mutualism breaks down and *M. laevis* actively competes with live corals for space. The apparent association of *M. laevis* with live corals is driven less by a mutualistic relationship, and more by post-settlement mortality due to predation and substratum availability.

Grad, Oral

Dropping science on the variation of inducible resistance between *Spartina* populations in the field

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Intraspecific variation in the strength of inducible plant defenses plays a central role in the interactions between plants and herbivores. Studies of this variation are typically conducted in the greenhouse or laboratory rather than the field, which limits the ability to identify realized consequences. We simultaneously manipulated densities of local consumers in the field within Maine and South Carolina populations of the smooth cordgrass *Spartina alterniflora*. South Carolina, but not Maine, plants induced resistance when grazed by local consumers. South Carolina populations of *Littoraria* snails and planthoppers colonized control more than previously-grazed South Carolina plants, and *Littoraria* snails consumed more control than previously-grazed plants. The inducible feeding deterrents in South Carolina plants appear to be water-soluble, but not phenolic-based. In contrast, grazed and control plants from Maine populations did not differ in attractiveness or palatability to Maine herbivores. Thus, inducible plant responses by South Carolina plants had a strong effect on the South Carolina herbivore community, but no analogous effect occurred in Maine. Field experiments are a powerful approach to detecting realized strength of inducible plant resistance and their impacts on local herbivores, which in this case were shown to vary with location.

Fac, Oral

Interactive effects of enrichment and the manipulation of intermediate hosts on infection prevalence and food web structure

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In benthic food webs, parasites with complex life cycles frequently increase their transmission to definitive hosts (where reproduction occurs) by increasing the susceptibility of intermediate hosts to predation by definitive hosts. While recent evidence finds that eutrophication can alter the relationships between hosts and parasites, whether eutrophication interacts with intermediate host modification to influence infection prevalence and food web structure remains unknown. We develop a nutrient-limited

food web model to investigate how parasitic manipulation of intermediate host susceptibility, nutrient supply, and predator diversity determine parasite abundance and infection prevalence in intermediate and definitive hosts. We show that the effects of intermediate host susceptibility on parasite abundance and infection prevalence are not only less responsive than effects due to increasing nutrients, but are also dependent on enrichment. In contrast, the coexistence of competing definitive hosts and “dead-ends” (where parasites cannot reproduce) depends on the susceptibility of intermediate hosts, but does not depend on enrichment. Our results suggest that anthropogenic changes in nutrient supply will have a greater effect on parasite abundance and infection prevalence in benthic systems than responses of intermediate hosts to parasites, but responses of intermediate hosts will have a greater influence on benthic food web structure than enrichment.

Fac, oral

***Solenastrea bournoni* and *Stephanocoenia intersepta* sexual reproduction offshore southeast Florida, USA**

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Although scleractinian coral reproduction has been widely studied since the early 1980's for many species throughout the Caribbean, it has not been documented in *Solenastrea bournoni*, and only limited information has been collected for *Stephanocoenia intersepta*. The purpose of this study is to determine the reproductive mode and gametogenetic cycle of *S. bournoni* and *S. intersepta* offshore southeast Florida. Tissue samples were collected bi-weekly from July 2008 through July 2009, and weekly or semi-weekly from August through November 2009. Samples were processed for histological examination of gamete stage and oocyte abundance. Both *S. intersepta* and *S. bournoni* are gonochoric broadcast spawning species. Data for *S. intersepta* indicate spawning occurred after the full moon of August in 2008 and after the full moon of September in 2009. Late stage gametes were present in samples of *S. bournoni* from June through December. Abundance of late stage oocytes indicates spawning potentially occurred monthly after the full moon from August through October in 2008 and from July through September in 2009. This study will broaden our understanding reproductive capabilities of these two locally abundant species and may also benefit future management practices in areas of reef restoration and recovery.

Grad, Oral

Effects of the northward expansion of *Avicennia germinans* on *Spartina alterniflora* salt marsh benthics.

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Avicennia germinans (black mangrove) is moving northward into *Spartina alterniflora* salt marshes. This northward expansion of species is generally attributed to global warming, as mangroves were historically restricted by winter freezes. The influence that mangroves have on salt marsh ecosystems has not been documented. Therefore, this study examined the effects of mangrove expansion on benthic communities. Our results indicate that presently mangrove expansion has had no major effects on the community structure. Tests of fiddler crabs (genus *Uca*) habitat preference showed they only preferred drier soil not vegetation type. Texas coastlines exhibit zonation where black mangroves are established, with mangroves in the higher, drier soil and *Spartina* submerged. Our results showed no significant difference in benthic organism counts between the habitats but it was slight ($p=0.069$). The sites used did exhibit a significant difference in organism counts ($p=0.013$) with the more established mangrove stands of the Lower Laguna Madre containing more organisms than the mangroves of Corpus Christi Pass. However, if

stands continue to grow, noted effects may occur in the future. This research provides a baseline to which future ecosystem responses may be compared as mangroves become more established in Texas.

Grad, Poster

Shrimp-goby mutualism: insights into evolution of partner specificity and dependency

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Variation exists in the degree to which mutualist species depend on one another. Dependent mutualists have morphologies and behaviors that increase survival of their partners which in turn increases their own survival. The system of interest involves the relationship between Alpheid shrimp and Gobiidae fishes. Shrimps provide gobies with burrows to escape predators while gobies warn the poor sighted shrimp of predator presence. In this study, I examined behavioral differences between three goby species that appear to exhibit different levels of dependence on a single Alpheid species. In the field, I observed gobies and recorded several variables related to dependency on shrimp. I also conducted laboratory behavioral experiments testing for preferences in gobies for burrows with or without shrimp. The results of both imply that a single goby species, *Nes longus*, is dependent. *Coryphopterus glaucofraenum* appears to only accidentally use shrimp burrows while avoiding shrimp contact. *Ctenogobius saepepallens* is an intermediate between the two. My results demonstrate that multiple strategies can persist within a single mutualism system. I discuss future plans to elucidate the selective forces that promote and deter dependency. My work may provide a clearer answer to why mutualist species exhibit great variation in their interactions.

Grad, Oral

Relationship between the bright coloration of juveniles and agonism by territorial adults in damsselfishes.

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Many reef fishes are more colorful as juveniles than as adults, and one explanation is that juvenile coloration reduces the agonism juveniles receive from adults. We tested the effect of juvenile coloration and size on the territorial defensive behavior of adults of two damsselfishes, *Stegastes planifrons* and *S. adustus*. We presented adults with wooden "intruder" models which differed by both color and size. We then recorded four common indicators of agonism (approaches, displays, touches and bites) exhibited by the adults. Overall *S. planifrons* territory-holders had higher levels of agonism than *S. adustus*. Juvenile coloration significantly decreased agonism from conspecific adults, but model size had no effect. The pattern of intraspecific agonism supports the hypothesis that juvenile coloration reduces agonism from conspecific adults. Juvenile coloration surprisingly did not decrease agonism from heterospecific adults, however, and actually led to an increase in agonism against *S. planifrons* from *S. adustus*. This last result might be because *S. planifrons* are more aggressive as adults, and *S. adustus* benefit from chasing juvenile *S. planifrons* from their territories before they become too large to evict. In any event, the effect of juvenile coloration on adult aggression is not necessarily transferable across species.

Fac, poster

Impacts of intense fishing pressure on energetic pathways in a coral reef ecosystem

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The reorganization of food webs due to overfishing has been hypothesized to have had important cascading effects both directly and indirectly on marine communities. Typically, traditional descriptors of community structure (changes in organism size, relative abundance, and biomass) have been used to

support this hypothesis but none describe impacts of intense fishing pressure on how energy flows through the system. We utilized food web macrodescriptors (species richness, community trophic level, connectivity, and linkage density) to compare pathways of energy flow in food webs located at fished and no-take reefs in the Florida Keys (USA). In comparison, species richness, community trophic level, mean number of linkages, and linkage density were higher at no-take than fished sites. While connectivity was higher on fished than no-take reefs, differences in connectivity were small. Reanalyzing these metrics following removal of exploited species from the no-take site data set led to results that were similar to those calculated for fished reefs. These results suggest that foraging by lower order consumers is not affected to any great extent by the presence of higher order consumers or that the estimated magnitude of difference in piscivore composition among these sites is not ecologically significant.

Grad, Poster

Landscape impacts on water quality in three oligohaline tidal creeks

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A series of physical, chemical and biological samples were taken at 12 sites within three oligohaline creeks of differing human development, during both dry and wet weather. The most urbanized stream yielded the highest BOD, orthophosphate, chlorophyll *a*, total suspended solids (TSS) and surfactant concentrations, while the most rural stream yielded the highest total organic carbon concentrations. Percent watershed development and percent impervious surface coverage were positively correlated with BOD, orthophosphate, and surfactant concentrations, but negatively with total organic carbon. Excessive fecal coliform bacteria abundance most frequently occurred in the most urbanized catchments. BOD was strongly correlated with chlorophyll *a* for all sites combined. Fecal coliform bacteria, TSS, turbidity, orthophosphate, total phosphorus and BOD were significantly higher during rain events compared to non-rain periods. Rainfall preceding sampling was positively correlated with turbidity, TSS, BOD, TP and fecal coliform bacteria concentrations. Turbidity and TSS were positively correlated with phosphorus, fecal coliform bacteria, BOD and chlorophyll *a*. Periodic severe hypoxia occurs at several of these sites, likely a function of both algal bloom decomposition and stormwater-driven runoff of BOD-inducing materials into the creeks. That, plus the strong relationship between TSS and pollutant parameters argues for better sedimentation controls under all landscape types.

Fac, Oral

The effect of temperature on virulence factors in a pathogenic marine fungus

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Changing climate factors in oceanic environments of the Caribbean have lead to more favorable conditions for many marine pathogens. Aspergillosis, a common disease of the octocoral, *Gorgonia ventalina*, caused by fungal pathogen *Aspergillus sydowii*, has contributed to widespread mortality across the Caribbean. Temperature increases associated with global climate change have been linked to this increase in disease prevalence and are hypothesized to decrease host resistance and/or augment pathogen virulence. We investigated the effects of incubation temperature on several measures of virulence in *A. sydowii*. Factors for virulence include protease activity, growth rate, and growth under oxidative stress conditions. Three specific strains of *A. sydowii* isolated from diseased corals were grown at ambient and elevated temperatures and virulence factors were measured. We predicted that more virulent strains will have higher protease activity, higher growth rates, and resistance to oxidative stress. Preliminary data indicate that temperature has an effect on protease activity and growth rates under normal and oxidative stress conditions. Strains grown on casein plates had significantly larger clearing zones and in general, higher levels of extracellular protease were shown by the fluorescent casein assay when incubated at elevated temperatures. These results are important in context of coral diseases and uncovering mechanisms by which temperature exacerbates disease prevalence and severity.

Grad, Poster

Spatial and temporal distribution patterns of *Ostrea equestris* within Southeastern North Carolina

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The crested oyster (*Ostrea equestris*) is a cryptic native oyster occurring throughout Southeastern North Carolina and areas south. Compared to the eastern oyster very few studies have focused on the biology of *O. equestris*. Interest in this small oyster has increased recently due to the discovery of two parasites (*Bonamia* spp.), that could potentially impact restoration efforts for *Crassostrea virginica*. The purpose of this study was to determine the distribution patterns in NC among critical habitats at 5 sites along the North Carolina coast looking at prevalence, density, and patchiness. While previously thought to be restricted to subtidal environments *O. equestris* has been sampled subtidally and intertidally, at all sites. In many locations, abundances were much greater than indicated in previous literature reports. *O. equestris* are temporally variable with highest densities occurring in areas of low intertidal sandy shell and on oyster reefs. The presence of recent shell scars and articulated boxes indicates high mortality and the potential for larger populations at most sites. High variance measures suggest a large degree of patchiness. This distribution, along with life history characteristics size, condition, and aspects of reproduction suggest considerable spatial variability in natural populations of this species.

Grad, Oral

St. John: A Fluctuating Ecosystem

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This film is an exploration of the fluctuating ecosystem on the small Virgin Island of St. John. After catastrophic storms and diseases wiped out the habitats of many underwater organisms, nature struggles to re-grow and flourish once again. Man often tries to intervene to fix the situation but sometimes organisms must work together to survive in this coevolved world. Sophomore filmmaking majors at Montclair State University have collaborated with students in the Biology Department to comprehend as much as they can about St. John's Communities and specifically the research regarding *Diadema* and Mysid Interactions in St. John's southern coast.

UG, Film

Regional Warming and Increased Abundance of Tropical Snappers and Groupers in the northern Gulf of Mexico: Could resident reef fishes be in hot water?

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Large and apparently unprecedented increases in juvenile gray snapper (*Lutjanus griseus*), lane snapper (*L. synagris*), and gag grouper (*Mycteroperca microlepis*) abundances within northern Gulf of Mexico (nGOM) seagrass meadows have been recently documented. Although naturally occurring within the nGOM, this region is a northern limit for these more tropically-associated species, and their increased abundance is suggested to reflect regional warming trends. Given past stability in the relative abundance of commercially important snappers and groupers in the nGOM, increases in tropically-associated confamilials may have consequential impacts upon the ecology of offshore fish assemblages. Increased numbers of lower latitude invaders establishing offshore adult populations could lead to competitive interactions with resident nGOM species and result in permanent species composition shifts within offshore fish assemblages. We have begun to investigate the increased abundance of early adult tropical snapper and grouper species within offshore nGOM hardbottom habitats through underwater video observations and by collections with chevron trap. Additionally, competitive interaction intensities between tropically-associated snappers and red snapper (*L. campechanus*) are being monitored within experimental mesocosms. We anticipate documenting warming-related shifts within offshore fish

assemblages, and assessing the ecological consequences of these lower latitude invaders upon the commercially important reef species of the nGOM.

Grad, Poster

Isolation and Characterization of Pigments Produced By Bacteria Associated with Chesapeake Bay Sponges

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Sponges are sessile animals which rely on pumping water through central chambers for nutrient uptake and removal of waste products. In many cases, sponges rely on symbiotic bacteria to help acquire oxygen, to produce secondary metabolites, or to aid in chemical defense against predators. The overall goals of our work are to identify secondary metabolites and to resolve how these compounds are utilized to provide a selective advantage for the sponge. Two different sponges, *Halichondria bowerbanki* and *Clathria prolifera*, were collected from the Chesapeake Bay. Bacterial species were isolated from their sponge larvae and 16S rDNA of all culturable, pigmented bacteria was sequenced. Two species of *Pseudomonas* (Cp101 and Hb301) were chosen to be investigated for their pigment-producing phenotypes. Pigments from Cp101 and Hb301 were extracted and purified using column chromatography and were subjected to initial spectroscopic characterization using UV-VIS, fluorescence spectroscopy, and mass spectrometry. Then, a fosmid library of the Cp101 genome was created and screened for the biosynthetic gene clusters responsible for producing the pigmentation. Determining the genes responsible for pigment production by the bacteria and characterizing the pigments will provide new information on the symbiotic relationship between these bacteria and the host sponges.

UG, Poster

Impacts of invasive Nile tilapia (*Oreochromis niloticus*) on coastal food webs

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Biological invasions are hypothesized to be among the greatest of the current threats to the structure of estuarine ecosystems. Concurrent with the increased rate of invasions in coastal areas is the increased dependence on wild fish stocks. One proposed solution to relieving fishing pressure is to increase the use of aquaculture, particularly using tolerant species such as Nile tilapia (*Oreochromis niloticus*). However, many of the characteristics that make tilapia a desirable aquaculture species also contribute to its success as an estuarine invader. A number of anecdotal reports show that tilapia have successfully invaded the waters of coastal Alabama. Here, we present the results of a test designed to experimentally assess the impact of unintended releases of tilapia on the habitat utilization patterns and food web ecology of native fishes. Laboratory experiments indicated that the agonistic behavior exhibited by tilapia leads to competitive displacement of native fish from their preferred structured habitats. As a result, this displacement led to decreased fish survival when piscivores were added. Based on these findings, we predict that the successful establishment of tilapia into coastal ecosystems will have important and catastrophic indirect effects on the functioning of native food webs.

Grad, Oral

Stoplights on the reef: The molecular biology, physiology and ecology of photoreception in coral larvae

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Photosensitive behaviors and circadian rhythms are well documented in reef-building corals and their larvae, yet the ecological role that photoreception plays in larval navigation and substrate recognition is poorly understood. While waterborne and membrane-bound chemical cues are known to influence larval settlement and metamorphosis, we provide evidence that color may also play a role. Here we provide evidence for attraction to red, during settlement, by larvae from two species of corals. Settlement experiments with *Porites astreoides* and *Acropora palmata* demonstrated that larvae are attracted to and preferentially settle on red substrates. Preference for red was not observed when larvae were maintained in the dark, suggesting that color sensitivity and selection was responsible for the observed preference. Immunohistology, indicates the presence of an opsin-like protein localized in epithelial cells of several species of larvae. Using Blast analyses and a PCR-based approach, we have identified, sequenced and cloned two full-length opsin cDNAs from *A. palmata* larvae. Electroretinographic traces confirm an opsin-like photosensitive response and indicate the spectral sensitivity peaks of coral photoreceptors are shifted towards the orange-red region of the visible light spectrum, similar to the spectral emission of preferred artificial (plastic) and natural (crustose coralline algae) settlement substrates.

Grad, Oral

The effects of biogenic oyster reefs on infaunal and epifaunal community structure in Rhode Island estuaries.

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The Eastern Oyster (*Crassostrea virginica*) is an ecologically important species that provides multiple ecosystem services, including the potential to increase complex habitat for resident marine fauna. The objective of this study was to determine if the presence of restored oyster reefs in Narragansett Bay (RI, USA) had significant effects on sediment nitrogen and carbon, and the abundance and diversity of benthic infaunal invertebrates, mobile epifaunal invertebrates, and finfish. During the summer of 2009, oyster reef (OR) and non-oyster reef (NOR) control sites were sampled on a biweekly basis using a combination of baited traps and benthic core samples. These data were used to determine if there were any differences in sediment characteristics and community structures of the OR and NOR sites. Time series data were also analyzed to determine if the community structure of these habitats significantly changed over the course of the summer sampling period. This study aims to evaluate the role of *C. virginica* biogenic reefs as an effective tool to restore coastal and estuarine habitats along the Atlantic coast.

UG, Oral

Selective filtration in the tropical marine sponge *Rhopaloeides odorabile*: impacts of elevated seawater temperature on feeding behavior.

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Climate change currently represents the most significant and increasing threat to coral reef ecosystems worldwide. Sponges that rely on strong microbial symbioses are particularly sensitive to elevations in seawater temperature. In this study, the impacts of elevated seawater temperature on feeding behavior in the tropical marine sponge *Rhopaloeides odorabile* were assessed. Feeding efficiencies on both heterotrophic and phototrophic bacteria of sponges exposed to temperatures ranging between 27 and 32°C were determined based on filtration and volume flow rates. No differences in volume flow rate or feeding efficiencies on both bacterial types were detected in the 27°C-30°C treatments. In contrast, sponges exposed to 31°C exhibited significantly reduced flow rates and feeding efficiencies on heterotrophic bacteria after 24 hours but maintained normal feeding efficiency on phototrophic bacteria through 3 days.

Sponges exposed to 32°C exhibited cellular necrosis and dramatically reduced flow rates and feeding efficiencies on both bacterial types after 24 hours. The threshold for normal sponge feeding behavior was 31°C, and there was clear evidence of selective filtration by *R. odorabile* in response to thermal stress. This thermal threshold is identical to the symbiosis threshold for corals and their zooxanthellae, indicating that sponges may be similarly threatened by climate change.

UG, Poster

Prey state and resource levels influence the strength of non-consumptive predator effects in a rocky intertidal food chain.

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Predators can shape ecological communities via trophic cascades. Growing evidence suggests that many trophic cascades emerge because prey decrease foraging activity to lessen the risk of predation, resulting in positive indirect effects of predators on resources (i.e., trait-mediated indirect interactions, or TMIs). For prey, however, decreasing foraging activity incurs the cost of reduced energy intake and growth (non-consumptive predator effects). Hence, physiological (energy reserves, prey state) and environmental conditions (resource availability) may influence how prey balance the foraging-predation risk tradeoff. Theory predicts that prey will accept the predation risk associated with foraging when the risk of starvation is sufficiently high, thus weakening the strength of TMIs. Using a model rocky intertidal food chain (*Carcinus maenas*, predator - *Nucella lapillus*, prey - *Semibalanus balanoides*, resource), we examined how prey state (*Nucella* developmental stage) and the availability of resources (barnacle abundance) influenced the strength of non-consumptive predator effects and TMIs. We found that the negative effects of predation risk on foraging activity were strongest for adult *Nucella* and weakest for juveniles, and that these effects varied across different resource levels. Consequently, the factors influencing individual decision-making by prey may ultimately determine how predators influence community dynamics through TMIs.

Grad, Oral

Is foraging by the rock crab, *Cancer irroratus*, affected by the green crab, *Carcinus maenas*?

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Throughout southern Atlantic Canada, the distribution and preys of the invasive green crab, *Carcinus maenas*, and native rock crab, *Cancer irroratus*, overlap. Effects of the green crab on rock crab foraging are only partially understood and likely to vary in the predominantly cold water system surrounding Newfoundland and Labrador. This study investigates effects of crab size, prey size and density, and cold water temperature on patterns of intra- and interspecific crab competition for a common prey species, the blue mussel, *Mytilus edulis*. In laboratory experiments individual crabs, and monospecific and heterospecific groups of crabs preyed upon 10-40mm mussels both directly and when exposed to crab odors only (no physical or visual contacts), in warm (12°C) and cold (4°C) water. Although smaller than adult rock crabs, adult green crabs in isolation consumed comparable numbers of equally sized mussels, independent of temperature. Prey consumption for crabs in monospecific or heterospecific combinations, and those exposed only to crab odors, was consistent. Intra- and interspecific interference between crabs was also comparable, demonstrating predator redundancy. When prey was limited, green crabs successfully retained prey independent of both crab size disparity and temperature. These results suggest that unless preys are limited, green crabs do not negatively affect prey consumption by rock crabs.

Grad, oral

Primary Production in the Caloosahatchee River / San Carlos Bay Ecosystem

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Urban and agricultural development in and around the Caloosahatchee River and Estuary has altered the flow, supply, and quality of water in this system for more than two hundred years. Recently, algal blooms have brought attention to nutrient issues and processes affecting biomass accumulation there. The major purpose of this project was to measure primary production rates in the Caloosahatchee River and Estuary system in order to create an empirical model that can be used to predict the response to changes in nutrient load. Primary production rates in terms of oxygen evolution were measured at four sites (one each in the upper estuary, middle estuary, lower estuary, and San Carlos Bay) using simulated in situ light:dark bottle incubations involving a flow-through raceway. Key water quality parameters such as temperature, salinity, dissolved oxygen, photosynthetically active radiation (PAR light), and macronutrient levels (nitrogen, phosphorous, and silica) were also determined at each site for their direct and indirect affect on primary production. The structure and abundance of the phytoplankton was determined to identify shifts in primary producer communities.

The effect of settlement angle on juvenile chlorophyll concentrations in the temperate scleractinian, *Oculina arbuscula*.

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Light intensity varies over small spatial scales in marine communities and can affect photosynthetic efficiency, survival, and growth of juvenile corals. The goals of this study were two-fold. First, to verify that red, green, and blue (RGB) color data from photographs of juveniles of the temperate coral *Oculina arbuscula* can be used as a proxy for chlorophyll concentrations. Second, to determine if the differences in light intensity experienced by juvenile *O. arbuscula* settled at the same depth but various substrate angles affects chlorophyll levels. Settlement angle was quantified for juvenile *O. arbuscula* occurring on hard-bottom reefs of coastal Georgia by using a profile gauge. These juveniles were subsequently photographed and collected for quantification of chlorophyll. A chlorophyll concentration proxy was derived by collapsing RGB data into a single principle component explaining 89.2% of the variance in color. This single axis was positively correlated with chlorophyll concentrations indicating that it can serve as a proxy for chlorophyll levels. Color was dependent on settlement angle ($R^2=0.724$) indicating that juveniles on vertical surfaces possess less chlorophyll than those on horizontal. These results suggest that settlement angle may impact juvenile photosynthetic rates in *O. arbuscula* and, ultimately, may lead to differential growth rates.

Grad, Poster

In-situ growth rates of the interface-feeding polychaete *Polydora cornuta* at different tidal elevations

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Most spionid polychaetes suspension feed in fast flows and deposit feed in slow flows, and flume experiments reveal that growth is enhanced by conditions favoring suspension feeding. These worms rapidly colonize disturbed sediments, are food for fishes and birds, and alter sediment geochemistry. Growth rates of estuarine spionids probably vary on a range of spatial and temporal scales, and measuring growth rates in situ is required to model population dynamics and gauge the functioning of ecosystems. We transplanted pre-measured *Polydora cornuta* juveniles to a mudflat in the Tijuana Estuary at high, middle, and low intertidal elevations and measured the growth of individuals over 7 days. Four transplants were performed in July and November 2009, with two spring and two neap tides represented. Individuals in the low intertidal consistently grew faster than those in the other elevations ($F_{2,111}=17.4$,

P<0.001). We suspect the reduced growth rates resulted from an inability of worms to suspension feed during low tides. A spring-tide period in November, which included afternoon low tides, resulted in slower growth than the other three transplants ($F_{3, 111}=3.99$, $P=0.010$), especially in the high and mid intertidal. Extreme afternoon low tides probably cause additional desiccation that also inhibits deposit feeding.

Grad, Oral

The relative importance of the Inland Bays as spawning habitat for *Limulus polyphemus*

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The American horseshoe crab, *Limulus polyphemus*, is one of several horseshoe crab species, but the only one found along the coast in North America. With a range from northern Maine to the Yucatan peninsula in Mexico, this species has its highest spawning densities in Delaware Bay and is of great importance to the fishing, biomedical and ecotourism industries. The Inland Bays are three inter-connected, lesser known bays also in Delaware. Though in close proximity to Delaware Bay, little work has been done to determine the importance of this bay as *L. polyphemus* spawning habitat. The study presented here is the result of a two summer census of horseshoe crab spawning at 6 beaches within the Inland Bays (James Farm, Holts Landing, Bay Colony, Camp Arrowhead, Coastal Kayaks and Tower Road Bay beach). The census procedure used in this study was identical to that already in use at Delaware Bay beaches. Spawning densities in the Inland Bays (2.4 individuals/m) were lower than the average in the Delaware Bay (3.5 individuals/m). Bay Colony was identified as an Inland Bays “hot-spot” in 2009, with a peak of 19 individuals/m. This is comparable to the 2008 peak in Delaware Bay (Pickering Beach, 15 individuals/m).

Grad, Poster

A study of the range expansion and feeding habits of *Corambe obscura* and their effects on the invasive prey item, *Membranipora membranacea*

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The presence of *Corambe obscura* in the Gulf of Maine has only recently been observed in the fall of 2009 at docks located in Durham and Portsmouth, NH, where it has expanded from its natural habitat south of Cape Cod, MA. Very little work has been done on this species in its natural habitat, and no work has yet been done on this species in its new environment or its feeding habits on the prey *Membranipora membranacea*, an invasive bryozoan. Though previously observed in 1977 feeding on *Electra crustulenta* in New Jersey, in the Gulf of Maine (GOM) it otherwise feeds exclusively on *M. membranacea*. I have proposed a study to determine how prevalent *C. obscura* is in the GOM and how it is affecting *M. membranacea* populations by recording a variety of information from bryozoan-covered kelps both off of docks and in kelp beds with the use of SCUBA diving. Data recorded will include number and size of *C. obscura* present, percent cover, colony amounts, and presence or absence of defensive spines of *M. membranacea*, and kelp size and species. Lab study will consist of determining feeding rates of *C. obscura* by measuring *M. membranacea* polypides ingested per day.

Grad, Poster

Near bottom dinoflagellate populations on the northwest Florida Shelf during July 2009.

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Harmful algal bloom (HAB) populations, such as the dinoflagellate *Karenia brevis*, occur suddenly in Gulf of Mexico surface waters between 18-74 km from shore. Models suggest that bloom seed populations may exist near the higher nutrient sediment interface during stratified conditions. Cross-shelf transects were conducted in July 2009 between the 20-60 m depth contours off Panama City, FL. Sampling included ACROBAT and CTD/rosette surveys for nutrient and chlorophyll *a* concentrations. Water samples were analyzed with HPLC-CHEMTAX and FlowCAM for phytoplankton community composition. Cross-shelf, a pycnocline existed between 10-20 m depth, the 1% light level reached to about 45 m depth, nitrate-nitrite concentrations started increasing about 10 m above the sediment interface out to 50 m depth and then increased below 40m depth across the rest of the outer shelf. The chlorophyll *a* maximum occurred between 20-30 m depth. Near-bottom, dinoflagellates were 2-8 times more abundant than diatoms across the shelf with peak concentrations between 35-55m. Time series samples at the 50 m contour exhibited a dinoflagellate distribution pattern suggestive of diel vertical migrations. Such diffuse, near-bottom populations are staged to seed possible near-shore dinoflagellate blooms, including *Karenia brevis*, in response to upwelling favorable winds and behavioral accumulation at upwelling fronts.

Grad, Oral

Variation in marsh benthic invertebrate presence and abundance related to altered *Spartina alterniflora* density

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Sudden loss of a foundation species like the salt marsh grass *Spartina alterniflora* can drastically affect ecosystem functioning, including altering habitat support. Dieback areas following droughts in GA and LA were opportunistically used to set up manipulation plots encompassing a range of *Spartina* densities (vegetated/control, low/high density transplants, affected/bare). During fall of 2006-2008, we sampled infauna (meiofauna >63 µm, macroinfauna >500 µm) and epifauna (crabs, snails, bivalves). In GA, higher densities of most organisms (meiofauna, macroinfauna, *Littoraria*, bivalves) were found in vegetated plots (no trend in infaunal crabs or blue crabs). In LA, there were higher densities of *Littoraria* and blue crabs in vegetated plots, but meiofauna were more abundant in bare areas (no trend in macroinfauna or infaunal crabs). There were also differences between states: periwinkle and fiddler crab abundances were higher in GA (3x and 10x, respectively), whereas blue crab abundances were higher in LA. Overall meiofaunal density was similar between states with nematodes and copepods comprising >90% of individuals. Macroinfaunal density was 5x greater in LA and dominant taxa differed: oligochaetes were most abundant in LA, whereas polychaetes were most abundant in GA. Stable isotopes show that food webs are behaving similarly in each state and in bare and vegetated plots.

Grad, poster

Stress, *Symbiodinium*, and coral decline: an inter-cladal comparison of symbiont responses to elevated temperatures.

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Algal symbionts from the genus *Symbiodinium* enable coral to inhabit oligotrophic tropical waters, and play a large role in the coral reef response to climate change. Field observations have found that hosting different symbionts correlates with variations in coral stress tolerance, particularly susceptibility to

bleaching, and these differences are attributed to the effects of elevated temperatures on algal physiology. To further understand the mechanisms behind these differences, 7 strains of *Symbiodinium*, representing 6 clades, were exposed to elevated temperatures, and changes in the production of reactive oxygen species (ROS), antioxidants, and algal respiration were measured. Inter-cladal differences were observed in all studies. Clades believed to be more tolerant, such as clades A and D, produced less ROS in response to thermal stress, while clades that are more susceptible to bleaching in the field, such as clade C, had higher production of ROS under the same conditions. Changes in algal respiration rates were measured and results followed a similar trend, with tolerant clades showing minimal increases in respiration rates. The production of the antioxidants superoxide dismutase and catalase were measured and again demonstrated inter-cladal differences. These findings will be applied to elucidate the physiological responses of *Symbiodinium* to stressors associated with climate change and their role in coral decline.

Grad, Oral.

Fiddler crab larval settlement at Ward's Creek in Beaufort, NC

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Uca pugnator, *Uca minax*, and *Uca pugnax* are three species of fiddler crabs that co-occur on the East coast of the United States. As adults, they occupy different habitats based on sediment grain size and salinity. At Ward's Creek in Beaufort, NC, the adult fiddler crab population is exclusively *U. minax*. This could occur either by selective settlement by larvae or random settlement of all three species followed by post-settlement mortality. Planktonic megalopae and settlers were collected from Ward's Creek and identified to species using multiplex polymerase chain reaction (multiplex PCR). If settlement is random, then we expect the species distribution of the settlers to reflect the distribution in the plankton; however, if selective settlement is occurring then the settlers should be primarily *U. minax*. We found larvae of all three species in the plankton, but all settlers identified were *U. minax*. This indicates that *U. minax* settles selectively at Ward's Creek.

UG, poster

Annual variation in energy content of the copepod, *Calanus finmarchicus* from the Bay of Fundy, Canada

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Many species rely on the dominant copepod *Calanus finmarchicus* as a primary prey item in the Bay of Fundy, Canada (BoF). The energy content of this zooplankton increases over the summer, peaking in August (May-1051.60 cal g⁻¹, August-1371.86 cal g⁻¹ wet weight) (Michaud and Taggart, 2007). These data were, however, collected from a single summer season (2002). Our study further investigated energy content of *C. finmarchicus* over multiple years (2006-2008) to evaluate whether predators have access to zooplankton of predictable quality each year. Samples were collected biweekly (July-September) using vertical plankton tows and energy content measured using bomb calorimetry. During the summers of 2006 and 2007 the caloric values of *C. finmarchicus* were significantly lower in July than in August and September (p=0.013; 2006: July-1200.91, August-1563.57, September-1521.12; 2007: July-1377.53, August-1552.30, September-1626.41 cal g⁻¹ wet weight) supporting an increasing trend in copepod energy content throughout the summer. In contrast, seasonal variation was not detected in copepods in 2008. There was also no significant difference in average energy content between years. Despite the importance of *C. finmarchicus*, this is the first study to consider annual variation in nutritional quality; data which are necessary to investigate annual trends in this marine ecosystem.

Grad, Oral

Trends in the Associations between Octocorals and Sponges in Florida Keys

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Space is often limiting for benthic sessile organisms. Sponges commonly circumvent this limitation by growing epibiotically on other sessile organisms. On Caribbean reefs, sponges are often epibionts on octocorals. However the incidence of sponge-octocoral association and the outcome varies among both sponge and octocoral species. In this study the abundances of sponges and octocorals and the frequency of associations (contacts) between the two on several Florida Keys reef were determined. In some cases, the number of associations increased with higher octocoral and sponge density. The number of associations between both taxa was random but the nature of the interaction was species-specific. Of the total sponge diversity, 61% (30/49) of the species were associated with 66% (18/27) of the available octocorals species.

