

Past Research Projects

Georgia Sea Grant has funded 40 years of research examining Georgia's coast.

Since 1971, Georgia Sea Grant has funded research on the state's most pressing coastal issues and challenges. The program helps resource managers learn more about the environments they are overseeing and industries understand the ecological impact of their practices.

2012-2014 Projects

Controls on Effectiveness of Reef Filtration

Principal Investigators: James Byers, University of Georgia

- Oysters and other reef-associated filter feeders like clams have the potential to enhance water quality and control nutrients and contaminants along the U.S. eastern seaboard. However, that ecosystem function may be mitigated by predation, competition or other species interactions. The objective is to address how effectively oyster reefs affect water quality on natural and constructed reefs and to what degree predators alter reef filtration abilities. By investigating filtration potential of reefs under multiple scenarios in both the lab and the field, this study should offer insights into optimal locations for reef construction efforts and the best filter feeding species to promote (e.g. clams vs. oysters).

Property and Insurance Markets in Coastal Georgia

Principal Investigators: Caroline A. Dehring, University of Georgia; David L. Eckles, University of Georgia

- The Georgia coast is an important economic driver for the state. A study by the Georgia Department of Community Affairs Office of Planning and Quality projects annual population growth in the region to be 4 percent through 2020. The coastal region of Georgia is estimated to see an approximately 30 percent increase in housing stock by 2020. While increased population and development increases risk exposures to natural disasters, the frequency and severity of possible losses is further exacerbated by changing climate and resultant weather patterns. More development results in greater potential damage from flood and windstorm events, while a rising sea level or changes in weather patterns could well increase the number of loss events. The purpose of this study is to lay a foundation for future analysis that will examine the effects of this flood zone remapping on flood insurance provision and property markets in coastal Georgia. In laying this groundwork, we will provide an overview of the current state of coastal Georgia's building and insurance landscape.

Long-Term Strategic Planning for the Port of Savannah

Principal Investigators: Stephen J. Ramos, University of Georgia

- With the simultaneous expansion of the Panama Canal and the deepening of the Port of Savannah, projections show that trade flow activity will increase dramatically for the port and its hinterland. The greater capacity afforded to the Savannah port through the dredging of 32-mile channel from 42 to 47 feet will require parallel, coordinated planning at the local, metropolitan and regional level, both to accommodate the increased trade movement and to avoid wasted investment as result of duplication. The objective of the research is to analyze the physical circumstances of the Greater Savannah Metropolitan Region in planning for future growth resulting from increased trade, and then propose solutions for intermodal, comprehensive planning for that growth.

Reconstructing Georgia's Hurricane Record: A 260-year GIS Database of Coastal Impact

Principal Investigators: Brian Bossack, Georgia Southern University; Mark Welford, Georgia Southern University; Ethan Gibney, independent contractor

- There is a clearly defined need for better characterization of the risk of hurricane landfalls along the Georgia coast. Complacency regarding hurricanes in coastal Georgia is rampant, particularly among the general public. Part of this complacency is due to the fact that during the most recent decades, direct landfalls on the Georgia coast have been rare. However, a cursory examination of historical hurricane records suggests that this pattern has not held throughout time; the 18th and early 19th centuries are rife with examples of hurricanes wreaking havoc in areas such as Savannah, Brunswick and St. Marys. These storms are largely excluded from return period calculations for Georgia hurricanes, suggesting that such calculations may be artificially low. Moreover, there is a need to better resolve weaker storms in the historical record which, although less of a wind hazard than stronger storms, may still pose significant flooding/storm surge hazards to residents living along the coast.

Estuarine Response to Land and Water Use Changes and Development at the Georgia Coast

Principal Investigators: Renato Castelao, University of Georgia; Daniela Di Iorio, University of Georgia

- The Georgia coastal region provides great services to the environment and has a wide variety of resources greatly valued by tourists, industry and coastal communities. Georgia's coastal population is increasing dramatically, and so is pressure on the environment due to urbanization, development, water use, pollutant inputs, among others. One challenge is to determine

ways to develop the Georgia coast in the most sustainable way. An important step toward that goal is the identification of regions along the estuaries that are susceptible to anthropogenic pressures, and regions where the effects of changes in land and water use practices would be less substantial. Vulnerability maps will be developed, identifying where water quality sensitivity to land and water use changes is high, moderate or small. That information can be used by coastal managers and stakeholders to guide coastal sustainable development, so that projects are preferentially done in areas where the environmental impacts are minimized.

