Project Backgound and Objectives

Eelgrass beds provide a diverse suite of services which increase the diversity and productivity of coastal ecosystems. Recent losses of this essential fish habitat have been attributed to degradation of water quality coupled with episodes of extreme stress caused by macroalgae blooms. This water quality degradation decreases the light available for seagrasses to complete the photosynthetic processes necessary for growth, survival and reproduction. While current research has documented these light requirements in many coastal regions, the importance of these parameters within the unique Barnegat and Great Bay estuaries is lacking. This information, as well as those abiotic and biotic parameters indicative of eelgrass health, are necessary to more accurately propose restoration strategies. Monitoring of eelgrass bed health via an assortment of these important parameters, coupled with focused physiological studies of photosynthetic performance stress, are necessary to assess the role of water quality on resiliency of these habitats within our region and the potential strategies most appropriate to restore the ecosystem.

The objectives of this study are two-fold:

1) Monitor the health of the seagrass beds (submerged aquatic vegetation and associated marine fauna) throughout the summer bloom period

2) Assess the photosynthetic performance of seagrass and macroalgae throughout the bloom period

Background Work Accomplished

My previous experience in seagrass ecosystem monitoring and experimentation provides the necessary skills and background to successfully execute the project proposed in this application (see included abbreviated CV). Additionally, initial seagrass surveys were completed during Summer 2014 at two sites in Barnegat Bay: Barrel Island and Seaside Heights. During this time, undergraduate students assisted in establishing sampling protocols to measure important abiotic and biotic parameters indicative of seagrass bed health: seagrass bed density, habitat complexity, seagrass above and belowground biomass, epiphytic cover, macroalgae biomass and sediment carbon content (Faculty Plan Scholarship Goal #5: Long-term monitoring of seagrass ecosystems and Teaching Goal #3: Incorporation of undergraduate students into research agenda). The results of these initial surveys provided baseline data and an opportunity from which to more accurately expand the research project to include physiological parameters such as photosynthetic performance as suggested in this application.

Statement of the procedures/methodology

Sampling using the protocols established during the Summer 2014 sampling season will be conducted once per month at Barrel Island and Seaside Heights. This sampling includes the collection of seagrass above and belowground biomass via cores, macroalgae biomass via quadrat, sediment carbon via sediment cores and measurement of abiotic factors (light, temperature, salinity, pH, dissolved oxygen). Seagrass epiphytic coverage will be calculated via a haphazard selection of 15 shoots of eelgrass. Each shoot will be labeled, placed into an

individual sampling bag and placed in a cooler of ice with the biomass and sediment core samples. In the lab, the length and width of each shoot will be measured prior to the removal of all epiphytic biomass. These epiphytes will then be dried and weighed in order to calculate a mass per area of epiphytes at the site. Macroalgae and seagrass above/belowground biomass will be calculated as dry weight per area after samples have dried for no less than 72 hours in the sample oven. Sediment carbon content will be calculated from nine sediment cores that have been subdivided into 2cm depth profiles. Each sample is dried, weighed, combusted in the furnace for 24 hours and then weighed again to determine total organic carbon stored in the sediment. A visual census will be completed to determine percent cover of each benthic cover (seagrass, macroalgae, sponge or mud) and maximum seagrass blade height will be measured in replicate throughout the seagrass bed (n = 5). Areas with suspected eelgrass within Great Bay will be explored, sampled using the same protocol and mapped.

Photosynthetic performance will be measured weekly at the Stockton Long-Term Sampling Station at Barrel Island using a Pulse-Amplitude-Modulation (PAM) Fluorometer and the Saturation Pulse Method (n = 8 sites within the eelgrass bed). This method utilizes *chlorophyll a* fluorescence as a signature of photosynthesis. During these PAM measurements, a modified sampling of the eelgrass bed will be conducted, including the collection of macroalgae biomass (n = 5), visual census (n = 5) and measurement of abiotic parameters.

Timeline: The schedule for data collection is largely dependent on weather and forecasts for safe boating. Weekly collection strategies and progress points are suggested in the timeline below.

Week 1 (1 June): Barrel Island PAM, modified sampling; evaluate northern Great Bay for potential sites
Progress point – samples processed, sites of interest mapped

Week 2 (8 June): Barrel Island PAM, modified sampling; present at Barnegat Bay Festival
Progress point – samples processed, data entered

Week 3 (15 June): Barrel Island PAM, modified sampling; evaluate southern Great Bay for potential sites
Progress point – samples processed, sites of interest mapped

Week 4 (22 June): Barrel Island PAM, Barrel Island and Seaside Heights full sampling
Progress point – samples processed

Week 5 (29 June): Barrel Island PAM, modified sampling; evaluate eastern Great Bay for potential sites
Progress point – samples processed, data entered, site map completed, begin comparative analysis to Summer 2014 data

Week 6 (6 July): Barrel Island PAM, modified sampling
Progress point – samples processed

Week 7 (13 July): Barrel Island PAM, modified sampling
Progress point – samples processed, data entered, continue comparative analysis to Summer 2014 data

Week 8 (20 July): Barrel Island PAM, Barrel Island and Seaside Heights full sampling
Project conclusion: samples processed, data entry and comparative analysis to Summer 2014 data completed

Project Importance

Monitoring of eelgrass bed health coupled with focused physiological studies of photosynthetic performance stress are necessary to assess the role of water quality on resiliency of these habitats in Barnegat and Great Bay. Results from this proposal can advance our understanding on those factors important for habitat restoration and recovery. Additionally, there is a paucity of research within the Great Bay region even though this area can be considered a hot spot of diversity. This research project will provide an unparalleled opportunity for two undergraduate students to participate in a research project that will greatly improve our understanding of the local ecosystems. Undergraduate involvement in this research will not only increase their scientific literacy, it will also make them more competitive Stockton University graduates in job and graduate school applications.

Further Research

Results from this project will provide the background necessary to support subsequent proposals on the feasibility of eelgrass restoration within Barnegat Bay. Data is lacking on the potential success of such strategies and information gleaned from these surveys and physiological studies can largely shape the trajectory of eelgrass habitat restoration not only in this region, but throughout the New Jersey coastline. Using the data on photosynthetic stress, I will be able to more accurately predict locations with adequate light quality that will be conducive to eelgrass restoration, a key consideration in all proposals suggesting a restoration.

Additional funding opportunities will be available from the Barnegat Bay Partnership, National Oceanic and Atmospheric Association's field offices (e.g., Sea Grant) and other potentially unanticipated calls for proposals on restoration of nearshore ecosystems.

Outcome

Data from this study will be disseminated through the Coastal Estuarine Research Federation Biennial meeting, Stockton University's Undergraduate Research Symposium and, depending on results, publication will be pursued in relevant journals (e.g., Coastal and Estuarine Shelf Science, Aquatic Botany). A final report of all findings will be compiled and made available through my research lab website (www.stockton.edu/merl). Events such as the Barnegat Bay Festival in June will also provide an opportunity for students to represent the University and speak about our findings and the importance of these habitats to the community.