Grad, Poster

Diversity and distribution of benthic macroinvertebrates in a temperate, sewage-enriched estuary

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West Falmouth Harbor (WFH) is a shallow estuary in Cape Cod, MA, USA, subject to increasing nitrogen loads due to sewage contamination. We performed multi-annual (2007-2009) field surveys of benthic macroinvertebrate communities in relation to a spatial gradient of degradation in the primary sub-embayments of WFH (inner basin [IB]; outer basin [OB]). Samples were collected from both vegetated (*Zostera marina*) and non-vegetated patches, and relationships were assessed between invertebrate composition and the following variables: macroalgal standing stocks, benthic chlorophyll (chl) *a*, and benthic oxygen consumption (BOC, dark only). Opportunistic taxa were present in the IB across sampling years, including *Ampelisca abdita* (Amphipoda), *Gemma gemma* (Bivalvia), *Hydrobia totteni* (Gastropoda), and the polychaetes *Alitta succinea*, *Capitella capitata*, and *Polydora cornuta*. Faunal richness and evenness were highest in the OB, with substantial inter-annual variability in species composition. In the IB, we observed enhanced rates of BOC, increased chl *a*, and dominance of *Ulva* sp. (Chlorophyta) and *Gracilaria* sp. (Rhodophyta), while a more heterogeneous suite of macroalgal taxa were reported in the well-flushed OB. In both basins, invertebrate diversity was generally higher in vegetated sediments. Continued evaluation of survey data will enable assessment of eutrophication impacts in an estuary undergoing nutrient enrichment.

Grad, poster

Demography of the giant barrel sponge *Xestospongia muta* – a stage-based matrix modeling approach

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Little is known about the demographics of sponges on coral reefs, despite their abundance and the important functions they perform. We have monitored permanent plots on reefs off Key Largo, Florida, to study the demography of a particularly important species, the giant barrel sponge, *Xestospongia muta*. From 2000 to 2006, population densities of *X. muta* significantly increased at sites on Conch Reef by a mean of 46% (range=16–108%) and on Pickles Reef by a mean of 33%. To explore the demographic processes behind the population increase and determine future population growth of *X. muta* under present reef conditions, a stage-based matrix modeling approach was used. Variable recruitment pulses and mortality events were hypothesized to be large determinants of the demographic patterns observed for *X. muta*. Elasticity and life table response analysis revealed that survival of individuals in the largest size class has the greatest effect on population growth. Projections indicate that populations of *X. muta* will

continue to increase under present conditions; however population growth may be negatively affected by continued mortality of the largest individuals from a recently described pathogenic syndrome.

Grad, Oral

Using Relaxation Techniques to Determine the Effect of Sex Ratio on the Reproductive Output of Cultured Florida Apple Snails, *Pomacea paludosa*

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Scientists at Harbor Branch Oceanographic Institute began culturing the Florida apple snail (*Pomacea paludosa*) for stock enhancement purposes in 2007. Interest in culturing the snail developed because of an increased need to protect the federally endangered snail kite; a bird that depends on the snail for food. To improve captive breeding success and maximize production, two experiments were conducted to determine the best relaxation procedure for adult snails and to identify if egg production could be increased by manipulating sex ratios. Because it is difficult to identify male and female apple snails, chemicals were needed to relax them to view their internal sex organs. Six chemicals known to induce relaxation in invertebrates were tested, and benzocaine mixed in methanol was the most effective relaxant. This chemical was then used in the second experiment, testing four sex ratios: 5F(female):5M(male), 7F:3M, 8F:2M, and 3F:7M. A Repeated-Measures ANOVA was used to determine differences over the eight week study in the number of egg clutches laid, total number of eggs per clutch, percent hatch rates, and number of egg clutches per female per week. Although not significant, trends showed that at least a 1:1 ratio was needed to sustain commercial production.

UG, Poster

Up, down and sideways: mantis shrimp currents analyzed by particle image velocimetry. Mead, Kristina S.¹; Colin, Sean²; Costello, Jack³, ¹Denison University, Granville OH 43023; ²Roger Williams University, Bristol, RI 02809 and ³Providence College, Providence RI 02918.

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The mantis shrimp *Squilla empusa* burrows in temperate sandy substrates at depths between 10-20 m. Poor visibility combined with crepuscular activity patterns cause it to rely heavily on olfactory cues to execute predatory behaviors. *Squilla* detect these cues via olfactory flicking, an out-and-back movement of the antennules that facilitates obtaining small, discrete odor samples. We analyzed this behavior in five *Squilla empusa* in their natural burrows offshore near Woods Hole, MA by SCUBA and using a laser-light sheet and a video camera. We filmed at night, orienting the laser light sheet parallel or perpendicular to the burrow to capture different axes of motion. Particulate matter moved through the laser light sheet enabling tracking of water movement in a plane. Antennule velocities were 2.2 ± 0.8 cm/s on the outstroke and 1.3 ± 0.8 cm/s on the return stroke. The actual water movement created by flicking was small and relatively transient (0.8 ± 0.1 cm/s and 0.4 ± 0.1 cm/s). *Squilla* also generated currents in and out of the burrow (1.3 ± 0.5 cm/s and 2.7 ± 0.4 cm/s). These currents were sometimes larger than ambient flow (2.0 ± 0.8 cm/s), injecting significant energy into the benthic environment.

Evaluation of the relative importance of sexual and asexual recruitment in the population dynamics of a common Caribbean sponge

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In this study, the relative importance of sexual and asexual recruitment in the population dynamics of the sponge, *Amphimedon compressa* was examined by developing simple size-based population matrix models under three different situations: (1) a scenario including both sexual and asexual recruitment, (2) a scenario including only sexual recruits, and (3) a scenario including only asexual recruits. Data on sponge growth, survivorship and recruitment were obtained by monitoring twenty 1 m² quadrats for one year at Las Pelotas (LP) and at Media Luna West (MLW), two reefs in the southwest of Puerto Rico. Projections

matrices including both sexual and asexual recruitment, revealed a decrease in the abundances of the studied populations with an estimated population growth rate (λ) of 0.92 at MLW and 0.78 at LP. In the absence of sexual recruits λ was reduced by about 10% at LP and 12% at MLW whereas in the absence of asexual recruits λ barely change. Results suggest that sexual reproduction may play a more important role on local population size than asexual reproduction.

Grad, Poster

Temperature Effects on Shell Disease on the American Lobster (*Homarus americanus*)

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The American lobster, *Homarus americanus*, fishery is one of the most important fisheries in New England. Recently, the fishery has been detrimentally impacted by the increase presence of shell disease on lobsters. The prevalence of disease, which occurs when chitonolytic bacteria settle on the lobster shell and erode the shell, started in southern New England waters (New York and Rhode Island) and has tracked northward through northern Massachusetts. Yet lobsters in Maine and Canada have little to no disease incidence, which indicates a temperature effect on disease rate and occurrence. We studied the impact of temperature on shell disease severity in juvenile laboratory raised lobsters. Juvenile lobsters were held at three different temperatures (10, 15, and 20 °C) and fed either a diet with little pigment or a pigment-rich diet. Shell disease severity was monitored visually. Shell disease is a multifactorial issue; this study suggests that the time bacteria have to degrade the shell and environmental temperature are two contributors to disease severity. Preliminary results will be discussed as well as a description of an infection method to potentially determine the causative bacterial agent of shell disease.

Fac, Oral

Does aposematism exist on Caribbean coral reefs?

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Previous investigations have shown that brilliant colors and disruptive patterns are important warning signals that increase the ability of predators to learn to avoid undesirable prey. While aposematism and mimicry are well-studied phenomena among terrestrial animals such as butterflies, snakes and frogs, much less is known about the ecological importance of coloration among marine invertebrates in coral reef habitats. Synthetic prey composed of hydrated gels infused with powdered squid mantle to provide nutritional content will be subjected to feeding assays using Caribbean reef fish species to assess the impact of various prey colors and patterns on predation. We will attempt to understand how the combination of color, pattern and palatability help marine predators learn to avoid undesirable prey.

Grad, Poster

Digitization of Historical (1950's) Benthic Invertebrate Data from the Delaware Estuary River and Bay

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In the 1950's, William H. Amos conducted extensive surveys throughout the Delaware Estuary. Invertebrate species records with date, locality, and some hydrographic data, originally compiled on 5"x8" note cards, have been digitized and made accessible by SQL, R and Matlab codes. These data include over 5500 records of nearly 400 species from over 40 geographic sector locations, and descriptive locality field data promises much more precise georeferencing for up to 130 distinct sites. Benthic invertebrates were collected by trawl, dredge and Peterson grab, planktonic organisms by net, and epifauna by scrapings from navigation buoys. Records are dominated by July and August collections from

the years 1952-54 and 1956. Many records of copepods and mysids are included from a zooplankton survey project from 1951 through 1953. Thus, in addition to representing a time in the history of the Delaware Estuary before major industrialization and development, these data present a uniquely comprehensive picture in terms of the functional groups, life habits and taxonomy of the fauna of the river and estuary. Codes have been developed to generate species lists by site (to guide ongoing fieldwork), plot species' distributions and sampling effort, and to extract a sector by species matrix for multivariate analysis.

Fac, Poster

The Impact of Piscivorous Birds on the Fish Assemblage of Barrier Island Salt Ponds

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Salt ponds are natural features of many barrier islands. In area they can range from a few hundred m² to twenty thousand m². Their clearly defined boundaries simplify sampling and obtaining robust measurements of species richness and abundances. These ponds support a diverse fish assemblage comprised of several dozen species of omnivores and planktivores, which fall prey to a host of avian predators. To examine the impact piscivorous avians have on the fish assemblage of barrier island salt ponds, we designed an exclusion experiment. Ponds were paired by size, to account for size-based influences, and then a member of each pair was randomly assigned as a control while an enclosure was built around the remaining pond. This design was replicated eight times during the fall of 2009. Time delayed field cameras were used to monitor the enclosures to ensure they functioned as intended. Ponds visited by avian predators showed a noticeable drop in fish abundance compared to ponds in which birds were excluded. Despite changes to fish abundance, fish diversity did not change. This could indicate that avian piscivores feed on their prey in proportion to its abundance in these ponds.

Grad, Oral

Behavior, morphology, and a warming climate: thermal stress in high intertidal grazers

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Grazing by herbivorous snails is an important structuring agent in intertidal communities. At the upper reaches of the intertidal zone, the influence of abiotic factors, particularly temperature and desiccation stress, may be important in controlling the survival of these grazers and their impact on the algal community. Using a mechanistic heat budget model coupled with field and physiological data, I explore the role of snail behavior and morphology in controlling body temperature during low tides. Under current conditions, thermal mortality in high shore grazers should be extremely rare, primarily due to the efficacy of behavioral strategies for controlling body temperature. However, future warming may exceed the thermal limits of these species in some portions of the habitat, effectively limiting their local-scale distribution and influence on the algal community.

Fac, Oral

Spawning patterns and variable fertilization in upper Florida Keys elkhorn coral.

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Massive adult mortalities in imperiled Caribbean corals such as *Acropora palmata* invoke an even greater imperative for successful recruitment to sustain and rebuild populations. Observations of asynchrony in spawning patterns for *A.palamata* in the upper Florida Keys suggest the reproductive potential of this population is even less than genotype abundance would suggest. For example, within a stand at Elbow Reef with eight genets mapped, the largest genet has been observed to spawn on different nights than the other seven in multiple years. Genets also spawn on different lunar nights between years. Fertilization

success in *A. palmata* is also extremely variable (30-88% for different crosses in 2009) including significant difference between reciprocal crosses of the same two genets. This suggests a degree of genet-specific reproductive compatibility that further reduces potential reproductive output from this depauperate population.

Fac, Oral

Biotope characterization of coral communities in the south coast of Sal Island, Cabo Verde (North Atlantic)

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An ecological assessment of coral communities was conducted in the south coast of Sal Island, Cabo Verde (North Atlantic). Extensive underwater surveys of the study area recorded coral species composition, distribution and relative abundance using photo-quadrats, at three different depth classes (4-6 m, 10-12 m and 16-18 m). Hard bottom substratum characteristics and orientation (vertical/horizontal) were also recorded, mapped and georeferenced during fieldwork. Imagery analysis, using CPCe software, produced abundance estimates of occurring sessile species. Multivariate statistics (such as nonmetric Multidimensional Scaling and analysis of similarity) on the compiled data identified community structural patterns and tested depth and substratum roles determining different biotopes. These biotopes range from *Palythoa* sp. dominating over bedrock and *Dictyota* sp. coverage over hard substratum with sand patches (4-6 m), to multispecific coral coverage over bedrock (10-12 m) and gorgonian fields over bedrock (16-18 m).

Grad. Oral

Restoring Trophic Dynamics in Created Salt Marshes of the Northern Gulf of Mexico

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Natural ecosystem function is often assumed to follow the restoration of emergent macrophytes in coastal salt marshes. The blue crab, *Callinectes sapidus*, is the dominant aquatic predator within salt marshes in the Gulf of Mexico and is the primary predator of the periwinkle *Littoraria irrorata*. Although *Callinectes* and its prey species rapidly colonize restored marsh habitats, it is unclear whether or when quasi-natural trophic relationships become established. We evaluated habitat utilization by *Callinectes* within restored salt marshes in coastal Alabama using: (1) tethering experiments; (2) assessments of sublethal injury in *Littoraria* shells; and (3) multivariate descriptions of antipredatory shell morphologies. Field and laboratory experiments confirmed that among-site variations in *Littoraria* shell morphology result from predator-induced plasticity by *Callinectes*. Shell repairs and shell morphology, which are integrated measures of predatory activity, exhibited more stable among-site differences over time than instantaneous rates of predation potential, as measured by tethering experiments. Filtering effects of the marsh grass *Spartina alterniflora* reduced both the number and size of crabs entering the marshes. Metrics of the predator-prey relationship between *Callinectes* and *Littoraria* provide an inexpensive and time-efficient means for assessing the extent of habitat utilization by *Callinectes* and the development of marsh function.

Fac, Oral

The grass is greener on the other side: Seagrass species influences foraging success of a common fish predator

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Seagrass systems are important habitats worldwide, and provide structural refuge and trophic support for both resident and transient animals. Seagrasses in Chesapeake Bay have been declining for decades and there is some evidence that the relative abundance of widgeongrass (*Ruppia maritima*) may be increasing relative to eelgrass (*Zostera marina*) as water temperatures increase. We manipulated vegetation type (*R. maritima* and *Z. marina*) in outdoor mesocosms and in laboratory experiments to determine whether these seagrasses differ in their ability to mediate predator-prey interactions between crustacean mesograzers and pipefish, a natural predator. While pipefish predation strongly influenced mesograzers in both seagrass types, there were no obvious differences in predation between the two habitats in the mesocosm experiment. However, experiments in indoor aquaria with pipefish preying on three crustacean mesograzers species, showed that pipefish were more likely to encounter and attack prey in *R. maritima* vegetation. This effect may depend on the traits of the prey species involved: for example, the isopod *Erichsonella attenuata* appeared to avoid detection in both habitats, whereas amphipod *Cymadusa compta* was most easily detected. Our results indicate that changes in seagrass species may affect predator-prey interactions, potentially influencing trophic transfer in these habitats.

Grad, Oral

What's really limiting larval recruitment in upwelling regions?

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Larvae are thought to be highly vulnerable to offshore transport in upwelling regions along the eastern margins of continents, thereby limiting recruitment to infrequent wind-relaxation events and years of weak upwelling. In contrast several studies conducted in a region of strong, persistent upwelling have shown that a diverse array of crustacean larvae are neither advected offshore nor limited to recruiting during relaxation events. New evidence suggests that the spatial and temporal variation in surfzone hydrodynamics may play a substantial role in regulating recruitment to communities in upwelling regions.

Fac, Oral

The role of temperature and salinity on *Hematodinium* infection rate in South Carolina blue crabs.

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Though *Callinectes sapidus*, the blue crab, maintains one of the largest fisheries along the entire eastern seaboard of the United States, a noticeable decline in their population size has been observed. Previous studies have suggested an increase in *Hematodinium perezii*, a parasitic dinoflagellate, may be contributing to this decline. *H. perezii* prevalence is known to vary with environmental changes, particularly in relation to temperature and salinity. In this study, we report eight quarterly censuses of crab density and infection rates at 27 sites in the three rivers of the ACE Basin NERR. Blood samples from each crab were assayed for infection using primers for the *H. perezii* 18s rRNA gene. Of the 384 crabs sampled only 19 tested positive for *Hematodinium* infection. *Hematodinium* infection was found in Dec. 2008 after a prolonged period of regional drought, but not in Dec. 2009 with near normal river discharge. Infected crabs were found more often at higher salinity locations, but were observed at salinities as low as 15 ppt. These preliminary results suggest that *Hematodinium* infection is highest when temperatures and salinities are highest, but may require an additional trigger related to decreased river discharge.

UG, poster

Setting Seagrass Density Targets for the Indian River Lagoon, FL

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There are >73,000 acres of seagrass lining the eastern and western shores of the Indian River Lagoon (IRL). However, not all seagrass beds are created equal. A sparse grassbed would not provide as much habitat, primary and fisheries productivity, nutrient buffering, and sediment stability as a dense grassbed. Therefore, in addition to the area and depth targets set in 2005, a density target is needed to assure that the desired ecological services are being provided. Methods similar to those used to establish depth targets are being applied to set density targets. The densest part of seagrass beds (dense zone) was determined to be between the depths 0.3 and 1.0m by calculating average percent coverage and coefficient of variation (CV) from 14 yrs of transect monitoring. The average density throughout the IRL within the dense zone ranged from 64% to 21% with corresponding CV ranging from 20% to 63%. The same four stable segments used to set maximum depth targets have an average dense-zone density >55% and CV < 24%. The challenge is to set target densities that are historically based, attainable, and optimally supports habitat functions characteristic of a seagrass ecosystem.

Fac, Oral

Coral-Associated Microorganisms and Competition with Macroalgae

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Highly diverse microbial assemblages associated with reef building corals play key ecological and physiological roles in coral health. Thus, shifts in coral health may be correlated with corresponding changes in their microbial assemblages, but little is known about how competition with macroalgae affects coral microbiota. Macroalgae often compose >15% of the benthic cover on Caribbean reefs and are strong spatial competitors with corals. In addition, many exude potent secondary metabolites that can stimulate and/or inhibit the growth of bacteria. To determine the effects of encroaching macroalgae on coral-associated microbiota, the bacterial assemblage in the presence and absence of *Dictyota* brown algae and *Halimeda* green algae was compared using DGGE employing universal Bacteria primers in a PCR. Surface mucus was collected from *Montastraea faveolata* and *Porites astreoides* corals interacting with these macroalgae in Florida, Belize, and St. Thomas to examine species-level and geographic variation in coral-microbiota associations. Macroalgal contact impacted colony-wide patterns of coral-associated microorganisms, which also varied between coral species and within each host species among regions of the Caribbean. We conclude that coral-microbial assemblages are influenced by macroalgae, with potential implications for the outcomes of coral-algal competition, and increased occurrences of coral disease and bleaching.

Grad, Oral

Application of a gene-based population dynamics model to the optimal egg size problem: why bivalve planktotrophic eggs vary in size?

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Larger eggs should be favored by selection. Counterweighing the tendency is the number of eggs that can be produced if egg size remains small. We employ a gene-based population dynamics model configured for crassostreid oysters to examine how egg size and egg number counterbalance, resulting in an average egg size near 50 micron. A series of simulations imposing a variety of ranges in larval survivorship from little advantage for large eggs relative to small eggs to a great advantage yields some anticipated outcomes in which genotypes generating larger eggs were favorably selected and became more common in the population. In other simulations, however, genotypes generating smaller eggs became increasingly common in the population. In these cases, egg size declined as did the likelihood of survival for a given

larva: the antithesis of the expectation from individual larval fitness. Few simulations identify preferred egg sizes near the center of the egg size range, suggesting that, under most field conditions, a selective advantage exists towards smaller or larger egg sizes than those typically spawned. Thus, observed egg size is a balance between the chanciness of larval survival imposed by the production of a larger number of eggs and the genetically-determined individual probability of larval survival that is a function of egg size. Each year the population is pulled towards smaller or larger egg sizes, but in the next year, by chance, the impetus is independent of the previous year. Environmental stochasticity is preeminent in stabilizing a balance between the two selectivity extremes.

Fac, Oral

A land-based coral nursery for the restoration of *Acropora cervicornis*

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With the recent listing of staghorn coral *Acropora cervicornis* as a threatened species, restoration techniques to aid in recovery are of particular interest. High growth rates and asexual reproduction through fragmentation make *A. cervicornis* an ideal candidate for propagation through aquaculture. A pilot project was undertaken to test the feasibility of culturing *A. cervicornis* in a land-based nursery with the ultimate goal of eventual use for reef restoration. Branch tips of two lengths (3cm and 5cm) were collected in July 2009 from 10 colonies at each of two sites and attached to a cement base. Fragments were photographed monthly, and total linear extension was calculated after six months. Growth rates of the 5cm fragments were significantly higher than the 3cm fragments. Compared to *A. cervicornis* in an offshore nursery established in 2007, survival in the land-based nursery was higher, but growth rates were lower. Preliminary results indicate that land-based culture of *A. cervicornis* is a technique that potentially can be used for reef restoration.

Fac, Oral

Population and harem dynamics of a marine isopod.

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Many species have developed alternative reproductive strategies where the competing sex shows different morphs or behaviors. In these systems dominant male morphs often establish territories to control resources and access to females. Dispersal strategies of marine species can play an important role in population and distribution dynamics. Therefore, in order to understand the evolutionary processes in alternative mating strategies, a first step is to address the interplay between dispersal strategies and harem formation. The isopod *Paracerceis sculpta* has three different male morphs with life history trade-offs. This species occurs in relatively shallow waters where alpha males establish harems. Through a series of field surveys and experiments in the northern Gulf of Mexico we are addressing how *P. sculpta* harems are formed, with three potential hypotheses. First, harems are established by alpha males seeking new habitats and attract females while holding the territory. Alternatively, females could perform the dispersing phase, and males cue on habitats with females. Finally, colonization to new habitats is random and after settlement, individuals will interact to decide harem structure. Once we understand how harem formation occurs, we can address the ultimate mechanisms behind dispersal and territoriality.

Fac, Oral

Habitat partitioning by congeneric Acanthurid herbivores across the Bermuda reef platform

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Comprehensive fish and benthic surveys at over 100 sites across the Bermuda reef platform demonstrated habitat partitioning by three congeneric species of Acanthuridae. Juvenile and adult populations of each species occupied distinct habitats that differed in distance from shore within the reef lagoon and across

the fore-reef. *Acanthurus coeruleus* (Blue tang) dominated in forereef sites and were absent within the inner lagoon, while *Acanthurus chirurgus* (Doctorfish) demonstrated the opposite pattern. *Acanthurus bahianus* (Ocean Surgeonfish), alternatively, were abundant across the platform, but with high densities of juveniles only observed within the lagoon and not on the forereef.

Fac, Oral

Feeding Behavior of *Upogebia Affinis*: Food Source Partitioning and Effects on Benthic-Pelagic Coupling

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Suspension feeding infauna provide a link between the pelagic and benthic realms; the strength of which depends on food source and feeding rate. Burrowing mud shrimp (*Upogebia affinis*) are active suspension feeders on tidal mudflats of the Coastal Carolinas. This species is exposed to three possible food sources; 1) a pelagic source, 2) a resuspended epibenthic source, and 3) the burrow wall. Pelagic and epibenthic food sources are available to shrimp during inundation and should occur at different ratios during flood/ebb tidal stages based on flow velocity and shear stress. In contrast, shrimp have continual access to the burrow wall food source, which is higher in total C, total N, and microbial activity than surrounding sediments. We are using a coupled model and field sampling program (including stable isotope and gut content analyses) to test the hypothesis that shrimp can alter their diet by adjusting when they feed during the tidal cycle; a potential that could influence both benthic-pelagic coupling and biogeochemical cycling within the sediments. Preliminary analyses suggest that *U. affinis* has a diet comprised of all food sources considered in this study, so that effects of shrimp on resource pools are density dependant.

Grad, Oral

Predatory impacts of the Indo-Pacific lionfish on warm-temperate hard bottom reefs in continental shelf waters of the southern U.S. Atlantic.

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The Indo-Pacific lionfish (*Pterois volitans*) has become widely established along the United States southeast coast yet their biology and ecology is only beginning to be understood. We utilized stomach contents and stable isotope analyses to determine the food web consequences of the lionfish invasion to the rocky reef community in the southeast U. S. In 2004 and 2006, we collected lionfish from 17 different locations in Onslow Bay, NC. In 2006 we also conducted visual surveys to estimate the relative abundance of potential prey. Analyses of stomach contents (N=183) and stable isotopes (N=100) suggest a generalist carnivorous diet, and prey categories were predominately fish (99% of total prey volume) from 16 different families. Major differences in the importance of prey were seen between years. Serranidae and Scaridae dominated the diet in 2004 while Haemulidae and Carangidae were important in 2006. Visual surveys suggest that prey are consumed in relation to their local abundance. Given current theory, the expanding lionfish distribution, and observations that lionfish appear capable of settling to many different habitat types, the overall pattern of generalist piscivory emerging from these data indicates the potential for significant impacts to the invaded community.

Fac, Oral

Effect of nutrient enrichment on herbivore preference in shoalgrass (*Halodule wrightii*) meadows

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The pinfish *Lagodon rhomboides* is important as the numerically dominant fish herbivore in seagrass meadows of the Gulf of Mexico and also for their ability to control amphipod abundances. Increasing nutrient levels in coastal waters could greatly enhance the grazing impact of herbivores within these seagrass meadows, as many types of grazers are known to preferentially feed on nitrogen-rich plants. We examined the preferences of *L. rhomboides* for the shoalgrass *Halodule wrightii* of high and low nutrient concentrations in “choice” and “no-choice” laboratory experiments. In no-choice experiments, both high and low nutrient leaves were consumed in nearly equal proportions (~17%). In choice experiments, however, we found that *L. rhomboides* consumed nearly twice as much *H. wrightii* with high rather than low nutrient concentrations (27 vs 11%). A future field experiment will assess the impact of amphipods, a second group of important grazers, on shoalgrass and its epiphytes at varying nutrient levels by using Carbaryl (a known amphipod poison) dissolved into plaster of paris blocks to directly exclude them from some plots, while other plots will retain their full complement of amphipods.

Grad, Poster

Simple ecological trade-offs give rise to emergent cross-ecosystem distributions of a coral reef fish.

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Ecosystems are intricately linked by the flow of organisms across their boundaries, yet it is often difficult to elucidate the underlying mechanisms that drive such across-system movements. Many coral reef fish populations are purportedly supported by the movement of individuals from spatially-segregated juvenile habitats, such as mangroves and seagrasses, and such connectivity can be essential to the structure and function of linked ecosystems. Here we investigate the ecological trade-offs between growth, predation risk, and maturation of a common Caribbean reef fish species, *Haemulon flavolineatum* (French grunt), to examine the mechanisms that give rise to the apparent ‘nursery’ role of mangroves and seagrasses. Extensive underwater visual surveys indicated that adults were primarily found on coral reefs, whereas juvenile fish only occurred in non-reef habitats. Predator densities were an order of a magnitude higher on the coral reef than in the nurseries, resulting in considerably higher mortality in the former. Growth rate was higher on the reef than in the nurseries, and mature fishes were seldom found in nursery habitats. Predation thus seems to be the primary factor responsible for driving across-ecosystem distributions of juvenile fish, whereas the need to reproduce appears to drive the movement of subadult fish to the reef.

Fac, Oral

Modeling the environmental effects on the settlement of oyster larvae (*Crassostrea virginica*) in Delaware Bay.

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Understanding the settlement patterns of commercially important species has been a challenge for scientists. Especially because of the different biotic and abiotic processes that drive the ultimate settlement location of any release larvae in the water column. In this study we coupled a circulation model

to a larval growth-behavior model to address the settlement of eastern oyster in response to biophysical processes. Model simulations follow larvae from a number of release points (reefs) over a time span (2 to 4 weeks) sufficient for them to mature (attain a length of 330 micron) at which point they sink and attach to the bottom. Simulations were performed for the spring-summer season of 1984, 1985, 1986 and compare with *in situ* observations. The simulated settlement pattern agrees with the observations where the majority of the released larvae settle in the lower Bay, this seems to be driven by a recirculation area in this part of the bay. Environmental factors control the growth and behavior of the oyster larvae, and therefore the final settlement location. Strong river discharge also influence the dispersion of larvae, causing a shift in the upper and lower Bay settlement. These results can be considered as an example of the importance of interdisciplinary approaches in studies of larval dispersion and marine connectivity.

Grad, Oral

Predicting the ability of a non-native, subtidal mussel *Mytella charruana* to invade Florida's intertidal oyster reefs

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Mytella charruana is a mussel from South and Central America that was first found in Jacksonville, Florida and now extends northward to South Carolina. In its native range, *M. charruana* is subtidal but occasionally extends into the intertidal zone. In Mosquito Lagoon, FL it has been occasionally found in large numbers on intertidal reefs of the native oyster *Crassostrea virginica*. The purpose of this study was to determine at what levels of temperature and aerial exposure *M. charruana* could survive during low tide conditions to predict possible establishment on intertidal oyster reefs. Mussels were exposed once daily to 5 different time periods of air exposure at 4 different temperature treatments via laboratory incubators for 1 week. Warm and cold temperature experiments were conducted and matched with actual oyster reef temperatures. High temperatures greatly affected survival of *M. charruana*. At 44°C, mussels exposed for 4 hours had 0% survival after 1 week, while mussels exposed to 25°C had 88% survival. Cold temperatures also affected survival. Mussels exposed to 8°C had 3% survival at 12 hours of exposure while 12 hours at 20°C resulted in 88% survival. This information will help us predict if *M. charruana* is a threat to native oysters.

Grad, Poster

Linking statolith chemistry of the sea hare, *Aplysia californica*, to watershed runoff along the open coast.

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Tools are needed to track larval origins within and out of small coastal zones (e.g., MPAs). Seawater chemistry among watershed sites, areas influenced by rivers and creeks, is often site specific and may be incorporated into calcified structures (induce natural tags) in nearby benthic species. If so, natural tags could be used for coastal tracking at a watershed-site spatial scale (5-15 km). Seawater was collected after a rain event at three watershed sites and elemental concentrations were significantly different among sites for Pb, Zn, Al, Mn, Co, and Cu. In the laboratory, developing egg masses of the sea hare, *Aplysia californica*, were cultured in a blocked, factorial design under seawater, exposure and temperature treatments to explore whether or not field study at the watershed-site spatial scale is warranted. Lead statolith chemistry was positively correlated with seawater chemistry, but only when exposure lasted throughout embryogenesis. Temperature (Ba) and brood effects (Ba, Pb, Zn, for exposure ≤ 8 d) were also significant. These findings suggest that field study for use of natural tags at this spatial scale is warranted, especially among areas influenced by year round runoff from urbanized watersheds.

Grad, Oral

Nursery Habitat Viability for Surf Zone Fishes at Developed and Undeveloped Nourished and Unnourished Beaches

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Previous studies of surf zone fishes in beach nourishment areas have consisted of comparing nursery habitat viability at unnourished sites with viability at sites where beach nourishment has occurred. The problem with these studies is the unnourished and nourished sites are highly to moderately disturbed and developed. Also the unnourished sites are in close proximity to the nourished sites. In this study three undeveloped sites were used. Two sites were at Masonboro Island North Carolina, one which was undeveloped and unnourished and one which was undeveloped and nourished. The last site was located on Hutaff Island North Carolina, which is a completely pristine barrier island. At each site juvenile Florida Pompano (*Trachinotus carolinus*) and juvenile Gulf Kingfish (*Menticirrhus littoralis*) were collected using a 30m seine net. Twenty specimens of each species were collected from each site, both in August and September 2009. The viability of these areas as nursery habitats was determined using the lipid content of each fish. This lipid data will be compared with previous similar studies, which were conducted at highly and moderately disturbed nourished and unnourished beaches. This will allow for the isolation of nourishment and development as variables in nursery habitat viability.

UG, Oral

The effects of bottom-tending mobile fishing gear on soft-sediment benthic community structure in the Gulf of Maine

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Fishing with mobile gear is the most common source of anthropogenic disturbance in marine systems. This fishing technique can directly alter the biological structure of benthic communities and therefore change functionality of the benthos. To address the question of how these communities change in the presence of anthropogenic disturbance caused by bottom-tending mobile fishing gear as well as the extent of their recovery associated with the cessation of this disturbance, we designed a four-year observational study (2001-2004) in the southern part of the Gulf of Maine. We sampled infaunal communities associated with both fished and unfished areas in the Stellwagen Bank National Marine Sanctuary and Western Gulf of Maine Fishery Closure using a Smith-McIntyre grab. We conducted Epifaunal sampling using still-photographs and video imagery. Statistical analyses (Mann-Whitney U test; Kruskal-Wallis test) indicated a significant decrease in abundance of structure-forming organisms (tube builders: Maldanidae, Ampharetidae, and Terebellidae; Cucumaridae, Molgulidae, and Porifera) at fished sites. While sand infauna appeared to be more resilient to fishing disturbance than mud infauna, both mud and sand epifaunal community structure was significantly different between fished and unfished areas (MDS; ANOSIM analysis).

Grad, Poster

Effects of the parasitic barnacle *Loxothylacus panopaei* on *Panopeus herbstii* foraging rates

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Mud crabs (*Panopeus herbstii*) are major predators within South Carolina, USA intertidal oyster reefs, affecting the density of various reef organisms and the species richness of reefs. The rhizocephalan barnacle (*Loxothylacus panopaei*) is a rare *P. herbstii* parasite affecting about 5% of males, decreasing normal growth rates and castrating the host crab. Specific behavioral patterns also differ between infected and noninfected crabs; e.g., infected crabs do not seek out females for mating. To investigate the effects of infection on crab foraging a series of controlled feeding experiments were conducted. Individual

enclosures containing either infected or noninfected crabs of the same size were stocked with either mussels (*Geukensia demissa*) or oysters (*Crassostrea virginica*). Crabs were allowed to feed for a total of 48 h and the number of prey consumed recorded. Foraging rates for infected compared to noninfected crabs on both mussels and oysters were decreased significantly. Results suggest that the negative parasite effects on foraging rate may be the cause of reduced growth rates and ultimately may lead to crab death from starvation.

UG, poster

Impacts of algal biomass accumulation on salt marsh community structure

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Despite excessive growth of macroalgae in estuarine systems, relatively little research has been conducted on the increased algal biomass that drifts into salt marshes and accumulates on tidal flats. Many opportunistic algal species store excess nitrogen for future growth and, upon decomposition, release these nutrients. Since lower marsh plants can be nitrogen limited, algal decomposition has the potential to significantly alter marsh communities by pulsing nutrients into the system. We conducted monthly surveys in nine fringing salt marshes around Narragansett Bay, RI, documenting the species composition and biomass of macroalgal blooms in these habitats. We also conducted *in situ* cage experiments to determine the bottom-up impacts from blooms on the dominant salt marsh plant (*Spartina alterniflora*) and herbivores. Neither herbivore densities nor the growth rate of *S. alterniflora* were significantly affected by algal biomass ($p=0.5231$ and $p=0.2531$, respectively), suggesting no short-term community impacts from increased macroalgal biomass. Future research will explore the possibility that uptake rates of *S. alterniflora* rhizome mats may delay the effects of nutrient additions until subsequent growing seasons. The possibility that most of the excess nutrients from the decomposition of the macroalgae are removed from the system during tidal cycles will also be explored.

