Abstracts

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Listed in alphabetical order by first author of each abstract

Investigating the role of zinc in retinal glutamate toxicity

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Glutamate is a major neurotransmitter in the vertebrate retina, where it is continuously released by photoreceptors in the dark. It is possible that excessive and unregulated glutamate release could lead to glutamate excitotoxicity. Previous studies have indicated that zinc may protect the retina from such damage by acting as a neuromodulator. Evidence suggests that ionic zinc is co-released with glutamate at the photoreceptor terminals, where it feeds back to reduce calcium entry, thereby decreasing the release of glutamate and zinc. To test this hypothesis, different zinc chelators (1,10- Phenanthroline, Histidine, EDTA, and TPEN), were injected into one eye of the Skate (*Raja erinacea*) and the other eye was left as a control and injected with the vehicle. Retinal tissue was fixed, embedded in EPON, and 1 µm sections were obtained using a Reichert-Jung Ultracut microtome. Histological comparison between control and experimental tissues is currently underway.

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Changeable Camouflage: How cuttlefish choose the right pattern

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Cuttlefish can change their color, intensity, pattern, and texture to camouflage in any natural environment. This study sought to determine an "activation function" for the 11 skin components that make up disruptive body patterns, and whether their activation could be predicted based on different proportions of grayscale disks in the visual background. The Common Cuttlefish, Sepia officinalis, was used in a psychophysical behavioral assay based on human vision to determine this "activation function" (Chubb et al. 1994). Four complementary pairs of visual patterns were designed with proportions of five grayscale disks varying in mean intensity, contrast, skewness, and kurtosis. Each pair of patterns was tested against white, 50% gray, and black backgrounds. The pairs potentially provide the ability to determine the sensitivity of the cuttlefish to each of the five grayscale disks. In total, 10 animals were each tested with 32 different visual environments. Preliminary analyses indicate that cuttlefish showed a disruptive body pattern in environments with disks that had white and black backgrounds more often than environments with disks on gray backgrounds. Cuttlefish were not strongly sensitive to the proportion of disk intensities on a gray or black background. Cuttlefish showed a disruptive body pattern on white backgrounds with disk patterns that were either low mean intensity, high-contrast, or all-black. These three disk patterns have in common a large proportion of black disks, thus suggesting that cuttlefish are more sensitive to black objects rather than white or gray objects when the objects are placed against a light background. Initial analyses of this extensive new data set suggest that predicting which background features will elicit activation of specific body pattern components may be complex and probably involve additional experimentation.

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Vegetation indices as proxies for above ground biomass in salt marsh ecosystems

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Remote sensing or ground based reflectance can be used to establish vegetation indices which can be compared to direct measurements of above ground biomass. NDVI and EVI are two indices that have been used as a proxy for above ground biomass in other systems. We tested whether these indices could be used to estimate biomass in salt marsh ecosystems. Taking place from July 15th to August 3rd, the major goal was to establish a relationship between ground base reflectance and biomass of the two dominant salt marsh plant species. What makes these two species unique is they both have different growth forms. *S. alterniflora* can grow at different heights while *S. patens* grow in a "cowlick" like pattern. To define these correlations a Unispec-DC (hand held sensor) was used. Spectra was obtained in 27 plots and of those, 15 were measured for above ground biomass. These plots were located in Plum Island Estuary, Little Sippewissett Marsh, and Great Sippewissett Marsh in Massachusetts. After calculating indices from the spectra produced by the Unispec-DC and comparing them to the biomass samples we concluded that NDVI has a stronger relationship to these species than does EVI. R^2 value calculated in the linear regressions for NDVI and biomass in *S. patens (n=8)* were 0.4342 and were greater than the R^2 values for EVI. The R^2 value for NDVI and biomass for tall form *S. alterniflora* was 0.3972 (n=7) and there was no correlation between EVI and biomass. These relationships seem to be different for short form *S. alterniflora*, but we could not analyze them due to a small sample size (n=2). Our research indicates that the NDVI is more useful when comparing biomass for these salt marshes.

