Project Title: Intertidal Meiofaunal Density and Diversity on Sapelo Island, Georgia

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Project Rationale and Objectives: This past summer, I taught a new field research course that exposed 13 upper class biology majors to an intensive field research experience at the University of Georgia Marine Institute (UGAMI) on Sapelo Island. Five student - created projects resulted from the course, all of which culminated in successful presentations at a course - concluding research poster symposium. Students working on two of the projects have opted to continue their studies during this academic year. This narrative describes one of these projects, a study designed largely by the participating students, of the meiofaunal density and diversity, as related to depth and tidal exposure, across the sandy beach intertidal zone. The term meiofauna describes heterotrophic (consumer) organisms that range in size from 50 – 1,000 micrometers (for comparison, a human hair is about 75 micrometers across). Meiofauna are a critical part of the beach, ocean and salt marsh food webs; their diversity and abundance appear to be very high and new species are found frequently. Already the students have produced a valuable catalog of meiofaunal diversity on one Sapelo beach; their additional studies will compare this diversity to the diversity of another Sapelo beach with different physical conditions. Furthermore, the ongoing study will consider the richness of both beaches' photosynthetic phytoplankton, which is the essential base of these food webs.

Research Question #1: Is there a difference in diversity and abundance of intertidal meiofauna phyla *between tidal zones or sediment depths on a Sapelo Island beach*?

Research Question #2: Is there a difference in diversity and abundance of intertidal meiofauna phyla *between beaches with different environmental conditions*?

Research Question #3: Is there a correlation between diversity and abundance of sandy beach organisms at the lowest trophic levels (phytoplankton – photosynthetic organisms - and meiofauna – consumers)?

Background: Meiofaunal diversity is an integral part of the marine ecosystem that has not been extensively researched. Since meiofauna are so small (most between 50 micrometers and 1 centimeter), they have greater species diversity per unit area than larger animals. They are also nearly ubiquitous in close proximity to water, occurring on surfaces from moss to the deep trenches of the ocean. Several known factors contribute to the diversity and distribution of meiofauna, including sediment grain size, depth, hypoxia and tidal zone differences (which correlates to difference in water content of the sand and time during which sand is covered with water). Sandy sediments are hospitable substrates for meiofauna to reside, with larger pores than muddy or silt- laden sediment. Therefore, meiofaunal abundance is very high on medium to fine grain sandy beaches, as are found on Sapelo Island. Little is known, however, about the distribution of these organisms within and between beaches; this study provides valuable insight into variances due to environmental conditions and acts as a baseline for future studies.

Beaches are threatened by pollution and are vulnerable to disturbance because of off – shore shipping and oil drilling and the frequent presence of humans. Meiofaunal species composition changes with human disturbance, with resistant species becoming more abundant in disturbed environments. They provide an inexpensive and simple way to assess beach health. Meiofauna reproduce rapidly, with multiple generations per year, thus allowing for detection of pollutant effects on growth rate and longevity, as well as abundance and diversity. The nutrient – poor, highly exposed sandy substrate on beaches creates harsh living conditions that can change quickly with disturbance. Most of the abundant meiofauna on pristine beaches are sensitive to disturbance and will show adverse effects at lower pollutant concentrations than other organisms. Because almost the entire island is under state or federal protection, Sapelo's beaches remain unspoiled. However, beaches on neighboring barrier islands encounter more frequent human

traffic. Understanding meiofaunal composition of pristine southeast Atlantic beaches will provide practical information for research and monitoring beyond Sapelo Island.

Three students began this project during the summer field research course (BIOL 4226) addressing research question #1 above. Their studies showed clear differences in meiofaunal diversity across intertidal zones and at different depths. Meiofaunal richness was greatest in the lowest zone, nearest the waterline, while abundance was greatest in the mid intertidal zone, which undergoes tidal immersion twice per day. These results are in agreement with diversity and abundance data for larger beach burrowing animals. The students also found that meiofauna preferentially lived in the upper 5 centimeters of sediment, which is likely due to a greater abundance of food (bacteria and phytoplankton) at this depth. The students are continuing their studies by comparing results from one Sapelo Island beach to another one that has different tidal currents and sand movement (research question #2). They also plan to examine the abundance of phytoplankton, an important meiofaunal food source, at both depths and in all zones to establish the relationship between food availability and meiofaunal presence (research question #3).