Alligators as apex predators in a marine ecosystem

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Prehistoric ancestors of modern crocodylians once dominated the world's oceans as top predators. Now, however, their marine food web primacy is thought to be limited to crocodiles with salt-secreting glands in near shore habitats of Australasia and the Americas. Here, we test the hypothesis that American alligators (*Alligator mississippiensis*) also occupy the apex position in fully marine ecosystems across the southeastern U.S. coastline. We use GPS telemetry, stable isotope analysis, and stomach-content analysis to show alligator's increase foraging in marine marshes with increasing size. Movement data and blood chemistry analyses suggest marine-foraging alligators behaviorally regulate their osmolality by both engineering and moving to and from freshwater wetlands near the marine-terrestrial border. The failure to recognize and incorporate alligators as apex predators in near-shore marine systems likely stems from both a prevalent theoretical bottom-up bias in estuarine systems and population increases following cessation of intense overhunting in the early 20th century. Our results overturn a long-standing ecological paradigm that alligators are solely freshwater apex predators, shifts salt marsh ecosystems into marine systems (kelps, coral reefs, and sea grasses) characterized by large resident apex predators, and demonstrate the importance of identifying cross-ecosystem linkages to inform marine food webs and community structure.

Grad, Oral

Coral-associated bacterial communities in healthy and diseased *Acropora cervicornis*: a comparative analysis using TRFLP.

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White band disease (WBD) has caused unprecedented losses (up to 95% cover) of the reef building coral *A. cervicornis* in the Caribbean. Despite the ecosystem level impact of this disease, critical information including the identity of the pathogen is still lacking. Two separate studies have implicated different putative WBD pathogens. One study identified a *Vibrio* bacteria and the other suggests a *Rickettsia*. We characterized and compared bacterial communities on healthy and WBD (type I) infected *A. cervicornis* coral colonies in Panama using the bacterial fingerprinting technique 16s rRNA Terminal Restriction Fragment Length Polymorphism (T-RFLP). In addition, we compared the bacterial communities at the disease interface and along a healthy portion of the same colony. We found that the bacterial diversity is high regardless of disease state, but the identities of the bacterial community members differed significantly between healthy and diseased coral colonies and within healthy and diseased portions of the same colony. The whole community analysis indicates that WBD is associated with a widespread change in bacterial community structure. Many bacteria were found to be in strong association with diseased corals, including the two previously described putative pathogens.

Grad, Oral

Benthic Community Development on Edge vs. Interior of Created Salt Marshes.

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Created salt marshes are often used to replace the functions lost when natural marshes are destroyed. Hence, an important question is whether created marshes actually function like natural marshes and how to assess whether wetland creation and restoration projects are successful. Previous studies have shown that the vegetation of created marshes establishes quickly and is similar to that of natural marshes. However, benthic infaunal communities appear to be more complex and may develop more slowly. Several studies have compared the benthic communities in created marshes to that of natural marshes, but few have considered spatial variability within the marshes. Benthic communities in edge and interior habitats are likely to differ with regard to several factors including accessibility (recruitment), predation, and sediment characteristics. In this study, infaunal communities inhabiting the edge and interior of created and natural reference marshes are compared to examine potential differences in marsh development between edge and interior based on age of the marsh. Our hypothesis is that the infaunal community along the edge of created marshes will differ from the interior and will approach that of similar habitats in natural marshes at a different rate than the interior.

Grad, Oral

Benthic-pelagic coupling: Microalgal transfer of mercury from contaminated sediments.

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Transfer of mercury from sediment into the water column is a critical component of bioaccumulation that ultimately results in mercury-contaminated fish. The purpose of this study was to characterize microalgal community in the Weeks Bay and Grand Bay National Estuarine Research Reserves, quantify mercury concentration in the water column particulates and sediment, and define the relationship between resuspension, microalgae and mercury transfer. Two sites in Grand Bay and three sites in Weeks Bay were sampled seasonally. Mercury concentrations in Grand Bay were relatively low but Weeks Bay exhibited 4-10x higher mercury concentrations in water and sediment comparing to Grand Bay. The high percentage of methylmercury in the water column suggested that either methylation occurs in the water

column or that material containing methylmercury is preferentially resuspended. Three resuspension experiments showed that resuspension events alter the mercury concentrations and phytoplankton community. Mercury concentrations increased during resuspension and remained elevated. Phytoplankton composition shifted during resuspension but did not revert to the initial state as turbidity declined. Benthic diatoms and chlorophytes that increased in abundance during resuspension contributed to the mercury increase. This supports the hypothesis that resuspension events introduce mercury into the water column making it available to other trophic levels.

Grad, Oral

From natural ecosystems to artificial mesocosms: How functional diversity loss affects ecosystem functioning.

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The importance of environmental factors on ecosystem functioning is often decoupled from that of biodiversity in empirical work by using artificial assembled communities in mesocosms. In this study, similar assemblages were created both in natural rockpools in the field and artificially in laboratory mesocosms to allow direct assessment of the way in which varying environmental factors influence the effect of macroalgal biodiversity on productivity. Three morphological groups (turf, subcanopy, canopy) were manipulated to test for light resource partitioning in primary productivity using additive and replacement designs. The consequences of functional diversity loss on ecosystem processes were investigated by estimating gross primary productivity through incubations and dissolved oxygen measurements. There was strong competition for light resources when more than one morphological functional group was included in the assemblages. Hence, rather than a positive effect of functional diversity, strong negative interspecific competition was observed. To further explain the results, primary productivity of each functional group was also measured at increasing irradiances (P-I curve) and defined by the reciprocal shading from each group density. This was related to the productivity measured in natural rockpools and mesocosms.

Fac, Oral

Dynamics of Northwestern Hawaiian Island spiny and slipper lobsters: examination of spatial heterogeneity and drivers of somatic growth.

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Sustainable exploitation of valuable species requires accurate estimates of somatic growth and an in-depth understanding of the drivers of spatial variability. The Northwestern Hawaiian Islands (NWHI) supported a fishery for spiny *Panulirus marginatus* and slipper *Scyllarides squammosus* lobsters until it closed in 2000 because of increasing uncertainty in population models. The uncertainty stemmed from the disregard of spatial heterogeneity and assumption of synchronous dynamics, regardless of species and locations. To examine NWHI location and species-specific lobster dynamics, a tag/recapture program was conducted from 2002 to 2008. Growth rates were found to vary significantly between species, sexes, and locations. Spiny lobster growth was slowest at Necker Island and fastest at Maro Reef while slipper lobster displayed the opposite pattern. Neither density nor temperature could account for the spatial

differences in growth. Currently, stable isotope and proximate composition analyses are being utilized to examine the role of diet (prey availability and diversity) in location-specific growth rates. Recognition of and accounting for the variability in an important life history trait of both lobster species will result in more accurate stock assessments while identification of the drivers of the spatial variability will further understanding of lobster dynamics and the NWHI ecosystem.

Grad, Oral

Temperature effects on photosynthetic and respiratory CO₂ and O₂ exchange of *Symbiodinium*: evidence of functional diversity.

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Photosynthetic and respiratory rates of the coral symbiont *Symbiodinium* were determined via simultaneous CO₂ and O₂ measurements to calculate gross photosynthetic CO₂ and O₂ flux as well as light-enhanced respiration rates. Cultures were selected from clades A-E to reflect host, geographic and putative functional diversity. Measurements were taken using an infrared gas analyzer (IRGA) and Clark-type oxygen electrode, without the use of ¹⁴C labeling. Dark-level fluorescence (F₀), maximal fluorescence (F_m), quantum yield (F_v/F_m) and nonphotochemical quenching (NPQ) were monitored by simultaneous pulse amplitude modulated (PAM) fluorometry. *Symbiodinium* cultures were exposed to temperature treatments from 18°C to 32°C. Cultures exhibited diversity in photosynthetic responses to different temperature regimes at the sub-clade level. Some remained photosynthetically competent at temperatures reported to cause widespread bleaching events (30-32°C) while others experienced photosynthetic impairment at lower temperatures (26°C). Respiratory rates were greatly elevated at higher temperatures due to Q₁₀ effects, resulting in significantly higher gross photosynthetic rates. Carbon flux plays a central role in coral physiology and bleaching resistance. These methods allow for greater precision in estimating carbon flux within coral tissues and how these fluxes change across thermal gradients.

Grad, Poster

The “safe” alternative to *Caulerpa*? Hitchhikers, fragment generation and fragment survivorship of aquarium strains of *Chaetomorpha linum* and *C. crassa*

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Aquarium release threatens the ecological integrity of aquatic systems as a vector for ecologically harmful introductions of non-native species. After invasions by aquarium strains of *Caulerpa taxifolia*, the aquarium industry began promoting the genus *Chaetomorpha* as a “safe” alternative. Our goal was to assess factors that could promote invasion by *Chaetomorpha* if introduced by aquarium release. *C. linum* and *C. crassa* purchases were evaluated for “hitchhiker species” and fragments generated. Filaments were cut into fragments between 0.5 and 10 mm in length and placed in 5, 22, and 30°C. Survivorship was monitored for two weeks. In three of four trials, fragment size was not significant in determining survival, but temperature had significant effects. These results indicate that invasiveness of fragments of *Chaetomorpha* likely depends on geographic and seasonal thermal properties of introduction locations. Shipments contained up to 3470 fragments at least 1 mm in length. Aquarists dispose of these fragments with shipping water and may introduce them to natural waterways. Shipments included various “hitchhiker” species, including known invasive species of *Caulerpa*. High survivorship from small fragments of *C. linum* and *C. crassa* and large quantities of fragments makes one wonder whether *Chaetomorpha* really is a “safe” alternative to *Caulerpa*.

Grad, Poster

Linking blue crab megalopa settlement to fishery landings in North Carolina

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Fishery landings of the blue crab *Callinectes sapidus* have varied greatly in North Carolina in recent decades, but mechanisms resulting in this variability are poorly understood. The purposes of this study were to determine the primary mechanisms regulating blue crab megalopa settlement in NC estuaries and to develop a recruit-stock relationship. Megalopae were caught nightly at the Duke University Marine Laboratory dock from September to November in 13 years using passive hog's hair collectors. Nightly settlement was compared to environmental variables using cross-correlation analysis. Winds from the northeast, onshore winds and nighttime flood tides were the primary mechanisms regulating settlement. For the recruit-stock relationship, an annual settlement index was developed using the central 75 % of daily relative abundance values to minimize the effect of extremely high or low values. The settlement index was compared to annual commercial landings and CPUE (kg/trip) of hard crabs (lagged 2 y for growth to maturity) in the Albemarle, Pamlico and Southern regions. Significant positive relationships were observed between settlement and landings in the Pamlico region (where megalopae were collected) in low salinity years ($p = 0.002$) and CPUE in high salinity years ($p < 0.001$), but not for the Albemarle or southern regions.

Fac, Oral

Trends in Northeastern South Carolina's Coastal Climate & Relationships with Global Phenomena and Estuarine Epibenthic Mesozooplankton.

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Using 30-year environmental and biological databases from North Inlet Estuary, Georgetown, SC, significant relationships between rainfall, salinity and the strength of El Niño/Southern Oscillation (ENSO) and tropical storms were detected. Stronger El Niños were correlated with greater winter rainfall, which caused noteworthy decreases in salinity during those winters. An increased frequency of summer tropical storms with heavy rainfall from the mid-90s through mid-2000s was also correlated with a decline in summer salinities. One result of both of these climatic events was a significant reduction in total epibenthic mesozooplankton (2 – 20mm) abundances. Nevertheless, even though the epibenthic faunae were sensitive to major changes in salinity, they showed a capacity to recover in time frames of seasons to years. Water temperature over the past 3 decades (1980-2009) has risen approximately 0.9° C (1.6° F), with winter water temperatures increasing 2.1° C (~ 4° F). The North Atlantic Oscillation (NAO) index was positively correlated with winter temperatures. Earlier recruitment dates of winter shrimp and fish larvae into North Inlet Estuary were significantly correlated with warmer winter temperatures. Clearly, climate variability is having effects on this Estuary's environment and biota; however, further investigation is needed to elucidate other consequences and mechanisms causing this variability.

Fac, Oral

Using thermal tolerance to predict changes in geographic distribution in the seastar, *Cosinasterias tenuispina* due to climate change

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This study was undertaken to determine how the geographic distribution of a local seastar, *Cosinasterias tenuispina*, a species that is known to have a very strict thermal tolerance, will be affected by potential rises in water temperatures off the coast of North Carolina. The thermal stress of *C. tenuispina* was tested by observing righting time response, the amount of time it takes for the animal to return to a natural

position after being inverted. Six individuals of *C. tenuispina* were subjected to elevated temperatures of 26, 27, 28, 29 and 30°C maintained by a water-bath system for a 24 hour period before the righting time was measured. There was a significant difference in mean righting time response at different temperatures, determined by a one-way ANOVA test. (F statistic = 34.91, $F_0 = 8.5$, $P = <0.05$, $N = 6$) A Tukey test was conducted to determine significant differences between the mean righting time response at different temperatures. It is expected that there will be a temperature at which the organism can no longer right itself, and this represents a lethal point. If the potential rises in water temperature produce high levels of thermal stress, the distribution of *C. tenuispina* will be affected.

UG, poster

***Aplysina* Red Band Syndrome: Characterization of the associated bacterial communities**

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The decline of shallow water coral reefs has been attributed to a number of factors, including contagious diseases of reef organisms. Most studies of coral reef diseases have focused on scleractinian corals, whereas sponge diseases have been less frequently documented. Investigations of *Aplysina* Red Band Syndrome (ARBS), which affects Caribbean rope sponges, indicated that the rust-colored leading edges of the lesion were likely due to the presence of filamentous cyanobacteria. Although the presence of this distinctive coloration is used to characterize the diseased state, it is not yet known whether this cyanobacterium is the causative agent of this disease. In an attempt to better characterize the bacterial and cyanobacterial associates of both healthy and visibly ARBS-affected tissue, terminal restriction fragment length polymorphism (TRFLP) analyses were conducted. Samples collected in Belize and the Bahamas in 2008 and 2009 showed differences in the associated communities by date (year of collection) and health status (healthy or ARBS-affected) by not by location. These data suggest that the bacterial communities associated with *Aplysina* sponges can shift over temporal scales while remaining consistent over spatial scales. Additional studies are underway to further elucidate these patterns.

Fac, Oral

Seagrass community metabolism in intertidal areas: *in situ* measurements on *Z. marina* and *Z. noltii* over a tidal cycle

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Seagrasses are among the most productive coastal ecosystems. Yet, little attention was given to *in situ* carbon at the community scale. *Zostera marina* and *Zostera noltii* communities are situated on different intertidal zones (infralittoral and midlittoral zone, respectively), thus subjected to different emersion-immersion time throughout the year. Therefore, metabolism of these two seagrass communities was hypothesised to be greater during emersion owing to favourable condition in CO₂, temperature and light with a higher magnitude for *Zostera noltii* community inhabiting the upper zone. The Gross Primary Production (GPP) and Respiration (R) of *Zostera marina* and *Zostera noltii* communities were estimated in July, over a tidal cycle, by *in situ* CO₂ flux measurements during emersion and Dissolved Inorganic Carbon measurements during immersion in North East Atlantic coast (France). Surprisingly, maximal production and respiration were greater during immersion than during emersion with a greater magnitude for *Zostera noltii* community (GPP: 3 and 4 times higher and R: 2 and 7 higher for *Zostera marina* and *Zostera noltii* respectively). The role of desiccation, carbon concentration mechanisms (C₄, C₃ or CO₂/HCO₃⁻ pumps) or development strategy (belowground to aboveground biomass ratio) were discussed to explain the difference between emersion-immersion and the two communities.

Grad, Oral

Multiple techniques reveal stock structure of the demersal fish *Cynoscion nebulosus*

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Spotted seatrout (*Cynoscion nebulosus*) is an important commercial and recreational fishery. This species is stocked and managed by several states. Stocking and management practices are based on stock structure, but previous results for morphological and physiological characters and genetic markers are contradictory. Thus, we used three techniques to examine stock structure in the western Gulf of Mexico: microsatellite markers, ND4 (mtDNA) sequence, and otolith chemistry. For the ten microsatellites examined, observed heterozygosity was high across all loci and all populations ($H_o = 0.762$, s. d. = 0.033). F_{ST} , which is a measure of the amount of variation among populations versus within populations, was 0.064 ($P = 0.005$). Furthermore, of the 1018 nucleotide sites we examined from ND4 gene, 54 were polymorphic and produced 56 different haplotypes. F_{ST} for this mitochondrial gene was 0.099 ($P = 0$). These data indicate weak, but significant genetic structure among spotted seatrout in bays of the western Gulf of Mexico. Discriminant function analysis using stable isotope concentrations of $\delta^{13}C$ and $\delta^{18}O$ in otoliths revealed that on average 94% of samples were assigned to the correct bay.

Consequently, all three of our techniques suggest that fish from different bays represent different stocks.
Fac, Oral

Unexpected impacts and consequences of an invasive ecosystem engineer, *Crassostrea gigas*.

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The introduction of non-native species is one of the most important anthropogenic impacts on natural communities around the globe. Once introduced, species are difficult if not impossible to remove, can spread, and can have wide-ranging impacts in areas distant from their original source of introduction. This is especially true for species with dispersal larvae, including aquaculture species such as the Pacific oyster, *Crassostrea gigas*, the most widely cultured bivalve in the world. Ecosystem engineers are readily recognized to have important impacts on systems where they inhabit. Introduced species that are ecosystem engineers are predicted to have extremely large impacts on the systems they invade. Although *Crassostrea gigas* does not generally build reefs, it is an engineering species. It modifies the substrate and space for other species, displacing some and offering habitat for others. In addition, it can alter the thermal environment experienced by associated species, potentially altering species interactions and local biodiversity. The directions and types of impacts of this ecosystem engineer are density, habitat and site specific, and may provide an opportunity for us to determine more general drivers of patterns of diversity and interactions in the communities they invade.

Fac, Oral

Effect of Ocean Acidification on Metabolism and Growth of Olympia Oyster (*Ostrea lurida*) Larvae

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Anthropogenic carbon dioxide enters the ocean and reduces pH and carbonate saturation state, influencing the ability of organisms to build calcium carbonate shells. The current study determined metabolic rates and growth of Olympia oyster (*Ostrea lurida*) larvae under elevated seawater CO₂ concentrations. Adult oysters collected from Tomales Bay, CA were held in culture cones until veliger larvae were released. Veligers were reared through settlement under exposure to one of 3 CO₂ levels: 380 ppm (present-day concentration), 540 ppm, and 970 ppm, the higher values corresponding to predicted future atmospheric CO₂ concentrations. Throughout development, respiration rates and protein content, the latter used as a

proxy for tissue mass, were determined for groups of veliger larvae exposed to the different carbon dioxide levels. During early development, larvae from the elevated CO₂ treatments exhibited higher respiration rates than the control; however, larvae from these same cultures experienced a decrease in respiration rate as they grew, contrasting with the pattern observed in the control. These patterns provide hints of physiological stress in individuals exposed to elevated CO₂. Such results suggest that marine larvae may be useful as focal organisms for assessing potential impacts of climate change.

UG, Poster

Short-term sediment deposition rates in a *Spartina alterniflora* marsh: Relationships with marsh elevation, distance to creek, and canopy structure

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Short-term sedimentation deposition rates were quantified in a *Spartina alterniflora* dominated southeastern estuary (North Inlet, South Carolina) during July to September of 2009. Sediment samples were collected by allowing sediment to accumulate on 0.013 m² ceramic tiles for one full tidal cycle. Deposition rates were then determined as sediment mass accumulated over the period of inundation at each location. Replicate tiles were placed at 4 locations along each of 3 creek-perpendicular transect that varied in distance to creek, marsh surface elevation and plant canopy structure (stem density and average canopy height). Average rates of total sediment deposition ranged from 1.72 g/m²/hr to 18.75 g/m²/hr, and sediment accumulation was dominated by inorganic material (average % inorganic material, determined by loss on ignition, equaled 8.41 ± 15.18%). Across all locations, sediment deposition rate was significantly related to marsh surface elevation, with surface elevation explaining 58 % of the variability in sediment deposition rate. Comparisons between specific sites of equal elevation and distance to creek, however, also revealed a significant effect of plant stem density on sediment deposition rates.

Long-term Environmental Monitoring of the Macrobenthic Communities at McMurdo Station, Antarctica

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Monitoring of human impacts has been conducted in the near-shore marine environment adjacent to McMurdo Station, Antarctica for 9 years. The monitoring program collects marine sediment from two transects in historically contaminated (disturbed) areas which are compared to a control (undisturbed) transect. Each transect consists of three stations, at 12, 24 and 36 meters. Diver collected cores of sediment are analyzed for chemical contaminants, toxicity and macrobenthic community structure. Chemical contamination has remained largely the same at the contaminated stations since 2000, when monitoring was initiated. Contaminated stations are high in PCBs, DDT, petroleum hydrocarbons and heavy metals relative to the control stations. The toxicity test results have been compromised due to interference with naturally occurring sponge spicules at the reference transect. The macrofaunal community structure is distinctly different between the two contaminated transects and the control transect. Macrofauna community structure has changed over time, however the changes do not correlate with contaminant history and thus appear to primarily the result of natural variability at the study sites.

Fac, Oral

Assessment of *Diadema antillarum* density and size frequency in St. John, USVI

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In the 1980's, the *Diadema antillarum* population underwent a significant decline in the Caribbean due to disease. This mass mortality event led to elevated algal cover and smothering of some coral reefs. During the last 20 years, *D. antillarum* have been recovering on Caribbean reefs, but some populations still remain depressed. We assessed the density and size distribution of *D. antillarum* in four bays of St. John, USVI and compared this to previous studies. Density differed among the bays ranging from 0.86 to 1.58 m⁻². The average test size ranged from 54 to 62 mm with individuals as small as 12 mm measured. An inverse relationship between size frequency and density was found which may be attributed to the competition for resources among the urchins.

UG, Oral

The effects of a synthetic pyrethroid pesticide on two estuarine fish species.

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Pesticides can enter into coastal waters via surface water runoff and aerial drift, posing a risk to non-target aquatic species. Permethrin is a synthetic pyrethroid insecticide used in agricultural, turf grass, commercial, and residential settings to control a wide range of insect pests. Permethrin application in the United States is increasing as it is being used to replace other insecticides such as organophosphates and carbamates. This study examined the effects of permethrin on two species of fish found abundantly in South Carolina estuaries, the mummichog (*Fundulus heteroclitus*), and the red drum (*Sciaenops ocellatus*). The 96h median lethal concentration of permethrin was determined to be 22 µg/L for juvenile *S. ocellatus* and 54 µg/L for adult *F. heteroclitus*. Sublethal cellular stress effects of permethrin were also assessed. Lipid peroxidation activity of the liver was significantly higher in permethrin-treated fish compared to control animals after 24h. SDS-PAGE analysis of immune function in splenocyte extracts, and cholinergic receptor activity of the brain was also examined. The effects of permethrin on fish cellular stress enzymes and survival occurred at levels greater than those typically measured in the environment. Based on previous testing, the two fish species were less sensitive to permethrin than invertebrates such as shrimp. This study will further understanding of the effects of permethrin on estuarine organisms and may prove useful to the future management and regulation of pyrethroid insecticide application near estuarine habitats.

Grad, Oral.

The influence of environmental temperature on the virulence of marine pathogens

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Massive outbreaks of yellow band, white blotch/band, and black band disease have devastated coral populations around the globe. A number of bacteria are known to be affiliated with coral disease and temperature change plays a pivotal role in the way bacteria, from coral, normally function. This research examined the affects of temperature on several different bacterial virulence factors. Bacterial growth, protease activity, bio-film production and anti-bacteria activity are all virulence factors that were investigated in this study. This study investigated *Vibrio alginolyticus*, and *Serratia marcescens* (Pd1100) two specific bacteria, suspected to initiate disease in coral experiencing thermal stress. We also examined *Vibrio cambelli*, *Vibrio splendidys* and *Aeromonas trotai* these strains were isolated from a *Montastraea faveolata* infected with Caribbean yellow band disease. This study establishes that as temperature is increased the virulence of all the bacterial strains increased. While the results from the allelopathic interactions and protease activity revealed no clear trends, the growth rates as well as the bio-film production were shown to be influenced by environmental temperature. These data support our hypothesis that as environmental temperature is increased the virulence of coral pathogens amplified. Further investigation must be conducted to understand fully how thermal anomalies impact coral bacterial communities.

UG, Poster

Associations are flexible during the early ontology of Acroporid coral-algal symbioses.

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Adults of the threatened Caribbean elkhorn coral, *Acropora palmata*, associate predominantly with endosymbiotic zooxanthellae belonging to clade A3. Coral gametes were collected and crossed during summer mass-spawning events in Puerto Rico to yield aposymbiotic planular larvae. Larvae produced in 2008 were settled on preconditioned tiles and shipped to 6 aquaria (Shedd, Baltimore, Omaha, Dallas, Columbus, Smithsonian) for rearing in tropical tanks containing corals with Pacific and Caribbean algal symbionts. The internal transcribed spacer 1 (ITS1) region of the large ribosomal subunit rDNA of zooxanthellae were isolated and sequenced from surviving coral spat. 1-month-old spat from across 5 aquaria hosted A3 (n=57), D1a (n=10), or a mix of both clades (n=54). 4-month-old larvae from 1 aquarium not previously sampled (n=27) and 1 resampled aquarium (n=10) hosted only clade A3. At 3 hours post-fertilization, larvae produced in 2009 were exposed to a combined slurry of parental and genetically distinct adult tissues containing dominant homologous (A3) zooxanthellae. ITS1 and microsatellite analysis of 0- to 3-day-old larvae (n=7) showed the presence of both homologous (A3) and heterologous (C1) zooxanthellae. Taken together, these data demonstrate flexibility in the early ontology of the Acroporid coral-algal symbiosis that contrasts with the relative specificity exhibited during adult stages.

Grad, Poster

Morphological variation of blue crabs, *Callinectes sapidus*, in the ACE Basin NERR

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Blue crabs make up one of the most important commercial fisheries in the US but there has been some concern over the health of blue crab populations due to large declines in landings seen in recent years. We have taken several approaches to attempt to experimentally evaluate why crabs are declining in the ACE Basin National Estuarine Research Reserve. During our quarterly sampling over the last two years significant differences have been observed for the number of crabs caught between the three rivers of this system. In light of these differences in quantity we wanted to know if there were other differences in the crabs within the rivers. In order to examine this question, landmark-based geometric morphometric analysis was done using 18 carapace landmarks extracted from digital photos of each crab using the image analysis program TPSdig. Thin-plate spline analysis was performed using the program TPSpline to create multivariate shape variables. These composite variables will then be analyzed using a MANOVA to evaluate how crab shape varies with respect to size, sex, season, river, and salinity. Significant shape differences have been found between adult males and adult females as well as differences between adults and juveniles.

Grad, oral

Evaluating relationships between water quality and phytoplankton community characteristics in the Skidaway River Estuary

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Phytoplankton are key contributors to estuarine primary production, thus the ability to predict responses of phytoplankton to variation in water quality is important. The goal of this study was to assess relationships between sensor measurements of physical and chemical water characteristics and changes in phytoplankton biomass and community composition in the Skidaway River. Two intensive field samplings were conducted following major rain events to increase the likelihood of measurable

phytoplankton responses to changes in water quality. Temperature, pH, salinity, dissolved oxygen, conductivity, and nitrate concentration were measured twice daily at high and low tide using handheld instruments or chemical analysis of water samples, and recorded hourly using a YSI sonde and nitrate analyzer. Both methods of data collection resulted in similar temporal patterns for each physical and chemical parameter. Increased nitrate concentration preceded concurrent increases in phytoplankton biomass and alteration of species composition during both sampling events. For example, several diatom species became more abundant with increased nitrate availability. Phytoplankton biomass increases were also associated with decreased salinity and conductivity, and increased dissolved oxygen. The results from this study will be useful in the development of a model that incorporates water quality data to predict characteristics of estuarine phytoplankton communities.

Grad, Oral

Comparing predatory fish populations between two islands: densely populated Roatan, Honduras, and sparsely populated San Salvador, Bahamas.

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While human impact on lower trophic levels of the reef environment are well documented, impacts on top predators are less well understood. In this study, predatory fish populations were compared between reefs surrounding Roatan, Honduras, and San Salvador, Bahamas. The reefs at Roatan were located near West End, a very heavily populated town, while San Salvador is much less densely populated or impacted by tourism. It was hypothesized that reefs at Roatan would have less diverse and abundant predatory fish than reefs near San Salvador. During half-hour underwater surveys, data were collected on types and abundances of predatory fish species at eight reef sites for each island, and diversity indices were calculated. Water temperature, salinity, and pH at study sites were also collected. Contrary to the hypothesis, Roatan actually showed higher numbers of predators than San Salvador, and there was so significant difference in diversity between the two locations. This could be due to the presence of a locally-run marine park off of West End, which may have reduced the negative effects to those reefs from high human population density. The marine park may thus constitute a good model for other island nations who are considering a similar set-up.

UG, poster

Long-term effects of beach nourishment on the diets of juvenile *Trachinotus carolinus* (Florida pompano) and *Menticirrhus littoralis* (Gulf kingfish)

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Beach nourishment is widely utilized to combat shoreline erosion. Consequences of nourishment practices on the foraging success of juvenile surf-zone fishes are poorly documented. We examined the long term effects of beach nourishment on the diet of juvenile *Trachinotus carolinus* (Florida pompano) and *Menticirrhus littoralis* (Gulf kingfish). Four developed sites (two nourished, two unnourished) were sampled on Carolina and Wrightsville Beach during July and August 2008. Fish specimens were collected using a 30x2m haul seine. Viscera were dissected, contents separated, and identified to lowest possible taxon. Mean gut fullness was higher at unnourished sites compared to the nourished sites for *T. carolinus* (10.8% versus 4.2% body weight) and *M. littoralis* (4.3% versus 3.2% body weight). Dominant prey for *T. carolinus* at unnourished sites, based on percent index of relative importance (%IRI), were *Emerita talpoida* (47.6%), *Donax variabilis* (18.3%), and amphipods (15.0%). *T. carolinus* diets at nourished sites were dominated by *E. talpoida* (57.4%), amphipods (11.3%), and insects (11.4%). Dominant prey for *M. littoralis* at all sites were *E. talpoida* (74.7 and 46.8%) and amphipods (16.2 and 19.9%). Our findings suggest that beach nourishment practices may sufficiently alter benthic invertebrate communities, affecting the diet and foraging success of juvenile surf-zone fishes.

UG, poster

Denitrifying community dynamics in transplanted sediments at Cape Fear River Estuary (CFRE)

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Denitrification is the microbial process by which nitrate and nitrite is reduced to nitrogenous gas. Along with anaerobic ammonia oxidation (ANAMOX), it is an important pathway of removing fixed nitrogen from the environment. Denitrifiers are highly diverse and ubiquitously distributed in various ecosystems. Four enzymes carry out denitrification; nitrate reductase, nitrite reductase, NO reductase, and nitrous oxide reductase. The nitrous oxide reductase encoded by the *nosZ* gene converts nitrous oxide to dinitrogen gas. The *nosZ* gene has been used as a genetic marker for denitrifiers to compare their community structures in various ecosystems. However, little is known about the environmental factors controlling denitrifying community structures and activities in estuaries. Thus, we conducted *in situ* sediment transplant experiments to monitor the changes in denitrifying communities at the CFRE, which is heavily impacted from agricultural and industrial N inputs. Sediment samples were collected from three sites and transplanted into three different locations where salinity varies from oligohaline to polyhaline conditions. During one year of *in situ* incubation, the transplanted sediments were re-sampled every three months. Based on molecular analysis of *nosZ* genes, we found that changes in salinities and nitrate availability highly influenced the denitrifying community structures.

UG, poster

Cumulative impacts of multiple stressors on (*Zostera marina*) populations in New York estuaries.

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The south shore estuaries of Long Island have undergone substantial ecosystem changes in the last three decades. Once possessing the most productive hard clam fisheries in the nation, the ecosystem now is characterized by the loss of this filter feeder, high phytoplankton biomass and harmful algal blooms, and subsequent low light penetration to the sediment surface. Concomitant with this fishery induced habitat modification has been the loss of eelgrass. *Zostera marina* is the foundational species of NY's estuaries and it is the services provided by these plants that largely determine ecosystem structure and function. Because of their recognized importance, eelgrass is targeted for management and restoration strategies. The primary potential stressors on eelgrass populations in NY coastal waters include eutrophication-related light shading, sulfide toxicity and increased water temperature. This research project quantified the effects of these three specific natural and anthropogenic stressors both individually and when combined on eelgrass productivity and survival through a series of mesocosm and field experiments. The data from this study will allow the effectiveness of alternative ecosystem-based management strategies for eelgrass to be assessed.

Oral

Untangling the roles of historical and site-specific effects in the development of alternative states.

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Changes in species composition observed in experimental clearings from 1996 to 2008 suggest that rockweed (*Ascophyllum nodosum* and *Fucus vesiculosus*) stands and mussel (*Mytilus edulis*) beds are alternative states on sheltered bays in the Gulf of Maine. By 2005, 78% of small clearings (diameter, 1 m) returned to *Ascophyllum*, while 33% of large clearings (2, 4 and 8 m) switched to mussel beds and 33% to *Fucus* stands. However, it is not clear what is driving this divergence, and here long-term datasets (1997-2008) on mussel mortality and recruitment, and density of the predatory dogwhelk *Nucella lapillus* are used to explore the underlying causes. Poisson regressions and AIC weights were used to evaluate competing models. In the best supported models, the clearing size is the single most important factor although location (North vs South facing bays) can have a large effect on recruitment (25-fold change)

and mortality (7-fold change). Non-metric MDS and constrained PCO plots suggest North-facing bays can support alternative states while South-facing bays are likely to contain only rockweed stands. The development of mussel beds appears to be a historical accident and linked to a period (2002-2004) when dogwhelks were nearly absent and mussel recruitment was usually high.

Fac, Oral

Long distance dispersal and strong population differentiation characterize *Symbiodinium D1* from *Pocillopora* in the Eastern Pacific

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Coral reefs are extremely valuable, yet fragile, ecosystems whose existence is currently under threat from global climate change. Symbiotic dinoflagellates (genus *Symbiodinium*) are essential for coral survival, and the dispersal capability of these symbionts is likely to be an important factor in how these symbioses respond. Eastern Pacific populations of *Symbiodinium D1* (= *Symbiodinium glynni*) harbored by *Pocillopora* were analyzed using five microsatellite loci. A majority of the ~400 colonies sampled (~80%) were dominated by a single symbiont genotype (i.e., genetically distinct individual). Reef populations were characterized by a diversity of genotypes, with weak population subdivision between adjacent reefs (<100 km), suggesting dispersal is common at this scale. Regional comparisons of *S. D1* indicate major biogeographic breaks between the Sea of Cortez and the coast of central Mexico (~650 km), but no differentiation between some populations over 1000 km apart. Therefore, distance alone does not limit the dispersal ability of *S. D1*. Instead, these breaks correspond to previously known biogeographical regions (e.g., the Sea of Cortez) where oceanic environment limits gene flow. The lack of population differentiation over long distances (>1000 km) for *S. D1* is unique relative to previous findings and indicates this symbiont has a greater dispersal capability; a feature probably influenced by the transmission of this symbiont directly from parent to offspring.

