Meteorological modulation of the Exchange Between Raritan Bay and the Coastal Ocean - R/6010-0013

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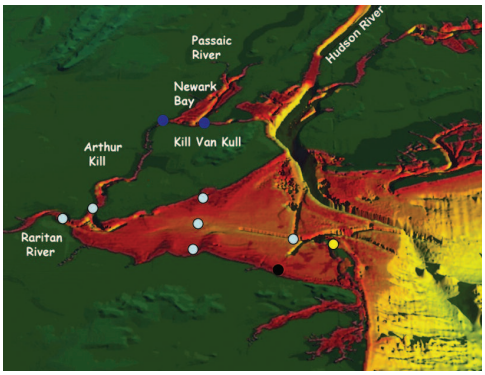
Research Summary

Estuarine residence time is the average time water particles take to escape or leave an estuary. It is perhaps the most important quantity water quality managers need to know in order to determine Total Maximum Daily Loads (TMDL) for a water body. It also plays a central role in determining the character of material that an estuary discharges into the coastal ocean. For example, in estuaries with short residence times (less than one week), such as the Hudson River estuary, inorganic nitrogen from the watershed is exported unassimilated into the coastal ocean where it may fuel large plankton blooms that lead to anoxic conditions in the coastal ocean. In contrast, in estuarine systems with long residence times (many months), such as the Chesapeake Bay and Long Island Sound, inorganic nitrogen is assimilated within the estuary which ultimately fuels the chronic anoxia found within these estuaries. Raritan Bay lies somewhere between these two extremes.

Reliable estimates of estuarine flushing time require detailed hydrographic observations of velocity and salinity at both long time and spatial scales. In Raritan Bay, there are no such observations that enable us to characterize the bay's circulation, to quantify the relative importance of tides, winds and river discharge on the bay's flow structure, or provide reliable estimates of the bay's flushing time. Nevertheless, water quality remains a major concern in the bay. Indeed, parts of the bay exhibit chronic hypoxia that appears to be related to low wind events and times of strong vertical stratification. This research project will release year-long mooring deployments throughout the bay together with targeted shipboard surveys to provide the first detailed investigation of circulation processes in Raritan Bay. In addition to providing critical information to managers the data will also provide insights to fundamental processes that drive estuarine exchange. Particular emphasis will be placed on seasonal scale variability in circulation and dispersive processes associated with variable wind and river discharge.

The mooring array used for this project includes four elements in Raritan Bay, one at the mouth of the Raritan River and one at the southern edge of the Arthur Kill. Each mooring element will contain a profiling Doppler current meter and a surface and bottom conductivity and temperature sensor for measuring salinity. In addition the two moorings where recurrent low dissolved oxygen occurs will include dissolved oxygen sensors. Shipboard surveys will provide higher spatial scale resolution of flow parameters and include measurements of current velocity, salinity, temperature nitrate, chlorophyll-a and dissolved oxygen. This will represent by far the most comprehensive data set in this highly urbanized estuary and will provide managers with information and insights into the processes that determine water quality.



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Reducing uncertainty in stock-recruitment relationships and fishery reference points using Bayesian meta-analysis - R/6010-0011

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Research Summary

Stock-recruitment relationships (SRRs) describe the link between the abundance of mature adults (the spawning stock) in a fish population and the abundance of surviving offspring (the recruits) that these adults produce. These relationships are far from simple since many complex factors other than spawner abundance play a role in determining recruitment. But knowledge of the SRR is critical to the calculation of biological reference points based on maximum sustainable yield (MSY). Reliable estimates of MSY-based reference points, such as the fishing mortality rate and biomass that result in MSY, allow for greater use of fishery resources and lower the risk of overfishing. Without such reference points, fishery managers are forced to use proxies that do not explicitly depend on knowledge of an SRR. Despite the fact that these proxies are inconsistent in their effectiveness, they are still widely used for management of many species in the mid-Atlantic and elsewhere. Uncertainty in the SRR is the key barrier to adoption of MSY-based reference points. By reducing and quantifying uncertainty in the SRR, fishery management can be improved through better estimates of biological reference points.

While individual SRRs are not simple to discern, there's strength in numbers. Analyzing SRRs from multiple species together has proven to be an effective method of reducing uncertainty. We will use a new global stock-recruitment database, regional trawl surveys, and fishery-dependent data (commercial catch and catch-per-unit-of-effort) to improve our understanding of SRRs for summer flounder, black sea bass, winter flounder, weakfish, scup, and tautog. Analysis methods include hierarchical Bayesian models and linear mixed-effects models. This research will be conducted in collaboration with scientists at the New Jersey Department of Environmental Protection and the National Marine Fisheries Service Northeast Fisheries Science Center.