Production and Shoot Loss Estimates of Creek Bank Spartina alterniflora in an Experimentally Eutrophied Salt Marsh

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As a result of anthropogenic activity, nutrient inputs to coastal ecosystems are dramatically increasing worldwide. These increased inputs may have significant effects on the growth and production of salt marsh plants. Seven years worth of end- of-season measurements have shown that shoots of creek bank *Spartina alterniflora* in tidal creeks experimentally manipulated with nitrogen fertilizer are consistently taller and heavier than those in reference creeks, but have consistently lower stem densities. These end-of-season measurements give an underestimate of *S. alterniflora* productivity, as shoots are lost during the growing season. Stem densities and heights of creek bank *S. alterniflora* were measured in mid-June and mid-July 2001 at both fertilized and reference creeks. The fertilized creek lost 23.9 stems 0.25 m^{-2} between June and July (June $\bar{x}$ = 94.6 stems 0.25 m^{-2}, July $\bar{x}$ = 70.7 stems 0.25 m^{-2}), while the reference creek lost 25.0 stems 0.25 m^{-2} during the same time period (June $\bar{x}$ = 112.04 stems 0.25 m^{-2}, July $\bar{x}$ = 87.08 stems 0.25 m^{-2}). Average stem height increased by 26.98 cm in the fertilized creek between June and July (June $\bar{x}$ = 88.5 cm, July $\bar{x}$ = 115.5 cm); while in the reference creek it increased by 39.7 cm (June $\bar{x}$ = 70.3 cm, July $\bar{x}$ = 110.1 cm). A stem height-stem weight regression was used to estimate the quantity of biomass exported to the system over this interval. Measures in August and September will allow estimate of growing season export and an improved measure of tall *S. alterniflora* seasonal above ground production.

Effects of the Anti-Apoptotic Protein BCL-xL on Acute Synaptic Plasticity

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BCL-xL is a known anti-apoptotic mitochondrial protein of the BCL-2 family that plays a role in cell survival. It has been shown to promote synaptic development in addition to its function in cell death prevention. Also it is know, that overexpression of Bcl-xL in neurons enhances synaptic size and activity and improves mitochondrial targeting to the synapse, but whether Bcl-xL can induce synaptic plasticity acutely has not been previously studied. Through the technique of patch clamp, whole cell recording of the CA1 neurons of the hippocampus of fresh coronal rat brain slices will be conducted to observe synaptic currents produced before and after high frequency stimulation of Schaffer collateral inputs to the CA1 neurons. Responses of neurons transduced with lentiviral constructs of scrambled shRNA and those transduced with lentiviral constructs of Bcl-xL shRNA will be compared. Through this electrophysiological assay we will be able to determine if endogenous Bcl-xL is required for long term potentiation of synaptic responses. These studies will provide information for further research regarding the mechanism underlying the potentiation of synaptic currents after high frequency synaptic activity. This electrophysiological paradigm is thought to be a model for the actual electrophysiological events that occur during memory formation. A plausible hypothesis is that BCL-xL may be necessary for certain key metabolic changes that foster synaptic plasticity. The expansion of data regarding the electrophysiological effects of BCL-xL in acute synaptic plasticity will provide more data for future studies of this specific protein.

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The Role of α-Synuclein and Fast Axonal Transport in Parkinson's Disease

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Parkinson's Disease (PD) is characterized by alterations in synaptic function, resulting in reduced levels of critical presynaptic proteins and ultimately causing progressive degeneration of axons. Abnormalities in the functionality of major motor proteins responsible for fast axonal transport (FAT) have been associated with pathologies featuring dying-back degeneration of neurons. This suggests that alterations in FAT might represent an important pathogenic event in PD. Previous microscopic experiments have shown that familial PD-related forms of α-synuclein markedly increase retrograde and significantly decrease anterograde FAT, suggesting that mutant α-synuclein may be a critical protein in the misregulation of molecular motor proteins in PD. Furthermore, pharmacological experiments demonstrated that the pathogenesis of mutant α-synuclein on FAT requires the activation of a kinase pathway involving non-receptor tyrosine kinases (NRTK) and the Protein Kinase C (PKC) isoform, PCKμ. Supporting these findings, biochemical experiments in the squid giant axon presented here suggest that mutant α-synuclein increases tyrosine phosphorylation of several axonal proteins. Specifically, we focused on the tyrosine 463 residue of the regulatory domain of PKCμ, the preferential sequence of the NRKT Fyn. However, data analysis determined that phosphorylation of tyrosine 463 does not translate into PKCμ activity and that another NRKT is responsible for the increased activity of PKCμ in PD.