Grad, Oral

The consequences of elevated temperature and the presence of Yellow Band Disease on the growth of symbiotic algae

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Recent global climate change has adversely affected shallow water ecosystems, specifically coral reefs. The subsequent rise in ocean temperatures interferes with the fundamental relationship between the coral animal and their intracellular symbiotic algae, known as zooxanthellae. When exposed to external stressors like elevated temperature, the coral may expel their zooxanthellae, resulting in a condition known as coral bleaching. Bleached corals are compromised resulting in consequences such as starvation and disease susceptibility. Pathogens may also infiltrate the coral tissue and directly afflict the zooxanthellae. An infectious disease suggested to be associated with zooxanthellae is the increasingly prevalent Caribbean Yellow Band Disease (CYBD). The present study investigated a possible correlation between zooxanthellae growth when exposed to elevated temperatures and the presence of CYBD. Zooxanthellae strains from clades A-D were grown in water baths set at 27 °C and 32 °C. Random cultures were inoculated with seven strains of combined, freeze-dried CYBD. Studies suggest that different zooxanthellae clades exhibit characteristic levels of tolerance to environmental stressors. However, there is limited information addressing cladal CYBD tolerance. These preliminary results will be discussed in the context of previous studies to determine if certain zooxanthellae clades are more resistant to climate change stressors and CYBD pathogens.

UG, Poster

Status of seagrasses as indicators of nutrient pollution in Guam

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Seagrass beds are among the most valuable but threatened ecosystems. In Guam, the combination of increasing coastal development, poorly-maintained sewage treatment plants, and plans to add up to 20,000 troops and support staff, have raised serious concerns over the fate of the island's coastal ecosystem including the seagrasses. Here, we report on surveys and isotope analyses of the common seagrass *Enhalus acoroides* from 10 sites in order to: 1) document the health of the seagrasses, and 2) assess dominant sources of N inputs as baseline for future comparisons. Where appropriate substrate was available, we found beds with cover ranging from 9.4 to 50% (mean \pm se = 29 \pm 4.6%). Isotope values ranged from 2.3 to 6.5 (3.7 \pm 0.40 ‰) for $\delta^{15}\text{N}$ and -6.3 to 10.1 (-8.1 \pm 0.33‰) for $\delta^{13}\text{C}$. The high $\delta^{15}\text{N}$ values indicate the presence of sewage-derived N at several sites; however, $\delta^{15}\text{N}$ values were unrelated to seagrass cover suggesting the over-abundance of N in the coastal environment.

UG, Poster

Assessing the importance of ecological specialization and isolation-by-distance in the diversification of dinoflagellates in the genus *Symbiodinium*

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Coral reefs harbor diverse communities of symbiotic dinoflagellates in the genus *Symbiodinium*. Biogeographic and ecological data indicate specialization to particular host has generated much of the diversity in this group. In order to examine the relative significance of specialization and geographic isolation as barriers to genetic exchange between ecologically separate populations, we analyzed the levels of gene flow among populations of *Symbiodinium A3* associating with different Caribbean corals, including *Acropora cervicornis*, *A. palmata*, *Stephanocoenia intersepta*, and *Montastraea annularis*. Eight microsatellite loci were developed, tested and optimized. All samples contained a single identifiable multilocus genotype indicating a single *S. A3* clonal line dominated each colony. We identified 138 distinct multi-locus genotypes out of 218 samples. Samples collected from three geographic locations, Mexico, Panama, and Colombia showed significant structure among populations harbored by different hosts. There was little or no indication of gene flow between *S. A3* populations originating from *Stephanocoenia intersepta* and those from *Acropora* existing on the same reef. There was also significant genetic dissimilarity among populations from the same host species surveyed in different reefs. A combination of selection pressure probably influenced by host-symbiont selectivity and geographical isolation leads to population subdivision and diversification among populations of symbiotic dinoflagellates.

Grad, Oral

Impacts of urbanization on annual and seasonal changes in macrobenthos in tidal creek nurseries

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Tidal creeks provide important nursery functions, such as supporting macrobenthic invertebrates that serve as food for upper trophic levels. Macrobenthic organisms can also serve as effective bio-indicators of habitat degradation associated with land use. Annual and seasonal changes in macrobenthos were examined over a 5 year period in high salinity tidal creeks in Bogue and Core Sounds, North Carolina that were classified as urbanized or non-urbanized by percent impervious surface. Patterns in macrofaunal

species dominance and diversity supported this classification. Although annual and seasonal changes in mean benthic metrics were similar among creeks, seasonal variances were much higher in urbanized creeks, with macrobenthos in some cases crashing to near zero in fall after the predation season. Thus, when compared to non-urbanized creeks, macrobenthos in urbanized tidal creeks appear to be (1) more degraded, (2) more variable, and (3) likely highly dependent upon outside larval sources for annual replenishment.

VIERS Research: A Way of Life

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A short documentary about the Virgin Islands Environmental Resource Station on St. Johns, USVI and the time spent both promoting and living at camp. Waking up at 7am to the food bell with 3 minute showers and a feeling of community VIERS is not the ordinary vacation spot. This is a place for learning and growth and a different way of viewing the world with a chance to have fun on the side.

UG, Film

Decapod biodiversity: a near-shore comparison of geographically widely dispersed sites.

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The stated purpose of the 2000-2010 Census of Marine Life (CoML, www.coml.org) is to assess and explain the diversity, distribution, and abundance of marine life, with the near-shore component, known as Natural Geography In Shore Areas (NaGISA, www.nagisa.coml.org) being one of the CoML projects. The composition and abundance of benthic decapod Crustacea of the rocky shore habitat, from the intertidal to 10 m depth, was investigated as one component of the NaGISA project to compare and contrast the near-shore fauna, seaweed and seagrass biodiversity globally. Data were obtained from sites sampled during 2003-2007 by numerous partners within eight regions covering the major ocean basin, using standardized sampling protocols and methods. Among the findings for rocky shore sites ranging from polar to tropical latitudes, is one of much higher anomuran decapod diversity in the northern Pacific, compared to similar latitudes in the Atlantic and even warm-water environments. Challenges in attempting such an approach are discussed.

Fac, Oral

Site-specific responses to thermal stress in larvae of the reef-building coral *Montastraea faveolata*.

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Adaptation to climate change depends in part upon the standing genetic variation present in wild populations. In corals, the dispersive larvae are particularly vulnerable to the effects of stress. Larval

survival and stress-response during dispersal and settlement will play a key role in the persistence of coral populations. To test the hypothesis that larval transcription profiles reflect population specific responses to thermal stress, symbiont-free gametes of the scleractinian coral *Montastraea faveolata* were collected from Florida and Mexico and raised under normal and elevated temperatures. These populations have been shown to exchange larvae frequently enough to prevent significant differentiation of neutral loci. Differences among thousands of genes were simultaneously characterized using microarrays to compare gene expression among wild populations under stressful conditions. Results provide evidence of site-specific variation in key cellular processes including energy metabolism, stress-response and protein biosynthesis, and reveal both local and general components of stress response during later stages of larval development. This may represent functional genetic variation in different subpopulations in the face of gene-flow, and supports the idea that coral host genomes may house the adaptive potential needed to deal with environmental change. Efforts to similarly characterize variation in another species, *Acropora palmata*, are currently underway.

Grad, Oral

Impact of Shoreline Stabilization Structures on Infauna and Nekton

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Shoreline stabilization structures, such as bulkheads, revetments, sills and living shoreline components, are an increasingly common constituent of our estuarine landscape. The demand for these structures may increase over the next several decades with changes in coastal populations as well as potential increases in sea level rise and storm threats. The presence of these structures has raised questions about their impact on coastal ecosystems with several states investigating rules regarding preferred approaches based in part on perceived environmental impacts. We have conducted several studies examining the benthic communities and nekton associated with various structures. These studies suggest that significant differences may occur between communities associated with these structures and non-stabilized shorelines and that differences may occur among structure types. However, the patterns also appear to vary depending on location and adjacent landscape, suggesting a complex relationship between the addition of these shoreline structures and faunal responses.

Fac - Oral

Simulation of the development of disease resistance in oyster populations using a gene-based population dynamics model.

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Oysters are challenged by two diseases, Dermo and MSX. MSX resistance has developed much faster than resistance to Dermo; in Delaware Bay, oysters have become almost completely MSX resistant whereas Dermo continues to contribute significantly to yearly mortality. A gene-based population dynamics model is configured with the known distribution of genes contributing disease resistance among the 10 chromosome pairs with alleles contributing resistance assumed to be rare in naive populations. Simulations of the development of disease resistance in a naive population show that the intensity of the initial epizootic significantly influences the time course of development of disease resistance. Doubling of natural mortality rate, a typical increment seen in disease-ravaged populations in Delaware Bay, results in development of disease resistance but slowly over a long period of time. Rarely is half of the increment in natural mortality rate compensated by the development of disease resistance in 200 generations; 200 years in Delaware Bay. This conforms to the observed slow development of disease resistance to DERM in natural populations. Rapid changes in resistance observed for MSX require some other process beyond compensation for a simple increase in the natural mortality rate.

Fac, Oral

Delimiting species and isolated populations in *Porites*

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Plastic morphologies and low mtDNA variation have hampered our ability to delineate coral species and recognize isolated populations. We have used a combination of nuclear genetic markers to delineate species and to identify isolated population within *Porites*, important reef building corals in both the Caribbean and the Pacific. Multi-copy ITS sequences have previously found two major crown lineages within the Pacific. Single-copy nuclear DNA (scnDNA, including exons, introns, and anonymous non-coding regions) confirms this split, but also reveals introgression between the two lineages. Caribbean species likewise share divergent alleles and tests for linkage disequilibrium suggest some clades show greater differences based on geography than current taxonomy. Simulations suggest that a combination of introgression and incomplete lineages sorting may explain this pattern. Multi-locus genotyping (based on microsatellites) of Pacific *P. lobata* populations finds strong differentiation between many that share scnDNA alleles. Overall, nuclear variation in *Porites* species often fails to sort to monophyly due to long generation times and (sequences suggest) high effective population sizes, so a combination of markers will be needed to recognize species, infer their demographic history, and the degree to which they have been exchanging genetic information with other species.

Grad, Oral

Linking benthic microbial populations, coral settlement and coastal water quality

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With the rapid development of coastal regions and the associated decline of coral reef ecosystems, cost-effective, sensitive indicators of watershed impacts on coral reef health are needed to 1) assess resilience of coral reefs to watershed disturbances and 2) detect environmental change early. Surface attached microbial communities (*i.e.*, biofilms) respond rapidly to water quality changes through shifts in abundance and composition of microbes, the absorption of chemical contaminants and occurrence of marine pathogens. As such, they may provide sensitive, cost-effective indicators of watershed effects on coral reefs. Biofilms that occur on hard substrates directly influence settlement of coral larvae as well, providing a measurement of coral reef resilience. In this study, we investigated larval settlement of *Pocillopora damicornis* and *Acropora millepora* on biofilms treated with 50 mg/L of silt sediments (>63 um) and an addition of organic matter. Preliminary results suggest that settlement declines dramatically in both species when larvae are exposed to surfaces treated with water containing silt sediments, even when biofilms are not directly coated with sediments and larvae are in filtered seawater. Results suggest that coral reef surfaces that experience watershed disturbances prior to larval and gamete release of corals may lower retention of new recruits.

Grad, oral

Effects of elevation and nutrient availability on the production and stability of coastal salt marshes (Onslow County, NC).

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As the dominant macrophyte in Southeastern and Gulf Coast salt marshes of the United States *Spartina alterniflora* Loisel is responsible for maintaining the elevation of its environment, in equilibrium with sea

level rise (SLR), through mineral (sediment) and biogenic accretion. We used nutrient addition (nitrogen and phosphorus) and manipulation of the growth elevation to determine their effects and importance *S. alterniflora* above ground production, the primary means of active accretion for these systems. Fertilized samples showed a significant increase in above ground biomass with respect to the control ($P=0.0135$) while elevation also showed a significant influence on both the fertilized and control experiments ($P=0.0132$ and $P=0.0011$). Increased above ground production can provide these systems with an enhanced sediment trapping ability as a means allowing them to keep up with increased rates of SLR. Coupled with Lidar elevation data and a mathematical model we hope to be able to determine the relative stability of these salt marsh systems in the face climate change.

Egg Size and Development rates in American Lobsters: Relationship to female Size

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American Lobsters are an extremely important element in the North American Economy. Recruitment is important for the future of this fishery, but which female lobsters are most important for contributing to new generations is not well understood. Previous studies have shown that the size and quality of eggs increases as carapace length (CL) increases; however, these data assume a “large” lobster has CL=110mm. In the Bay of Fundy (BoF) Canada, female lobsters routinely exceed CL=140mm, yet little is known about eggs produced by these “very large” females. We analyzed egg diameter and the Perkins Eye Index (measure of development) in eggs from 74 lobsters sampled in the BoF during June 2008, December 2008, and June 2009. Generally larger females produced larger eggs (135-160mm CL; $1.87\pm 0.02\text{mm}$), than did smaller females (<105mmCL; $1.78\pm 0.02\text{mm}$; linear regression $p=0.027$), except with females with CL >160, whose eggs were of similar size ($1.79\pm 0.07\text{mm}$) to small females.

UG - Poster

Recruitment by red mangroves is affected by maternal genotype, environment, and the genotype x environment interaction.

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Understanding the nature of the response of marine foundation plant species to stressors and resources requires study of local adaptation and plasticity in traits. We conducted a field experiment to assess differences in responses among 86 half-sibling seedling families of the red mangrove (*Rhizophora mangle*) to different environmental conditions of hydrology imposed at low and high intertidal settings. At 3 years, survival and growth varied with maternal tree genotype, elevation, and genotype x elevation. Different islands that were planted had slightly different micro-environments resulting from proximity to passes and wave fetch and possibly other factors. Significant genotype x island interactions further supported the hypothesis that seedlings from distinct maternal genotypes can have unique responses to different environmental conditions. Whether our results show adaptation to local conditions or differences in plasticity among genotypes will require additional study of fitness as the plants mature. However, either adaptation or plasticity provides a basis for maintenance of *Rhizophora* dominance over a range of environmental conditions and may be important for adaptation to conditions that will vary with global climate change.

Faculty, oral

Several large or several (more) small: a metapopulation-based approach for designing marine reserve networks for oyster restoration

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Marine reserve networks are a potentially powerful management tool for restoring populations, such as eastern oyster (*Crassostrea virginica*), however, the design of reserve networks within the single large or several small (SLOSS) debate remains unclear. We integrated demographics and larval connectivity of an oyster reserve network in Pamlico Sound, NC within a metapopulation framework to (1) identify source and sink reserves, (2) determine the potential for network persistence (i.e., $\lambda \geq 1$), and (3) evaluate the tradeoffs of increasing reserve size or number on network connectivity. Mark-recapture studies, fecundity analyses, and larval dispersal simulations were conducted to parameterize a spatially-explicit metapopulation model of the existing network and assess design strategies. The relative contribution of reserves to the network (λ_C) ranged from 0.7 to 1.4, indicating the presence of “source” and “sink” reserves. The intrinsic growth rate of the existing reserve network (λ) was 0.52 due, primarily, to limited network connectivity. Doubling reserve area increased network connectivity by 11% more than doubling reserve number. These results suggest that while the oyster reserve network in Pamlico Sound is not currently self-sustaining, increasing the size, as opposed to number, of existing reserves may be a more effective strategy to improve network connectivity.

Grad, Oral

Piscivorous fish abundance has potential for cascading indirect impacts through invertivore abundance and behaviour in coral reef ecosystem.

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Many studies show that the removal of large predators can have strong and cascading impacts in simple food webs. In contrast, few studies have found these same impacts in species-rich food webs following similar removals of large predators. Why this is so remains uncertain, but we hypothesize that this discrepancy is due more to extremely patchy distributions of large predators than to an overall absence of strong top down effects on lower order consumers in diverse systems. To test this hypothesis, we compared the impacts of variation in piscivore density on the composition, density and feeding rates of invertivores among two back reefs (piscivore-poor settings) and fore reefs (piscivore-rich settings) in the Florida Keys. Visual census methods were used to document piscivore impacts on invertivore density and composition. Underwater video recordings, in addition to two forms of tethering experiments, were used to document impacts of larger predators on invertivore predation rates. The results showed that when piscivores are abundant they significantly impact invertivore abundance and their feeding rates. Our findings also illustrate that the intensity of trophic cascades can vary greatly over very small spatial scales. As such, there is a need to better document piscivore distribution patterns.

Grad, Oral

Limited dispersal despite high dispersal potential: The fine scale population structure of *Patiria miniata* in the Southern California Bight

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The bat star, *Patiria miniata*, is a common, omnivorous sea star found in the shallow coastal waters of California. Dioecious broadcast spawners, bat stars have a 6-10 week planktonic larval stage. Despite this high dispersal potential, previous phylogeographic analyses of *P. miniata* (Keever et al. 2009) detected significant population structure across small spatial scales (~250 km); however, other populations of bat stars showed evidence of high connectivity across large spatial scales (~1000 km). This complex phylogeography demonstrates the need of fine scale sampling to fully understand the population structure of this species. In this study, we sampled 24 populations of *P. miniata* spanning the California coast from Fort Bragg to Point Loma. Over 600 individuals were genotyped at 7 different microsatellite loci and sequenced at two separate mitochondrial DNA loci. Using frequency and coalescence based population genetic analyses as well as landscape genetic analyses, we demonstrate that despite overall high levels of genetic connectivity, select populations (including two Marine Protected Areas) of bat stars are

genetically isolated. We hypothesize that large fresh water inputs near these populations may be acting as barriers to dispersal.

Grad, Oral

Tracing marine outfall organic discharges into a dispersive coastal area using carbon and nitrogen stable isotopes

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Stable isotopes were used to trace organic sources of carbon and nitrogen in sediments and benthic macrofauna in a dispersive coastal area under multiple organic enrichment sources, namely sewage outfall and estuarine outflow. The study of baseline sediment descriptors indicated that fines content and total volatile solids were similar to outfall pre-operation period (1994). Nevertheless, the incorporation of terrestrial organic matter within the sediments located up to 250 meters from the outfall was diagnosed by depleted $\delta^{13}\text{C}$ values (-25 to -23‰) and $\delta^{15}\text{N}$ values (+2 to +3‰). The isotopic depletion in these sites was however much stronger in the biota ($\delta^{13}\text{C}$, -24 to -20‰; $\delta^{15}\text{N}$, +2 to +10‰), than in the sediments. An enrichment of 2‰ in the sediments, and 2-6‰ in the species was noticed in sites located farther than 1500 meters from the outfall. The bivalve *Abra alba* and the polychaets *Pectinaria (Lagis) koreni* and *Nephtys* sp. were reliable indicators of the input of terrestrial organic matter into this coastal area, whether originated in the sewage outfall or the estuarine outflow. Depositivores and carnivores/omnivores gave the best picture of the sewage dispersion extension and incorporation into the food web.

Fac, Poster

Impact of Seagrass Cover on the Density of Blue Crabs in Shallow Seagrass Beds of Chesapeake Bay

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Over the past two decades, the blue crab (*Callinectes sapidus*) population in Chesapeake Bay has declined substantially. One hypothesis for this phenomenon is that reductions in cover of potential nursery habitat, particularly seagrass (eelgrass *Zostera marina* and widgeon grass *Ruppia maritima*), have driven the decline due to a concomitant decrease in survival of young juveniles. This hypothesis is based on several small-scale lab, mesocosm and field experiments in which crab survival was higher in seagrass than in unstructured habitat. We tested this hypothesis at a broad spatial scale by quantifying the abundance of juvenile blue crabs in seagrass beds throughout Chesapeake Bay after recruitment in 2006-2008, using suction sampling, an efficient sampling gear in shallow, structured habitats. Overall, percent cover of seagrass in a sample explained 20-65% of the variation in crab density. We conclude that, although seagrass cover explains a significant fraction of the variance in crab density, there are other factors that need to be considered when attempting to explain variation in the density of blue crabs.

Oral, Grad

The ghost of fouling communities past: evidence for carry-on effects on transplanted panels

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Biofouling of boats and ships creates operational problems and has also been linked to the spread of invasive species. Previous research suggests that fouling community composition and quantity will be modified by prior fouling settlement and for ships and boats traveling between different ports this may have significant impact on the organisms that become established. This experiment was designed to determine how preconditioning affects the rate and composition of re-fouling after a transplant is performed. A series of 10.16 x 20.32 cm panels were placed at three locations in Florida (Ponce Inlet, Sebastian Inlet and Port of Miami) which were characterized by distinct fouling communities. Panels were immersed for six months and then cleaned and transplanted among the three sites. Fouling

community composition and coverage was characterized at bimonthly intervals both before and after transplantation. Fouling was highly variable; however, the data showed that community structure at Sebastian and Ponce Inlets were affected by surface conditioning from different exposure sites.

Grad, Oral

An experimental model to assess the exploratory activity and efficiency in invasive versus native species of marine crabs

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Organisms ranging from paramecia to humans tend to explore places that have been least recently explored. This behavioral pattern emerges without any reinforcement mediation and is referred to as spontaneous alternation. Although organisms rely on different sources of information in alternating between places, the emergent behavioral pattern is likely advantageous during exploration and foraging. Here we present spontaneous alternation as an experimental model to assess the exploratory activity and efficiency of the invasive green crab, *Carcinus maenas* compared to the native blue crab, *Callinectes sapidus* in a plus-maze submerged in seawater. This is the first time spontaneous alternation behavior was demonstrated in Crustacea (i.e., *C. maenas*) and significant interspecific differences in alternation performance were observed. *Carcinus maenas* exhibited a pronouncedly higher spontaneous alternation performance than *C. sapidus*, and on average alternated at levels higher than chance, whereas *C. sapidus* showed chance level performance. Time course of exploratory activity also significantly differed between species. These observations point to a behavioral policy that might contribute to the competitive success of green crabs over blue crabs in areas where they co-occur.

Fac, Oral

Killer seaweeds of coral reefs: Seaweeds can poison corals when not removed by herbivores

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Coral reefs are in dramatic global decline, with seaweeds commonly replacing corals. It is unclear, however, whether increased seaweeds are a cause or a consequence of coral mortality. We know little about how the outcome of seaweed-coral competition varies among species or the relative importance of different competitive mechanisms. Here, we show that lipid-soluble metabolites from seaweed surfaces directly damage corals – causing suppressed photosynthesis, coral bleaching, and occasionally death in 75% of 32 seaweed-coral interactions (4 corals x 8 seaweeds) in Fiji. Effects of seaweeds on corals were limited to areas of direct contact for 94% of the interactions assayed, and declining corals like *Acropora* were more susceptible than more stable corals like *Porites*. Herbivory appears critical for minimizing seaweed damage to corals, and for maintaining reef resilience. In replicate areas protected from fishing, seaweeds were rapidly consumed by fishes, corals were abundant, and seaweeds rare. In adjacent fished areas, grazing was low, seaweeds abundant, and corals rare. Thus, numerous seaweeds can damage corals directly via surface-associated allelotoxins when reefs are fished and seaweeds released from herbivore control. Management of processes such as herbivory can suppress seaweeds, minimize seaweed-coral contacts, prevent allelopathic damage to corals, and thus improve reef resilience.

Grad - Oral

Cleaner shrimp symbionts display short term fidelity to host anemones

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Client fish who seek cleaner shrimps that are obligate with host sea anemones may need to alter their search patterns frequently if the shrimps often change hosts. A 2-year study of the population dynamics of

the anemone *Bartholomea annulata* and its shrimp symbionts indicates 50% turnover in anemones every 3 months. The symbiotic cleaner shrimp associated with the anemones may be even more dynamic, such that the number of each shrimp species on each individual anemone is not correlated between 3-month surveys. These findings prompted us to investigate whether the various symbiotic shrimp species show fidelity to individual anemones over a shorter term – 1 day to 1 week. We repeatedly surveyed approximately 50 tagged anemones in Brewers Bay, St Thomas, VI, recording the number of each shrimp species on each anemone in early September 2008. For each species, we conducted regression analysis of the number of shrimps found on one day versus on subsequent days. All species of shrimp displayed statistically significant correlation over 5-7 days, suggesting these species have some loyalty to individual anemones, at least for periods less than a week. Lack of long-term fidelity means that client fishes must often search for new locations of cleaning stations.

Fac, Oral

Invasion/Community Dynamics in a Metacommunity: a Marine Model System

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The recent advancement of the metacommunity concept has been a great boon for the field of community ecology, as it has helped to develop a theoretical framework for understanding how dispersal and connectivity influence ecological pattern and process at local and regional scales. While implicit in processes of community assembly, species invasion has not been explicitly examined using an experimental metacommunity approach. This study seeks to understand how community connectivity influences the invasion processes in a marine model system, how community assembly is altered and ultimately how species richness is affected. Benthic hardsubstrate epifaunal communities lend themselves well to this type of experiment because they are composed of organisms that are small, fast growing, easily manipulated and many have relatively short dispersal distances. Metacommunities with three different levels of connectivity were created by constructing ‘metacommunity’ structures. Connectivity was manipulated between treatments by augmenting the distance between 10 X 10cm communities. We will present results demonstrating the effectiveness of the system as a metacommunity as well as demonstrating the effects of dispersal distance on community assembly.

Grad, Oral

Spiny brittle stars’ (*Ophiocoma paucigranulata*) movement and directional behavior in relation to light and protection.

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Although brittle stars do not have visibly developed eyes, they still respond to light and are found in dark sheltered crevices. This study took place at Bonefish Bay in San Salvador, The Bahamas during May 2008 to determine whether brittle stars inhabit dark crevices to avoid predators and/or to escape bright sunlight. The experiment consisted of placing a brittle star in a testing area of its natural habitat with regions representing different conditions: protection without light, protection exposed to light, a shaded region without protection, and open water (as a control region). Brittle stars were observed until they moved to a testing region or out of the area. The hypothesis was that brittle stars would move towards the protected, dark region more frequently than the other regions in the testing area. Of the 96 brittle stars tested, 76 moved into one of the designated regions. Significantly more brittle stars (51) moved to one of the dark areas rather than the protected, light region or control region ($X^2_3 = 10.27$; $p < 0.05$). Brittle stars tended to move towards areas of darkness or low light, but not specifically toward shelter; therefore, they seem to inhabit dark crevices to avoid bright sunlight.

Fac, Poster

Cascading effects of frightened herbivores on grateful seaweeds

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Herbivores structure seaweed communities via consumption and can alter seaweed phenotypes when defenses against grazing are inducible. Here we demonstrate that predators may nonconsumptively influence inducible seaweed defenses by reducing the population growth and grazing rates of herbivores. In behavioral assays the herbivorous amphipod *Ampithoe longimana* fed more slowly on *Sargassum filipendula* in the presence of cues from pinfish (*Lagodon rhomboides*). To examine whether such behavioral changes influence herbivore population growth rates, populations of *A. longimana* were placed with *S. filipendula* in outdoor mesocosms and a subset were exposed to persistent pinfish cues. After 42 days, amphipod populations were smaller in the presence of pinfish cues and greatest in their absence. Predator-mediated changes in herbivore feeding rate and population size had cascading effects on *S. filipendula* biomass and palatability. *A. longimana* preferentially consumed tissue exposed to both pinfish cues and amphipods relative to tissue exposed only to amphipods. These results indicate that in the absence of predator cues, amphipods have greater negative impacts on seaweed growth rates and induce stronger seaweed defenses. Predators can indirectly influence seaweed phenotypes via behavioral changes in herbivore grazing intensity. Because predators are thought to scare more prey individuals than they consume, nonconsumptive predator-prey interactions may have cascading effects on basal resources, with important indirect effects on ecosystem functioning.

Grad, Oral

Crawling to Collapse: Ecologically Unsound Ornamental Invertebrate Fisheries

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The last decade has seen aquarium hobbyists shift their display preference from fish-only tanks to miniature reef ecosystems that include many invertebrate species, creating increased demand for biological control species. We analyzed the Florida Marine Life Fishery (FLML) landing data from 1994 to 2007 for all invertebrate species. We organized the data to reflect both ecosystem purpose (in the wild) and ecosystem services (commodities) for each reported species to address the following question: Are ornamental invertebrates being exploited for their fundamental ecosystem services and economic value at the expense of reef resilience? We found that 9 million individuals were collected in 2007, 6 million of which were grazers. The number of grazers now exceeds, by two-fold, the number of specimens collected for curio and ornamental purposes altogether, representing a major categorical shift. In general, landings have increased 10-fold since 1994, though the number of licenses has been dramatically reduced. The once small ornamental fishery has become an invertebrate-dominated major industry supplying five continents. Current management is static and the lack of an adaptive strategy will not allow for adequate responses associated with managing this multi-species fishery. Despite current management strategies, the FLML Fishery appears to be crawling to collapse.

Fac, Oral

A survey of infaunal annelids in a *Spartina* dominated salt marsh on Cumberland Island, Georgia.

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Macroinfaunal communities (>500µm) in salt marshes are generally dominated by two classes of annelid worms: polychaetes and oligochaetes. Although investigators have reported a positive relationship between annelid abundance and *Spartina* density, few have examined their response to vegetation disturbance and/or loss. We examined infaunal annelids at 5 sites on Cumberland Island where horses had grazed the vegetation. At each site, samples were collected at 6 plots along a transect spanning healthy, transitional and disturbed zones. Oligochaetes, which accounted for 87% of the annelids, had the highest densities in healthy areas (35.8 ± 10.2 per 0.01m^2), with fewer in transitional (14.1 ± 5.3 per 0.01m^2) and the least in disturbed (7.00 ± 2.8 per 0.01m^2) zones. These observations will be analyzed in relation to marsh soil and porewater conditions (salinity, pH, redox potential, percent water and organic matter) and *Spartina* characteristics (stem density and height, percent cover, root mass).

Sediment Organic Content's Effect on Hard Clam, *Mercenaria mercenaria*, Settlement

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Populations of the hard clam, *Mercenaria mercenaria*, have undergone sporadic fluctuations in the Indian River Lagoon (IRL), Florida, and once supported a viable fishery. The observed declines in the *M. mercenaria* fishery have been attributed to a combination of natural climatic events, degrading habitat quality, depensation effects, and overharvesting. Concurrently, there has also been a rise in high organic sediment recorded in certain areas of the IRL. This study explores the effect of sediment organic content on hard clam recruitment through its manipulation in both lab and field experiments. Three treatments were created: clean, low organic (historical IRL sediment analog), and high organic sediments. Organic content was altered using an algal powder from dried and blended *Gracilaria* spp. Preliminary results indicate that while clams may be induced to settle more readily in suitable habitats of clean or low organic sediments (ANOVA, $F = 9.665$, $P = 0.002$), their ability to choose suitable habitat may be significantly hindered (ANOVA, $F = 12.072$, $P < 0.001$) in the presence of high organic sediment, as hard clam mortality was also significantly greater (ANOVA, $F = 35.953$, $P < 0.001$) in this treatment.

Grad, Oral

Predator-prey dynamics between non-indigenous stone crabs and eastern oysters in North Carolina

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Increasing trends in global sea surface temperatures have led to range expansion, shrinkage and even extinction of certain species with little information on the consequences to key ecological processes like predator-prey dynamics. The Florida stone crab (*Menippe mercenaria*) has extended its range northward in NC, preying on oysters within oyster broodstock reserves in Pamlico Sound. We conducted field surveys of stone crab distribution and abundance patterns and laboratory predation experiments to determine the functional response of stone crabs to varying densities and sizes of oysters. Stone crabs exhibited higher densities (mean = $0.126/\text{m}^2$) in high salinity (> 20 ppt) regions of Pamlico Sound compared to lower salinity areas (0 crabs/ m^2 ; < 20 ppt), and were voracious predators, eating up to 23 oysters/12 h. Moreover, stone crabs exhibited a type II functional response, consuming disproportionately higher numbers of oysters as oyster density decreased, potentially leading to localized extinction. When field and laboratory data were integrated into a population simulation model, results suggested that certain densities of oysters may be vulnerable to localized extinction by stone crab predation at certain stone crab densities, suggesting that restoration efforts strive for relatively high local densities of oysters to enhance survival from stone crab predators.

Grad, Oral

Global and local stressors reduce coral larval survival and settlement

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Coral reefs face multiple threats including global stressors such as elevated seawater temperatures and ocean acidification, and local stressors that could include poor water quality, reduced herbivory and exposure to algal blooms. To determine how global (+2°C elevated seawater temperature) and local (the presence of microcolin A, a secondary metabolite isolated from a benthic cyanobacterium) stressors might interact to inhibit coral recruitment we tested the survival, settlement and oxidative stress response of larvae of *Porites astreoides* when exposed to each of these stressors independently and together. After exposure to these stressors for 4 days, the heat stress had no significant effect on larval survival and settlement; however signs of sublethal stress were evident with an increase in superoxide dismutase activity, lipid peroxidation and protein carbonylation levels. Microcolin A decreased the survival and settlement of larvae of *P. astreoides* and increased the activity of superoxide dismutase but not the other biomarkers. In the presence of both stressors there was a significant interaction that reduced larval survival. Overall, the presence of a cyanobacterial compound caused a strong reduction in larval survival and settlement, and our data illustrate that two stressors can interact synergistically to reduce coral larval survival.

Fac, Oral

Informing managers: Blue Crab Spawning Biology and Stock Assessment

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Accurate assessment of the spawning stock should be important in informing fisheries management. Blue crab life history makes spawning stock assessment complex. In NC from March through November, female blue crabs undergo their terminal molt and mate. After variable amounts time, ovaries become mature and the first clutch of eggs extruded. Crabs that mature in low salinity (<20) move to high (>22) salinity to release their larvae. Crabs then forage and produce subsequent clutches of eggs, continuing to move seaward with each subsequent clutch. Using by-catch data from Division of Marine Fisheries monthly gillnet surveys in low and high salinity may be a good way to estimate blue crab spawning stock. Spawning crabs build up in high-salinity areas in the sounds and coastal ocean. The spawning population peaks in August/September with some crabs releasing their first clutch and others releasing their second or higher clutch. The observed pattern in spawning females is correlated with the return of blue crab megalopae from the coastal ocean to a tidally driven estuary.

Fac, Oral

Macrofaunal pattern and ecosystem services in deep basin sediments on Atlantic Canada's shelf

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Macroinvertebrates residing in the soft sediment layers, which cover 70% of the ocean seafloor, are thought to be both patchy in distribution but also key players in delivering benthic ecosystem services such as nutrient cycling and sediment oxygenation. In the summer of 2009, we collected multicore samples of benthic sediment from four basins in the Gulf of Maine and Scotian shelf. This research aims to investigate the influence of habitat predictors on infauna, and infaunal predictors on ecosystem services. We measured chlorophyll-a levels and CHN as potential habitat variables and microbial concentrations and sediment oxygenation as ecosystem service variables at three different sediment horizons and 39 spatial locations. Preliminary analysis from a single site, Jordan Basin, indicated no relationship between total macrofaunal abundance and chlorophyll-a. Macrofaunal abundance was also unrelated to microbial abundance but was significantly correlated with oxygen penetration. Considerable

spatial variability was found in these variables within samples collected from Jordan Basin. Future analysis will focus on community biodiversity within Jordan Basin, along with a more extensive data set spanning a broader range of environments and spatial scales ranging from metres to hundreds of kilometres within the Gulf of Maine and Scotian shelf regions.