Juvenile weakfish ***- Kevin Stierhoff***

- Janet Nye

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Assessing Plant Performance of 'Cape' American Beachgrass, *Ammophilia breviligulata*, Against Local Beachgrass Ecotypes - R/6010-0030

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Research Summary

American Beachgrass *(Ammophila breviligulata)* is a vital component of New Jersey's coastal environment. As the initial plant species used to colonize the dune system, American Beachgrass initiates an important process by intercepting wind-blown sand and stabilizing it with below-ground structures promoting the development of maritime forest. Despite the stabilization properties of dune grasses, coastal systems are highly dynamic and undergo alternating periods of accretion and depletion. In addition, there is increased human demand on these systems for residential and recreational purposes. As a result, society requires these systems remain in place to protect the multi-billion dollar infrastructure built on many barrier islands, and millions of dollars are spent on beach nourishment projects and dune restoration for this purpose.

In New Jersey, beach renourishment often occurs by pumping sand from offshore to create an artificial fore-dune, then subsequently planting American Beachgrass. Often these plantings are of a single species and in particular a single genotype, 'Cape' American Beachgrass. In 1970, the USDA Natural Resources Conservation Service released the 'Cape' variety of American Beachgrass specifically for these restoration projects. Since the 1970s numerous restored dune systems were planted with this variety along the eastern U.S. and in New Jersey particularly, primarily in clonally propagated monoculture. In these restoration projects the single genotype planting of the 'Cape' variety assumes that this single genotype will perform better (e.g. ecosystem functioning; successional progression; resistance to disease, etc.) than a genetically diverse planting of Beachgrass and will result in the desired successional progression to healthy dune development. But, success has been mixed. For example, the town of Avalon, New Jersey conducted a beach renourishment project in the early 1990s and is now seeing a return of maritime forest. It is estimated that a restoration effort in Atlantic City in 1997 has seen nearly 100% plant mortality in a 'Cape' variety planting.

The underlying principle addressed in this project is that a single genotype present in a population cannot function in a wide range of microhabitats, or adapt to changing climatic and other environmental pressures. Therefore genetic monocultures are less likely to persist through time than would a genetically diverse population. This project will compare the 'Cape' genotype to five New Jersey American Beachgrass ecotypes under commonly encountered abiotic stress conditions in a greenhouse setting. The researchers hope to highlight the potential importance of genetic diversity in *A. breviligulata* populations since coastal dune systems are prone to disturbance and sensitive to climate change. Education and resource material developed during the project will be distributed to the community to allow for a more complete understanding and appreciation of coastal dune communities.

American Beachgrass *(Ammophila breviligulata)*

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Collection of Sex-Ratio Data for Summer Flounder Landings: Commercial and Recreational - R/6010-0012

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Research Summary

Summer flounder, *Paralichthys dentatus,* is an important commercial and recreational fishery along the northeast coast of the United States from North Carolina to Massachusetts. Highly sought after by consumers of seafood, it accounts for a substantial fraction of angling trips by Mid-Atlantic Bight anglers. Summer flounder was seriously overfished in the late 1980s to early 1990s and, as a result, a stock rebuilding program was implemented. In 2004, the spawning stock biomass returned to historically high levels and the most recent benchmark assessment in 2008 determined that the stock was found to be in a non-overfished state. However, while the stock is thought to be on a rebuilding trajectory, final rebuilding goals have not yet been met and the 2008 benchmark assessment identified a number of continuing limitations in data resources and biological information available for the summer flounder assessment. One of the primary research needs identified was obtaining sex-at-age data from recreational and commercial landings. Sex-specific differences in the population dynamics of summer flounder, such as natural mortality and growth rate, require that a sex-structured model be employed in an assessment. Sex-specific data needed to run such a model are available for the federal survey, however, no sex data are collected on recreational and commercial landings.

This research project will test a survey design to obtain information on sex-at-length keys for commercial and recreational landings in New Jersey; evaluate the adequacy of survey sex-length keys for application to landings through the comparison of state and federal survey data with directly-obtained data on sex-at-length for commercial and recreational landings; and evaluate the effectiveness of minimally-invasive alternatives to obtaining sex-ratio data in comparison to the standard method requiring dissection.

Removing otoliths through the gills. Once a fish has been measured and sexed, scales and, for fish larger than 60cm, otoliths, are removed for subsequent aging.

Identifying the sex of a summer flounder by examining the gonad on an already filleted fish. The exposed orange ovary in the photo identifies the fish as female.

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