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Morphological and Histological Examination of Toadfish Papillae and Light Organ

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The plainfin midshipman fish (*Porichthys notatus*) is a species of Pacific toadfish characterized by the presence of over eight hundred ventral photophores that they employ for counterillumination. These fish also possess a transparent “window” of tissue directly below each eye. The function of this suborbital window is unclear, but its location is similar to subocular photophores and bacterial luminescent organs observed in other fish. These organs are predominantly used for intraspecific signaling and prey illumination. Morphological examination of the midshipman subocular window using light and electron microscopy failed to reveal reflectors, lenses, or shutters common to other suborbital organs. However, we identified a series of upward-facing photophores located on the ventral margin of the window. The orientation of these photophores and their proximity to the eye suggest their function may be related to equilibrating the intensity of light emitted from the midshipman photophores with the intensity of downwelling light, a process necessary for effective counterillumination. Additionally, a large branch of the anterior lateral line nerve was found in the organ, suggesting possible innervations of the organ. Neuroanatomical tracing studies were employed to examine the central projections of the observed nerve fibers.

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Immune processing of Gram-negative bacteria in the Limulus polyphemus blood clot

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The blood clot serves as an early line of defense against invading pathogens that may gain entry across the integuments of metazoans. The American horseshoe crab, a model for the investigation of the role of the blood clot in immunity, has the best-characterized blood clotting system of any invertebrate. These animals inhabit a septic environment and reach reproductive maturity only after 12 years of age. This condition of longevity requires a particularly efficient immune system.

To investigate the interaction of bacteria with the horseshoe crab blood clot, a monolayer of blood cells was collected on the surface of microscope coverslips then challenged with a suspension of washed *Vibrio fisheri*, a marine Gram-negative bacterium. The blood cells then secreted the elements of the extracellular blood clotting system and established a clot above the layer of attached cells. Bacteria became entrapped in this clot and could be studied by microscopic examination.

The first function of the horseshoe blood clot is entrapment of bacteria in the mesh-work of the clot and adhesive capture of bacteria at the surface of the clot. Entrapped bacteria lose the ability of flagellum-directed swimming motion and are held so securely as to lack even Brownian motion. It is suggested that adhesion and entrapment serve to limit penetration to the wound surfaces and to prevent systemic dissemination of bacteria into the internal milieu. Currently under investigation is the ultimate fate of bacteria entrapped within the clot. Clot-entrapped bacteria undergo reductive division, whereby cells divide without cell growth during interphase and, in some instances undergo cytolysis.

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Quantitative Analysis of Flexible Margins in Animal Propulsors

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Propulsion through fluids at high Reynolds Numbers is dependent on the transfer of kinetic energy via vortices. Organisms existing in fluid environments have evolved unique morphologies and structures to optimize vortex creation. Biologically-inspired engineering seeks to take advantage of these aerodynamically efficient structures. Though studies have observed certain kinematic qualities of biological propulsion through fluids, interspecies trends of propulsor characteristics have been largely overlooked. In this study, we observe the different mechanistic properties of propulsor margins, specifically those that relate to flexion. We extracted data from multiple species across divergent lineages in order to quantify the extent that a propulsor exhibits flexible tendencies at or near its tip. We specifically measured the organism's angle of flexion, determined by the angle of its extended propulsor and the orientation of its flexed tip, and the inflection ratio, which is the percentage of the propulsor that is not flexed at the tip. Our results indicate an aggregate grouping of the values within a strict range for both the flexion angle and the inflection ratio, with low standard deviation within the sample. We also observed certain clusters of similar values within the sample relating to morphological qualities of the species, suggesting slightly different patterns of flexion exhibited by different propulsor materials. More studies must be done to evaluate additional characteristics of flexion before a generalization can be made about optimal propulsors. However, this data suggests that the flexing of wings or fins may be an aspect of biological propulsion partly guided by convergent evolution, resulting in similar propulsor guidelines for organisms inhabiting two different fluid environments.