Understanding social attitudes and prioritizing geo-spatial risks for climate adaptation outreach in coastal Georgia

Principal Investigators: Jason Evans, University of Georgia; Matthew Hauer, University of Georgia; Margaret Myszewski, University of Georgia

- The communities of coastal Georgia are highly vulnerable to sea level rise. On the one hand, there is a high natural potential for adaptation due to the relatively low level of development in most of this region. On the other hand, the population and residential development footprint are both rapidly growing, and there is anecdotal evidence suggesting that local skepticism about anthropogenic climate change may be hindering effective adaptation responses. This project is intended to provide both detailed geospatial information into the societal risks from sea level rise, and initiate alternative modes of framing adaptation that may appeal more broadly to local officials, regional planners, the development community and the general public.

Spatio-Temporal Assessment of Tidal Inlet and Stream Movements and their Influence on Coastal Vulnerability

Principal Investigators: Chester W. Jackson Jr., Georgia Southern University; Clark R. Alexander, Skidaway Institute of Oceanography

- The movements of tidal streams and inlets have the capacity to promote substantial changes to adjacent shorelines and coastal environments. Deficiencies exist in the studies of tidal stream migration and inlet morphodynamics along coastal Georgia and their impacts on shoreline erosion and vulnerability. Of the few studies that exist, most were either limited to a single stream and/or were limited by technology at that time. Likewise, few studies have assessed tidal inlets morphodynamics and were also limited geographically and technologically. Furthermore, current models used to assess the vulnerability of coastal areas to sea level rise, such as the SLAMM model, do not take into account tidal stream and inlet migration. Ultimately, data from the proposed study will assist scientists and managers with assessing coastal vulnerability and managing shoreline erosion associated with tidal stream and inlet dynamics.

Paleotempestology of Coastal Georgia: A Study of Spatial and Temporal Variability of Hurricane Activity along the Coast of Georgia

Principal Investigator: Lawrence Kiage, Georgia State University

- The vulnerability of US coastal environments to hurricane impacts continues to grow significantly due to population migration and accompanying economic investments, growth in coastal property and wealth and tourism. In view of this, a question of practical and scientific significance is: how likely is a coastal city such as Savannah or Brunswick to be directly hit by a catastrophic storm of category 4 or 5 hurricane on the Saffir-Simpson scale? This question is important because of its implications for insurance underwriting, real estate values, tourism development and emergency planning along the coast. This project will answer that question by producing the first comprehensive paleotempestological record from coastal Georgia based on multiple proxies from multiple study sites. This data in turn will in turn provide information on the return period of intense hurricanes on coastal Georgia. These empirical estimates of the return period of catastrophic hurricanes on the Georgia coast will lead to improved risk assessment for coastal communities.

Natural Hazards, Amenities, and Land Use: A Participatory Approach for Visualizing Resilient Coastal Communities

Principal Investigators: Warren Kriesel, University of Georgia; Elizabeth Kramer, University of Georgia; Susana Ferreira, University of Georgia

- Results from an earlier Sea Grant project demonstrated that homebuyers prefer subdivisions with higher housing densities if they also gain more open space, implying that developers have a market incentive to adopt this aspect of low-impact housing. Building upon this base, additional real estate market analysis will consider flooding hazards and whether the market incentives have been affected by the prolonged economic recession. Many of these open space components can also be used to help local governments better manage their water resources in the wake of climate changes.

2010-2012 Projects

Oyster Spat Sticks to Improve Coastal Water Quality

Principal Investigators: Marsha Black, University of Georgia; Erin Lipp, University of Georgia

- Human sewage from faulty septic systems emit harmful contaminants found in Georgia's coastal waters, including bacteria, parasites and viruses as well as human pharmaceuticals. Filter-feeding organisms such as oysters and clams can concentrate microbial, chemical and metal contaminants in their

tissues, making them susceptible to adverse effects of toxic levels of contamination or chronic exposures and if consumed, vehicles for disease in humans. However, in short-term exposures, their ability to efficiently accumulate contaminants from the water column could provide a sustainable method of removing low-level chemical and microbial contamination from coastal waters. This study evaluates the effectiveness of small-scale experimental oyster spat stick culture in removing low-level chemical and microbial contaminants in tidal creeks.

