BOSTON UNIVERSITY

BUMP - BLOCK II

First Biennial Conference of Coastal Biogeochemistry & Marine Urban Ecology

October 26, 2011

8:30 am - 9:15 am: *Breakfast, Load Presentations*

9:15 am - 9:30 am: Introduction by Prof. Fulweiler and Prof. Rotjan

9:30 am - 10:00 am: NITROUS OXIDE (N_2O) AND DINITROGEN (N_2) FLUXES IN HYPOXIC CONDITIONS ALONG A EUTROPHIC GRADIENT IN WAQUOIT BAY, MA
Andrews, S.N., Forest, D.J., Luthringer, J.E., Rogener, M.K., Foster, S.Q.

10:00 am - 10:15 am: URBAN CHARACTERIZATION OF THE MYSTIC, NEPONSET, AND CHARLES RIVERS BY WATER, SOIL, AND FLORA
Bornstein, C., Law, K.

10:15 am - 10:30 am: URBAN POLLUTANTS AND THEIR EFFECTS ON ECOSYSTEM SERVICES PROVIDED BY ALGAE SPP. AND THE COMMON PERIWINKLE, LITTORINA LITTOREA
Danorwayan, K., Olsen, N.

10:30 am - 10:45 am: KEEPING IT CURRENT: COMPARING MODERN TO HISTORICAL WATER QUALITY PARAMETERS ALONG THE CHARLES RIVER
Exner, A., Stephens, C.

10:45 am - 11:00 am: *Coffee Break*

11:00 am - 11:15 am: ANTHROPOGENIC EFFECTS ON PLANKTON SPECIES DIVERSITY ALONG AN URBAN GRADIENT
Grunin, J., Smith, C.

11:15 am - 11:45 am: SILICA CYCLING AND GREENHOUSE GAS EMISSIONS FROM PHRAGMITES AUSTRALIS AND NATIVE MARSH GRASSES IN UNIMPACTED, RESTORED AND RESTRICTED SALT MARSHES
Janaszak, M., King, L., Wylie, B., Emery, H.

11:45 am - 12:00 pm: SALT MARSH HEALTH ALONG AN URBAN GRADIENT IN MASSACHUSETTS
King, E., Lauzon, B.

12:00 pm - 12:30 pm : MIGRATING MICROBES: THE INFLUENCE OF BEGGIATOA SPP. AND MICROPHYTOBENTHOS COMMUNITIES ON TIDAL FLAT SEDIMENT GAS FLUXES
Mclean, E., Stone, E., Valentine, K., Vieillard, A.

12:30 pm - 12:45 pm: THE BLUE MUSSEL *MYTILUS EDULIS* TOLERANCE AND REACTION TO URBAN POLLUTANTS
Papakyrikos, C., Sargent, S., Gossner, H.

12:45 pm - 2:15 pm: *Lunch, Wrap - Up, Award Ceremony*

ABSTRACTS

Andrews, S.N., Boston University Marine Program, Coastal Biogeochemistry, *sandrews@bu.edu*
Forest, D.J., Boston University Marine Program, Coastal Biogeochemistry, *dforest@bu.edu*
Luthringer, J.E., Boston University Marine Program, Coastal Biogeochemistry, *jel2191@bu.edu*
Rogener, M.K., Boston University Marine Program, Coastal Biogeochemistry, *mkrog@bu.edu*
Foster, S.Q., Boston University Marine Program, Coastal Biogeochemistry, *sqfoster@bu.edu*

NITROUS OXIDE (N_2O) AND DINITROGEN (N_2) FLUXES IN HYPOXIC CONDITIONS ALONG A EUTROPHIC GRADIENT IN WAQUOIT BAY, MA

Nutrient loading caused by an increase in human population has influenced dissolved oxygen concentrations and thus nitrogen cycling in coastal marine systems. Incidences of hypoxia and anoxia have the potential to alter the flux of N_2O, a powerful greenhouse gas. In order to quantify changes when progressing from oxic to hypoxic conditions, dark incubations were conducted with benthic sediment cores collected from two sites along a eutrophic gradient in Waquoit Bay Estuary, MA. N_2O was measured using Gas Chromatography (GC) and N_2 using Membrane-Inlet Mass Spectrometry (MIMS). At the less eutrophic site, benthic microbial activity sinks N_2O in all oxygen conditions. At the more eutrophic site, N_2O production occurs in oxic conditions, where nitrification and denitrification are coupled. In hypoxic conditions, the microbial community consumes N_2O, creating a N_2O sink, as it is the only consumable electron acceptor in the denitrification process. Overall, N_2 is produced at both sites, more so at the less eutrophic . Although in eutrophic hypoxic conditions N_2O is consumed, further research is needed to understand how the intensity, frequency and duration of these low oxygen events may affect the flux of N_2O.

