State of the Bay Symposium Report

2016

Jamaica Bay, NYC

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STATE OF THE BAY SYMPOSIUM REPORT

Jamaica Bay, NYC June 15 & 16, 2016

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COVER PHOTO BY DON RIEPE, AMERICAN LITTORAL SOCIETY

Introduction

Jamaica Bay is a critical regional ecosystem containing one of the largest and most important tidal wetland complexes in New York State. It is also an important stopover for thousands of water, land, and shorebirds migrating along the Atlantic Coastal Flyway bird migration route. The Bay and its watershed are home to nearly two million people and provide 10,000 acres of parklands to over three million visitors annually. It is a central feature in the City of New York's plan as a Special Natural Waterfront Area.

Hurricane Sandy caused devastation and destruction in Jamaica Bay—a remarkable reminder of the importance of increasing coastal resilience in urban areas. It exposed existing stresses and vulnerabilities of infrastructure, population, and the environment around the Bay. The need for knowledge about the complex relationships among natural and social systems in urban coastal regions has never been greater, nor has the need for translating this knowledge into meaningful policy and practices that can build resilience to risks. It is imperative to change current thinking and embrace new cutting edge knowledge and practices that can address these challenges.

The State of the Bay symposia series is designed to bring together agencies, scientists, decision makers, and community groups to discuss relevant science knowledge and management strategies that enhance the resilience and ecological integrity of Jamaica Bay. Initiated in 2004 by the National Park Service (NPS), the symposia series was expanded through an affiliation with the NYC Department of Environmental Protection's (DEP) 2007 Jamaica Bay Watershed Protection Plan (JBWPP). Under Local Law 71 of 2005, the DEP was required to develop the JBWPP and provide updates to the plan every two years. The State of the Bay symposia serve to inform the plan and subsequent updates through regular convening of the various communities of actors working and living in the Bay.

The Science and Resilience Institute at Jamaica Bay (the Institute), the DEP, and the NPS were excited to host the 2016 State of the Bay Symposium in Brooklyn, NY, on June 15 – 16, 2016. The 2016 event emphasized the intersections of human, physical and ecological components of Jamaica Bay and explored opportunities for enhanced resilience within those systems. The focus of the Symposium aligns with SRIJB's mission to produce integrated knowledge that can be used to increase biodiversity, well-being, and adaptive capacity in coastal communities and waters surrounding Jamaica Bay and New York City.

It is our hope that the biennial symposia will continue to fuel future discussions, scientific investigation, and the actions needed for ongoing improvements to the health of Jamaica Bay and its surrounding communities. This report documents the 2016 symposium proceedings, providing summaries of the each of the sessions and presentations. More information and speaker presentations can be found at srijb.org.

Executive Summary

The 2016 State of the Bay two-day symposium focused on the management and decision-making context within the Bay, community perspectives and needs, and current relevant science spanning the Bay's socio-ecological systems.

The primary objectives of the symposium were to engage and connect a variety of audiences in a discussion of relevant knowledge, strategies, and practices in Jamaica Bay, and to link science and research with decision-making and inform management efforts. To achieve these objectives, the planning committee developed a program of speaker presentations, panel discussions, and breakout working groups designed to engage participants. Approximately 130 people attended on day one and 140 attended day two. Participants represented the full range of SRIJB partner institutions including the City University of New York, Columbia University Earth Institute, Cornell University, Rutgers University, NASA Goddard Institute for Space Studies, New York Sea Grant, Stony Brook University, Stevens Institute of Technology, and the Wildlife Conservation Society. Another group of participants represented local, state, and federal agencies with decision-making authority in Jamaica Bay, as well as key NGOs and community groups. The high turnout reflects the growing interest in research, management, and community issues related to ecosystem functions and resilience in and around Jamaica Bay.