Using ecosystem services to evaluate future development scenarios in coastal Georgia

Principal Investigator: Ronald Carroll, University of Georgia

- The coastal Georgia ecosystem is one of the most unique and valuable ecosystems in the United States, containing 1/3 of the remaining salt marsh on the Atlantic seaboard, supporting vast species of migratory water and shorebirds, sustaining highly valuable fisheries and shellfish industries and removing numerous pollutants from coastal waters. Ten thousand new housing units were built in coastal Georgia from 1999 to 2001, and the U.S. Census Bureau projects that 11 million additional people will reside in the Carolinas and Georgia by 2025. These trends will change land use, increase demands on the water supply and wastewater disposal systems, increase demands on some ecosystem services (e.g., recreational fishing) and change the productivity and attractiveness of coastal resources. This study evaluates how future development may impact coastal ecosystems through an ecosystem services approach. Ecosystem services are defined as “the benefits people obtain from ecosystems” with common valuation categories including supporting, regulating, provisioning and cultural services. The goal of the project is to understand how coastal development can proceed in a way that has minimal environmental impact using an ecosystem service methodology for valuing environmental change.

Using landscape interfaces and ecological activity to determine zones of influence on tidal marshes by upland development in Georgia

Principal Investigators: R.T. Kneib, University of Georgia; James Byers, University of Georgia

- Georgia’s Coastal Marshlands Protection Act (1970) formally recognizes the economic value of tidal marshes and mandates their protection in the public interest. The law established a clear and dynamic upland boundary for coastal marshes, but was less definitive regarding the degree to which upland activities may influence the living resources of coastal marshlands. Development pressures and changing land-use patterns adjacent to coastal

marshes have led to disagreements over the size of upland buffers and the need to consider potential impacts of storm water runoff in implementing legally mandated protections for the marshes living resources. This study addresses the need for science-based guidance on these issues.

Modeling Spatial and Temporal Land Use Patterns in Coastal Georgia

Principal Investigators: Kurt Schnier, Georgia State University; Andrew Hanson, Georgia State University

- Given that coastal development has been increasing in recent years, it is necessary that we begin to understand the economic factors that are driving this change in land use within coastal Georgia. This research directly addresses that issue by focusing on the determinants of land use change in the five water basins that feed into the coastal six counties of Georgia. Policy simulations will be used to evaluate alternative land use tax policies on changing land use trends. The objective is to expand the academic land use literature and provide important projections for regional managers.

Stakeholder Involvement: A Multi-Methodological Approach to Determining the Factors that Affect Quality, Satisfaction and Impact of Public Participation in Coastal Policy Making

Principal Investigators: Robert Williams, University of Georgia; Courtney Tobin, University of Georgia; Dionne Hoskins, Savannah State University

- Recently, significant research and fieldwork have focused on improving the process or “craft” of involving the public. However, understanding the craft of public participation has not been matched by a deeper understanding of organizing principles and models related to involving the public. What appears to be missing is a better understanding of the “why”: why public leaders involve the public (and at what point), and why the public does or does not choose to participate. This study examines the intent and perceptions of public leaders trying to engage stakeholders as well as determine the expectations of the public for participation in policy development and how those expectations influence their participation.

Property and Insurance Markets in Coastal Georgia

Principal Investigator: Caroline A. Dehring, University of Georgia – Terry College of Business

- The coast of Georgia is an important economic driver for the state. A study by the Georgia Department of Community Affairs Office of Planning and Quality growth projects annual population growth in the region to be 4 percent through 2020. The coastal region of Georgia is estimated to see an approximately 30 percent increase in housing stock by 2020. While increased population and development increases risk exposures to natural

disasters, the frequency and severity of possible losses is further exacerbated by changing climate and resultant weather patterns. More development results in greater potential damage from flood and windstorm events, while a rising sea level or changes in weather patterns could well increase the number of loss events. The purpose of this study is to lay a foundation for future analysis that will examine the effects of this flood zone remapping on flood insurance provision and property markets in coastal Georgia.

2008-2010 Projects

Accumulation of Common Ingredients of Personal Care Products in Estuarine Food Webs

Principal Investigator: Aaron Peck, Skidaway Institute of Oceanography

- The presence of persistent ingredients of personal care products in natural environments is well recognized and may be a threat to the functional integrity of estuarine ecosystems. Growth in coastal populations and the per capita use of these compounds suggests that their input to coastal aquatic systems is increasing. The objective of the study is to determine the extent to which antimicrobial compounds, musk fragrances and sunscreen agents used in common personal care products bioaccumulate in estuarine food webs. It also seeks to characterize seasonal fluctuations of those compounds and determine the relative importance of septic systems and wastewater treatment plants to their accumulation.