The Effects of Arsenic as an Endocrine Disruptor: Sodium Arsenite Alters Activation of Nuclear Receptors Involved in Lipid Metabolism

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Arsenic is currently listed as the number-one chemical contaminant of concern in the United States by the EPA, and considered to be the chemical that poses the greatest threat to human health worldwide by the WHO. Chronic exposure to arsenic – a naturally occurring element that is ubiquitous throughout the earth's crust – has been associated with an increase in the risk of human lung, skin, and bladder cancer, as well as type 2 diabetes, vascular and cardiovascular disease. Previous research has shown that arsenic is a strong endocrine disruptor, even at very low concentrations. Specifically, arsenic affects nuclear hormone receptor-dependent gene regulation by altering receptor function. It has been proven to cause significant disruption of transcription in several classes of the nuclear hormone receptor (NR) superfamily. In this study we were interested in examining how arsenic affects peroxisome proliferator-activated receptors (PPARs) of the Retinoid X Receptor (RXR) Heterodimer class. PPARs exist in three isoforms (PPARα, PPARβ, and PPARγ), all of which play important roles in regulating lipid metabolism. We analyzed the effects of varying concentrations of sodium arsenite on PPARα and PPARγ isoforms. We tested the ligand binding domains (PPARα-LBD and PPARγ-LBD) as well as full-lenth PPARα and PPARγ in two different cultured human cell lines (HeLa and HepG2). Our data indicate that at intermediate doses arsenic inhibits agonist-induced PPAR-LBD activity, and suggests a pattern of enhancement in full-length PPARα similar to what was previously observed in other nuclear receptors. By studying the effects of sodium arsenite on PPARs, we should gain a better understanding of the mechanism through which arsenic affects nuclear receptors governing lipid metabolism, and its role in contributing to type 2 diabetes and cardiovascular disease.

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The effects of eutrophication on the abundance and distribution of tidal salt marsh nekton

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Coastal eutropication has been implicated as the cause of large scale loss of salt marsh habitats across the eastern seaboard. We examined the response of nekton to the eutropication of a coastal salt marsh, as part of a long-term ecosystem wide experiment in which a salt marsh tidal creek is being artificially nutrient enriched. We installed flume nets at both nutrient enriched and reference creeks that contained multiple habitats typically found along salt marsh tidal creeks. We measured and determined the relative composition of the habitat types within each net. During night time high tides in June and July we set the nets to capture species that had moved into the creek edge habitats during the high tide. We found greater species richness at the reference creek (9 species reference, 5 species enriched), fertilized creeks exhibited lower species abundance, and reference creeks exhibited higher per net diversity than nutrient enriched creeks. We conclude that these results are likely caused by the differences in distribution and quality of habitats between the reference and nutrient enriched creeks.

Leaf trait analysis and spectroscopy of white oak forests throughout the growing season

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The process of photosynthesis plays a vital role in forest ecosystems and the global carbon cycle. Certain leaf traits, such as pigment content and total carbon and nitrogen concentration are known to be indicators of photosynthetic capacity. Our overall objective is to use spectroscopy to measure leaf traits and better understand leaf function in a nondestructive way. This summer, we focused on chlorophyll measurements that will later be used to quantify a relationship with the spectroscopic measurements. Due to the fluctuation of leaf traits throughout plants' growing seasons, we hypothesize that these changes are driven by seasonal patterns of the climate and will be reflected by the spectroscopy readings. To test this hypothesis we collected leaves from upper and lower canopies of three trees from a site of *Quercus alba* in Martha's Vineyard, Massachusetts. Leaves were taken for leaf spectroscopy readings and 6mm diameter leaf discs were collected for chlorophyll spectrophotometer readings. Other leaves from the same branch were collected for carbon and nitrogen analyses. We developed a protocol to refine the chlorophyll extraction procedure and have been able to analyze the results of the chlorophyll readings. We observed seasonal variation of the chlorophyll levels overall showing an increase of chlorophyll a and the chlorophyll a/b ratio in the early summer, leading to a plateau of chlorophyll levels in mid and late summer. We found that the chlorophyll a/b ratio and the chlorophyll a concentration by leaf area were higher in the upper canopy than in the lower canopy, most likely due to less light exposure in the lower canopy. This research will be continued by comparing these chlorophyll readings with the corresponding spectroscopy measurements and by collecting further data in the fall and spring seasons.