Grad, Oral

One Crab, Two Crab, Blue Crab, Green Crab: How *Carcinus maenas* detects its prey

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Predation has a large effect on prey populations and the structure and function of communities. Even though predation is a strong force driving community structure, the effect of predators on prey is usually reduced in habitats with extensive environmental stress. Using green crabs, (*Carcinus maenas*), we investigated how environmental stress in the form of hydrodynamics modifies foraging behavior. In both lab and field studies, we tested the effects of increased flow velocity and turbulence on the ability of green crabs to locate and consume prey. Our results suggest that higher velocity and more turbulent flows diminish foraging success in the field and decrease search efficiency in the lab.

Grad, Oral

Male mate choice behaviors are influenced by female parasite load in a damselfish.

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Male choice of female mates is an important source of variation in mating success, but historically male mate choice has been overshadowed by female choice of males. Male mate preferences have been demonstrated in some *Stegastes* damselfishes. In Jamaica, a large, externally parasitic isopod (*Anilocra partiti*) parasitizes the bicolor damselfish (*S. partitus*), and this parasite makes males less as mates. In this study we examined the effect of this isopod on male mating preferences. We presented males with parasitized and unparasitized females. Males preferred unparasitized females in paired-female presentations. The preference for unparasitized females was also present during single-female presentations, but the preference was less obvious. During observations on natural courtship patterns, we found parasitized females were courted less often than expected. In addition, unparasitized males courted unparasitized females more often than expected. Correspondingly, parasitized males courted parasitized females more often than expected. It appears that although the effect of *A. partiti* on preferences of male *S. partitus* is not as dramatic as on females, this parasite can still play an important role in the reproductive success of females. Parasites, which are known to play an important role in female choice of males, apparently also affect male choice behavior.

Fac, Oral

Development of nontoxic commercial marine antifouling paints using natural products from the sponge *Aplysilla longispina* and tunicate *Eudistoma hepaticum*

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The fouling of submerged hard bodies has prompted the creation of toxic or otherwise harmful antifouling coatings containing organotin, copper, and other heavy metal derivatives as biocides. Upon entering the marine environment, these compounds can have deleterious effects. This study seeks to address the need to mitigate biofouling in an ecologically sound way, drawing upon the natural antifouling properties of some marine organisms. Natural products from the sponge *Aplysilla longispina* and tunicate *Eudistoma hepaticum* were extracted and crude organic extracts were incorporated into a biocide-free commercial paint formula and painted on plexi-glass panels. Each set of panels was subjected to six weeks of field exposure and observation. Visual percent cover estimation and photo-based point-cover analyses were used to gauge the effectiveness of the paints against a positive and negative control. Results suggest a significant initial repression of biofilm creation and settlement by extracts of both *Aplysilla longispina*

and *Eudistoma hepaticum* observed only during the first week of field testing. No significant inhibition of fouling was observed in any other week in any treatment. Future commercial use of marine natural products in antifouling coatings may help solve the worldwide need for ecologically safe yet effective fouling deterrents.

UG, Poster

Eelgrass *Zostera marina* growth, photosynthetic efficiency, and survival in response to groundwater exposure with nitrate and the herbicide Diuron.

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Eelgrass communities in the Peconic estuary of Long Island NY have been in decline for several decades prompting resource managers to reduce nitrogen loads into the estuary. Despite improved water quality in recent years, eelgrass continues to decline. This lack of response has caused the management agencies to suggest that seepage of groundwater contaminated with herbicides such as Diuron and high nitrate from regions with a long history of agriculture may be to blame. We performed two types of manipulative experiments during the summer of 2009 to assess the possible impacts of groundwater on eelgrass growth and survival. Although previous experiments have found little or no impact of low Diuron concentrations on eelgrass growth, we exposed the plants to multiple stressors of decreased light availability and increased water temperatures as well as herbicide exposure. In addition, we conducted a mesocosm experiment that delivered high nitrogen groundwater to the sediment of eelgrass planters via peristaltic pumps to assess the relative stimulation of grass growth versus phytoplankton biomass. In addition to measuring eelgrass survival and productivity, a PAM fluorometer was used to assess the impact that the herbicide had on the photosynthetic efficiency of the plants.

Grad, Oral

Can you tell me what this is?

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“Can you tell me what this is” intends to draw the attention upon marine Invertebrates through photography. If the world of terrestrial Invertebrates is far from us, arguably that of marine Invertebrates is even further away. Many of such species are totally unknown to people or even to biodiversity students and yet, the colors, the patterns and the sheer beauty of these animals make it often difficult to hide expressions of astonishment. We hope that this presentation may stimulate the curiosity and self willingness to know more about such animals. With knowledge comes understanding, caring and respecting and this is the key to develop a will to protect.

Fac, Poster

Geographic Variation in M7 Lysin Allele Frequency: A Test of the Hypothesis of Reinforcement

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In broadcast spawning organisms, speciation is believed to be primarily determined by differences in gamete binding proteins which tend to differentiate rapidly and show a signal of positive selection. Reinforcement, the evolution of pre-zygotic barriers due to the presence of post-zygotic barriers, is one of the possible explanations for positive selection on gamete binding proteins. We tested for a signal of reproductive character displacement in M7 lysin allele frequency between the *M. edulis* and *M. galloprovincialis*. M7 lysin consists of two distinct clades within *M. galloprovincialis*, one of which (the “D” clade) is highly divergent and shows a strong pattern of positive selection. It has been hypothesized that the positive selection on the D clade is a result of reinforcement. Samples were collected from a series of sympatric and allopatric populations of *M. galloprovincialis* in a mosaic hybrid zone in Europe. If reinforcement is the driving force behind the divergence of the D clade, then D clade alleles should be most common in areas of range overlap between *M. edulis* and *M. galloprovincialis*, where they are

hypothesized to be favored as a mechanism that decreases hybridization. We were able to find evidence for reproductive character displacement in our study.

Grad, Oral

How much of the regional-scale variability of deep-sea meiofaunal abundances can be explained by environmental variability?

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Little is known about the distribution of deep-sea meiofauna in comparison to deep-sea macrofauna. To further our knowledge, a multiple corer was used to collect deep-sea samples from four stations near the 2700-m isobath and four near the 3700-m isobath off the west coast of the United States. From these samples, we will examine the meiofauna abundance (nematodes, harpacticoid copepods, kinorhynchs, and ostracods) and compare them with the environmental data (carbon and nitrogen, bacterial counts, granulometry, pigment, and enzyme hydrolyzable amino acids) from each station.

Grad Poster

Optimizing defenses by chemical and structural means – Defense strategies of the sponge *Melophlus sarassinorum*.

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Sponges are well known for their ability to deter feeding. While lots of examples of chemical defense are known in sponges, demonstrations of structural defense and interactions between chemical and structural defenses are still rare. We used field and laboratory experiments to investigate the anti-predatory defense mechanisms of the sponge *Melophlus sarassinorum* from the tropical Pacific. Specifically, we aimed to investigate whether *M. sarassinorum* is chemically and/or structurally defended against predation and if the defenses are expressed differently in the ectoderm and endoderm of the sponge, which would be in accordance with the optimal defense theory (ODT). Our results demonstrate that the chemical defense is evenly distributed in the entire sponge body, but that predation is further reduced by a structural highly defended ectoderm. The endoderm of the sponge contained higher protein levels, but revealed no structural defense. We conclude that the distribution of chemical defense in *M. sarassinorum* is not in accordance with the ODT, while structural defense supports the ODT by being restricted to the surface layer that experiences the highest predation risk.

Postdoc, Oral

Effects of the Florida red tide dinoflagellate, *Karenia brevis*, on oxidative stress and metamorphosis of larvae of the coral *Porites astreoides*

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Florida red tides have historically had a negative impact on coastal communities along the South Florida coast. We provide evidence that short term exposure of naturally occurring concentrations of *K. brevis* and their associated toxins can induce oxidative stress in the coral larvae of *Porites astreoides*. Larvae of *P. astreoides* were exposed to aliquots of intact *K. brevis* cells at naturally occurring concentrations (4×10^6 cells L⁻¹) or cellular lysates (containing 5.40 μ g L⁻¹ brevetoxin) for 20 hours and a variety of larval physiological biomarkers were measured. In the presence of bloom scale concentrations of *K. brevis* larval respiration of *P. astreoides* was inhibited. This was accompanied with an increase in lipid hydroperoxide content and catalase activity indicating oxidative damage and a subsequent antioxidant response were occurring. However, when larvae were exposed to intact cells of *K. brevis* or their sonicated, lysed exudates stress indices including zooxanthellae expulsion (bleaching), larval protein

carbonylation, and superoxide dismutase activity were not significantly altered. The effects of *K. brevis* exposure on the survival and settlement rates of *P. astreoides* larvae will be discussed.

Fac Oral

Survival is not enough: coral-population dynamics in the western Pacific Ocean

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Coral-population dynamics are influenced by population parameters that act on individual colonies at all life-history stages, from differential recruitment and survival, through to senescence. Still, we know little about population parameters and how they vary spatially, seasonally, and under different environmental conditions. This study sought to quantify four coral population parameters, (i) recruitment, (ii) growth, (iii) partial mortality, and (iv) total colony mortality, to determine which most influenced corymbose *Acropora* population dynamics on reefs in southern Japan. Here we focus on tracking corymbose *Acropora* colonies, which are the dominant corals on shallow Indo-Pacific reefs, from 1996-2001, through a thermal anomaly (+1.8°C in 1998). Recruitment at the windward site remained consistent through time, whereas recruitment at the leeward site varied at all depths with a considerable decrease after the 1998 thermal anomaly that returned to pre-stress rates by 2001. Size-frequency distributions consistently followed a log-normal distribution that shifted towards larger mean diameters after 1998.

Sensitivity analyses revealed that total-colony mortality was the most sensitive parameter, at all depths, causing the most change to coral population growth (λ). Quantifying the population parameters that lead to state changes is a pre-requisite for understanding regime shifts and reef dynamics in a warming ocean.

Grad, Oral

Establishing baselines far from shorelines: examining corallivory in the world's largest marine protected area

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Establishing ecological baselines of coral reef structure and function is not possible for most tropical reefs, given their proximity to shorelines and thus their degradation by local human activities. Here, we examined the relative impact of corallivory (consumption of live corals) as a function of live coral cover and corallivore community in the remote, uninhabited atolls of the Phoenix Islands Protected Area, the world's largest and most remote marine reserve. We conducted transects surveying the diversity, abundance, and biomass of both fish and corals, as well as the incidence and extent of corallivory. We found a relatively intact fish community and a range of coral cover from 18-95%. Corallivory incidence ranged from 3-24% and averaged 9% across all sites, suggesting that an ecologically relevant portion of colonies regularly experience total or partial mortality, with possible consequences for growth and reproduction. Nonetheless, highly grazed colonies persist, suggesting some level of tolerance. These data represent a first attempt at quantifying baseline corallivory levels; such relative baselines can only be calibrated far from shorelines in remote environments relatively free from local anthropogenic impacts.

Fac, Oral

Nondestructive diet analysis of Leopard Sharks (*Triakis semifasciata*) in southern California bight

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The leopard shark (*Triakis semifasciata*) is a common inshore shark that is found along the coast in the northwest Pacific from Oregon (USA) to the Gulf of California (Mexico). Leopard sharks are benthic predators that feed on fish eggs, fish, decapods crustaceans, worms, clams, and other benthic invertebrates (Webber 1998, Ebert 2005). Current passive acoustic tracking studies show evidence of sexual segregation in southern California coastal sites (Nosal 2009). Our objectives will be 1) to gather site-specific data on the food habits of leopard sharks in coastal sites along southern California using non-destructive techniques and 2) to assess sexual and habitat-related dietary differences using percent index of relative importance (Cortés, %IRI).

UG, Poster

Discharges from Lake Okeechobee shape macroinvertebrate communities associated with created oyster reefs

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Few studies of oyster reef community ecology have been conducted in southeast Florida. Our research focuses on the development of the invertebrate community associated with newly created oyster reefs. Oyster reef restoration in the St. Lucie River (SLR) estuary is a component of the Comprehensive Everglades Restoration Plan with a goal to restore 20 acres of oyster reef habitat. Approximately 1300 reef patches (10 acres) have been created in the SLR estuary since August 2009. Colonization of sessile and motile species was noted on the reefs three weeks after installation; however, oyster spat settlement remained sparse at that time. Within four months, spat settlement increased, as did colonization by sessile and motile species. Future analyses will evaluate colonization relative to river discharge rates, sedimentation rates, reef subsidence into muck, and shallow versus deep reefs between newly created oyster reefs, existing restored and natural reef communities.

Grad, Oral

Deep-Water Refugia: A Review of Evidence, Implications and Avenues of Future Research for the Caribbean Spiny Lobster

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The Caribbean spiny lobster (*Panulirus argus*) supports the most important commercial fishery throughout the Caribbean and Florida, and it is an ecologically dominant species in the food web. Unfortunately, habitat degradation, overfishing and other environmental disturbances have caused significant declines in spiny lobster populations. Various lines of evidence suggest that lobsters inhabiting deep-water refugia may subsidize heavily exploited shallow-water populations via migration or larval transport. Broad availability of new technologies such as the use of underwater remotely operated vehicles coupled with SCUBA surveys may prove essential in quantifying the importance of deep-water refugia. These refugia can ultimately be targeted for protection with Marine Protected Areas, and therefore serve to sustain the ecological and economic benefits of Caribbean spiny lobster.

Poster, Grad

Hypoxia in an urbanized southeastern coastal embayment: Long Bay, SC

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Long Bay, near Myrtle Beach, South Carolina, recently (approximately Aug 17-28, 2009) experienced hypoxic and anoxic events similar to an event which occurred in July 2004. A working group of state and

federal agency and academic partners quickly responded to this event with a variety of research and monitoring efforts. This multi-state and multi-agency collaboration has led to a more robust dataset compared to the event in 2004. Data collected has included measurements of natural resources such as fish and phytoplankton, nutrients, organic matter, currents and wind, and water chemistry. In addition, remotely sensed data such as sea surface temperature and chlorophyll have been evaluated. The preliminary assessment of the data indicates that the previous conclusions regarding mechanisms have not generally changed; the most pronounced difference being that the 2009 event was accompanied by higher substrate concentrations and lower DO levels than observed anytime during our previous 2006 – 2008 sampling. Importantly, however, we were able to document that hypoxia only occurred along the Grand Strand region of Long Bay. We were also able to determine that the low DO was maintained in a cohesive water mass that moved around over small spatial and temporal scales.

Fac, Oral

Multi-scale spatial variation of nearshore submerged aquatic vegetation seascapes at Biscayne Bay, Florida, USA

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Metrics developed by landscape ecology are ideal to quantify the spatial pattern of submerged aquatic vegetation (SAV) systems since these habitats have a natural tendency to form variable-sized patches. The patchiness, fragmentation, spatial heterogeneity, and dynamics of SAV landscapes are driven by internal and external regulatory mechanisms that vary spatially and temporally. In this project, we: (1) evaluate the role of freshwater deliveries from management structures on the landscape characteristics of nearshore SAV communities of Biscayne Bay, South Florida; and (2) identify the scale/s with the largest spatial heterogeneity of SAV landscape characteristics and relate these spatial patterns to the distribution of freshwater delivery points. Our exploratory seascape approach identified two major SAV landscape structures: fragmented SAV landscape (FSL) structures and continuous SAV landscape (CSL) structures. The FSL structures were concentrated within the vicinity of large freshwater point sources. In contrast, CSL structures tended to be distant from freshwater point sources and in areas with higher and more constant salinity. This research will improve our understanding of how future impacts of management activities may affect the spatial distribution and assemblages of marine nearshore habitats in Biscayne Bay.

Grad, Oral

Urban runoff and oxygen dynamics on salt marsh platforms

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In much of the southeastern US, open canals and ditches are used to channel urban stormwater into surrounding marshes. The hardened surfaces characteristic of most urban areas can result in the delivery of large quantities of labile nutrients into marsh estuaries in a short period of time. We predicted that these events would have significant consequences for the oxygen balance on adjacent marsh platforms. We compared O₂ dynamics on a marsh receiving discharge from a canal draining the southeastern portion of Savannah, GA, with a second site that received no freshwater input. Stormwater discharge effects were evident in the large variance in salinity at the canal site; however there was no evidence that these effects produced a persistent difference in oxygen concentration or consumption rate between the two locations.

Fac. Oral

Top-down effects by *Panopeus herbstii* on *Littoraria irrorata* foraging on *Spartina alterniflora* in a South Carolina marsh system

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Decapod predators may exert top-down regulation on gastropod herbivores within southeastern salt marsh habitats reducing the chances of overgrazing and system collapse. When present, the mud crab *P. herbstii* reduces snail foraging and may affect plant and snail biomass. Crab effects on biomass were measured in a 1.5 mo. long field experiment. Snail and crab densities were manipulated within mid-marsh enclosures (0.5 dia, 0.9 m height) constructed at Waties Island, SC. Snail feeding events and snail and cordgrass biomass were determined for initial and final field and all final enclosure samples. Initial presence of *P. herbstii*, even in enclosures where crabs escaped, significantly reduced snail foraging events but may or may not affect snail or plant biomass. Crabs appear to exert a top-down effect on snail foraging even at snail densities appreciably less than reported in previous experiments. A lack of biomass effects may indicate snail foraging on alternative food sources, an ability of cordgrass to supplement biomass losses through the rhizome, and/or timing of the experiment coinciding with a seasonally slow growth period. Whatever the ultimate consequences, the mere past presence of a salt marsh decapod is capable of inducing a trait mediated response in snail foraging.

UG, Poster

Abundance of the sea urchin *Diadema antillarum* in 5 sites of Puerto Rico after 25 years of mass mortality.

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In the Caribbean, one of the major driving forces of coral reef degradation is attributed to the mass mortality of the sea urchin *Diadema antillarum* in the early 1980s. Populations were reduced by 93-100% from their original number within the region as a consequence of an unknown pathogen. After 25 year of the mass mortality little is known about the current population condition. Therefore, the main objective of this study was to assess the current population status, with respect to densities, at five sites in Puerto Rico. All urchins within five belt transects (10 x 2 m) were counted. Median densities differed significantly among sites (KW One-Way ANOVA $p < 0.001$), although overall abundances were relatively low at all sites varying between 0.02 ind/m² and 1.84 ind/m². This result indicates that abundance of *D. antillarum* is still low compared to pre-mass mortality abundances.

UG, Poster

Saving St. John

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Saving St John is a documentary about this small tropical island's ailments and what we as humans can [if we even should] do to protect it. We interview experts and get a range of contrasting opinions on the top issues: global warming, hurricanes, dying species, and human interference. It delves deep into issues that most researchers are totally unaware of. *Warning, this film is a "mocumentary" and contains almost no valid scientific information. It is purely to entertain.

UG, Film

Assortative fertilization of natural hybrids promotes reproductive isolation in the Gulf of Maine *Mytilus* hybrid zone

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Hybrid zones contain genotypes that span a continuum of genetic contributions from parental species. Often, species-diagnostic alleles at condominant loci are tallied to yield a "hybrid index." For example, a

hybrid index from species B alleles would be 0 for pure species A, 3 for F₁ hybrid, and 6 for pure species B individuals. Intermediate hybrid index scores dominate so-called “unimodal” zones, which may represent an earlier stage following secondary contact, if assortative mating has not yet evolved. “Bimodal” hybrid zones, in contrast, are dominated by pure parentals and late-generation backcrosses, but intermediate genotypes are uncommon. Such zones are thought to reflect a later stage of speciation, after assortative mating evolves. The *Mytilus edulis*/*M. trossulus* hybrid zone in the western Atlantic is bimodal (it is unimodal in the Baltic Sea). The hypothesis that bimodality is driven by assortative fertilization is supported by strong gametic incompatibility in crosses *in vitro* between pure *M. edulis* and pure *M. trossulus*. In this study, we demonstrate that assortative fertilization also extends to crosses between natural hybrids, and that compatibility increases with the “hybrid index difference” between male and female. This outcome should further promote bimodality and progress towards speciation in this hybrid zone.

Grad, Oral

Propagation of the threatened staghorn coral *Acropora cervicornis*: Methods to minimize the impacts of fragment collection and maximize production.

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Coral reef restoration methods are increasingly accepted as viable alternatives to mitigate reef degradation and enhance recovery of depleted coral populations. In this study, we describe several aspects of coral gardening that identify this approach as an effective tool for the propagation of the threatened Caribbean coral *Acropora cervicornis*: (1) the collection of fragments did not result in any mortality to the donor colonies; (2) decreases in linear extension of the damaged branches on donor colonies were only temporary; (3) fragmented branches grew faster than unfragmented control branches after an initial recovery period; (4) temporary reductions in linear extension were limited only to fragmented branches within colonies; (5) fragments experienced initial mortality resulting from handling and transportation stress, but surviving fragments grew well over time; and (6) when the growth of the fragments is added to the regrowth of the fragmented branches, the new tissue produced is 1.4–1.8 times more than tissue produced by the same number of branches in unfragmented control colonies over time. Based on these results, the collection of small (2.5-3.5 cm) fragments from parent colonies is an effective propagation method for *A. cervicornis* resulting in maximized biomass accumulation and limited damage to depleted parent stocks.

Fac, Oral

An investigation of the sub-lethal effects of ocean acidification on regeneration, growth, and behavior of the soft bottom sea star *Luidia clathrata*

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Ocean acidification (OA) is triggered by the absorption of excess anthropogenically-derived atmospheric carbon dioxide that reacts in seawater to elevate free hydrogen ion concentrations. This process can cause a wide range of impacts on marine organisms. To date no studies have focused on the sub-lethal effects of ocean acidification on aspects of sea star regeneration, growth or behavior. As sea stars exhibit high regenerative capacity, arm loss provides an excellent model to evaluate the effects of OA on regenerative processes. In the present study, replicate individuals of *Luidia clathrata* had two of their arms excised, and were then maintained in seawater either bubbled with air alone (pH = 8.2, control treatment) or with a mixture of air/CO₂ (pH 7.8, experimental treatment) for a period of 14 weeks. Individuals in both treatments were fed a maintenance diet. We measured regeneration (arm length), growth (total body wet wt), and righting response times. We found that the reduced pH treatment did not inhibit arm regeneration or whole-body growth. However, righting behavior times were significantly higher at the lower pH

treatment. Thus, OA inhibits behavioral activity in *L. clathrata* and suggests that foraging efficiency and flight from predators may be compromised.

Grad, Poster

Coral reef habitat variation influences the behavior of bicolor damselfish

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Physical and social conditions vary considerably across a coral reef, but few studies have explored how this variation influences the behavior of reef taxa. In this study, we examined associations between habitat conditions and the behavior of bicolor damselfish (*Stegastes partitus*), a species that shows high site fidelity but is found across a range of reef habitats. Specifically, we quantified variation in physical and social conditions and bicolor damselfish behavior among Curaçao's fringing reefs. Principal components analysis reduced the physical habitat variables to two components: PC1, which included depth, coral cover (%), rugosity, and average hole size; and PC2, that represented the number of holes. PC1 increased with the reef slope as the habitat transitioned from rubble to live coral. This increase in PC1 was associated with altered social conditions, indicated by a decrease in bicolor damselfish density but an increase in overall fish diversity. Bicolor damselfish behavior also showed a relationship with PC1, with large (>4cm TL) damselfish behaving more aggressively in shallow, rubble habitats with small holes (low PC1 values). This finding provides evidence that bicolor damselfish display intraspecific variation in behavior that is associated with variation in the physical and social conditions of a coral reef habitat.

Grad, Oral

Morphology, growth and resource allocation of the seagrass *Syringodium filiforme* in outer Florida Bay, Florida.

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Morphology, growth and resource allocation patterns of the seagrass *Syringodium filiforme* growing on a shallow banktop (0.5 m) and at an adjacent deeper water (1.5m) site in outer Florida Bay, Florida were measured and compared. Ramet density, total biomass, leaf formation, and leaf growth did not vary between sites. Significant differences in the biomass and growth of stems, rhizomes and roots were observed between sites. Banktop plants had reduced stem growth compared to plants growing nearby in 1.5 m of water. In contrast, rhizome and root growth were higher on the banktop compared to the deeper water site. Whole plant productivities at the 0.5 and 1.5 m sites were 11.0 and 15.9 g dw m⁻² day⁻¹ respectively. The ratio of above-ground to below-ground production at the 1.5 m site was 17.7, indicating that the plants at this site allocated the majority of their resources to above-ground growth. In contrast, banktop plants allocated a larger percentage of their total production to rhizome and root growth, as evidenced by a ratio of above-ground to below-ground productivity of 4.1. These results suggest that leaf growth and production are not good indicators of whole plant growth resource allocation or productivity patterns.

Fac, Oral

Tidepools as nurseries for limpets: temporal and spatial patterns of limpet recruitment (SW continental Portugal)

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Limpets are abundant on rocky shores of SW Portugal, and tidepools are presumably important for their recruitment. This coast has experienced anthropogenic changes due to the setting of the Port of Sines. A lower density of limpets inside this Port, compared with outside adjacent areas, was previously reported. The hypothesis of differential patterns of limpet recruitment along a gradient of proximity to the Port (inside the Port, 4 and 8 km away) was examined in a series of tidepools which were limpet-cleaned at three-monthly intervals from May 2005 to July 2008. Minimum density of recruits (maximum shell length - MSL < 3 mm) of *Patella depressa* and *Patella ulyssiponensis* was consistently found during end-of-summer periods. Recruitment of these species was higher during other seasonal periods but there was inter-annual variability in the highest recruit density peaks. The maximum density of *Siphonaria pectinata* recruits (MSL < 2 mm) was recorded during the end-of-summer of 2005, recruitment being comparatively low during the following years. Recruitment of Patellids was significantly higher in the farthest shore from the Port but no spatial differences were found for *S. pectinata*. Considerable variability in specific composition and density of juveniles (MSL < 10 mm) was found when comparing tidepools with other intertidal microhabitats.

Grad, Oral

Interactive effects of urchin density and algal cover on urchin mortality in a marine reserve

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In kelp forest habitat, sheephead (*Semicossyphus pulcher*) and spiny lobsters (*Panulirus interruptus*) are thought to exert significant predation pressure on purple and red urchins, thereby regulating kelp forest community structure. However, little is known about their relative roles in urchin population regulation. We manipulated urchin density, understory algal cover (presence or absence), and period of exposure (day or night) to test the interactive effects of all three factors on urchin proportional mortality. We also made video recordings of daytime predation to determine whether sheephead are the primary daytime predator of urchins and if they exhibit an aggregative response to urchin density. For daytime and nighttime trials, urchins with no algal cover experienced inverse density dependence, in which urchin proportional mortality decreased with urchin density, whereas urchins under algal cover showed density-independent mortality. Algal cover significantly reduced urchin proportional mortality during the day, but not at night when urchin mortality rates were low. Video recordings showed a weak positive relationship between urchin density and the number of sheephead present. This work suggests that in a southern California reserve, time of day and the algal cover influences urchin mortality and that predator-induced urchin proportional mortality does not increase with urchin density.

UG, Oral

Source-sink dynamics in the bivalve *Macoma balthica*: hypoxia and sediment effects.

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In source-sink theory, species occupy interconnected, heterogeneous habitats that differ in quality (sources and sinks). Hypoxia (low dissolved oxygen), is a serious environmental stressor that substantially reduces the abundance of organisms in local populations, which therefore require subsidies from adjacent sub-populations to persist. Sediment characteristics alter predator foraging abilities, creating localized habitat refuges in some areas and allowing abundant foraging in others. We examined the effects of hypoxia on the clam, *Macoma balthica*, in the York and Rappahannock Rivers (Chesapeake Bay). We also examined *Macoma* densities in habitats with differing sediment types shortly after recruitment and again after intense benthic predation. In both rivers, hypoxia resulted in local extinction of the population and may have decreased individual clam growth. Locally extinct populations (sinks) were later repopulated by nearby source populations. Similarly, predation in sand habitats and subsequent replenishment by nearby mud sources was apparent in the York River. In a matrix model, hypoxia resulted in coupled source-sink metapopulation dynamics, with hypoxic areas acting as black hole sinks. Moreover, increasing the spatial and temporal extent of hypoxia caused the population to decline toward extinction. Thus, the *Macoma* metapopulation persists in an interconnected mosaic of source and sink habitats.

Fac, Oral

Detection and comparison of osmotic stress in *Hemigrapsus sanguineus* and *Carcinus maenas*.

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The invasive Asian shore crab, *Hemigrapsus sanguineus*, has efficiently established itself along the north east coast of the United States since its first recorded appearance in 1988 in New Jersey. It can now be found in staggering densities and is outcompeting the previously established European green crab, *Carcinus maenas*, in the intertidal zone. This project was designed specifically to investigate possible physiological advantages *H. sanguineus* may possess over native and currently established invasive crabs regarding salinity tolerance. The two crab species were exposed to three different salinities and were sacrificed along a fine time gradient between 0 hours and 7 days. Hemolymph osmolality and regulation of the Na/K ATPase activity in the gills were measured and compared between the two species. This information will help establish reliable techniques for detecting osmotic stress in crabs and will provide insight into the mechanisms allowing the successful invasion of *H. sanguineus*.

UG, Poster

Spatial and temporal trends in estuarine water quality on the Georgia coast

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We examined trends in coastal water quality data that have been collected by the Georgia Dept. of Natural Resources (GA DNR) to support shellfish sanitation, nutrient monitoring, and beach monitoring programs since 1998, 2000, and 2004, respectively. Temporal patterns have been fairly uniform across the spatial domain, with nearly all sites exhibiting the same direction of change and most sites exhibiting similar rates of change for dissolved oxygen, ammonia, nitrite, nitrate, phosphate, salinity, temperature, pH, turbidity, *Enterococcus*, and fecal coliform. Temporal changes in silicate and TDP were more variable spatially. Temporal trends in several variables appear to be linked to patterns of freshwater input: a drought in 1998-2002 was followed by a wet 2003, then more moderate rainfall and another drought from

2006-2009. Nutrients generally rose in late 2002 as the drought broke, then fell in 2003 along with a pronounced decline in DO to $<4 \text{ mg L}^{-1}$ for many sites. *Enterococcus* abundance, collected since 2004, also appears to be related to freshwater input patterns but results are confounded by a switch in labs at the beginning of the 2006 drought. This research is part of a project to analyze GA DNR data for status and trends in water quality.

Fac, Oral

Whole genome analysis of bay scallop population structure in North Carolina

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In recent years, bay scallops (*Argopecten irradians*) in North Carolina are of growing concern due to decreased abundance. The decline is attributed to a combination of natural and anthropogenic factors that have not completely eradicated bay scallops, but have likely upset the natural connections between local aggregations once sufficient to keep bay scallops abundant throughout North Carolina. This study utilized amplified fragment length polymorphism analysis (AFLP), a whole genome analytical technique, to characterize the amount of genetic differentiation in scallops from eight sites in North Carolina (NC) and one in New York (NY). Six primer combinations yielded a total of 563 fragments. All 302 scallops analyzed exhibited unique fragment profiles. Analysis of Molecular Variance revealed significant differentiation between NC and NY ($\Phi_{ST}=0.067$, $P<0.001$) and among NC populations. Pairwise comparisons among NC populations yielded Φ_{ST} values ranging from 0.002-0.037 (22/28 comparisons significant, $P<0.001$). Assignment tests correctly assigned all 35 NY scallops. A moderate proportion of NC scallops were correctly assigned to source populations; however accuracy increased markedly when collections sites were combined based on geographic proximity. Overall, results suggest subtle but significant genetic structure in North Carolina bay scallop populations.

Grad, Poster

Effects of the parasitic isopod *Probopyrus pandalicola* on the starvation rate of the daggerblade grass shrimp *Palaemonetes pugio*.

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Probopyrus pandalicola is a bopyrid isopod that infects the grass shrimp *Palaemonetes pugio* and decreases the energy available to its host by feeding on its hemolymph. The purpose of the present study was to determine the effects of *Probopyrus pandalicola* on the starvation rate of the grass shrimp *P. pugio*. Parasitized shrimp (n=25), unparasitized shrimp (n=25), and shrimp with parasites removed (n=25) were placed into individual aquaria and held without food until 100% mortality occurred. On average, parasitized and deparasitized shrimp survived 2 days less than unparasitized shrimp due to the energy loss caused by the parasite. Removal of the parasite did not result in a substantial increase in the survival time of deparasitized shrimp. Therefore, shrimp do not seem to recover quickly from the effect of the parasite.

UG, Oral

One fish, two fish, red fish, cod fish: exploring the life-history implications of color variation in Gulf of Maine cod (*Gadus morhua*).

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Cod display strikingly different coloration in the Gulf of Maine, and red and olive (more common) colored cod can be found in close sympatry. Here we examined whether color types from Cashes Ledge, a shallow offshore (~ 100 km) seamount, differ in key life-history traits including diet, depth distribution, growth and body morphologies. Red cod consumed significantly more crabs, lobsters, and demersal fish,

whereas olive cod consumed more shrimp. Stable carbon isotope signatures ($\delta^{13}\text{C}$) were significantly different among color types. Observed differences likely reflect baseline differences in $\delta^{13}\text{C}$ at Cashes Ledge, and could potentially be useful for determining residency. Red cod were largely confined to a small area of shallow water (< 20 m) and were significantly smaller at age than olive cod. Body shape was used to classify color types correctly with 84% accuracy; red cod had shorter snout lengths, deeper bodies and more slender tails than olive cod. Collectively these results suggest that red cod are resident on the top of Cashes Ledge and represent a distinct life-history strategy from olive cod (more transient). Management of cod in the Gulf of Maine currently does not distinguish between these life-history types, which could inadvertently impact their distribution and relative abundance.

Fac, Oral

Four things everyone needs to know about sharks.

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Most people believe that sharks are a threat to humans, and that “the only good shark is a dead shark”. The reality is very different, and if everyone knew just four things about sharks, one of the world’s most misunderstood and threatened creatures would be in much better shape. Come watch the world premiere of this educational documentary, featuring stunning photos and videos from some of the world’s best shark photographers. Soon after the Festival, this film will be made available free of charge to any educator, scientist, or concerned citizen, and the information it includes is being made into a brochure that ocean-friendly businesses worldwide will distribute. The filmmaker, “WhySharksMatter” of the popular marine biology and conservation blog Southern Fried Science (southernfriedscience.com) is happy to answer any questions that you have about sharks, the film, or collaborations between your group and the blog.

Grad, film.

Climatic Extremes Shift Key Interactions Regulating Biodiversity on Patagonia Rocky Shores.