Bornstein, C., Boston University Marine Program, Marine Urban Ecology, *carab@bu.edu*
Law, K., Boston University Marine Program, Marine Urban Ecology, *khlaw@bu.edu*

URBAN CHARACTERIZATION OF THE MYSTIC, NEPONSET, AND CHARLES RIVERS BY WATER, SOIL, AND FLORA

Urban rivers provide utility and aesthetic value to residents and visitors. The health of an urban river translates to economic value as well, boosting tourism, recreation, and the real estate market, while reducing human health-related expenses (due to contamination, pollution, toxic algal blooms and the like). To maintain this health, a balancing act of several human and natural factors must be played, i.e. utility without overuse. It is therefore important to set baselines and then continually measure a river to document changes in water quality as well as urban-ness. Urban rivers and flora on the banks are subject to an array of anthropogenic effects, such as increased levels of nutrients from runoff and reduced species abundance and diversity. The Mystic and Charles Rivers are also both locked, which drastically affects their natural flow, tide, and salinity. The Neponset River on the other hand is not locked, so comparing the water quality and flora along these three Boston-area rivers will allow us to see how riverbank ecosystems may be influenced by various urban activities, especially the impact of locks. Samples were taken from the Mystic River Reservation, the Charles River Esplanade, and the Neponset River Reservation, all of which were in close proximity to a major highway. The distances from the

banks to nearby benches, lampposts, walkways, and roads were recorded to characterize anthropogenic structures that may affect the river. Invasive species of flora were found on the riverbanks of the Mystic River. A salinity gradient was observed in the Neponset River, while the Mystic and Charles River were mainly freshwater. Our study provides a glimpse into the river-land interface in various urban environments, which is an important aspect of riverbank health.

Danorwayan, K., Boston University Marine Program, Marine Urban Ecology, *kristian@bu.edu*
Olsen, N., Boston University Marine Program, Marine Urban Ecology, *noelleo@bu.edu*

URBAN POLLUTANTS AND THEIR EFFECTS ON ECOSYSTEM SERVICES PROVIDED BY ALGAE SPP. AND THE COMMON PERIWINKLE, LITTORINA LITTOREA

Ecosystem services are a combination of processes and resources found in natural habitats from which mankind can benefit. Urbanization drastically changes the natural ecosystem largely by removing or altering habitat and disrupting the chemical composition of the environment—affecting the performance of organisms and reactions that perform such ecosystem services. Algae and sea vegetation provide primary production and oxygen to the surrounding marine environment. The common periwinkle, *Littorina littorea*, is an intertidal gastropod mollusk that grazes on algae, supplying checks and balances to vegetation overgrowth. We will investigate how the following pollutants compromise the ecosystem services provided by algae and *L. littorea*: fertilizer, motor oil, copper, ammonia, and caffeine. In a series of three different experiments we will test the effects of the pollutants on the production rate of algae using pulse amplitude modulated fluorimeter (PAM), the effects on grazing rate of contaminated periwinkles on uncontaminated algae, and the effects on grazing rate of contaminated periwinkles on contaminated algae. We hypothesize that these toxins will reduce both photosynthetic production and *L. littorea* grazing rates of algae. Pollution is a byproduct of the technological and modern conveniences that fouls the natural environment. Understanding the effects of pollutants on both the organisms and the ecosystem services they provide will present a more thorough assessment of the health of an ecosystem influenced by human urbanization.

Exner, A., Boston University Marine Program, Marine Urban Ecology, *aexner@bu.edu*
Stephens, C., Boston University Marine Program, Marine Urban Ecology, *csteph@bu.edu*

KEEPING IT CURRENT: COMPARING MODERN TO HISTORICAL WATER QUALITY PARAMETERS ALONG THE CHARLES RIVER

The Charles River of Boston is 80 miles long, runs through 22 towns, and ends at the Boston Harbor leading into the Atlantic Ocean. It passes through a wide range of residential and urban areas and is fed by many brooks and streams along the way. Its banks have been shaped by the land expansion with has occurred throughout the history of Boston to accommodate the city's growing population. To explore how the water quality of the Charles has changed over time, we collected water samples in October 2011 and compared the results to water quality records spanning the last 18 years. We tested the hypothesis that recent attention to environmental issues has led to an improvement in water quality has improved over the years, and that water quality would be correlated with the degree of urban-ness surrounding the river. Ten samples were taken

(via canoe) of surface water at various locations similar to the locations sampled by the Massachusetts Water Resource Authority. The samples were then analyzed for bacterial content, ammonia levels, pH, and phosphates. Previous samples from the MWRA included pH and bacterial content. Results have indicated clear trends in relation to bacterial concentrations, which are highest near parks and areas of possible combined sewer overflows. No traces of salinity or ammonia were found. Results vary by water quality parameter, most likely correlating with distinct urban features along the banks. Accurate baselines are essential for determining current trends and environmental trajectories in urban waters; despite the challenges in using historical datasets, our study highlights the potential strengths of this approach.