One challenge to studying meiofauna is extracting the organisms from the sandy sediment to which they adhere. Because of their small size, meiofauna have adapted various methods for clinging to individual sand grains. The students tested four different published extraction methods and developed an approach that incorporates components of each method. They have optimized this method and now have a standardized approach that ensures uniformity of sample collection. Sand samples were collected, meiofauna were then extracted, preserved in formalin and dyed with Rose Bengal (for visualizing these otherwise translucent organisms) to make the later analysis accurate and simple. Because these samples were stained and preserved, some have also been added to our permanent laboratory teaching collection. Further, their optimized extraction technique is a valuable method that will be used in future marine biology courses.

Given the amount of effort already invested in this project, the continued enthusiasm of the students (who have become far better than me at meiofauna identification) and the relatively low cost:benefit ratio, this project represents a good investment into promoting undergraduate research. Already, positive impacts on students have been observed. Students from the marine biology course were required to attend the research course poster session. Three students from the marine biology course were so intrigued that all plan to enroll in next summer's research course. In addition, one of the students working on the meiofauna project found the research experience unexpectedly rewarding; she is now reconsidering her career plans and will be attending a UGA open house next month to explore options for doctoral research in ecology.

Products: Already the students have produced a poster that was presented at a biology department symposium. They plan to continue the study and present their work (probably two presentations) at the annual Association of Southeastern Biologists meeting next April. Further, the students are motivated and we anticipate submitting a manuscript either to the North Georgia journal, "Papers and Pubs" or to an outside peer – reviewed journal. Finally, as the department plans to continue offering the research course, the results will provide a basis for subsequent meiofaunal studies at Sapelo Island that will track possible temporal changes in diversity or abundance. These data will become part of UGAMI's academic holdings and may be used by UGAMI, state or federal agencies in the administration of Sapelo Island's protected areas.

Productivity from previous CURCA funded projects:
2009 – "Using the FETAX system to assess the developmental toxicity of recycled tire mulch leachate" This ongoing project that examines the effects of run – off from tire mulch on frog embryo development has resulted in 3 student presentations at regional conferences and one presentation at a state conference.

Currently, three students are involved in the study and are planning on submitting abstracts to present their work at a regional conference in April. This project has also spurred two related side projects, examining the effect of the recycled tire leachate on the feeding process of the ubiquitous freshwater protist, *Tetrahymena pyriformis*. In addition to a set of biological studies on the toxicity of the tire leachate on *Tetrahymena*, two students developed a science education study using the *Tetrahymena* protocol in a freshman biology class and examining whether this guided inquiry exercise resulted in improved student understanding of the scientific method. Both *Tetrahymena* projects (biology and education) have been presented at regional and state conferences; twice the educational study has won a Best Student Presentation Award. In all, this CURCA funded project has supported the work of 13 students.

2010 – "Gender differences in antioxidant response and free radical damage in the brains of methamphetamine exposed mice" This project was designed to be a part of a larger ongoing study conducted by Drs. Ryan Shanks and Steven Lloyd. Unfortunately, a series of ill - fated events caused the project not to go as planned. The two students with whom the study began got some promising preliminary results but then failed to follow through on subsequent work. There was an initial period of trial and error while we optimized our methods; this is a common occurrence when conducting new laboratory techniques. The reagents purchased with CURCA funding where used during the optimization and early experiments (so none went to waste); remaining CURCA monies went towards shared supplies (with Drs. Shanks and Lloyd) for mouse colony maintenance. At that time, my work responsibilities changed and increased, forcing me to refocus my scholarly efforts on established research in areas with which I was already familiar. Therefore, I have not recruited other students to continue the study. I hope to one day revive this line of work and use the baseline data as a starting point.

Budget: Minimal supplies and equipment are needed to conduct this study and most are already in – house. The main cost is for travel to the research site where samples are collected. Three students are currently involved in this study; more will continue the study during next summer's field research course. We are requesting funding to support transportation to and from Sapelo Island, plus lodging in the UGAMI dorms. We anticipate two additional trips, of 3 nights each, will be necessary to get all of the samples needed at the correct times of the tidal cycle. A breakdown of costs is below:

Lodging (4 people x 6 nights x $35/person/night) = $840
*The UGAMI dorms have a stocked kitchen and students provide their own food so there is no cost for meals.

Gas (2 cars x 2 round trips) = $400 (obviously a semi – educated guess, since who know what gas will cost?)

TOTAL = $1240

Timeline: The project was started in June, 2012 and is ongoing. Given the students' experience and enthusiasm, the additionally proposed studies will easily be completed by early spring semester of 2013. At that time, students will submit an abstract for presentation at the Association of Southeastern Biologists annual meeting and also begin exploring publication options. By May 2013, we anticipate a completed study, with at least one (and probably two) presentations and a manuscript submitted.