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Climate change is one of the main drivers of the global biodiversity crisis, yet we know little about its impacts on species interactions that maintain local biodiversity. Here, we show that climatic extremes shift the interaction network that maintains biodiversity on wave-exposed, rocky shorelines from keystone predation to facilitation by foundation species. Surveys over 2100 km of wind-swept, arid Patagonian coastline and experimental manipulations reveal that the entire 46 species animal assemblage is obligately dependent on living within the mussel matrix for protection from potentially lethal desiccation stress, and that predators do not impact diversity. These results reveal that, under extreme climates, maintenance of whole-community diversity is dependent on positive interactions that ameliorate physical stress and suggest preserving foundation species should be a priority in remediating the biodiversity consequences of global climate change.

Hawaiian seamounts, a diversity hotspot for gold coral-related zoanthids?

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Gold coral has been exploited from the deep slopes and seamounts of the Hawaiian Islands. Due to its peculiar characteristic of building a scleroproteic skeleton, this zoanthid has been referred as *Gerardia* sp. (a junior synonym of *Savalia* Nardo, 1814) but never formally described or examined by taxonomists despite its commercial interest. Multiple samples of this precious species and other octocoral-associated zoanthids were collected from Hawaiian precious coral beds. The molecular and morphological examination of these symbiotic zoanthids revealed the presence of at least four different species. Among those, two (*Gerardia* sp?) appeared to create their own skeleton while the two others are probably simply using the octocoral as substrate. Phylogenetically all these species appeared related to members of the genus *Savalia*, but also to the octocoral-associated zoanthid *Corallizoanthus tsukaharai*. This unexpected species diversity leads to reconsider the biology, evolution and taxonomy of octocoral-associated zoanthids.

Fac, Poster

Impact of suspended oyster (*Crassostrea virginica*) aquaculture on eelgrass (*Zostera marina*) photosynthesis, growth rate and distribution.

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Production of southern Gulf of St. Lawrence (sGSL) suspended bag oyster aquaculture (SBOA; *Crassostrea virginica*) in New Brunswick, Canada has increased six-fold between 2000 and 2007 with further expansion planned throughout Atlantic Canada. In examining potential environmental effects of this culture method on eelgrass (*Zostera marina*), synoptic surveys of sGSL bays and estuaries from 2006-2007 demonstrated significant reductions in underwater irradiance (positive photon flux density, PPFD), leaf growth rate, above-ground biomass, shoot density, canopy height, relative electron transport rate, and effective quantum yield at SBOA vs. control sites. To determine causal mechanisms responsible for these effects, a manipulative experiment exposed plots of *Z. marina* ($n=3/\text{treatment}$; $\sim 3 \text{ m}^2$ surface area) to SBOA structures of varying levels of oyster stocking density (0, 3.2, 6.4 kg oysters m^{-2} @ 35-50 mm initial size) and shading (19.7, 28.5, and 60% subsurface irradiance) from July-October 2009. Preliminary results reveal significant effects of shading. By day 67 a 45% reduction in shoot density, relative to the control treatment, was observed beneath the highest shade treatment. Results of analyses on the effects of both shading and oyster stocking density on photosynthesis (PAM fluorometry metrics), leaf growth rate and above-ground biomass will also be presented.

Grad, Oral

Ambient Malathion Concentrations Increase Mortality and Modify Behavior of Blue Crabs

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Organophosphate insecticides can compromise water quality and harm non-target species unintentionally. In this study, we examined the effects of a commonly used organophosphate insecticide, Malathion, on blue crabs (*Callinectes sapidus*), which are economically and ecologically important estuarine species. Adult and juvenile crabs were exposed to environmentally-occurring concentrations of Malathion to determine how these factors would affect crab behavior and mortality. Initial Malathion concentrations of 1.0 ppb and 11.2 ppb caused a significant increase in mortality of juvenile blue crabs, and concentrations of 11.2 ppb caused a significant increase in mortality of adults, all within 36-h after exposure. For adult blue crabs, we measured the time needed for crabs to right themselves when placed on their backs before and after exposure to Malathion. After 1 h of exposure to concentrations of 11.2 ppb, adult crabs took significantly longer to right themselves, indicating that short-term exposure to Malathion at ecologically relevant concentrations can interfere with essential behaviors of blue crabs. Blue crab populations have been declining in recent years, and their decline has primarily been linked to overfishing. However, other

mechanisms including pollution and disease may also contribute to this problem and require further investigation.

Fac, Oral

Sexual size dimorphism in horseshoe crabs, *Limulus polyphemus*: A test of three adaptive hypotheses.

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Males and females of a species seldom have the same body size. Most endotherms show a pattern of male-biased sexual size dimorphism, while most ectotherms are female biased. Divergence in optimal body size due to differences in reproductive roles between the sexes is commonly thought to explain size dimorphism. However, many different hypotheses have been proposed, and understanding the evolution and maintenance of size dimorphism remains one of the fundamental questions in evolutionary and behavioral ecology. North American horseshoe crabs, *Limulus polyphemus*, show females biased size dimorphism. This dimorphism is the result of differences in growth patterns, as females undergo one more molt than do males. Yet the ultimate factors underlying this dimorphism are not yet understood. We examined predictions of three adaptive hypotheses of sexual size dimorphism in Horseshoe crabs: *mate competition*, *resource division*, and *loading constraint*. We found no support for the mate competition (larger males were not better at obtaining preferred positions in mating groups) or the resource division hypotheses (males and females did not differ in diet). We found tentative support for the loading constraint hypothesis that selection favors smaller males due to physical constraints of amplexus during spawning.

Grad, Oral

Considering the Net Effects of Oysters on Estuarine Nitrogen Cycling

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Oysters improve estuarine water quality by removing phytoplankton and particulate material. To assess the implications of oysters on water quality, previous laboratory studies examined the connection between filtration, biodeposition and nitrogen removal. To gain a more holistic understanding of the mechanisms of oyster modification of nitrogen cycling and water quality, we conducted field and laboratory studies in Bogue Sound, NC. Field measurements indicated that oyster reef sediments had both higher annual rates of denitrification (membrane inlet mass spectrometry) and dissolved inorganic nitrogen production than sediments from other estuarine habitats. In addition, laboratory incubations were conducted on oysters, sediment and the water column, alone and in combination. Oysters enhanced rates of denitrification over controls. However, oysters also increased ammonium production, likely from excretion. These data suggest that oysters alone enhance bioavailable water column nitrogen, affecting the ecosystem benefit of denitrification. Assessing the net effects of oysters on nitrogen cycling is critical for establishing effective management strategies to improve water quality and enhance ecosystem services.

Grad, Oral

Effects of the green alga *Dictyosphaeria ocellata* on the bacterial community

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Bacteria are highly abundant in seawater and play important ecological roles within marine communities. Bacteria associated with macroalgae have a great impact on both their health and interactions with other organisms, acting as pathogens, symbionts, mediators of the settlement of fouling organisms, nutrient providers and consumers, etc... Studies of temperate macroalgae indicate that these sessile organisms

have evolved mechanisms to regulate the bacterial community surrounding them. We examined the effects of the green tropical alga *Dictyosphaeria ocellata* on both growth of individual bacterial species in culture and natural bacterial assemblages in the field. *D. ocellata* can be found with pristine surfaces in intertidal areas where they are exposed to intense microbial pressure. Denaturing gradient gel electrophoresis (DGGE) demonstrates that species composition of planktonic bacteria in seawater enclosures was significantly altered by the presence of *D. ocellata* as was growth of individual bacterial species in culture. In some cases this effect could be attributed to compounds found either in algal treated water or in the alga itself. Interestingly, bacteria on the surface of *D. ocellata* were apparently not affected by the metabolites released from the alga since bacterial communities on the alga were similar to those on other objects from the same environment.

Grad, Oral

Mobilizing Marine Biodiversity Research: The Canadian Healthy Oceans Network

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The Census of Marine Life has provided a framework for collaborative research in marine biodiversity. Here we present a model for academic and government partnership that has created the Canadian Healthy Oceans Network (CHONe), a national research program that is uniting researchers to provide new insights into marine biodiversity and provide scientific guidelines for policy in conservation and sustainable use of marine biodiversity resources in Canada's three oceans. This initiative is structured around three interlinking themes. Theme Marine Biodiversity addresses the relationships between biodiversity and habitat diversity by testing hypotheses that link functional and species biodiversity to habitat complexity. Theme Ecosystem Function addresses how ecosystem function and health are linked to biodiversity and natural and anthropogenic disturbances. Theme Population Connectivity addresses how dispersal of marine organisms, typically by early life stages, influences patterns of diversity, resilience, and source/sink dynamics of species and biological communities using source-sink studies of existing management areas as model systems, and comparative studies of different dispersal metrics to estimate metapopulation connectivity. We will synthesize the outcomes of these themes across the Network to identify approaches to bridge science and policy, and communicate these results to the complex networks of user groups who ultimately influence policy application.

Fac, Poster

Dipole, an intriguing real life nature conservation story from the Pulau Banyak Archipelago, which passed the world's attention unnoticed.

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The archipelago is situated just south of the Indonesian island of Aceh and Sumatra, in the Indian Ocean. The islands have been hit hard over the last few years: first they had to deal with the 2005 tsunami, which they overcame quite well, then, 3 months later, they were hit by the Nias earthquake. An earthquake with a devastating force of 8.8 on Richter's scale. The archipelago was tilted, the inhabited islands went down, the uninhabited up. Houses were flooded, corals uplifted and died. The World Bank paid for road uplifting by paying for 20000 m3 of corals, corals collected both dead and alive. The World Bank left halfway, when they realized what they had done.. Till today, much of the the island is still in the state it was just after the March 2006 Nias earthquake. The islands are paradise with lush green vergetation and

white sandy beaches. On Bangkaru, one of the 100 or so islands, you find the largest turtle nesting beach in the whole of Aceh and Sumatra. Yayasan Pulay Banyak, an NGO, takes care of the turtle protection programme, without forgetting to aid the islanders. No more eggs are poached and education in English, and tourism is provided.

Film

Hot, cold or dry? Determining if boiling, freezing or dessication is the most effective method for hobbyists to kill aquarium strains of *Chaetomorpha linum* and *C. crassa*

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Biological invasions by aquarium strains of the green macroalga *Caulerpa taxifolia* have prompted the aquarium industry to promote the use of species in the green algal genus *Chaetomorpha*. With 67% of home aquarists we surveyed currently using *Chaetomorpha* in their tanks, potential aquarium releases pose a threat to our estuarine and coastal ecosystems. Our goal was to devise safe and efficient alternatives to aquarium release for the disposal of excess or unwanted *Chaetomorpha*. We tested three techniques commonly used for the disposal of aquarium plants: freezing, boiling and desiccation. We monitored mortality of both 1 cm fragments and small clumps of *Chaetomorpha linum* and *C. crassa* over a variety of exposure times to each treatment at repeated intervals for two days following exposure. Results from these experiments will be utilized in outreach materials to aquarium hobbyists and professionals in our efforts to prevent another detrimental seaweed invasion associated with aquarium release.

Undergrad, Poster

Ocean warming increases threat of invasive species in a marine fouling community.

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We addressed the potential for climate change to facilitate invasions by testing effects of ocean warming on species in a marine fouling community. We hypothesized that changes in the dominant fouling spaceholders will arise via species-specific differences in processes that influence acquisition and maintenance of space, the primary limiting resource in this system. Juveniles were exposed to simulated warming in laboratory mesocosms. Treatments included an ambient control temperature and two increased temperatures (+3°C and +4.5°C). We found that responses differed between species, species' origins, and demographic processes. Survival was unrelated to temperature for non-native species whereas a native tunicate experienced reduced survival at +4.5°C versus ambient temperature. Growth rates increased at +4.5°C relative to ambient temperature for 4 of 5 non-native species and one of 2 natives; enhancement of growth rate in the native species was lower than that of the invaders. As ocean temperatures increase, native and introduced species are likely to decrease and increase in abundance, respectively. Our results suggest that the effects of climate change on communities can occur via both direct impacts on the diversity and abundance of native species and indirect effects due to increased dominance of introduced species.

Grad, Oral

Rapid experimental evolution of host use traits in a generalist marine herbivore

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When confronted with seasonal variation in plant quality and quantity, generalist herbivores shift host use patterns. Such shifts are thought to be largely plastic, but theoretically may reflect fluctuating selection for using alternative and seasonal resources. The marine amphipod *Ampithoe longimana* occurs on

multiple seaweeds year-round (e.g., *Sargassum*, *Hypnea*, and *Ulva*). During summer within some habitats, the amphipod is restricted to diterpene-rich *Dictyota* species because of *Dictyota*'s value as a refuge from omnivorous fishes. Within five generations of initiating a controlled natural-selection experiment to mimic these field conditions, lines that were isolated on *Dictyota* had greater feeding tolerance for *Dictyota* and its secondary metabolites than did lines isolated with a seaweed mixture. *Dictyota*-line females reproduced more quickly than did mixed-seaweed-line females on *Dictyota*, but mixed-seaweed-line juveniles had greater growth and fecundity on *Sargassum* and *Ulva* than did *Dictyota*-line juveniles. These patterns suggest a cost to evolving a tolerance for *Dictyota*. Such tradeoffs, coupled with the capacity to rapidly evolve, predicts that host use traits may be subject to fluctuating selection across seasons. We conclude that for short-lived generalist herbivores that reproduce year-round, it is possible that seasonal shifts in host use have both a genetic and plastic basis.

Fac, Oral

Groundwater Nitrate Assimilation into Restored *Juncus roemerianus* and Associated Fauna

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Salt marshes may decrease eutrophication of coastal waters through transformation and direct uptake of nutrient rich groundwater. However, few studies have examined the specific role of plant biomass in removing groundwater nutrients and subsequent transfer to the food web. In June of 2008 we began an experiment to test the groundwater NO₃ absorption capabilities of *Juncus roemerianus* and neighboring fauna in 2 marsh restoration designs. To track the fate of NO₃ in an introduced groundwater plume, an enriched ¹⁵N NO₃ solution was pumped through the restored site continuously for 31 days. Half density plots of *J. roemerianus* assimilated (as plant biomass) an average of 22 mg m² d⁻¹ of the introduced NO₃, while full density plots assimilated 17 mg m² d⁻¹. The larger *J. roemerianus* uptake rates in half density plots can be attributed to higher nutrient demands as a result of increased areal expansion. Fauna captured in the restored marsh areas experienced significant ¹⁵N enrichment as a result of ¹⁵N NO₃ additions, indicating rapid uptake and propagation of the introduced NO₃ through the food web. Direct uptake by plants and fauna decreases N loads into coastal waters significantly, thereby reducing the effects of eutrophication.

Grad, Poster

Tracking the invasion of three nonnative species, *Mytella charruana*, *Perna viridis*, and *Megabalanus coccopoma*, along the southeastern United States.

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Tracking the spread of nonnative species is crucial for understanding how to control their populations. Since 2006, a biannual survey of the southeastern coast has been conducted from Jupiter, Florida to Charleston, South Carolina in order to determine the distribution of three marine invaders, *Mytella charruana*, *Perna viridis*, and *Megabalanus coccopoma*. We are currently monitoring 82 sites every June and December. Typically, the species are found on docks and boat ramps but also other substrates such as jetties, rock walls, and mangrove roots. The data shows that the three nonnative species have slowly established themselves in new locations over the past few years. For example, *M. charruana* was found in central Florida in 2005 and has since spread along the coastline into South Carolina. In December 2009, *M. charruana* was discovered at several new locations in Georgia and Florida where it had not been previously recorded. Additionally, the other two species, *P. viridis* and *M. coccopoma*, established themselves in new locations throughout Florida in 2009. These observations may lead to conclusions regarding how the species colonize an area and the potential impact they will have on local communities.

UG, poster

Latitudinal Fecundity Variations and Reproductive Timing in *Siderastrea siderea*

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The density and diversity of scleractinian corals along the southeast coast of Florida decrease with increasing latitude over a relatively small spatial scale. One of the possible factors influencing regional coral distribution patterns and population dynamics is reproduction. This study examines variations in fecundity along a latitudinal gradient (~ 25° N - 27° N) and reproductive timing in *Siderastrea siderea* on the southeastern coast of Florida. Tissue samples were collected from 2007 to 2009 from colonies at 25° N (Key Largo, FL), 26° N (Ft. Lauderdale, FL), and 27° N (Stuart, FL) and analyzed histologically. Gametogenesis was tracked over time at 26° N, and potential fecundity of female samples was calculated as volume of oocytes per tissue area (mm³/ cm²) across all sites. Relationships between oocyte abundance, lunar phase, and oocyte resorption suggest *S. siderea* spawns following the new moons of September or October. *Siderastrea siderea* fecundity in 2009 decreased 85% from 25° N to 27° N. Fecundity differences were not attributed to differing quantities of oocytes but to differences in oocyte volume which decreased by 69% with increasing latitude. Latitudinal decreases in oocyte size may have direct effects on the dispersal capabilities of larvae over small spatial scales.

The acoustic ecology of the California mantis shrimp (*Hemisquilla californiensis*)

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We examined the acoustic ecology of the California mantis shrimp (*Hemisquilla californiensis*), a common marine crustacean in the benthic habitat at Santa Catalina Island, California. We addressed two questions: (1) does anthropogenic noise impact acoustic communication in this habitat?; and, (2) what are the characteristics of the signals produced by this animal? We recorded mantis shrimp “rumbles” at four locations using an unattended video and hydrophone system, and deployed a passive-acoustics device for 8 days at another location. Rumbles were identified using an automatic detector and human visual/audio inspection, and it was noted whether or not a boat was present. We found that rumble recordings in the absence of boat noise had a dominant frequency of 168.8 Hz, which was significantly different than when boats were present (130.7 Hz). Time periods with boats present were on average 4.4 dB louder than with rumbles alone. We detected boats in 42% of our recordings; these boats are loud and either fully or partially overlap the bandwidth across which this animal is signaling, suggesting that acoustic masking may be occurring. We also detected sequential signaling from multiple individuals by comparing peak frequencies and peak power, indicating possible chorusing in mantis shrimp.

Grad, Oral

Bycatch of an economically-important grouper and its prey in a sub-tropical trawl fishery

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The unintentional capture of non-targeted species (i.e., bycatch) can be extremely high in trawl fisheries and understanding its ecological effects on food-web dynamics is important to management from an ecosystem-based approach. In Florida, a bottom trawl fishery operates in seagrass beds and targets juvenile penaeid shrimps. Juvenile gag (*Mycteroperca microlepis*; Serranidae) settle to and inhabit the same seagrass habitats where the fishery occurs. Using the rollerframe trawling equipment and techniques employed by the fishery, I measured bycatch of both juvenile gag and their prey across the

northeastern Gulf of Mexico. Bycatch of gag (measured as capture efficiency, hereafter E) was high shortly after settlement ($E_{\text{JUNE}} = 0.65$), but was negatively correlated with gag size ($r = -0.89$), and decreased through the summer months ($E_{\text{JULY}} = 0.19$, $E_{\text{AUG}} = 0.05$, $E_{\text{SEPT}} = 0.02$). On average, the number of non-targeted animals captured per sampling event was 4.65 times greater than the number of shrimp landed, and the former included several species identified as important prey of juvenile gag. Changes to the structure of these prey communities may have important indirect effects on the growth of juvenile gag, thereby possibly extending the period of time gag are themselves most susceptible to capture by the rollerframe gear.

Fac, Oral

A MODIFIED RAPID ASSESSMENT METHOD EXAMINING THE ECOLOGICAL HEALTH OF GALVESTON BAY WETLANDS

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Wetlands are one of the most productive ecosystems in Galveston Bay. They house diverse biota, including microorganisms, bacteria, mammals, and waterfowl. Important functions include the provision of nursery habitat and feeding grounds. Over the years, widespread wetland loss has increased, often due to coastal development and declines in water quality. Creation and restoration of wetlands is essential to reestablish lost functions, but entities responsible for doing so have no standard practices or procedures for creation. In this study, the Mid-Atlantic Tidal Fringe Assessment method, a field protocol to determine the health of wetlands, was modified to examine the ecological success of mitigated or restored wetlands and compare them to reference sites around Galveston Bay. Data on water quality, below ground plant biomass, vegetation cover, and other indicators of success were collected from 18 sites. A score criterion, based on tested and visual field parameters, was used to evaluate the ecological health of each site. Restored wetlands were generally not equivalent to reference wetland sites, often scoring lower in terms of landscape/site characteristics and wildlife habitat. This method will provide a standard assessment for all entities to use in determination of the health of wetlands around Galveston Bay.

Grad, Oral

Phenolic content of two subtropical seagrasses affects feeding behavior of mesograzers but not macrograzers

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Chemical defenses are commonly used by terrestrial plants and marine macroalgae to reduce herbivory. However, such defenses have been rarely studied in seagrasses, even though marine angiosperms produce a variety of phenolic compounds (common chemical deterrents in both terrestrial and marine systems) and are exposed to grazing by both macrograzers and mesograzers. In this study, levels of condensed tannins and phenolic acids in two seagrasses (*Thalassia testudinum* and *Halodule wrightii*) from two bays in the Florida panhandle were quantified and compared. Because nutrients are thought to affect herbivore feeding patterns, C/N ratios of these plants were also measured. Seagrasses with differing phenolic content were then offered to the sea urchin *Lytechinus variegatus* and the amphipod *Batea catharinensis*, and amounts consumed were quantified. *L. variegatus* consumed high and low phenolic seagrass equally in all of the trials. However, *B. catharinensis* consistently avoided the seagrass with higher phenolic content, even when this meant choosing food with low nitrogen content. These results demonstrate that seagrass phenolics may be used as chemical deterrents against mesograzers and that nitrogen content did not drive herbivore food choices.

Grad, Oral

Genetic diversity enhances resistance to predators in clonal microbial biofilms Steinberg, Peter; Koh, Kai; Le, Hoang L.; Tan, Chuan H.; Rice, Scott; Matz, Carsten; Marshall, Dustin J.; Kjelleberg, Staffan. Centre for Marine Bio-Innovation, University of New South Wales, Sydney NSW, 2052, Australia. p.steinberg@unsw.edu.au

Most studies on the ecological effects of genetic diversity compare the performance of populations with very high vs. very low genetic diversity. The ecological consequences of smaller differences in genetic diversity are poorly known. The specific genetic mechanisms underlying any emergent effects of diversity are also largely unknown. We used biofilms of the widespread bacterium *Serratia marcescens* to investigate the ecological effects, and underlying mechanisms, of genetic diversity. *Serratia* biofilms spontaneously produce variant cells which have stable, heritable variation in significant life history traits. These variants were tested individually and in multiclonal biofilms for their resistance to protozoan grazing. When grown individually in biofilms, none of the variants were more resistant to grazing than wild type parental biofilms. When grown together (with or without the wild type) the mixed variant biofilms had significantly increased resistance to predation. The variants in general performed better in the multiclonal biofilms, indicating complementarity. Enhanced multiclonal resistance against predation in the mixtures was biofilm specific; it was not observed in planktonically grown mixtures exposed to a planktivorous predator. The molecular mechanism generating the variants were single nucleotide polymorphisms at one gene, indicating that substantial ecological consequences of genetic diversity can result from minimal genetic changes.

Fac, Oral

Cascading processes driving recruitment of reef corals: Insights from experimental micro-phase shifts.

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Phase shifts on coral reefs occur when coral-dominated ecosystems become coral-depleted (usually algal-dominated). Although some reefs quickly recover to coral-dominance, Caribbean reefs rarely do. To study this, we deployed vertical pegs (called parrotfish exclusion devices; PEDs) around coral settlement plates on Belizean reefs to impede herbivory and assess effects of this process on macroalgal abundance and coral recruitment. Time-lapse videos and bite-mark patterns on plates showed herbivory from large parrotfish was significantly reduced by PEDs. Resulting macroalgal-dominated micro-phase shifts created islands of significantly increased macroalgae and reduced coral recruitment around the PEDs vs. the PED controls or unmanipulated settlement plates. Two coral genera recruited to our settlement plates but reef-building *Porites* was most affected. This coral settled nearest the outer edge of the underside of coral settlement plates and was absent from macroalgal dominated PED treatments. All coral recruitment declined with higher algal biomass surrounding the settlement plates. Synergies likely result from cascading ecological processes in that the process of herbivory controls algal community structure in ways that regulate coral recruitment. Managing for higher rates of herbivory by large-bodied herbivores could improve rates of recruitment of corals and aid the recovery of coral-depleted reef ecosystems.

Fac. Oral

Seasonal freezing adaptations of the mid-intertidal gastropod *Nucella lima* from southeast Alaska

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Nucella lima from the mid-intertidal zone of Bridget and Sunshine Cove, Alaska were exposed to multiple freezing emersion events during the winter. The average daily freezing exposure emersion of *N. lima* increased from 2.91 to 6.78h between the lower and upper limit of its intertidal range. Snails ceased feeding and moved into crevices, under boulders or into the sediment at the base of rocks in the winter which minimized freezing events. Egg capsules were also observed in the snail habitat between

September 27, 2007 and March 12, 2008. Snails supercool below the freezing point of seawater which delays freezing during tidal cycle related emersion. The supercooling point of snail tissues did not vary seasonally. Air temperatures below freezing were observed between October 20, 2007 and April 20, 2008. Air temperatures below the maximum supercooling temperature of snails (-4.94°C) occurred multiple times in December 2007 and January and February 2008. The freeze tolerance of *N. lima* varied seasonally and was always below the supercooling point indicating that *N. lima* physiologically tolerated freezing. Synthesis of the compatible osmolytes taurine, glycine, and proline was partially responsible for the seasonal variation in freeze tolerance of *N. lima*.

Fac/Poster

Predator variance, timing of arrival, and density affect community organization

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Empirical studies examining the role of predation in structuring communities largely focus on fixed predator densities. However, variation in predator demographic rates can result in considerable spatio-temporal variation in predator abundance, which may have consequences for predator-prey dynamics. We conducted a 4-month field experiment to compare the magnitude of effects of variance, timing of arrival, and density in affecting prey fish abundance and diversity. Our experiment contained five replicated experimental treatments: 1) "predator absent"- no predators for four months, 2) "early"- two predators for the first two months and no predators for the second two months, 3) "late"- no predators for the first two months and two predators for the second two months, 4) "low density"- one predator for the entire four months, and 5) "high density"- two predators for the entire four months. Compared to the predator absent treatment, predators strongly reduced prey abundance and caused shifts in composition, but had no effects on different components of prey diversity (i.e. α , β , or γ), and effects of predators increased with predator density and late timing of arrival. Our results demonstrate that the magnitude of predator effects in structuring reef fish communities is dependent upon both density and timing of arrival of predators.

Grad, Oral

Mangrove sponge host preference of a surface dwelling polychaete

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Sponges growing on mangrove roots provide habitat for smaller invertebrates like surface dwelling polychaetes. Because each mangrove root consists of a unique assemblage of sponge species and the distance between roots potentially limits dispersal, the extent to which polychaetes actively choose their host is unclear. Here, the mangrove sponge host preference of a Syllidae polychaete was examined using laboratory choice experiments and in situ observations in Belize. For laboratory choice experiments, pieces (4cm³) of five sponge species (*Tedania ignis*, *Spongia* sp., *Biemna caribaea*, *Halichondria magniconulosa* and *Haliclona implexiformis*) were collected from Twin Cays. After the polychaetes were removed, sponge pieces were combined in replicated beakers and approximately 15 polychaetes were added to each treatment for 8-10h. Polychaete abundance on sponges in naturally connected assemblages was also observed. While differences were not significant, patterns reveal that *B. caribaea* and *H. magniconulosa* hosted the most polychaetes and *Spongia* sp. hosted the least in the laboratory experiments, and *T. ignis* hosted the most polychaetes in field observations. In this study, no significant host preferences were observed in laboratory experiments or in situ observations; however, patterns were present that should be explored further with larger sample size.

Grad, Poster

The impacts of anthropogenic sedimentation on sponge diversity and abundance on the North shore of Jamaica.

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Jamaica's growing dependence on tourism has led to construction of new hotels and resorts on the north shore of Jamaica. These resorts must either truck in or dredge sand to create artificial beaches on the rocky shore. A higher level of sedimentation is found in areas near these hotels and has a direct impact on benthic reef organisms. Due to the high filtration requirements of sponges, suspended sediment levels may act as an environmental parameter controlling the distribution and abundance of sponge species. Surveys were conducted at three sites along the north coast of Jamaica to determine if species diversity and abundance were impacted by sedimentation over spatial and temporal scales. Both species diversity and abundance were lower in the sedimentation site as compared with the control sites. Sedimentation appears to be a controlling factor for the distribution of sponges on the reefs of Jamaica. Increasing coastal development will further exacerbate the reef degradation in this area by decreasing the habitat complexity of the reef.

Grad, Oral

Zooplankton abundance and chlorophyll biomass in the surf zone of renourished beaches at Wrightsville, Carolina and Kure Beach, North Carolina.

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Ocean beach surf zones have received far less attention than intertidal zones and estuaries. Most studies of surf zones have focused on macro-organisms, particularly in studies of beach renourishment and other disturbances. We sampled benthic and planktonic microalgal biomass and zooplankton abundance in the surf zone of 3 different beaches in southeastern North Carolina during 2008-2010. Planktonic chlorophyll *a* concentrations ranged from 1-30 $\mu\text{g/L}$, averaging close to 10 $\mu\text{g/L}$, generally markedly higher than in offshore waters of Onslow Bay, N.C. Benthic chlorophyll *a* concentrations ranged from 1-60 mg/m^2 and averaged 10-15 mg/m^2 , typically less than in bottom sediments offshore or in nearby estuarine habitats. Total copepod abundances ranged from 1,000-50,000 individuals/ m^3 , averaging 8,000 individuals/ m^3 , much greater than in offshore waters or even in some estuarine waters. Microalgal biomass showed relatively little seasonal variability and rather more variability associated with different beaches and substrate types. Zooplankton abundances varied somewhat seasonally, but not strongly in response to differences in microalgal biomass. Surf zones appear particularly productive in comparison to waters just offshore beaches, and may be particularly important as food resource areas for planktivorous invertebrates and fishes.

Grad, poster

Faunal edge effects among seagrass beds from Hoga Island, Indonesia

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Benthic faunal spatial distribution was investigated from seagrass meadows in Hoga Island, Indonesia with varying levels of human disturbance. For each site, samples were taken at shallow near shore edges, seagrass bed interiors, and deeper reef side edges. Results indicated that faunal densities were higher at both deep and shallow seagrass edges compared to interior regions. Sites also differed in faunal abundance potentially related to the level of human disturbance in the area. Floral growth was also elevated when it came to the seagrass bed edges. As such this study indicates the importance of seagrass beds in primary plant growth and faunal density.

Grad, Oral

Flume Study Of Particle-size-dependent Filtration Rates Of A Solitary Ascidian: The Influence Of Body Size, Flow Speed, And Drag

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We have investigated the filtration rates (FRs) of the solitary ascidian, *Styela plicata*, and found interacting influences of body size, food-particle size, flow speed and the force of drag. Consistent with the literature, we determined allometry between FR and body size, but our allometric exponents are comparatively lower than those found in other investigations. This is because of the confounding adverse effects of increasing flow speed, to which FR responded in a non-linear, unimodal fashion. The likely mechanisms for flow-dependent suppression of FR include deformation of internal feeding structures due to drag, and/or increased adverse pressure gradients between the siphons as a result of drag or flow itself. Interestingly, maximum filtration occurs at moderate flow speeds (~ 12 cm/s) when *S. plicata* filters particles in the range 1.25 to 6.03 μm . Maximum filtering of large particles (6.03 to 100 μm) occurs at low flow speeds (~ 0). The most likely reason for this shift in maximum filtering of different size particles is enhanced filtration of large particles at low speeds due to enhanced capture of large particles at the incurrent region of the inhalant siphon. This could also explain the enhanced allometric exponent relating 'large-particle' FR to body size.

Grad, Oral

Mobile Animals: A Dispersal Mechanism for Seagrass Seeds

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Animal mediated dispersal of seeds has been shown to be an important mechanism in moving seeds from the parent plant in terrestrial species, but very few studies have demonstrated this for seagrasses. Although seagrass seeds have been observed in guts of some animals there is little data on the viability of consumed and excreted seeds. We report here on seed viability experiments on animal ingested and excreted seeds of eelgrass (*Zostera marina*) from Chesapeake Bay. We then estimate potential seed dispersal distances by these animals from gut retention times and daily movement rates. A total of 240 viable eelgrass seeds were fed to mummichogs (*Fundulus heteroclitus*), Northern puffer (*Sphoeroides maculatus*), or diamond back terrapins (*Malaclemys terrapin*). Of the 78.8% of the seeds extracted from the feces, 69.3% were considered viable, planted, and monitored for germination. 71.3, 50.0, and 35.7% of planted seeds from the mummichogs, puffer, and turtles, respectively, germinated, demonstrating that seeds can successfully survive passage through the guts of some species. Potential seed dispersal distances based on gut retention times and daily movements suggest seed dispersal distances similar to some abiotic dispersal mechanisms and has broad ecological and evolutionary implications.

Grad, Oral

Effects of artificial light sources on *Vargula annecohenae* densities

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The bioluminescent ostracod, *Vargula annecohenae*, requires darkness for the execution of its bioluminescent courtship displays. Based on evidence that low levels of naturally encountered lunar illumination prevents *V. annecohenae* from engaging in reproductive displays, we developed a study to ask how artificial illumination impacts the behavior of *V. annecohenae*. Three sites in the sea grass beds just south of South Water Caye, Belize were sampled on five consecutive nights. Background densities were recorded on an initial night. Sampling then occurred for three nights with artificial lights placed at

each site and for one additional night after the artificial lights were removed. Captured individuals were categorized into male, female, juvenile and other species. Contrary to our expectations, results indicate that total *V. annecohenae* densities increased during nights with artificial lights. However, the ratio of adult:juvenile *V. annecohenae* decreased during nights with artificial lights indicating the increase in total *V. annecohenae* density was mainly due to increased juvenile densities. The post-light ratio of adult:juveniles is more similar to the ratios during nights with artificial lights than the night before artificial lights were at each site. This indicates that effects of artificial illumination can persist after the artificial illumination has ceased.

UG, Poster

Effects of Competition and Dispersal on the Recruitment of the Annual Kelp *Nereocystis luetkeana*
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Successful recruitment of kelp can be influenced by both the existing algal assemblages and by the supply of propagules from nearby adults. In central California, the range of two canopy producing kelps, *Nereocystis luetkeana* and *Macrocystis*, overlap. The role of various algal assemblages on the recruitment of the annual kelp *Nereocystis* was examined by experimentally manipulating both canopy and understory algae at two locations: one within a *Macrocystis* bed and the second within a *Nereocystis* bed. *Nereocystis* recruitment was significantly greater in the spring compared to recruitment observed later in the study. Additionally, *Nereocystis* recruitment was greater in plots where the understory had been removed. The presence of a *Nereocystis* canopy was not observed to affect *Nereocystis* recruitment, whereas the presence of a *Macrocystis* canopy showed a negative effect only during Fall. Greater recruitment in areas seeded with reproductive material indicated that dispersal may limit colonization of new areas following a disturbance. Observed recruitment throughout the study argues for a broad recruitment window, and suggests a mechanism for population resilience to late spring disturbances. Ultimately, recruitment of *Nereocystis* during the spring was controlled by understory algal assemblages. *Macrocystis* does not appear to competitively exclude the spring cohort of *Nereocystis* recruits.