Grunin, J., Boston University Marine Program, Marine Urban Ecology, *jgrunin@bu.edu*
Smith, C., Boston University Marine Program, Marine Urban Ecology, *csmith2@bu.edu*

ANTHROPOGENIC EFFECTS ON PLANKTON SPECIES DIVERSITY ALONG AN URBAN GRADIENT

Anthropogenic effects are known to have a large influence on the quality of water. These impacts are often more pronounced near urbanized areas given the increased nutrient loads due to runoff, pollution and sanitation facility outputs. In previous studies, altered water quality was found to impact marine ecosystems in various ways such as species abundance and diversity, fecundity, and potential mortality. Zooplankton and phytoplankton populations may be important bioindicators of water quality, since they can fluctuate rapidly in response to changing water conditions. In this study, we examined the diversity of plankton along an urban gradient to test whether plankton communities were accurate reflections of water quality. We performed plankton tows at different intervals along the Mystic and Charles Rivers, as well as testing the collected water for specific nutrient and heavy metal levels, as well as pH and salinity. Plankton species diversity was attempted to be correlated to the measured water quality of the collection sites. Water chemistry alone may be a decent predictor of urban impact, but concurrent characterization of plankton communities may better predict trophic-level impacts and changes within aquatic ecosystems. As urbanization continues to grow with increasing human populations, understanding the resulting change in both water chemistry and plankton ecology is essential for understanding human effects on aquatic communities.

Janaszak, M., Boston University Marine Program, Coastal Biogeochemistry, *janaszak@bu.edu*
King, L., Boston University Marine Program, Coastal Biogeochemistry, *king.leigha@gmail.com*
Wylie, B., Boston University Marine Program, Coastal Biogeochemistry, *wylieb@bu.edu*
Emery, H., Boston University Marine Program, Coastal Biogeochemistry, *ilex.rosaria@gmail.com*

SILICA CYCLING AND GREENHOUSE GAS EMISSIONS FROM PHRAGMITES AUSTRALIS AND NATIVE MARSH GRASSES IN UNIMPACTED, RESTORED AND RESTRICTED SALT MARSHES

Salt marshes are one of the most biologically productive ecosystems in the world, but in the last 150 years anthropogenic effects including tidal restrictions and species invasion have dramatically altered them. *Phragmites australis,* a cryptic invasive species in the United States,

thrives in salt marshes that are the most anthropogenically impacted, where it replaces native marsh grasses such as *Spartina alterniflora.* Salt marshes that have become restricted due to construction and diking are known to have a lower water table, a drop in water salinity and lower elevation. Once water composition within the marsh changes, variations in biogeochemistry within the marsh follow, potentially causing the marsh to transform from a carbon sink to a carbon source. Other biogeochemical cycles, such as silica cycling, may also be affected by changes in water chemistry. Restricted marshes can be ecologically restored through the installation of a culvert that restores tidal flow, but the effects of this restoration on biogeochemistry are not well studied. This research tests the hypothesis that *P. australis* invasion and tidal restriction and restoration result in higher greenhouse gas emissions (CO_2, CH_4, N_2O) and lower carbon uptake rates in marshes. Greenhouse gas fluxes from *P. australis* and *S. alterniflora* stands were compared in unimpacted, restored, and restricted salt marshes in the Plum Island Sound watershed area of northern Massachusetts. In addition, we addressed the question of silica cycling differences between sites and species.