The first day of the symposium took place at the Aviator Sports Complex on Brooklyn's historic Floyd Bennett Field. Following a welcome address, public agency representatives took to the podium to set forth their primary challenges, strategies, and objectives for the Bay. Morning sessions focused on 'Management Perspectives and Decision-Making for Healthy Ecosystems' (p. 10) and 'Community Perspectives' (p. 15) during which representatives from various community and environmental organizations voiced concerns and perspectives on their most pressing needs. The invited keynote speaker discussed how the San Francisco Bay Conservation and Development Commission is dealing with the impacts of climate change on the San Francisco Estuary. After lunch, attendees boarded the American Princess for a boat tour focused on the ecology of Jamaica Bay with narration by noted local naturalists Don Riepe, of the American Littoral Society, and Dan Mundy Sr., of the Jamaica Bay Ecowatchers. Navigating the western channels of the Bay, the cruise highlighted recent restoration projects, sites of ongoing research, and historically relevant locations.

William Tramontano, Provost and Senior Vice President for Academic Affairs at Brooklyn College, opened the second day of the symposium at the Brooklyn College Student Center. The morning seminars focused on the state of current knowledge of 'Physical Systems of the Bay' (p. 22) and 'Ecological Studies' (p. 28) while the afternoon

session 'People, Place and Social Meaning' (p. 35) examined social science research. Specifically, panelists were asked to address: What is the science saying and how does that fit with local knowledge? A broad range of topics including water quality, marsh restoration, storm surge modeling and hydrodynamics, the role of nature-based features, critical species and habitats, ecosystem services, and risk and community needs for resilience were addressed during morning and afternoon panel discussion sessions. This year's attention to economic, social, and cultural dimensions of the communities surrounding the Bay was an important addition to the symposia programming, which has historically focused on the natural and physical sciences.

The invited keynote speaker discussed the geomorphological and ecological factors that have shaped Jamaica Bay and its ecosystems for centuries, offering context for current decisions about flood protection and coastal ecology. Following the keynote speaker, an afternoon break out session allowed symposium attendees to address fundamental questions about the Bay and identify priorities, data gaps, and research and management needs for more effective resilience-based practices (p. 33). The session was structured around three questions: 1) What are the most salient findings heard today?, 2) What is missing from the conversation?, and 3) What are the opportunities to improve the conditions of the Bay? Stated research needs included improved understanding of sediment flux

and transport and nitrogen cycling, long-term sediment core data, and indicators and metrics for the Bay's systems and processes such as water quality and marsh health. Management needs included expanding community engagement efforts, improving communication between and among agencies and stakeholders, developing programs for education and stewardship, and coordinating, integrating, and standardizing datasets from various workers in the Bay.

The symposium concluded with a networking reception and the presentation of graduate student and postdoctoral research posters, including the work of SRIJB's Research and Development Fellows. Detailed symposium information and slides from the speaker presentations and research posters can be found on the SRIJB website.

Session Summaries: Wednesday, June 15th, 2016

Welcome & Opening Plenary

8:15 AM - 8:45 AM

Adam Parris

Executive Director, Science and Resilience Institute at Jamaica Bay

Highlights of the Science and Resilience Institute at Jamaica Bay include the 2016 fellowship program, National Park Service (NPS) funded research and the Resilience Schools Consortium Initiative. The themes for the next few days focus on:

1. Importance of place - Local, regional, and national levels. Innovative ideas, world class science, all aimed at transforming place.

2. Resilience - The term has gained prominence and that energy can be something we use. The trends promise to catalyze a shift in NYC from its industrial past to sustainable development.

3. Legacy - It is the centennial of the National Park Service. Writer and historian Wallace Stegner called national parks "the best idea we ever had. Absolutely American, absolutely democratic, they reflect us at our best rather than our worst." We use this idea in our work to chart our course for the second century of national parks.

Jennifer Nersesian

Superintendent, Gateway National Recreation Area, National Park Service

Gateway National Recreation Area (GRNA) serves over 6 million visitors a year and is home to significant natural, cultural and recreational resources. Visitors can kayak, camp, play beach volleyball, ride a horse, birdwatch, go a class trip to plant a pollinator garden, learn to sail, see world class art in the making or be a citizen scientist tagging horseshoe crabs, all for little or no cost.