Species-Specific Effects of Echinoids in Structuring Coral Reef Communities

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Following the Caribbean mass mortality of *Diadema antillarum* in the 1980s, community ecologists have worked to characterize the relative importance of herbivory by diadematid echinoids. The influence of other echinoids on phase shifts between coral and macroalgal dominance have yet to be clarified. In Moorea, French Polynesia the echinoids *Diadema savignyi*, *Echinothrix diadema*, *Echinometra mathaei*, and *Echinostrephus aciculatus* differ morphologically and behaviorally and likely have different effects on the benthic community. *E. mathaei* and *E. aciculatus* are associated with benthic cover of crustose coralline algae and algal turf, respectively, on small (<1 m²) scales and on the scale of individual coral heads only *D. savignyi* is correlated negatively with macroalgal cover. Despite having a less robust Aristotle's lantern, *D. savignyi* has greater mobility than *E. mathaei* and therefore likely removes more macroalgal biomass. The differential ability of echinoids *D. savignyi* and *E. mathaei* to reverse a phase shift from macroalgal dominance was tested by manipulating echinoid densities on artificial reefs dominated by the macroalga *Sargassum pacificum*. Macroalgal cover decreased significantly only on reefs with *D. savignyi*, suggestive of greater ability to alter community structure. These results demonstrate the ecological importance of species-specific interactions shaping reef communities.

Grad, Oral

Substratum roughness preferences of *Balanus* (=Amphibalanus) amphitrite.

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The invasive striped acorn barnacle, *Balanus amphitrite*, is a dominant fouling organism on both natural and artificial substrata in the Indian River Lagoon (IRL), Florida. We presented cultured, competent cyprids with glass panels divided into three degrees of roughness. For each treatment, we determined mean size, percent cover and density of recruits, which were all significantly less on smooth glass (one-way ANOVA; $P \leq 0.004$, $P < 0.001$, and $P \leq 0.004$, respectively). Biofilms are known to affect barnacle settlement, and surface roughness may influence the rate and quality of newly establishing biofilms. To determine possible biofilm effects on settlement, and the interplay between roughness and biofilm composition, settlement panels of three roughnesses were deployed in the IRL. Resulting biofilms were scraped and colonized microorganisms were scored. Members of the biofilm community, without regard for treatment, include, but are not limited to: diatoms in the genera *Toxarium*, *Navicula*, *Melosira*, *Synedra*, and *Cylindrotheca*; peritrich ciliates; nematodes; and cyanobacteria. Given that substratum type is a key component to the successful establishment of fouling organisms, results from these studies could aid in predicting the further establishment and range expansion of the invasive *B. amphitrite* in Florida waters.

Grad, Oral

Nutrient Dose and Seasonal Dependence of Epiphyte Abundance on *Halodule wrightii*

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Nutrient loading in estuarine habitats as a result of anthropogenic influences is potentially harmful to seagrasses and may increase epiphyte abundance. To explore nutrient effects we measured epiphyte abundance on *Halodule wrightii* exposed to two doses of nutrients during three seasons at two intrinsically different sites, East Flats in Corpus Christi Bay and Nighthawk Bay in the Upper Laguna Madre of the Texas Gulf coast. Patches of monotypic *H. wrightii* were clipped at the beginning of each experimental season and were fertilized for three weeks (less than the leaf turnover period). Epiphyte abundances were compared using a novel fluorescence method of epiphyte quantification with improved spatiotemporal resolution. Significant increases in epiphyte abundance were detected among fertilizer treatments at both sites during early summer and fall sampling seasons. No significant changes in epiphyte abundance were detected during late summer at either site. Bottom-up effects on epiphyte abundance, relative to seagrass growth, were evident from nutrient addition during single turnover periods for *H. wrightii*. Intrinsic differences between sites, possibly including top-down control, may be important factors limiting the magnitude of the effects that nutrient enrichment has on epiphyte abundance.

Grad, Oral

Implementing a volunteer monitoring program for oyster larval settlement throughout the North Carolina coast.

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North Carolina utilizes a cultch-planting system; however, the efficiency of this system is determined by the timing of cultch planting and the presence of oyster larvae. Our project asks the critical question: how do we assess oyster larval settlement along all of coastal North Carolina to facilitate the restoration of oyster populations? Since June 2007, volunteers have been recruited to track oyster settlement on a set of six 413 cm² ceramic tiles. Volunteers agree to a one year monitoring commitment and include individuals or groups with access to waterfront property. Volunteers are trained to collect hydrographic data, as well as identify oyster spat and local benthic organisms. Hydrographic data is collected twice weekly and oyster settlement is monitored every six weeks. There have been more than 110 participating volunteers to date, comprised of retirees, young professionals, teachers and students. Our data set includes 44 sites, ranging south from Brunswick County and north to Dare County. In 2010, we will expand our oyster

settlement monitoring efforts to additional locations in northeastern North Carolina. As we continue to establish a more long-term monitoring program, our current project network provides an excellent opportunity to acquire baseline settlement data for a large geographic area.

Poster, Fac

Integrative approaches for reconstructing the Porifera Tree of Life (PorToL)

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Sponges (phylum Porifera) are among the earliest diverging metazoans, with over 8,000 valid species. Despite their importance in benthic habitats worldwide, phylogenetic relationships within Porifera are not well resolved. Traditional morphological characters used in sponge systematics distinguish individual species, but often fail to resolve genera and families in quantitative analyses. Our team seeks to establish a robust phylogeny of sponges by integrating morphological systematics with analyses of gene sequences. Tier 1, representing each family, examines the monophyly of orders by sequencing 11 nuclear genes and complete mitochondrial genomes. Tier 2, representing 90% of sponge genera, examines interfamilial relationships and morphological character evolution by sequencing 8 nuclear and mitochondrial genes. Tier 3, including 4,000 species, evaluates relationships among species and genera, using traditional morphology and 2 barcoding genes. At the scale of major lineages, we present 3 views of sponge evolution based on phylogenies constructed from sequences of nuclear ribosomal 18S subunits, 7 nuclear genes, and complete mitochondrial genomes. To illustrate species-level questions, we present evidence supporting the reclassification of *Hyrtios violaceus* from family Thorectidae to family Dysideidae. The phylogenies generated by the PorToL project provide an evolutionary context that will improve the understanding of all aspects of sponge biology.

Fac, Poster

Gene Flow and Population Structure of *Ifremeria nautilei*, a deep-sea hydrothermal-vent-endemic gastropod, from three Western Pacific Back-Arc Basins

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Ecosystems associated with hydrothermal vents are dependent on chemoautotrophic primary production and form discrete, biomass-rich islands in the deep sea. Hydrothermal vents in the Western Pacific are found at a series of discrete back-arc basins. Across basins, vents are separated by up to tens of thousands of kilometers, while within basins vent habitats can be separated by as little as a few meters. Although most dominant species are shared among active hydrothermal-vent sites in the western Pacific, little is known about connectivity or gene flow between basins. *Ifremeria nautilei* is a large vent-endemic gastropod found in abundance at western Pacific back-arc basins, where it provides a foundational habitat for other invertebrates. *I. nautilei* were collected from Manus, Lau, and North Fiji Basins. Nine microsatellite loci and the COI region of the mitochondrial genome were analyzed to determine population structure, migration rate between sites, relative ages of populations, and demographic history. Two panmictic populations were identified: an older population from Manus Basin, and a younger population that occurs in Lau and Fiji Basins. Levels of gene flow within Lau and North Fiji populations were high ($F_{ST} < 0.004$), but almost non-existent between either Lau or North Fiji Basin and Manus Basin.

Grad Oral

Cues not a clock control the water-column entry of benthic copepods.

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A portion of the population of some benthic species actively swims out of or away from the sediment surface and up into the water column daily. The phenomenon is of interest for many reasons, e.g., because of its role in benthopelagic coupling and in recruitment, but the cue(s) for the behavior are not known. We did experiments with benthic copepods from a subtidal sand in the Gulf of Mexico and from an intertidal mud in Gullmars Fjord, Sweden. We found that the behavior is not cued by an endogenous clock but rather a cue associated with the onset of darkness. We found that the oxygenation of the uppermost sediment pore water decreased markedly at the onset of darkness, and we suspect that this change in chemistry may be the proximal cue.

Fac, Oral

A comparative study of benthic and coral reef fish communities on artificial versus natural reefs of Bonaire, Netherlands Antilles

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¹Trinity College, Hartford, CT 06106; ²CIEE Research Station Bonaire, Bonaire, Netherlands Antilles In an effort to alleviate anthropogenic impacts (e.g., anchor damage) in marine systems, artificial reefs are often deployed with most unintentionally becoming habitat or a food source for a variety of organisms.

This study compared the composition of benthic habitat and associated fish communities utilizing man-made mooring blocks versus natural coral reefs in Bonaire, N.A. Percent live benthic cover of the blocks was estimated and compared to physically paired natural reef sites (n = 8). Additionally, a visual census of fish abundance and diversity was conducted at each site. Results showed significantly greater live benthic cover on the natural versus artificial reefs, but benthic and fish community diversity did not differ. The composition of this diversity, though, differed between the natural and artificial reefs.

Montastrea annularis and sponges dominated the natural reefs while *Diploria* sp. dominated artificial reefs. Bicolored damselfish and brown chromis were found at the highest densities on the natural reef, while sergeant majors and bluehead wrasses were found at the highest densities on the artificial reef. This study suggests that artificial reefs do not cause a shift in overall benthic and reef fish community diversity on natural reefs, but may strongly influence community composition and function.

UG, Poster

Latitudinal variation in morphological traits of *Thalassia testudinum*.

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Trait variation within a foundation plant species can have important ecological consequences that affect function and stability. Variation in morphological traits may influence population persistence. Recovery from disturbance or stress may be enhanced in some phenotypes that have, for example, larger rhizomes and more stored reserves that provide greater physical resistance to removal and increased post-disturbance growth. A previous study showed greatly reduced genotype diversity in the Indian River Lagoon (IRL; temperate/sub-tropical climate), compared to Florida Bay (tropical climate). This may influence diversity in morphology. As part of a larger on-going study, we conducted a broad scale survey of morphological traits for individual clones at sites that cover the range of *Thalassia* in the IRL. In the southern IRL, *Thalassia* is abundant and relatively stable away from large freshwater influences such as the St. Lucie River. In the mid IRL, it begins to decrease and becomes essentially absent north of Sebastian Inlet. Key morphological traits varied between sites in the IRL including shoot density

(ANOVA, $P < 0.017$), internode length (ANOVA, $P < 0.0005$), sheath length (ANOVA, $P < 0.0005$), and number of leaves (ANOVA, $P < 0.0005$), including variation between leaves of different ages. Within a site the number of leaves between clones differed significantly (ANOVA, $P < 0.002$).

Grad, Oral

Effects of habitat variation on of growth, reproduction, and mortality in the corkscrew anemone *Bartholomea annulata* on Caribbean coral reefs

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Corkscrew anemones *Bartholomea annulata* are conspicuous members of Caribbean coral reefs, and are ecologically important as hosts to obligate cleaner shrimps that impact reef fish diversity. They also are major targets of the ornamental aquarium trade, but limited understanding of their life history prevents development of a scientific basis for sustainable harvest. At St. Thomas, U.S.V.I., we transplanted these anemones between coral reef habitats that differed significantly in physical characteristics, to examine effects of habitat variation on their life history traits. Anemone transplants grew larger and asexually reproduced much more rapidly on an inshore than offshore reef. Mortality was high at both sites after 1 month (25-31%) and 5 months (47-53%), and did not differ significantly between the 2 reef sites. However, the production of asexual pedal lacerates supported a stable population size on the inshore reef, while the offshore population steadily declined. We conclude that populations of this anemone experience frequent turnover, and that habitat variation significantly alters their life history traits, with consequences for their cleaner shrimp associates. Commercial collection thus should be limited to coral reef habitats that support rapid growth and clonal replication of this ecologically-important sea anemone.

Grad, Oral

Shell Morphology of Bivalves in the Presence of Predators

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Predators can have both lethal and nonlethal effects on prey. Nonlethal effects, such as morphological changes in prey, are often costly but necessary to minimize predation risk. The purpose of this study was to determine if oysters and other bivalves alter their morphologies in response to predation risk by mud crabs. Using mesocosms, we placed cages in pairs, one with a mud crab predator, and a no-predator control. After 40 days, the bivalves were removed and dry weights and ash-free weights were gathered to be able to compare the tissue to shell ratio between the control and experimental group. The preliminary results show a difference between the predator and control samples, suggesting that in the presence of a predator, the bivalves grow less tissue and more shell mass. The greatest change in tissue: shell ratio was observed in oysters. Thus, oyster fitness may be affected by an increased abundance of intermediate predators when large predators are removed from the reefs, with the oysters showing the biggest gap. When this ongoing study is complete, it will provide important insights that may improve oyster reef restoration. The present experiment will also examine the differences between single and multiple predator affects on bivalve tissue to shell growth.

Multiple prey effects: agonistic behaviors between prey species enhances consumption by their shared predator

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Behavioral interactions between prey species can alter functional relationships within predator-prey systems and lead to nonlinear community dynamics. By manipulating prey species richness and identity in mesocosms, we explored separately the effects of prey interactions between pinfish *Lagodon rhomboides* and pigfish *Orthopristis chrysoptera*, and between blue crabs *Callinectes sapidus* and mud crabs *Panopeus herbstii* on the consumption rates of a toadfish *Opsanus beta* predator. We also determined the effects of these interactions on the survivorship of each prey. In both fish and crab prey trials, interactions between prey increased the consumption rate of toadfish, and in each case, the survivorship of one prey was reduced while the other prey was not affected by these interactions. Observations revealed that pinfish chased pigfish out of a seagrass refuge and into a sand matrix where toadfish foraged, thus increasing pigfish vulnerability to predation. Blue crabs failed to reduce their activity in the presence of toadfish. In addition, mud crabs displaced blue crabs from the seagrass in mixed prey treatments, and so these conspicuous behaviors occurred in the sand matrix where blue crabs were more vulnerable to predation. We conclude that multiple prey effects can be important determinants of predator-prey outcomes when refuge space is limited.

Grad, Poster

The Ability of the Gastropod *Crepidula fornicata* to Suspension-Feed in the Presence of Cultured and Wild Populations of the Brown Tide Alga, *Aureococcus anophagefferens*.

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Brown tide is a type of harmful algal bloom caused by *Aureococcus anophagefferens*, a pico-planktonic alga which reproduces asexually. It is associated with a brown discoloration of the water and normally occurs in shallow estuaries with long residence times and high salinities. These blooms have very deleterious ecological effects on shellfish populations. Dense blooms significantly reduce the ability of the hard clam *Mercenaria mercenaria* to filter feed, causing die-offs. Biological control of brown tide may be possible using suspension feeders. The removal of *Aureococcus* by suspension feeding benthic organisms could provide an effective top-down grazing control to prevent brown tide. The objective of this project was to assess the ability of suspension feeding *Crepidula fornicata* to control brown tide blooms. Firstly, we found that *Crepidula fornicata* is abundant in Long Island estuaries with densities in the hundreds per meter squared. Secondly, *Crepidula fornicata* filters *Aureococcus*, which is 2 – 3 µm in size, as efficiently as it does larger phytoplankton cells. Thirdly, *Crepidula fornicata* suspension feeds at a rate 40-fold higher than *Mercenaria mercenaria* regardless of brown tide concentrations. Lastly, *Crepidula fornicata* is capable of actively filtering *Aureococcus* out of suspension during blooms while *Mercenaria mercenaria* cannot.

UG, Poster

Physiological responses of the seagrass *Thalassia testudinum* against the causative agent of wasting disease, *Labyrinthula* sp.

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Seagrass meadows represent an important component of many coastal ecosystems by serving as a refuge and nursery for a number of trophic levels, providing a source of organic matter, and stabilizing sediments thus reducing coastal erosion. Unfortunately, these habitats have experienced declines in abundance due to a series of environmental stressors including incidence of disease. Although the importance of pathogens in terrestrial ecosystems has long been documented, the role of diseases in most marine habitats is much less studied.

Wasting disease in seagrasses has been associated with the presence of an opportunistically pathogenic slime mold of the genus *Labyrinthula*. This organism is ubiquitous in seagrass beds and periodically becomes a virulent pathogen that is capable of destroying plant tissue. Current research, presented herein, is focusing on quantifying the impact of infection on plant health, as a function of salinity, by using pulse

amplitude modulated (PAM) fluorometry. In addition, to explore the possibility of an activated defense response in *T. testudinum*, a bioassay guided fractionation approach is being developed to screen for anti-labyrinthulid secondary metabolite production.

Grad Poster

On the Move: Pan-Atlantic Change in Intertidal Community Structure

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Changes in marine biodiversity have received considerable attention in recent years due to an increasing awareness of the conservation and socio-economic value of marine ecosystems. Shifts in species composition and abundance can impact the diversity and stability of communities often resulting in degradation of services. Quantifying temporal and spatial variation is difficult because of the lack of historical baselines. Using the unique opportunity afforded by the Census of Marine Life History of the Nearshore project, we demonstrate intertidal community change along the coasts of South Africa, Wales, and the Gulf of Maine/Bay of Fundy. Community assemblages of rocky and mudflat habitats were described by taxonomic structure, species composition and functional groups. All coasts showed significant changes associated with shifts in species biogeographic ranges, characterized by increased species arrivals. Departure from taxonomic structure was related to depth of historical baseline. Species contributing most to temporal dissimilarity were predators and grazers (rocky intertidal) and predators and suspension feeders (mudflat). Introduced species were found in all rocky communities sampled, yet only the South Africa sites showed successful colonization related to thermal tolerance. These changes in nearshore communities indicate a general pan-Atlantic phenomenon, primarily caused by range shifts in the regions of biogeographic boundaries.

Fac, Oral

Subtropical sacoglossan gastropods in Okinawa—at “special risk” or “predictably rare”?

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On low intertidal and shallow subtidal shores on the west coast of Okinawa, Japan, we investigated the trophic associations of sacoglossan opisthobranchs associated with Bryopsidalean green algae. During 11 short research visits (55 days in total) from 2002 to 2008, we recorded *ca.* 500 specimens of 11 species including a new record for Japan (*Caliphylla*), a recent record for Japan (*Placida daguilarensis*), two undescribed species, one unnamed (but well-described) species, and six other Indo-Pacific species. We found more sacoglossan species and higher slug abundances on Bryopsidalean algae than previously recorded for Okinawa or the Indo-Pacific region. In contrast to other regions (*e.g.*, N Atlantic, NE Pacific), several of these NW Pacific sacoglossans specialized feeding on hosts in a single algal genus rather than two or more genera from different families. However, monophagy has not yet been demonstrated in this guild of Okinawan sacoglossans. Given the broad geographic ranges, restricted host ranges, often predictable populations, and high frequency of life cycles with planktotrophic larvae, western Pacific subtropical sacoglossans should be considered “predictably rare” (*sensu* Rabinowitz 1981) rather than at “special risk” (*sensu* Clark 1994).

Fac, Oral

Direct and indirect effects of the mud snail *Ilyanassa obsoleta* on nutrient availability and algal production.

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We examined the effect of the Eastern mud snail *Ilyanassa obsoleta* on sediment-water column nutrient fluxes, benthic microalgae (BMA) and macroalgae in two estuaries: West Falmouth Harbor, MA (WFH), and South San Francisco Bay, CA (SFB). Results from simulated intertidal microcosms in SFB showed a positive effect of snails on sediment release of nitrogen and phosphorus and a negative effect on both BMA and the macroalga *Ulva* sp.. In subtidal microcosms in WFH, snails similarly affected BMA and nutrient fluxes, but in contrast promoted both *Gracilaria* sp. and *Ulva* sp. A field inclusion/exclusion experiment in WFH using mesh cages corroborated the effects on fluxes and BMA but with less dramatic results. To evaluate whether the snails promote macroalgal growth directly through excretion or indirectly by alleviating nutrient competition between BMA and macroalgae, we used ¹⁵N to trace the flow of N from sediment detritus to macroalgae. These results suggest that while snail-enhanced mineralization promoted nutrient availability, the dominant mechanism may be alleviation of nutrient competition between autotrophic groups. The contrasting effect on macroalgal growth between SFB and WFH could be explained by a lack of nutrient limitation in the nutrient-replete intertidal SFB system where physical stressors are more important.

Fac, Oral

Understanding uncertainty in seagrass injury recovery: an information-theoretic approach.

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In south Florida, motorized vessel groundings cause extensive, long-lasting injuries to seagrass beds but varying degrees of natural recovery have been observed at a number of grounding sites. Given this variation, the ability to predict potential recovery would enable management to focus restoration efforts on sites where recovery is less likely. We used an information-theoretic approach to evaluate the relative contribution of specific injury attributes to the natural recovery of 30 seagrass grounding injuries in Florida Keys National Marine Sanctuary. Recovery was defined by three dependent variables: (1) seagrass re-colonization, (2) volumetric filling, and (3) perimeter to area ratio and each was examined separately utilizing a global model and all possible subsets of the following independent variables: (1) injury age, (2) original injury volume, and (3) original injury perimeter to area ratio. Injuries demonstrating recovery were on average older, smaller, and had slightly larger P:A. Although the information-theoretic approach revealed considerable uncertainty in model selection, our findings suggest that these injuries may naturally recover to pre-injury condition, but likely in time measured in decades. Our analysis also reveals the critical role of sediment in-filling to the recovery process.

Fac, Oral

Food web impacts of intense fishing pressure throughout the Florida Keys National Marine Sanctuary: an assessment using no-take and fished reefs

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The negative impact of man's removal of large predators on food web structure and the resulting changes in the intensity and direction of trophic interactions is now a virtual paradigm of marine ecology. Using comparisons of food web structure and estimates of trophic transfer made at fished and unfished back reefs in two regions of the Florida Keys National Marine Sanctuary, we found that cessation of fishing led to increases in exploited species density in some unfished reefs but not others. We found no evidence of exploited species impacts on the density, or feeding behavior by herbivores or invertivores. Why these results contradict the existing paradigm is uncertain, but we noted that the majority of the exploited fishes were omnivores, not piscivores as was expected. We also noted that piscivores recorded at the study areas were very mobile transient, unexploited species including bar jacks and barracudas, not the expected commercially harvested species. It may be that exploited piscivores were never abundant enough to have greatly impacted lower trophic levels in reef food webs. Instead, our results show that the impacts of restoring exploited species are likely to be modest in structurally complex food webs, and vary greatly among locations.

Fac, Oral

The role of crab grazing and drought stress in marsh die-off

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Understanding the relative importance of both biotic and abiotic stress in regulating primary productivity within ecosystems is a central goal of community ecology. While salt marshes were historically considered model systems maintained by bottom-up forces (i.e. nutrient input, porewater oxygen), recent studies suggest that consumers play an important role in controlling productivity, and that runaway consumption can reduce large areas of previously healthy marsh grass to barren mudflats. Physical stressors such as drought, which raises salinity in the marsh, triggers die-off and intensifies top-down control. Evidence from southeastern marshes shows that the herbivorous crab, *Sesarma reticulatum*, is an important grazer in these systems. We performed a fully-factorial field experiment with 2 levels of salinity (through salt addition) to simulate drought conditions (ambient and elevated) and 3 levels of crab density (removal, control densities and addition). Preliminary results show naturally-occurring high densities of crabs can reduce *Spartina* stem density by up to 55%, and in crab removals and control densities, the addition of salt stress further reduces plant biomass. These results support the hypothesis that *Sesarma* grazing at high densities can drastically reduce *Spartina* productivity, and that both physical stress and grazing can interact to drive die-off in salt marshes.

Environmental predictors of marine debris in North Carolina salt marsh

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Marine debris has been observed to accumulate readily in salt marshes and have deleterious effects on the marsh plants and associated fauna already under the stress of sea level rise. We evaluated the composition, abundance, and distribution of marine debris within North Carolina sounds to determine accumulation rates with regard to environmental parameters, such as human use patterns, site wave exposure, shoreline exposure, direction, and shoreline length in salt marshes near Beaufort, NC. Marine debris surveys were conducted seasonally on 17 salt marsh sites in three areas of differing recreational use from September 2007-May 2009. Sites were sampled on foot utilizing a handheld GPS unit to record debris: category, type, size class, and position in or out of the wrack line, as well as the perimeter of each site sampled. Debris was collected, sorted and weighed at the laboratory. Plastics accounted for the majority of debris across all sites by count with foam a close second. Wood debris outweighed any other category across all sites. Preliminary results suggest that debris types reflect human recreational use of each area as well as proximity to development. Further examination of wave exposure could help to identify debris hot spots in the future.

Individual specialists in a generalist population: results from a long-term stable isotope series

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Individual diet variation is often overlooked in ecological studies, but a closer examination of individual resource use may reveal intrapopulational differences through time, and stable isotopes provide a means through which we can examine the ecological niche of individuals and populations. Adult loggerhead sea turtles (*Caretta caretta*) are generalist carnivores with a broad isotopic niche. We used scute, a persistent and continuously growing tissue found on the carapace, to examine long-term foraging (diet, habitat, and location) variation in 15 nesting loggerhead turtles from Florida. Samples were microlayered and analysed for stable isotopes of nitrogen and carbon. Scute records retaining up to 12 years of foraging history reveal that individual loggerheads are long-term specialists within a generalist population. We present our results in the context of a conceptual model comparing isotopic niches in specialist and generalist populations. Individual foraging consistency may have important ecological, evolutionary, and conservation consequences, such as the reduction of intraspecific competition.

Grad, Oral

Habitat complexity and patch choice: understanding non-random distributions of foraging shorebirds on intertidal sand flats.

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vandusen@unc.edu Widespread coastal development has resulted in extensive loss and degradation of the intertidal habitat used heavily by foraging shorebirds. Wildlife managers must understand the factors and processes that determine habitat value for target species to successfully implement habitat creation and restoration. This winter study looked at patch- and landscape-level factors driving spatial and temporal shorebird foraging patterns across four discrete, yet well connected, intertidal sand flats. Shorebirds were distributed non-randomly between flats, with major differences in abundance and species composition highly correlated with sedimentary characteristics (Spearman correlation coefficient $\rho = 0.836$, $p < 0.01$) while only weakly correlated with the benthic prey community ($\rho = 0.644$, $p = 0.06$). Within a flat, greatest foraging pressure occurred along the tidal line, though microhabitat utilization differed by species based on foraging method. Because prey activity is often highest at the newly-exposed tidal edge, a smaller area-edge ratio increases a flat's habitat value to foraging birds. Other landscape-scale characteristics including the composition of the surrounding matrix also influence overall habitat value. Managers can maximize impact of restoration efforts by considering key species-specific patch-level factors in conjunction with the broader landscape context.

Grad, Oral

Lysosomal autophagy as a response to anoxia stress in the mudflat polychaete *Glycera dibranchiata*

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Lysosomal autophagy functions to remove and recycle damaged and redundant cellular components that accumulate under stressful conditions. We hypothesize that this response allows marine organisms to survive variable abiotic stressors, such as oxidative stress. To investigate this, we studied lysosomal autophagy as a response to oxidative stress in erythrocytes of the mudflat polychaete *Glycera dibranchiata*, a species native to the anoxic mudflats of Maine. We quantified the average number of lysosomes present per cell during exposure to normoxia, following 24 h exposure to anoxia, and during a 24 h normoxia recovery period immediately following the anoxia exposure. Our preliminary data suggest that the number of lysosomes is reduced by 50% after 24 h in anoxia. After 1 hour in normoxia following anoxia, the average number of lysosomes doubles and then slowly decreases over an additional 24 h. During recovery from anoxia we observed the presence of putative autophagosomes, which are organelles

that capture damaged cellular components to be delivered to the lysosome for degradation. These data suggest that lysosomal autophagy plays a role in survival of *G. dibranchiata* in its natural habitat by removing oxidatively damaged proteins and organelles, which could otherwise compromise the cell and ultimately lead to death.

Grad, Oral

Biodiversity of Actinobacteria and a Comparative Chemical Analysis of *Micromonospora* spp. Isolated from Sponges and Marine Sediments of Puerto Rico

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A comparative study of culturable actinomycete bacteria recovered from 9 marine sponges and their surrounding sediments is reported. These sponges and associated sediments were collected from four separate locations including fringing reef habitats adjacent to rivers and offshore reefs in Puerto Rico. A total of 184 actinomycete colonies were isolated and identified based on 16S rRNA gene analysis. Phylogenetic analysis revealed the presence of at least 15 new species belonging to the groups *Micromonospora*, *Verrucosipora*, *Streptomyces*, *Salinospora*, *Solwaraspora* and *Rhodococcus*. Accordingly, 72 isolates had a 100% sequence homology with *Micromonospora* spp. Intriguingly, when fermented, the *Micromonospora* spp. isolates from sponges produced a large diversity of secondary metabolites relative to those isolated from the sediments. Extracts from the fermentation broth of *Micromonosporas* spp. were analyzed by LC-MS and tested against *Bacillus subtilis*, *Mycobacterium smegmatis*, and *Escherichia coli* to determine antimicrobial activity. This study shows that the microbial habitat of these Caribbean sponges has great potential for harboring new species of actinomycetes. Explanation of the greater biosynthetic potential of *Micromonospora* spp. isolated from sponges will be discussed.

Grad, Poster

Influences of coral reef habitat and rugosity on Dry Tortugas reef fish communities

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Fish community diversity is often associated with complex coral reef habitat and structure. Community dynamics may further be influenced by marine protected area implementation. We surveyed reef edges at 30 permanent stations in the Dry Tortugas, FL from 2001-09. Sites were located within the Florida Keys National Marine Sanctuary's Tortugas North Ecological Reserve, Dry Tortugas National Park, or the exclusive economic zone. Relationships between fish communities, benthic habitat percent cover, and reef complexity at 30m, 100m and 300m extents were investigated using mixed modeling. Reef complexity metrics included traditional chain rugosity, maximum change in site depth, and two metrics based on multibeam sonar bathymetry: fractal dimension and Benthic Terrain Modeler output.

Oral

Selective herbivory of the mud snail *Ilyanassa obsoleta* on bloom forming *Ulva* species

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On the Atlantic coast, *Ulva* blooms frequently co-occur with the mud snail, *Ilyanassa obsoleta*. Previous research has shown that mud snails rarely consume *Ulva*, preferring to eat the microscopic fouling organisms on the blades. This study aimed to determine the *cause* of this feeding preference by examining feeding rates on two bloom forming *Ulva* species (*U. compressa* and *U. rigida*). Blades were freeze dried, ground, and reconstituted with agar, thereby removing the influence of algal morphology while retaining their chemical properties. Reconstituted algae were presented to *I. obsoleta* in both non- and paired-choice feeding assays. We found that the snails consumed significant quantities of both

species when they were in the ground form (*U. compressa* $p = 0.0235$, *U. rigida* $p < 0.0001$). When ground *Ulva* was paired with diatoms in an agar mixture, the snails showed no preference for diatoms over *U. rigida*, but they significantly preferred *U. compressa* over the diatoms ($p < 0.0002$). However, when *U. compressa* was paired with *U. rigida*, there was no significant difference in the amount of algae consumed. These results indicate that *I. obsoleta* does not consume these *Ulva* species in their blade form due to their morphology, not their chemical properties.

UG, poster

Importance of macroalgae in the Indian River Lagoon: developing an assessment and management program.

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Drift algae (DA) is a major component of, and plays many roles in the Indian River Lagoon (IRL), which stretches 250 km along Florida's east coast. The IRL is the most biodiverse waterbody in the United States, due in part to its extensive cover of submerged aquatic vegetation. In addition to mapping, abundance of seagrasses and DA has been field monitored along the entire IRL's length during the last 16 years as part of this seagrass transect sampling effort. DA is also monitored by hydroacoustic surveys, especially in deeper water. The many roles of DA may include both beneficial and harmful impacts: (1) enhance water quality, due to nutrient uptake, (2) an indicator of water quality by C:N:P ratios and isotope ratios, (3) habitat for a host of estuarine fauna in densities equivalent to that on seagrass, (4) potential cause of low local dissolved oxygen, (5) shading of seagrass, (6) wrack build-up on shorelines, and (7) a possible biofuel source. This poster presents the potential roles that drift algae fills in the IRL and outlines an assessment study plan for determining management practices.

Fac, poster

Phytoplankton composition and abundance in relation to salinity, nutrients and light gradients in Apalachicola bay

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The Apalachicola National Estuarine Research Reserve (ANERR) is located in the Florida panhandle on the northern coast of the Gulf of Mexico. The estuary is important both ecologically and commercially; it serves as a nursery and spawning ground for aquatic wildlife, and supports a large shellfish industry which depends on the fresh water dominated estuary. The flow of the river has been reduced in recent years, due to both drought conditions and increased upstream anthropogenic water withdrawal, endangering the integrity of the estuary, including the structure and function of the planktonic and benthic communities.

The aim of the present study is to determine spatial and temporal patterns of phytoplankton composition and abundance in the estuary and correlate the results with observed gradients in salinity, nutrients concentration and light availability.

The study is intended for two years; samples for chemical analyses and phytoplankton composition and abundance are collected on a monthly basis at a range of sampling sites within the bay. The overall goal of the study is to help define how future changes in flow and nutrient content of the Apalachicola River will impact the structure and function of the phytoplankton community which is the foundation of the food chain.

Grad, Oral

The effectiveness of Marine Protected Areas in enhancing coral recruitment

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Coral cover and juvenile recruitment have decreased dramatically in Caribbean coral reef ecosystems over the last several decades. The establishments of Marine Protected Areas (MPAs) are viewed as a potential means of reversing these alarming trends. MPAs can enhance densities of dominant herbivores such as parrotfish that graze on macroalgae, a mechanism that may facilitate coral recruitment. While zoning restrictions and fishing regulations are thought to play an important role in preserving coral reef fish assemblages, the effects of MPAs on the benthic communities of coral reefs remain largely unknown. We surveyed 19 sites (3 MPAs, 5 No take reserves, and 11 Control sites) in Belize and quantified coral cover, coral recruit density, macroalgal cover, and parrotfish density. We found no significant differences in these parameters when comparing protected and unprotected reefs. Our findings suggest that at this time, the established MPAs and no take reserves of Belize have not detectably improved prospects of reef recovery. Our results are concordant with other recent studies of Belizean Reefs, and suggest that a combination of local, regional, and global factors may be playing a significant role in impeding their resilience.