King, E., Boston University Marine Program, Marine Urban Ecology, *ekking@bu.edu*
Lauzon, B., Boston University Marine Program, Marine Urban Ecology, *rlauzon@bu.edu*

SALT MARSH HEALTH ALONG AN URBAN GRADIENT IN MASSACHUSETTS

Salt marshes are important coastal habitats and provide many ecosystem services including natural water filtration, storm buffers, and nursery habitats. In New England, much of the salt marsh area no longer remains, as it has been filled and developed. To investigate the impact of anthropogenic development on the remaining marshes, we performed vegetation and invertebrate surveys, water quality and sediment analysis, and qualitative observations of the morphology of salt marshes along an urban gradient in Massachusetts. We compared data collected from Plum Island Sound, a “pristine” salt marsh, to data from Belle Isle, an “urban” marsh in the Boston metropolitan area. Specifically, we examined an experimentally fertilized area of Plum Island Sound with artificially enhanced nutrients, an undisturbed area of the same marsh, and Belle Isle. We tested the hypothesis that Belle Isle, as an “urban” marsh, would more closely resemble the fertilized area of Plum Island Sound. Preliminary observations support this theory; Belle Isle marsh exhibits fractures, mud terracing, an increase in aboveground biomass without equivalent root structure, and a high width:depth channel ratio. The results of this study will provide a better understanding of the resilience of salt marshes to human impact, and may inform more effective management of these important habitats.

Mclean, E., Boston University Marine Program, Coastal Biogeochemistry, *emclean@bu.edu*
Stone, E., Boston University Marine Program, Coastal Biogeochemistry, *hbstone@bu.edu*
Valentine, K., Boston University Marine Program, Coastal Biogeochemistry, *kendallv@bu.edu*
Vieillard, A., Boston University Marine Program, Coastal Biogeochemistry, *amariev@bu.edu*

MIGRATING MICROBES: THE INFLUENCE OF BEGGIATOA SPP. AND MICROPHYTOBENTHOS COMMUNITIES ON TIDAL FLAT SEDIMENT GAS FLUXES

Tidal flats are essential to coastal nutrient cycling because they link terrestrial and marine ecosystems; this is largely due to the presence of various benthic microbial communities.

Hydrogen sulfide oxidizing *Beggiatoa spp*. and photosynthetic diatoms (microphytobenthos; MPBs) are two prominent communities that impact tidal flat nutrient cycles. In particular, these communities have the potential to significantly influence the fluxes of oxygen (O_2), nitrous oxide (N_2O), and hydrogen sulfide (H_2S) in tidal sediments. The effects of these microbes on N_2O and H_2S are especially important when tracking global climate change because of their potentially harmful impact on the atmosphere. To investigate these effects, a study was conducted on a tidal flat in the Plum Island Estuary Long Term Ecological Research Site in October 2011. Using a microprofiler, O_2, N_2O, and H_2S gas profiles were measured in cores taken from visible mats of *Beggiatoa spp*. and MPBs as well as from reference cores. As expected, H_2S concentrations were depleted in the upper layer of sediment underneath the *Beggiatoa spp.* mat. Furthermore, concentrations of H_2S were higher in sediment underlying the *Beggiatoa spp*. mat than that of the MPB mat and the reference sediment. The N_2O concentration decreased with depth in the *Beggiatoa spp*. mat, but remained constant in the MPB mat and reference sediment, with lower concentrations under the MPB mat. This study makes it evident that microbial communities and their effects on gas flux cannot be ignored when examining global climate change.

Papakyrikos, C., Boston University Marine Program, Marine Urban Ecology, *cpapakyr@bu.edu*
Sargent, S., Boston University Marine Program, Marine Urban Ecology, *sargents@bu.edu*
Gossner, H., Boston University Marine Program, Marine Urban Ecology, *hgossner@bu.edu*

THE BLUE MUSSEL *MYTILUS EDULIS* TOLERANCE AND REACTION TO URBAN POLLUTANTS

The blue mussel, *Mytilus edulis*, is frequently used as an indicator species to detect degradations in water quality. Although they are known to have a higher tolerance to pollutants than other invertebrates, not much is known about the physiological effects of specific urban pollutants. It is also unknown where the thresholds to cause harm stand for the various pollutants. We looked at mussels from a range of urban to non-urban settings, using four locations as a proxy for the urban gradient. Our four locations, in order from most urban to least, were naturally growing populations from Boston Harbor, MA; Nahant, MA; Beverly, MA; and farm grown mussels for the food industry from Prince Edward Island, Canada. We tested these four populations of mussels against different concentrations of urban pollutants (motor oil, fertilizer, copper sulfate) reflecting pollutant concentrations found in the field. To determine the impact of each stressor, we measured filtration rate and time to mortality as indicators. We tested the hypothesis that lower filtration rate and higher mortality would be observed in higher concentrations of pollutants, and that mussels of urban origin would display more tolerance for urban stressors. Mussels provide an important ecosystem service by filtering water and improving water quality; assessing the impact of urban stressors on their filtration rate and survival is increasingly important as marine environments suffer from a myriad of stressors from the growing populations and urbanization.