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Addressing changes in intracellular signaling pathways of Parkinson's disease

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Early defects in synaptic function and axonal degeneration represent major pathogenic hallmarks of Parkinson's disease (PD). Previous research has shown that some degeneration of synaptic function may not be immediately caused by the death of neurons, but by the gradual loss of bidirectional movement of membrane bound organelles (MBO) within a neuron. While the vast majority of PD cases are sporadic, inheritable forms of PD (fPD) have been found in association with mutations in alpha synuclein. Pathological observations in mice expressing fPD-related forms of synuclein showed a marked reduction in the amount of critical presynaptic proteins in neurons affected. Consistent with this observation, microscopic experiments in isolated squid axoplasm by our group indicate that mutant a-synuclein promotes increases in retrograde fast axonal transport (rFAT) and a decrease in anterograde fast axonal transport (aFAT). Furthermore, this effect of a-synuclein involves activation of a kinase pathway that includes non-receptor tyrosine kinases (NRTKs) and the protein kinase C (PKC) isoform, PKCμ. NRTKs have been shown to phosphorylate the tyrosine 463 residue on the regulatory domain of PKCμ. Based on this finding, we hypothesized that alpha-synuclein indirectly activates PKCμ through a mechanism involving tyrosine phosphorylation by NRTKs. Biochemical experiments suggest that tyrosine 463 phosphorylation by the NRTK Fyn does not affect PKCμ activity. Our results suggest that a NRTK that activates a residue other than Y463 PKCμ may relay the signal from mutant alpha synuclein to PKCμ, although the identity of such NRTK is still unknown.

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Screening for Metabolic Differences in Drug Resistant Ovarian Cancer

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Identifying mechanisms of drug resistance is of great importance to cancer research. Of equal or greater importance is the ability to screen for drug resistance from patient biopsies in a rapid manner. This study focuses on both of these topics by exploring differences in metabolic intermediates between an ovarian cancer cell line that is resistant to cisplatin and its parental cell line. The hypothesis is that drug resistance imposes an increased metabolic demand on resistant cells. Of particular interest is lactate production to determine if anaerobic respiration may elicit distinguishable characteristics about cisplatin resistance. Experiments are performed on spheroids to mimic the *in vivo* structure of tumors allowing for the exploration of how cells may work together to develop resistance and combat chemotherapeutic agents. These studies are supported by viability assays using fluorescent markers to correlate modifications in metabolic intermediates with the percentage of live cells. Acquisition of knowledge concerning the role of cellular metabolism in resistance will provide alternative methods for identifying, and targeting drug resistance enabling appropriate chemotherapeutic treatment to ensue.

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Micromere cell membranes in *Lytechinus pictus* embryos have distinct properties

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Developing embryos undergo numerous cell divisions following distinct differentiation pathways before maturing into complex organisms. In sea urchins beginning as early as the fourth division, specialization occurs in the vegetal cells as an unequal division gives birth to macromeres and micromeres. These micromeres lose adhesion, migrate inside of the blastula, and give rise to the larval skeleton and germ cells. They have been found to vary from other cells of the embryo in more than just size and transcriptome though. Others have noted that these micromeres generally lack microvilli. Since microvillar membranes found on the apical surfaces of epithelial cells contain lipid rafts rich in gangliosides and cholesterol, we questioned whether membranes of micromeres lack such lipids. Using spinning disc confocal microscopy we observed the presence of gangliosides through use of fluorescent cholera toxin B in fixed and in live dissociated blastomeres giving birth to micromeres. In fixed blastomeres, the presence of an even actin rich cortex was observed on all cells by the use of fluorescent phalloidin. In contrast to the even distribution of actin, the cell membranes in micromeres were found to lack cholesterol rich lipid rafts observed on all other cells of the embryo likely due to the loss of apical membrane components caused by the unique division that leads to these cells. The process of cell division, where new membrane is delivered via exocytosis, may result in micromeres lacking “apical” cell surfaces found in the cells of the blastula.