Assessing Shoreline Change and Coastal Hazards for the Georgia Coast

Principal Investigators: Clark Alexander, Skidaway Institute of Oceanography; David Bush, University of West Georgia

- High resolution studies conducted within a Geographic Information System (GIS) framework can help both coastal scientists and managers better understand shoreline erosion and other coastal hazards as well as facilitate better planning and management of threatened areas and resources. The objective of this study is to create data and tools for managers and regulators to use in dealing with the changing face of the Georgia coast. The project will create maps, identify trends and educate scientists, managers and other stakeholders about shoreline change.

Development of high-resolution optical methods for the study of water quality in a tidal marsh setting

Principal Investigator: William L. Miller, University of Georgia, Marine Science Department

- Strong development pressure along marsh-dominated coasts threatens to change ecological dynamics and material exchange characteristics along the

Southeastern coast. Altered landscapes and nutrient loading can drive long-term modifications of salt marsh ecosystem function. The development of observation systems with the ability to monitor these changes will be critical to inform coastal management and policy decisions as they impact salt marsh ecosystems. The objective of the study is to use optical instruments in and around NOAA's Sapelo Island National Estuarine Research Reserve to obtain high resolution, high quality optical and chemical data for the evaluation of water quality. These data will be used to develop models for long-term monitoring of water quality changes in marsh-dominated estuarine and coastal systems.

Dynamics of benthic marine invertebrate communities on temperate offshore reefs of Georgia

Principal Investigator: Daniel F. Gleason, Department of Biology, Georgia Southern University

- This study explores how hard-bottom reefs recover after being damaged by natural events or human intervention. The project also seeks to determine if the invertebrate composition of these communities changes over time and if sedimentation creates or maintains the hard-bottom substrate necessary for these communities. These reefs are important links in the health and productivity of Georgia's coastal ecosystem.

Overcoming Constraints to the Development of a Sustainable Eastern Oyster, *Crassostrea virginica*, Aquaculture Industry in Georgia

Principal Investigator: Alan Power, The University of Georgia Marine Extension Service

- Georgia has the potential to develop an oyster aquaculture industry that will diversify the shellfish industry and provide employment for many of coastal Georgia's low-income families. The objective of this study is to determine the best method for growing oysters and evaluate the economic feasibility of re-establishing a once vibrant oyster fishery in Georgia. Because of loss of suitable habitat along the Georgia coast, oysters now grow in clusters so dense that individual oysters are constrained from growing to marketable size. Power's project will determine the optimum density for growing marketable oysters and develop a method to grow them at that density. The results will then be shared through workshops with shellfish growers and resource managers in order to promote this lucrative and sustainable industry in Georgia.

2006-2008 Projects

Profiles of Animal Waste-Associated Tetracycline Resistance Genes and their

Occurrence in Adjacent Riverine Environments

Principal Investigator: Andrei L. Barkovskii, Georgia College and State University

- Influence of land-based activities on riverine delivery of contaminants to estuaries

Principal Investigators: Aaron T. Fisk, University of Georgia; James T. Peterson, University of Georgia; Gregg T. Tomy, Department of Fisheries and Oceans, Canada

Enhancing Outreach and Technical Assistance Capabilities of Georgia's Nonpoint Education for Municipal Officials (NEMO) Program by Adding an Urban Planning Expert to the NEMO Team

Principal Investigator: Keith Gates, University of Georgia Marine Extension Service

Assessing the impact of residential development and recreational land use on shallow groundwater quality in coastal environments.

Principal Investigator: Samantha B. Joye, Department of Marine Sciences, The University of Georgia

An Economic Analysis of Alternative Development Options in Coastal Marshland Areas

Principal Investigators: Warren P. Kriesel, University of Georgia; Jeffery D. Mullen, University of Georgia

Nutrient processing at the land-ocean interface: Assessing groundwater transformations through reactive transport modeling

Principal Investigator: Christof Meile, Department of Marine Sciences, University of Georgia

Taking Georgia's Students to Sea: Hands-on Educational Experiences on a Research Vessel

Principal Investigator: James G. Sanders, Skidaway Institute of Oceanography

Validation of the Management Model System for the Satilla River Estuary

Principal Investigator: Charles Tilburg, Department of Marine Sciences, University of Georgia

A Case Study for Declining Dissolved Oxygen in Georgia's Estuaries

Principal Investigator: Peter G. Verity, Skidaway Institute of Oceanography