Integrated Reconnaissance of the Physical and Biogeochemical Characteristics of Jamaica Bay: Initial Activity Phase

A Coordinated Program of the Gateway National Recreational Area and the Columbia Earth Institute

Executive Summary

Researchers at Columbia Earth Institute have carried out an integrated, coordinated pilot reconnaissance of the physical, chemical, geological, and biological systems within Jamaica Bay, entitled “Integrated Reconnaissance of the Physical and Biogeochemical Characteristics of Jamaica Bay”. We believe that such an integrated approach is necessary to fully understand the complex inter-relationship of the wetland ecosystem. This effort was jointly funded by the US National Park Service/Gateway National Recreational Area and the Columbia Earth Institute of Columbia University.

The program focused on obtaining a synergistic view of the varied elements of Jamaica Bay by carrying out coordinated research in four areas: submarine sediment morphology, sediment and soil sampling, circulation and mixing, and chemical analysis of the Bay waters.

Results of the research can be summarized by the following key points:

Jamaica Bay is an energetic system:
- There is significant transport of coarse sediment in the channels; Grassy Bay is a sediment sink.
- The Jamaica Bay system is stratified, at least during summer; inflow to the Bay via Rockaway Inlet is likewise stratified.
- Stratification is highly time dependent; tidal influences have a profound impact on vertical structure throughout the Bay.
- Flushing times vary for different portions of the Bay; estimates using two independent methods yield a flushing time on the order of 1 week for the upper 5 meters of Grassy Bay.
- Multiple sources of freshwater contribute to the Bay—Hudson plume, sewage treatment outfalls, and surface runoff.
- Nitrogenous nutrients remain abundant throughout the summer, and we noted periods of suboxic conditions at the sediment-water interface in Grassy Bay.
- During hyper-eutrophic conditions the phytoplankton appear to be limited by the availability of carbon dioxide.

Jamaica Bay is an evolving system:
- In JoCo Marsh, the present *Spartina patens* marsh began forming 2000 years ago as a shallow pool atop sand.
- Marsh pollen and seed stratigraphy show the impact of human development in the region.
Recent loss of salt marshes has been rapid; the high rate is difficult to explain.

This pilot reconnaissance study has raised a host of questions worthy of further investigation:

- What is the sediment/energy budget of the system? Is marsh loss associated with a net change in sediment budget within Jamaica Bay and sediment transport between the surrounding lowlands and coastal ocean?
- How do two-layer flow & vertical mixing vary throughout the Bay over tidal cycles?
- What are the seasonal variations of stratification? residence times? freshwater sources?
- How significant are storm events on sediment movement, water properties & mixing times?
- Will the observed trend toward greater Bay production over the last two decades induce more frequent and extensive sub-oxic conditions?
- Can isotopic data be useful to gauge the amount of excess nutrients in the Bay?
- Do mainland marshes share the same history as the island marshes? What is the age and development of the marsh at Old Mill Creek (site 5)?
- What accounts for the high rate of salt marsh loss?

Submitted by:
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Robin Bell, Suzanne Carbotte and Roger Flood - Geophysical Mapping of Submarine Environments

Ellen Hartig, Alexander Kolker and Vivien Gornitz - Investigations into Recent Salt Marsh Losses in Jamaica Bay

Dorothy Peteet and Louisa Lieberman - Paleoenvironmental History of Jamaica Bay Marshes

Arnold Gordon, Robert Houghton and Bruce Huber - Temperature, Salinity and Currents in Jamaica Bay; Dye Tracer Experiments in Jamaica Bay

James Rubenstone - Stable Isotope Evidence for Water Mass Mixing in Jamaica Bay

Renee Takesue and Alexander van Geen - Patterns of Nutrient Enrichment and Depletion in Jamaica Bay

Chris Langdon - Trophic Status of Jamaica Bay: Spatial and Temporal Patterns

Ray Sambrotto - Nitrogenous Nutrients and Plankton Production in Jamaica Bay