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Investigating the Role of *let-7* in Rotifer Aging

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The recent discovery of microRNAs (miRNAs) in *Caernohabditis elegans* has ignited researchers to study its role in gene regulation. These small (~22 nucleotides), non-coding RNAs have been implicated in post-transcriptional regulation of protein-coding mRNAs. Together with *lin-4*, *let-7* was initially discovered in 1993. Since the year 2000, homologues of this miRNA have been identified in most animals. This miRNA is reported to regulate the expression of aging-related mRNA *daf-12* in *C. elegans*. Our intent is to correlate the expression of *let-7* to the aging process of the monogonont *Brachionous manjavacas*. This brackish-water rotifer is characteristic for having both sexual and asexual reproduction. Females that produce eggs by mitosis are considered to be amictic, and their eggs produce other amictic females. However, overcrowding signals amictic females to hatch mictic females, whose eggs carry haploid males. This species' growing genomic and transcriptomic information allows researchers to use it as a model system. In addition, its three-week lifespan and manageable size (~ 1mm, 1000 nuclei) make it an excellent model for aging research. RNA will be extracted at the four stages of the amictic female's life (egg, neonate, reproductive and post-reproductive); which will be reverse transcribed into cDNA. Amplifying with qPCR, the levels of expression will be quantified. A synthetic *let-7* RNA oligo will be used as a control to establish its presence in these animals. Preliminary results have demonstrated that we can obtain sufficient amplification of *let-7* cDNA from as few as ten animals.

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The Effect of Eutrophication on Intertidal Benthic Microalgae

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The extent that nutrient limitation affects benthic micro-algae (BMA) is a contentious issue due to high pore-water nitrogen concentrations and low light availability in the sediment. In this study we examined the effect of chronic low-level nutrient loading on intertidal BMA standing stock (chl-a) and gross primary production (GPP). A marsh fertilization experiment was conducted, which mimicked the conditions of coastal eutrophication. BMA standing stock measurements were made in 4 salt marshes, two of which were enriched to approximately 15 x background nutrient concentrations during the growing season. In addition, sediment cores were collected from 2 low marsh habitats (Tall *Spartina alternaflora* and Mudflat) within each of the 4 marshes. GPP of the sediment cores was measured in the lab under constant light using the oxygen exchange method. Preliminary analyses detected no apparent changes in standing stock. GPP was stimulated by fertilization in the mudflat habitats but not the Tall *Spartina alternaflora* habitats. The observed increase in production in the mudflat habitats without a corresponding increase in standing stock might be attributable to increased grazing rates in the fertilized marshes. Also, the lack of an apparent increase in production in Tall *Spartina alternaflora* indicates light is more limiting to BMA than nutrients in this habitat, a finding consistent with many smaller-scale plot-level experiments.

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Aminoglycoside-induced hair cell damage in the statocyst of squid (*Loligo pealei*)

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The hair cells of the statocysts of squid are evolutionarily ancient and rival vertebrate vestibular systems in complexity. Comparing hair cell death and possible regeneration between ancient invertebrates and modern vertebrates will therefore lead to a greater understanding of mechanosensation across species. Hair cell death has been induced in many other organisms by aminoglycoside treatment. To test if aminoglycosides damage squid (Loligo pealei) hair cells, we first used fluorescent immunohistochemistry to image untreated squid hair cells. We then injected directly into the statocysts of living, anesthetized squid either neomycin, gentamicin, or a saline solution, at various concentrations. After 5 hours of treatment we sacrificed the squid and imaged the hair cells. Anti-acetylated tubulin staining showed no morphological differences between the hair cells of saline-injected and non-injected statocysts, whereas the hair cell bundles in aminoglycoside-injected statocysts were either missing or damaged. Preliminary staining using acridine orange suggests that neomycin treated hair cells are undergoing programmed cell death, and preliminary electrophysiology suggests that aminoglycoside-injected statocysts are functionally impaired.