UG, Oral

Hydraulic cracking and sediment disruption by benthic macrofauna

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Animals living within sediments face the challenge of gaining oxygen for respiration. The work necessary to pump sufficient oxygenated water can constitute a substantial proportion of the organism's energy budget, especially when the infaunal lifestyle requires the injection of water into the sediment, as is the case, e.g. for polychaetes in blind-ending burrows or bivalves with subsurface ex-current siphons. The work performed during bioadvection is a function of sediment permeability and below a critical permeability threshold such organisms should not thrive. Here we show that in such muddy sands, hydraulic pressure pulses can result in the formation of sedimentary cracks with locally increased permeability and consequently in a lower energetic requirement for bioirrigation. Based on our findings with animals and bioadvection mimics we hypothesize that cracking of sediments by infaunal hydraulic activities is a common phenomenon in low permeability sediments with important implications for species performance, distribution, and interactions.

Fac, Oral

Feeding on suspense: Convergent evolution in suspension-feeding gastropods.

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Suspension feeders are frequently successful as invasive species in marine ecosystems. Suspension feeding is a comparatively rare feeding mode within aquatic gastropods, although it has evolved independently several times, most notably in the family Calyptraeidae, which includes the invasive species *Crepidula fornicata*. Alterations that permitted gastropod gills to collect food as well as to exchange gases probably involved minor evolutionary modifications of ciliated tracts and other structures in the mantle cavity. Therefore, the fact that so few gastropods are suspension-feeders is surprising. The trochid *Lirularia succincta* is unusual in that it participates in suspension feeding as well as grazing. We used histology, scanning electron microscopy, and video microscopy to compare the functional morphology of gills and other features of *Lirularia succincta* with other trochids that do not suspension

feed (*Margarites pupillus*, *Calliostoma ligatum*) and with other more distantly-related suspension-feeding gastropods. Unlike its close relatives, individuals of *L. succincta* have thin, elongated gill filaments that closely resemble the gills of *C. fornicata*. In addition, the mantle of *L. succincta* has modified ciliary tracts and a flexible flange on the mantle edge that permit it to form and transport strands of food-laden mucus to the mouth in a manner very similar to that of calyptraeids.

Fac, Oral

The interactive effects of nutrient loading and suspension feeding on estuarine resources.

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Living marine resources maintain the ecological and economic health of coastal systems. Eutrophication has been a primary driver of estuarine decline, although potential positive effects of eutrophication have been identified. Benthic suspension feeders, such as bivalves and sponges, can buffer some effects of eutrophication. The effects of nutrient loading and bivalve suspension feeding on the growth of eelgrass (*Zostera marina*) and juvenile bivalves (*Mercenaria mercenaria*, *Crassostrea virginica*) were tested in a series of mesocosm experiments. In an ecosystem setting, Florida Bay, FL, USA, high densities of sponges (*Spechiospongia vesparia*) were able to graze on cyanobacteria at rates sufficient to prevent harmful blooms, while areas with lower densities of sponges were susceptible to harmful blooms. In another ecosystem, Peconic Estuary, NY, USA, a naturally occurring nutrient loading gradient from eutrophic to mesotrophic waters was used for a grow-out experiment with eelgrass and juvenile bivalves (*M. mercenaria*, *C. virginica*, *Argopecten irradians*). *M. mercenaria* and *C. virginica* juveniles benefited from eutrophic conditions while the growth of *A. irradians* juveniles and eelgrass shoots was maximal under mesotrophic conditions. Nutrient loading and suspension feeding can have significant and complex effects on living marine resources, and future ecosystem-based management will need to understand these effects as managers target species and regions to be restored.

Grad, Oral

Biodiversity loss in benthic communities and impacts on the trophic availability of Hg to benthic feeding predators in the lower Hudson River estuary

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Organic mercury such as methylmercury is not only one of the most toxic substances found in coastal ecosystems but also has high trophic transfer efficiency. In this study, we examined implications of chronically altered benthic macroinfaunal assemblages for organic mercury trophic availability (based on organic mercury intracellular partitioning) to predators in the Arthur Kill-AK (New York, USA), which is part of the Hudson River estuary. Despite low species diversity, both density and biomass of benthic macroinvertebrates in the AK were significantly higher than those at a reference site. Disproportionately high biomass of benthic macroinvertebrates (mostly polychaetes) in the northern AK resulted in a more than twofold increase (an 'ecological enrichment') in the amount of organic mercury that is presumed to be trophically available to predators (i.e., trophically available metal; TAM). These results suggest that altered benthic community structure in the AK may play an important role in the coupling of sediment associated methylmercury and higher trophic levels and that community composition (and associated species-specific differences in internal partitioning) play a key role in the biogeochemical cycling of methylmercury in urbanized coastal ecosystems.

Fac, Oral

The feasibility of oyster reef restoration within urban-suburban swash estuaries along the NE South Carolina coastline

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Restoration of oyster reef habitats is recommended to improve a range of coastal environmental concerns from decreased shellfish harvests to reduced water quality. In northeastern SC, swash estuaries connected to the ocean by across-beach inlets have been modified as the region developed into a >14 mil a year tourist destination. Suspected consequences of development are a decline in swash water quality and an increase in beach advisories associated with outfalls. To investigate the feasibility of constructing reefs to improve swash water quality, data on biweekly and seasonal settlement and survival of oyster spat along with various physical parameters (salinity, pH, particulates) were collected in 2008 from an ocean-dominated estuary, Murrells Inlet, and two swash estuaries, Withers and White Point. Oyster recruitment within Murrells Inlet consistently was greater compared to recruitment within Withers and White Point swashes. Differences in physical characteristics measured did not suggest a consistent reason for reduced oyster recruitment within swashes. Existing swash oyster populations may be isolated from populations within the aerially greater surrounding inlets suggesting oysters are not substrate but recruit limited. If swash oyster populations are recruit limited, typical reef restoration efforts involving planting additional substrate will require modification to assure success within swashes.

Fac, Oral

Don't Release a Pest

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This animated film targets pet owners, specifically those that have aquarium tanks, to not release their pets and plants into coastal waters because they may become invasive. The film uses the invasion of the green alga *Caulerpa taxifolia* as an example for why people should not release unwanted aquarium pets or plants into the environment.

Fac Film

Marsh-scape Genetics: Spatial variation of genetic and biotic diversity in the salt marshes of Georgia

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Factors that maintain genetic and species diversity may act in concert in natural ecosystems. Here, we investigate correlations between genetic diversity (in eight salt marsh species) and community species diversity. A significant positive correlation existed between genetic diversity and species richness, although the relationship was not significant for any species individually. Nonetheless, four of the eight comparisons showed strong positive relationships between genetic and species diversity. Additionally, several abiotic variables were used in a model selection procedure to determine what site-level characteristics might drive differences in genetic diversity in this system. The rate of larval influx, as measured by barnacle abundance on *Spartina alterniflora*, was the strongest predictor of site-level genetic diversity in our samples. Our results suggest that estuarine management efforts should consider recruitment rates when selecting areas for protection.

Fac, Oral

Are we overestimating the prevalence and intensity of trait-mediated interactions?

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Recent reviews have concluded that predators may exert larger effects on prey species by modulating prey behavior than by direct consumption. Such effects are known as trait mediated interactions (TMIs) when predators affect prey, and trait-mediated indirect interactions (TMIIs) when these effects propagate to other species. Interestingly, much of the evidence for large TMIs/TMIIs is provided by studies where water-borne chemical signal transmission changes prey characteristics. A number of recent works, however, suggest that the physical environment may either enhance or suppress the potential for indirect interactions (relative to consumption) by differentially altering the ability of predators and prey to detect one another. Unfortunately, studies examining TMIs/TMIIs sometimes use unnatural physical environments, or environments that are characteristic of only some portions of the natural habitat. The use of static flow tanks, where chemical signal transmission may be particularly effective, is common. Indirect interactions clearly are important. Yet, the reliance on experimental techniques and environments where chemical signal transmission is maximized may result in an overestimation of the importance of indirect interactions in nature. Experiments with more realistic and quantified flow environments will be needed to go beyond documenting the presence of TMIs/TMIIs to reveal when and where they are significant.

Fac, oral

Metabolic integration between the sponge *Cliona varians* and its associated zooxanthellae provides direct evidence of a mutualism

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Cliona sp. sponges are common inhabitants of many coral reefs, including those in the Florida Keys. As bioeroders, they play an important part of the reef calcification cycle. Many species in the genus maintain intracellular populations of the dinoflagellate *Symbiodinium* sp., the zooxanthellae that are symbiotic with a variety of coral species. Unlike the zooxanthellae coral-interaction, however, the metabolic interaction between these symbionts and their host sponges is poorly understood. To assess this interaction and determine where it falls on the symbiosis continuum, we measured the stable carbon isotope ratio of *Cliona* species with and without zooxanthellae, performed a tracer experiment to follow C and N in the system, and performed reciprocal transplant experiments to study the influence of environment on the interaction. We found significant differences between the carbon metabolism of sponge species with and without symbionts, strong evidence of a transfer of C from zooxanthellae to its sponge host and some evidence of a transfer of N from sponge to zooxanthellae. We also saw significant influences of the environment on the metabolism of the sponges. These data strongly support hypotheses of metabolic integration between the zooxanthellae their sponge host, suggesting that the interaction is an intimate mutualism.

Fac, Oral

The role of evolutionary and historical experience in three whelks' adaptation to novel prey.

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Predator-prey interactions between invasive and native species, and between invasive species from different regions, are often unpredictable. A lack of shared evolutionary history is often assumed to aid the invader in its role as either predator or prey, but this assumption may not be valid. We tested whether shared evolutionary history predicted predation success of one native and two invasive whelk species on

prey that were either familiar (same origin as predator) or novel (different origin than predator). We offered *Acanthinucella spirata*, *Ocenebrellus inornatus* and *Urosalpinx cinerea* various species of mussels and oysters in a laboratory setup, and created preference hierarchies. In additional experiments, we compared the prey preferences of *U. cinerea* from a native East Coast population to *U. cinerea* from the West Coast. East Coast *U. cinerea*, while able to consume novel prey, did not display the same strength of preferences as West Coast *U. cinerea*, which have had decades or centuries to adapt to native West Coast and Asian prey species. Our results indicate that shared evolutionary history may not be the major factor determining predation success for generalist whelk predators, but that historical time after introduction may alter a novel interaction between predator and prey.

Grad, Oral

Settlement, survival and growth of bivalves within Myrtle Beach swash estuaries

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The relative importance of larval settlement, survival, and growth to maintenance of oyster, *Crassostrea virginica*, and mussel populations, *Geukensia demissa*, inhabiting 'swashes' along the coastline of Myrtle Beach, SC will be determined. Swashes typically are estuarine systems maintained by tidal rivers draining localized watersheds over mainland beaches. In December 2009 bivalves collected from a common field location were numbered, sized, and placed in 7.0 mm mesh cages within 3 swashes and 3 ocean-dominated inlets along the Grand Strand. Survival and growth of the caged bivalves will be monitored throughout 2010 to test whether differences in mortality and/or growth exist for swash and inlet populations. Beginning in April settlement samplers will be placed at the same swash and inlet locations and the contribution of larval settlement and survival to oyster population dynamics assessed. Results will provide critical information necessary to predict whether bivalve populations within swashes can be increased either through the addition of shell to construct new oyster reefs and/or actual transplantation of bivalves into new swash locations. Increasing bivalve populations within swashes is one possible solution to addressing historical declines in water quality and more frequent beach advisories directly attributable to swash runoff.

Grad, Poster

Ecological Implications of Iron Flux on *Vibrio cholerae*

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Iron is a critical trace element essential for almost all living organisms on earth. Iron availability has been characterized as an important controlling factor in marine production and nutrient cycling of marine ecosystems. Understanding the effects of iron flux on a particular assemblage in the marine environment has been complicated by the fact that iron has low solubility in oxic seawaters, it is nearly completely complexed to organic ligands, it can be trophically limited and its relative abundance is often limited by minimal external supply. A major source of iron to the surface waters of the world's oceans is aeolian dust delivered through long-range transport from arid continental regions. Deposition of African dust in surface waters of the Gulf of Mexico and western tropical Atlantic has been shown to elicit primary production growth responses. While much of the work on the ecological effects of dust deposition have centered on its potential stimulation of phytoplankton activity, we investigate how the growth of pathogenic *Vibrio* spp. may also be stimulated by iron from dust deposition.

Grad, Poster

Olfactory responses of the lemon-drop nudibranch, *Doriopsilla pharpa*, to its prey, the boring sponge *Cliona celata*.

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The boring sponge, *Cliona celata*, is an important agent of bio-erosion on oyster reefs and is a nuisance for commercial clam and oyster fisheries because it often attacks living bivalves. Thus, there is considerable interest in finding a means of biological control for this sponge. The lemon drop sea slug, *Doriopsilla pharpa*, is a common inhabitant of oyster reefs on the eastern U.S. where they are found in close association with shell rubble. *D. pharpa* has been characterized as a predator of the boring sponge, *Cliona celata*, because the two are often found in close proximity; however, empirical evidence of this relationship is equivocal. Importantly, juvenile *D. pharpa* undergo direct development without a dispersive larval stage. This presents a problem for *D. pharpa* finding suitable habitat containing *C. celata*. The purpose of this experiment was to determine if *D. pharpa* is able to detect *C. celata* using olfactory cues. A simple Y-maze was constructed to test orientation to sources of *C. celata* chemical cues. These tests have shown a strong preference for *C. celata* over many other sponges found in its habitat. Spicule analyses of stomach contents confirm that *D. pharpa* is a spongivore, and specimens were successfully kept alive in artificial aquaria with an exclusive diet of sponge prey and even reproduced successfully.

UG, Poster

Amphipods control epiphyte accumulation in a seagrass bed: cage-free field confirmation.

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Small crustacean mesograzers are the dominant primary consumers in many coastal benthic ecosystems and a key node in food webs. Yet, their grazing impacts on vegetated communities under natural conditions remain poorly known. Traditional cage exclusion experiments introduce severe artifacts when targeting small crustaceans. Poore et al. (2009) recently developed a novel method to suppress mesograzers abundances without the use of cages, a method which we have successfully utilized for the first time in a seagrass system. Carbaryl, a degradable insecticide used in agriculture and aquaculture, was incorporated into plaster blocks where it was slowly released into the water column. We crossed insecticide treatments with nutrient enrichment to investigate top-down and bottom-up influences on epiphytic growth and concomitant effects on eelgrass, *Zostera marina*. We ran the experiment in an eelgrass bed in the York River, Virginia for six weeks during summer 2009. Nutrient enrichment increased epiphyte biomass after the second week of the experiment, while carbaryl treatments lead to increased epiphyte biomass. Increased epiphyte loading, however, did not affect eelgrass growth. Our results confirm the promise of this technique, and corroborate lab and mesocosm results implicating mesograzers as important regulators of benthic community structure and biomass distribution patterns.

Grad, Oral

Indirect effects of a marine ecosystem engineer alter coral distribution

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Farmerfish engineer coral communities by facilitating algal turf and exerting resource control through territorial defense: Within territories, there are (1) increased interactions between coral and farmed turf and (2) decreased interactions with mobile grazers. Smallscale experiments indicated massive *Porites* were more vulnerable to competition with turf than branching corals, e.g., *Acropora*. In contrast, delicate branching corals were more vulnerable to predation and grew and survived better in the presence of *S. nigricans* defense. We addressed this indirect protection in a demographic context using size specific

population monitoring in the presence and removal of *S. nigricans* and lagoon surveys. It appears the disturbance history played a pivotal role in the observed community changes: While *S. nigricans* usually colonizes *Acropora* thickets, these habitats were virtually eliminated by disturbances and farmerfish now colonize the dominant disturbance-tolerant, but turf-sensitive, massive *Porites*. Taxa that can resist competition with turf can utilize dead portions of these massive corals. This increase in 'protected' settlement space enhances recovery of branching corals within farmerfish territories. These results support the idea that disturbance can alter the engineering role: *S. nigricans* adversely affects branching corals in relatively undisturbed habitats, but can indirectly protect these corals with shifts in grazer community structure.

Grad, Poster

Improving field estimates of pelagic larval mortality by accounting for spatial patchiness

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Mortality during the pelagic larval stage has a strong effect on connectivity and population dynamics in benthic organisms. Nonetheless, empirical mortality estimates remain elusive, primarily because larvae are patchy in space and time and subject to advection by currents. Currently, the best approach for estimating mortality involves vertical life tables, which use the ratio of abundances of adjacent life stages to estimate a joint mortality rate while accounting for advection. Unfortunately, this approach is stymied by samples that are extremely patchy and often produces implausible results. We developed a likelihood-based approach that improves on existing methods by explicitly accounting for spatial patchiness in larval abundance. This also produces independent mortality estimates for each larval stage. We describe this method and give an example of its implementation, using a 65-day time series of larval abundances for several species of intertidal crabs and barnacles sampled in Bodega Bay, CA. In general, mortality rates were on the order of $0.1 - 0.2 \text{ day}^{-1}$. These estimates are more precise and biologically plausible than those obtained using the older method. Though computationally expensive, this approach promises to improve our ability to estimate a key demographic parameter.

Fac, Oral

An assessment of genetic diversity in North Carolina populations of the eastern oyster *Crassostrea virginica* using microsatellite markers

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Genetic diversity among 10 populations of the eastern oyster, *Crassostrea virginica* was examined through the analysis of six microsatellite loci. All samples (N=30-48) were moderately to highly polymorphic. Significant Hardy-Weinberg deviations were detected in 30 of the 60 possible tests and are attributable to the presence of null alleles in all but 4 cases. Allelic and genotypic distributions were significantly heterogeneous among populations, particularly for comparisons of western Pamlico and southeastern coastal populations. Pairwise F_{st} -values in most cases were modest (<0.04) and not significant however, the greatest differentiation was observed between the northernmost (Wanchese) and westernmost (Deep Bay) populations in the Pamlico, and between the southern Pamlico populations (West Bluff, Legged Lump) and southeastern populations (White Oak River, New River and Hewletts Creek). No overall correlation (Spearman Rank Correlation $P=0.072$) between geographical distance and diversity (isolation by distance) was detected. The modest differentiation detected likely reflects some loss of connectivity between some locations.

Fac, poster

Measuring Success in Oyster Reef Restoration: Results from the Application of Standardized Monitoring Metrics for Nekton Utilization of Created Reefs.

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Oysters along the Atlantic and Gulf coasts of North America have supported a historically important commercial fishery. They are also increasingly recognized as key components of the coastal ecosystem, providing habitat for transient and resident fauna, affecting particulate concentrations in overlying waters, reducing wave energy along sensitive shorelines and influencing local biogeochemical cycling. As oyster populations have declined along the Atlantic coast, efforts to restore oyster reefs for their ecosystem functions have increased. With this increase in oyster reef restoration comes the need to evaluate the population and ecosystem functions of the created reefs. This presentation will provide a sub-set of results from a two year evaluation of created reefs of varying sizes, ages and tidal position (shallow subtidal and intertidal) in central and southern coastal North Carolina. The project includes comparison of selected habitat and population functions between created and reference reefs as well as examining the influence reef construction, varying tidal position, and landscape attributes such as shell depth and proximity of adjacent habitat types. The presentation will offer information on the habitat function and nekton utilization of the created reefs.

Grad, Oral

The effect of marine reserves on the size of American Lobster, *Homarus americanus*, in Newfoundland

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The American lobster (*Homarus americanus*) fishery in Newfoundland is an important source of income for inshore fishermen. Growing concern over increased pressure on the resource following the cod moratorium in the 1990's has led to the implementation of conservation measures aimed at maintaining a sustainable fishery, including the establishment of marine reserves. Current literature focuses on the effects of marine reserves on rock and spiny lobster species, and few empirical studies deal specifically with American lobster. However, the effects of marine reserves on different species of lobster may vary due to inter-specific differences, such as length of larval stage and mobility. In this study, we examined the effects of reserves on the size of American Lobster by sampling lobsters inside closed areas and in adjacent fished areas at seven locations in Newfoundland. Population size structure and average size inside and outside of reserves was compared. Mean size of males inside reserves differed significantly from those in adjacent waters in 5 of 7 locations and mean size of females inside reserves differed from adjacent waters in 3 of 7 locations. Explanations for varied effects of reserves on lobster size, including consideration of time since closure and trans-boundary movement, are discussed.

Fac, Oral

Christmas tree worms (*Spirobranchus giganteus*) and their role as bioindicators of environmental stress on coral reefs of Bonaire, N.A.

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The use of biological entities as indicators of environmental stress can provide links between changes in ecological conditions and ecosystem productivity. This study investigated the utility of sessile, filter feeding Christmas tree worms (*Spirobranchus giganteus*) as bioindicators of the presence of potential coral reef stressors. Worm density was assessed at low impact sites (> 200 m from a commercial establishment) and high impact sites (< 200 m from a commercial establishment). Data was compared with potential environmental stressors such as water parameters, *Enterococcus* bacteria, sedimentation

rates, and sediment particle sizes between high and low impacted sites and among depths. Live coral cover was similar for 12 and 18 m at both high and low impacted sites (~ 17 % - 20 %) but significantly lower at 6 m depth (~ 2 % - 8 %); however, there were significantly more worms at 12 m of high impact sites. At all other sites and depths, the worms never exceeded ~ 1.5 worms m⁻². *S. giganteus* may be found at high densities at high impact sites due to a greater availability of food acquired through filter-feeding and therefore may be used as novel indicators of environmental stressors in Caribbean coral reef systems.
UG, Poster

Live oyster reefs enhance odor-mediated predator success, negatively impacting associational fauna despite increased turbulence

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Oyster reefs can mediate interactions between organisms, provide habitat, and influence nutrient cycling in salt marsh systems. We investigated the role of oyster reefs in altering chemically mediated predator-prey interactions between predatory blue crabs (*Callinectes sapidus*) and whelks (*Busycon carica*), and their hard clam (*Mercenaria mercenaria*) prey. Field experiments showed that overall predation on hard clams was greater closer to oyster reefs ($p = 0.001$). Turbulent flow properties (based on field measurements) and oyster reef chemical cues were manipulated in a laboratory flume where we examined predatory success as a function of physical and chemical environment (treatments include: live reef, dead reef, live reef chemical cues, dead reef plus live reef chemical cues). The addition of oyster reef chemical cues significantly enhanced blue crab and whelk tracking success relative to dead reef treatments lacking chemical cues ($p = 0.001$ and $p = 0.002$ respectively). Individual-based tracking behavior indicates the primacy of oyster reef chemical cues as information for locating potential prey even in the presence of high turbulence intensity (a flow characteristic previously shown to decrease tracking success). Enhanced predation events near oyster reefs despite inhibitory flow characteristics result in negative indirect interactions (possibly apparent competition) between oyster reefs and hard clams.

Grad, Oral

Inheritance of color phenotype in the sea urchin *Lytechinus variegatus* (Echinodermata: Echinoidea)

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Variably colored sea urchins *Lytechinus variegatus* are common throughout the western Atlantic and Caribbean, from Beaufort, North Carolina to Brazil. Urchin spine color is white, green, purple, red, and pink and is often a combination of two or more colors. Test color too is highly variable and can be one or more colors and distinctly patterned. Sampling across the range reveals geographic differences in coloration with local phenotypes. Here I present data from laboratory crosses that demonstrate a genetic basis for color variability. A total of 9 crosses were made with urchins from Beaufort and Tavernier Key Florida to examine the mode of inheritance of color phenotype. Offspring of both within-site (i.e. Beaufort-Beaufort and Tavernier-Tavernier) and among-site (Beaufort-Tavernier) crosses were grown to late juvenile/early adult size (≥ 15 mm horizontal diameter) to assess maternal and paternal phenotypes on their color patterns. Color is shown to be a multigene trait. Spine and test colors are inherited independently and within crosses demonstrate a high degree of variability. Similarly, patterning of spines and test, common in Caribbean urchins, is heritable.

Grad, Oral

Movement and habitat use of California spiny lobsters *Panulirus interruptus* in southern California

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California spiny lobsters (*Panulirus interruptus*) are the target of intense commercial and recreational fishing in Southern California. The state of California is establishing marine protected areas (MPAs) to help maintain a sustainable lobster fishery and the top-down interactions exhibited by lobsters that enhance biodiversity in kelp forest and other habitats. However, we lack basic information about home range and habitat use of lobsters to determine the appropriate size and location of MPAs. Working within and outside of the La Jolla Ecological Reserve (LJER) near San Diego, we 1) monitored lobster movement using acoustic tracking techniques, 2) tethered lobsters to assess predation risk among different habitat types and time of day, and 3) surveyed lobsters to detect habitat associations during the day and night. Lobsters moved minimal distances overnight, but moved greater distances over a period of six months from April to October 2008. Lobster relative mortality rates were lowest at night and highest in surfgrass habitat during the day. Boulder substrate and *Plocamium pacificum* algae were strong predictors of lobster presence. This research provides novel information on movement behavior and habitat use of spiny lobsters in southern California that will be applied to the conservation of this species.

Grad, Oral

Testing predation and risk trophic cascades in the Galápagos Marine Reserve (GMR)

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Predators have important indirect effects on primary productivity as they intimidate rather than consume their prey, however, these risk Trophic Cascades (TC's) are rarely examined in oceanic food webs. We are testing the hypothesis that urchins are controlled by predation and/or risk by measuring predation on urchins with time-lapse cameras and by documenting spatio-temporal patterns of urchin abundance in and out of areas protected from fishing. Preliminary experiments with tethered pencil urchins (*Eucidaris galapagensis*) indicate that hogfish and triggerfish are major predators, with maximum consumption rates of 100% in 5 hrs, suggesting predation TC's. Experiments revealed little overlap between the nocturnal activity of pencil urchins and their principal fish predators, which are apparently diurnal, suggesting that nocturnal foraging of urchins is an adaptive behavioral response to avoid fish predation during the day, representing a risk TC. Analysis of *Eucidaris* abundance patterns indicates a small, but significant elevation of urchin densities at fished vs. no take sites, consistent with a release of top down control. In summary, both types of TC's are apparently operating in the GMR. An experimental framework is proposed to disentangle their relative contribution along with alternate factors regulating urchin populations.

Fac, Oral

Long-term patch dynamics in the community shaped by bivalves, barnacles, ascidians and red algae: multiple foundation species in the White Sea shallow subtidal.

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While facilitation by multiple foundation species (FS) shapes many terrestrial and marine communities, most studies focus on relatively simple systems structured by a single FS. At our research sites in the White Sea empty shells of a clam *Serripes groenlandicus* are the most frequent hard substrate on muddy sand. Shells are covered by clustered barnacles *Balanus crenatus*. Barnacles, in turn, carry co-dominating solitary ascidians and red algae; these FS host many other sessile species. Since 1998 we performed a field experiment to trace the patch dynamics on initially empty *Serripes* shells. During the first 2 years

primarily barnacles and algae occupied shells with later increase of barnacles' share towards the exclusive domination. Upon barnacle growth, a diverse assemblage of conspecifics, algae, ascidians and many more taxa developed on their surface. Nearly all ascidian and about a half of barnacle recruits were attached to adult barnacles. At the age of 9-10 17% of first generation barnacles died and 30% of ascidian biomass concentrated on their empty shells. This sequence of stages explains the variation in structure of epibenthic patches observed in nature. FS studied act as a facilitation cascade and likely also compete for space on primary substrate and barnacles' surface.

Grad, Oral

Testing interaction effects of temperature and salinity of the Asian green mussel (*Perna viridis*) and the charru mussel (*Mytella charruana*).

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In recent years, the number of introduced species has greatly increased in the marine environment, largely due to hull fouling and releases of ballast water. This study examines the temperature and salinity tolerances of two non-native marine mussels, the Asian green mussel (*Perna viridis*) and the charru mussel (*Mytella charruana*). These mussels have been found along coastlines and in estuaries of the southeastern United States. We hypothesized that both introduced species are able to survive in a wide range of environmental conditions and their physiological tolerances will facilitate range expansion. Currently, we completed warm trials for *M. charruana*, where large *M. charruana* can survive well in salinity at or greater than 5 ppt with temperatures less than 33° C, whereas small *M. charruana* had a narrower warm temperature range (20 – 30 °C) and wider salinity range (5 – 40 ppt). As for *P. viridis*, the survival of large *P. viridis* was highest in salinities that is greater than 5 ppt with temperatures at 20 °C or greater. These mussels did not survive at 9 °C or below at any salinity. We are continuing testing interactions and the results can aid in predicting the potential range of expansion for both mussels.

UG, poster

Is the range limit of a northern blue mussel determined by physiological tolerance, or a barrier to larval dispersal?

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Barriers to larval dispersal and physiological tolerance are often posed as alternative explanations for the range boundaries of coastal marine invertebrate species. However, water flow discontinuities are generally associated with large changes in salinity, temperature, and other chemical and physical properties. Consequently, the association of a species with a particular water mass is often equally consistent with both explanations. The southern range limit of a northern blue mussel, *Mytilus trossulus*, is strongly associated with the cold waters of the Eastern Maine Coastal Current (EMCC), just south of the Canadian border. We present preliminary satellite drifter data that suggest that the boundary between the EMCC and nearshore waters represents a barrier to larval dispersal on a spatial scale of a few tens of kilometers. In addition, transplant experiments indicate that juvenile physiological tolerance (presumably thermal) may set the southern range limit on slightly larger spatial scale, suggesting that both dispersal barriers and physiological tolerance play a role. Future work will test the physiological tolerance of earlier life history stages and map larval abundance onto physical data from hydrographic surveys.

Fac, Oral

Temporal patterns in macrofaunal diversity relative to benthic landscape structure

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Temporal patterns in macrofaunal diversity across several benthic landscapes (~ 50 km² each) in Long Island Sound (LIS) were investigated by examining seasonal changes in alpha and beta diversity partitioned over several spatial scales (within patches, among patches, across landscapes and across regions). Benthic landscape structure was determined based side scan sonar mapping. 144 taxa were identified from 864 samples collected over two years (1995, 1996) in central and western LIS, although a variable percentage of this total was present in any particular set of seasonal samples. All diversity components exhibited temporal fluctuations. In general, alpha and beta components at the patch and region level had the highest overall contributions to total richness. Smaller percentages of total richness were explained by beta diversity at the within-patch and landscape level. However, within-patch and landscape-scale beta diversity did make higher contributions in periods when there were varying levels of hypoxia in deeper water portions of the benthic landscapes in LIS. These temporal changes in the patterns of diversity across spatial scales may also be related to seasonal changes in species life histories and the longer-term interactions with disturbances such as hypoxia in maintaining macrofaunal diversity over different spatial scales.

Fac, Oral

Asymmetric Dispersal and the Maintenance of Larval Dimorphism in the Benthic Polychaete *Streblospio benedicti*.

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Offspring dimorphism is an unusual life history occurrence. The rarity of this strategy suggests that there are few circumstances where two offspring modes can be maintained, or that this strategy is unstable and indicates an evolutionary transition. *Streblospio benedicti* exhibits a larval dimorphism where individuals in the same population produce either small (~70µm) or large (~150µm) planktonic offspring. Small offspring have a planktonic phase that lasts 2-3 weeks. Large offspring are competent to settle in 1-8 days. This difference in development time could lead to large differences in dispersal, and suggests a trade-off between retention within a site and migration to a new site. To determine whether the difference in migration and retention is sufficient to maintain the two modes within a population, we use an analytical model to address this question. When dispersal between sites is asymmetric, the model predicts stable maintenance of both types. In order for an equilibrium to exist, small larvae migrating downstream must have higher survival than those migrating upstream, and the fecundity through retained larvae must be relative low for small larvae compared to large larvae. We conclude that larval dimorphism in *S. benedicti* could be explained by asymmetric migration among suitable habitats.

Grad, Oral

Variation in diatom community structure on antifouling and fouling release coatings from three static immersion test sites in Florida.

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Diatoms are primary colonizers of antifouling and fouling release ship hull coatings and cause increases in drag, fuel consumption, and exhaust gas emissions. There are few studies which report on diatom community development on modern ship hull coatings. This study looked at diatom communities on eight commercial ship hull coatings: three ablative copper surfaces, two copper free biocidal systems, three fouling release coatings, and one polyvinylchloride control surface. Coatings were exposed at 0.5 meter depth at three static immersion test facilities along the east coast of Florida (Daytona, Sebastian, and Miami) over a period of two months. The data were analyzed to compare differences in diatom communities among the coatings and among the sites. Over twenty five genera of diatoms have been identified, including some of the more commonly known foulers: *Achnanthes*, *Amphora*, *Cocconeis*, *Entomoneis*, *Licmophora*, *Melosira*, *Navicula*, *Nitzschia*, and *Synedra*. The eight commercially available coatings tested in this study showed significant differences in diatom fouling after 60 days of exposure.

Differences were seen in community structure with diversity changing among test sites and coating types. These results demonstrate difference in antifouling and fouling release performance and highlight the need to test coatings at geographically different static immersion test sites.

Are invasive species more temperature tolerant than natives? An evaluation of current hypotheses
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Invasive species may be more successful than natives in the warmer conditions predicted by climate change models. Correlative studies (e.g. with plants) have shown that invasiveness is related to latitudinal range width and presumably, broader temperature tolerance. In this study, we addressed the hypotheses that (a) geographic range size is related to temperature tolerance, (b) invasive species have higher temperature tolerances than natives, and (c) heat-shock protein expression is a subcellular mechanism that underlies differences in temperature tolerance. Our study species were 4 native and 6 invasive species in the subtidal epibenthic ‘fouling community’ of Bodega Bay, California. We conducted a lethal temperature (LT₅₀) experiment in which individuals were exposed to six treatment temperatures between 12°C and 32°C, and survival was determined after a 24 h exposure. We found a positive relationship between habitat temperature range – based on geographic distribution – and LT₅₀. Our results also showed that invasive species had a significantly higher LT₅₀ compared to natives. Finally, our heat-shock protein (Hsp70) analyses indicated that Hsp70 expression was higher in the more thermotolerant, invasive *Diplosoma* compared with the less thermotolerant, native *Distaplia*. We provide some of the first empirical evidence supporting the hypothesis that invasive species are more thermotolerant than natives.
Grad, Oral

Recent *Diadema antillarum* densities and macroalgal composition at Discovery Bay, Jamaica

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The relationship between macroalgae and the herbivorous urchin *Diadema antillarum* is well-documented. Currently *D. antillarum* grazing is confined to a narrow, shallow depth band on the western forereef at Discovery Bay, Jamaica. In May of 2007 and 2008, urchin densities, macroalgal cover and composition were surveyed. The “*Diadema*-zone,” a region of high urchin density, was found in this study to be between the depths of 3 - 5 m. Composition of macroalgae was different inside compared to outside the *Diadema*-zone, varying taxonomically and by per cent cover. Phaeophytes were 13 % more common where urchins were not present, while Chlorophytes and Rhodophytes appeared more often (5.7 % and 4.1 %) at higher urchin densities. Average macroalgal cover by *Dictyota* was 8.6 % inside the urchin zone and 30.9 % outside, where it was the dominant algae. *Dictyota* coverage in the urchin zone increased by nearly 8 % in 2008, triple that of 2007. *Sargassum spp.* made up 50 % of all algae inside the urchin zone and was the dominant algae. Recent trends suggest that increasing *Diadema* populations will continue to alter macroalgal community structure on the reef.

UG, Poster

LIST OF ATTENDEES -- BEM2010 -- 10-13 MARCH -- UNC WILMINGTON

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