Title: Do fine-scale water column structure and particle aggregations favor gelatinous-dominated food webs in subtropical continental shelf environments?

Driven by advances in ocean observing technologies, there is a growing recognition that biologically productive continental shelf waters can be highly structured and dynamic. While many studies have described the oceanographic causes of vertical structure and layers in these relatively shallow environments, approaches coupling physical conditions to broader food web properties are uncommon due to the challenges of measuring several processes simultaneously. Near the base of marine food webs, a diverse community of small animals, referred to collectively as zooplankton, serve as prey for larger animals including fishes and marine mammals. Zooplankton also influence lower trophic levels, such as marine microbes that drive nutrient and gas cycling throughout the oceans. Determining the role of physical oceanographic structure in the dynamics of zooplankton and subsequent changes to food webs, therefore, is fundamental to understanding ocean ecology and, ultimately, the oceanographic mechanisms leading to fisheries production or failures. Unraveling these processes has direct applications toward improving societally-relevant predictions of ecosystem responses to environmental stressors in shelf and coastal oceans. In addition to the scientific and societal impacts, this project will support graduate and undergraduate students, including several from Savannah State University – a Historically Black University with undergraduate and graduate programs in marine sciences. The field research will also provide authentic oceanographic experiences for at least 50 K-12 educators, who will participate in the planned research cruises, as well as research opportunities for ~600 juniors and seniors at Johnson High School – a Title I school in Savannah, GA with 96% underrepresented minority enrollment. The principles derived from the project will be shared with the public through annual open house events at the University of Georgia – Skidaway Institute of Oceanography campus (~2,000 visitors annually).

Biologically productive shelf ecosystems often oscillate between extremes of vertically mixed waters during windy and colder seasons, to vertically stratified waters during warm and calmer conditions. The latter scenario favors the formation of dense layers or aggregations of plankton and particulate material, generating "hot spots" of biological activity that allow marine organisms to potentially feed at much higher rates than water column average abundances would suggest. Although physical mechanisms of layer formation, and plankton groups associated with them, have been described in several shelf environments, less is known about layer influence on zooplankton community composition and trophic transfer. For fast-reproducing pelagic tunicates (salps, pyrosomes, appendicularians, and doliolids), these layers or aggregations may serve as rich food resources that prime pelagic tunicates to form dense blooms, which then ultimately serve as food for gelatinous predators. This sequence of events, from layer formation to pelagic tunicate reproduction and predation on the bloom, may generate high abundances of gelatinous organisms throughout the marine food web. This hypothesis will be tested by measuring the fine-scale abundances of gelatinous zooplankton with in situ imaging, their corresponding diets using molecular gut content analysis, and broader food web properties using compound-specific stable isotopes in contrasting vertically mixed and stratified conditions. To determine if these food web interactions are generalizable to water columns with and without vertical structure, these processes will be compared between the South Atlantic Bight and northern Gulf of Mexico shelf ecosystems, which both provide favorable conditions for doliolid blooms, yet have differing drivers of vertical stratification. These efforts to place zooplankton communities and food web properties within a predictive framework will address a critical component of ecosystem models resolving the biological consequences of environmental stressors that are increasingly impacting the oceans.