Environmental influences on guppy behavior

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The function of the Mauthner neurons and their role in the fast start escape response in fish is well studied and understood. The pair of large neurons in the hindbrain receives sensory inputs and triggers a response in the central nervous system to form a hydrodynamic image of the surroundings. However, little is known about the influence environment plays in modifying a neural circuit, thereby altering behavior. The Trinidadian guppy has been shown to adapt very quickly to changes in environmental pressures, such as predation. In this study, we used lab-reared descendants of wild-caught fish from sites with high and low predation pressure to compare fast start responses. We used an audio stimulus of 200 Hz and varying amplitudes to determine the response probability differences in the two populations. Preliminary analysis has shown a greater response to the louder stimuli in both populations, but no significant differences between the populations. We plan on constructing an ethogram to determine if there are more subtle qualitative differences that influence the guppies' behaviors.

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Nutrient effects on *Spartina patens* litter decomposition in a salt marsh ecosystem

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Decomposition of organic matter is a crucial process in salt marshes, with important implications for the rates of marsh accretion and carbon sequestration. Nitrogen addition may increase the rate of decomposition by supplying limiting nutrients that microbes require to break down carbon-rich plant litter. This study examines the effect of nitrate addition on decomposition dynamics in the *Spartina patens*-dominated high marsh zone of a salt marsh in the Plum Island Estuary, Massachusetts. Two marshes were fertilized yearly by adding nitrate to incoming tidal water at 15 times ambient concentrations throughout the growing season. Enrichments began in 2004, with two unfertilized creeks serving as control (reference) marshes. Decomposition dynamics were evaluated in four ways. 1) Above- and belowground litter bags were used to assess decomposition rates at fertilized and reference marshes. Decomposition of litter was evaluated based on change in mass, microbial respiration, changes in particle size, and changes in nitrogen content throughout field incubations ranging from 6 weeks to 15 months. 2) Sediment respiration measurements were conducted in the high marsh. 3) Standing stocks of live and dead plant material in the high marsh zone were measured at the beginning and end of the 2010 and 2011 growing seasons. 4) Nitrogen mineralization was measured using an *in situ* sediment core incubation. Preliminary results indicate a positive effect of nutrient addition on rates of sediment respiration, but no effect on respiration in aboveground litter bags that had been incubated for 6 weeks. A model is currently being developed to integrate the results of this study, with implications for the effect of nutrients on the ability of marshes to sequester carbon.

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Diversity of Leaf Waxes in Leaf Litter from the Nouragues Research Station, French Guiana

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Leaf waxes cover the plant's cuticle and serve to protect the plant from water loss, insects and harsh environmental conditions. Waxes can be preserved in sediment for thousands of years, making them important to study for paleo-climate reconstruction. Despite this importance, no data exists on wax molecular and isotopic composition from the northern Amazon rainforest. We characterized wax concentration and composition in forest floor leaf litter in the undisturbed primary rain forest at the Nouragues field station in French Guiana. Samples were collected along an altitudinal transect (340m increase in elevation over 2km) ranging from a forested wetland, uphill through typical rainforest communities and ending at the summit of a granitic inselberg that is covered with an unusual xeric (dry) plant community. Total wax concentration in the tropical leaf litter (2147 ± 413 μg/g carbon) showed no trend with elevation. However, the relative concentrations of the major wax classes and their within class molecular distribution varied significantly along the transect and reflected differences in the surrounding species composition. In particular, the wax composition of the inselberg vegetation was distinctly different from the typical forest samples. The composited wax composition for the forest leaf litter exhibited a dominance of C_{31} *n*-alkane, C_{28} – C_{34} *n*-alkanol and a secondary C_{max} of *n*-acid at C_{30} and C_{32}, consistent with other data from the vegetation of warm climates. Our study shows that waxes highlight differences in plant communities in the forest but do not show any marked altitudinal trends. This data provides a useful modern analog for examining changes in wax biomarkers within lake sediment cores for paleo-climate reconstruction.

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The Role of Nitrite as a Control on N Cycling Pathways in Marine Sediments; A Switch Between Heterotrophic Denitrification and Anammox

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Marine sediments host complex chemical interactions that can have far reaching effects in the environment on a local and global scale. Generally these sediments act as a sink for bioavailable nitrogen and produce N2 in low oxygen conditions. Traditionally, it is thought that the majority of nitrate removal in these systems is caused by heterotrophic denitrifying bacteria converting nitrate and organic carbon to N2 gas. As recently as the 1990's, a new type of denitrification pathway has been described where nitrite and ammonium are converted to N2 gas. This autotrophic Anaerobic Ammonium Oxidation (Anammox) can be a key pathway in sedimentary nitrogen cycling, but little is known about what controls Anammox activity. Stable isotope labeling can track nitrogen through these pathways allowing us to characterize the limitations and interactions between bacteria in the system. To examine if nitrite availability limits Anammox activity, we perfused 15N enriched nitrite and nitrate through thin discs of sediment collected from cores taken in Rhode Island and Block Island Sounds. If Anammox is limited by nitrite availability, an increase of nitrite should result in increased anammox-based N2 production. We measured the ratio of labeled 29N2 produced by Anammox to 30N2 produced by heterotrophic denitrification in order to determine the controls operating on the two pathways. Preliminary results reveal that Anammox is not influenced by excess nitrite and may be limited by other nutrients in our experimental system.

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Squid behavioral reactions to low frequency sound

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While much is known about the reaction of cephalopods to a visual stimulus, little is known about their reaction to sound. The "auditory" system of cephalopods consists of a statocyst, which is analogous to the fish otolith system. The statocyst provides the ability to detect changes in acceleration and orientation using a granule made out of the mineral aragonite, the statolith. This statocyst and associated neurons generate physiological responses to the particle motion component of sound stimuli from 50 to 500 Hz. In this study, we used the squid *Loligo pealeii* to examine behavioral reactions to tonal sounds. It was previously shown that they do not respond to the high frequency clicks of cetacean predators. So far, we found that *L. pealeii* respond to acoustic stimuli of 50 to 200 Hz by jetting or changing color. Next we plan to determine response thresholds, response directionality, and if they react to natural sound stimuli, such as the movements of other squid nearby, the headwake of a predator, or any anthropogenic noise.

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Spontaneous oscillations of extracellular pH and intracellular calcium in goldfish horizontal cells

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Subtle changes in extracellular pH can result in substantial modulation of synaptic transmission and neuronal processing in the central nervous system, including the retina. Alterations in the concentration of free protons can directly act on calcium channels to regulate the influx of calcium, with increased concentrations of extracellular H+ acting to reduce calcium influx and consequently reducing the amount of neurotransmitter released. Such changes in extracellular pH may act normally to shape the response properties of retinal neurons. While changes in extracellular pH levels are known to have significant effects on neuronal properties, little is known about alterations of extracellular pH mediate by horizontal cells, a process which may normally regulate neuronal communication in the outer retina. Using self-referencing pH-selective microelectrodes, we monitored changes in extracellular H+ concentrations adjacent to isolated horizontal cells of goldfish. In a substantial number of these isolated horizontal cells, spontaneous oscillations of extracellular pH were observed. Standard self-referencing protocols involve considerable averaging of accumulated data that might limit the ability to resolve such oscillatory pH changes. Accordingly, we explored altering standard recording conditions to maximize our ability to characterize this proton flux with a higher time resolution. In addition, spontaneous oscillations of intracellular calcium levels were also detected in isolated goldfish horizontal cells using the calcium-sensitive dye Fluo-4 AM, suggesting a potential link between intracellular calcium and extracellular pH oscillations. Current experiments attempt to combine calcium imaging with self-referencing techniques to more carefully examine the relationship between the spontaneous extracellular pH changes and spontaneous oscillations of intracellular calcium. Understanding the mechanisms that regulate proton flux may be important in elucidating the role that alterations of extracellular pH play in modulating neuronal signaling.

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