Since the last symposium in 2013, GRNA completed their General Management Plan for the park, laying out a 20-year vision of improved access, transportation, accommodations, recreation, restoration, stewardship, and environmental quality. Their natural resource management strategy focuses on 21st century urban ecological restoration and the financial mechanisms that can make it possible, such as major shoreline protection projects or mitigation banking. Their cultural resource management strategy considers the resilience of modern and historic structures in the face of a rapidly changing environment. For example, Sandy repairs will make structures better and smarter than before, with resilient designs and features that marry our history with a path forward to the future.

Human dimensions of resilience are also important. A major stride forward is the post-Sandy increase in the level of communication and coordination among agencies at various levels and the communities they serve. The NPS is using social science to better understand their visitors as well as the communities around the Bay and their needs, values and connections with the resources. This is critical because as much as we all value Jamaica Bay, those values will not be resilient unless they are relevant to a much larger, devoted and interconnected constituency heading into the future.

The conservation of the Bay, with all of its natural and cultural resources, open space and opportunities for recreation, crosses social and political boundaries. Looking at the State of the Bay in 2016, our greatest asset right now is momentum. While there are great challenges ahead in the next few years – shoreline protection, changing ecosystems, water quality issues and a legacy of fill and contaminants, all in the context of a rapidly changing environment -- with a common appreciation of this truly amazing resource and a shared vision of what it can become, we are on track for a long, bright future for Jamaica Bay.

Daniel A. Zarrilli

Senior Director, Climate Policy and Programs, and Chief Resilience Officer, NYC Office of the Mayor

As part of OneNYC, New York City is continuing to evaluate climate change vulnerability and the need for adaptative land use in its coastal neighborhoods such as those that surround Jamaica Bay. This work highlights the need for additional infrastructure upgrades to support systems that are vulnerable to climate change in places like Broad Channel and along the Rockaway Peninsula, such as Edgemere. Strategic investments in raised shorelines and tidal flood reduction methods will include improvements in both green and grey infrastructure that both reduce flood risk and also provide community amenities. Some of the larger solutions may take time to develop, and the City continues to advocate for the U.S. Army Corps of Engineers (USACE) to advance near-term investments to reduce coastal flooding on both the Atlantic Ocean and Jamaica Bay coastlines.

As part of this effort, the City and its partners will continue to engage Jamaica Bay communities to improve environmental literacy, enhance understanding of the environment, and clarify problematic issues. This effort to engage the community is necessary to identify local concerns and effectively address long-term infrastructure deficiencies amid the complications brought on by climate change.

The dialogue at this Symposium will address the need for more resilient neighborhoods, and will discuss investments to expand the use of LiDAR images, high resolution land cover maps, new technologies (e.g. flood mitigation measures), and accurate assessments to help describe climate risks.

Our goal is to provide greater resiliency for NYC, thus protecting households, mitigating economic impacts, and creating jobs. We will continue to bring science into decision-making and action, which will transcend Jamaica Bay and allow the Science and Resilience Institute to not only support Jamaica Bay, but also achieve regional and global impact.

John McLaughlin

Director, Office of Ecological Services, NYC Department of Environmental Protection

The NYC Department of Environmental Protection's (DEP) manages New York City's water supply, providing approximately 1 billion gallons of high-quality drinking water each day to more than 9 million residents, including 8.5 million in New York City. DEP maintains 7,500 miles of sewer lines and 96 pump stations that take wastewater to 14 treatment plants. In addition, DEP has a robust capital program, with a planned $14 billion in investments over the next 10 years that will create up to 3,000 construction-related jobs per year.

Over the last decade the City has invested more than $10 billion in upgrades to wastewater treatment plants and related efforts to reduce combined sewer overflows and testing confirms that the water in New York Harbor is cleaner today than it has been in more than a century. As traditional "grey" infrastructure upgrades became increasingly expensive, the NYC Green Infrastructure Plan was launched. An alternative approach to improving harbor water quality, it combines traditional infrastructure upgrades and the integration of green infrastructure to capture and retain stormwater runoff before it can ever enter the sewer system and contribute to overflows.

DEP continues to be an active local sponsor for Jamaica Bay restoration projects, including the marsh islands and perimeter uplands. Collaborative efforts to improve the environmental integrity of Jamaica Bay are underway involving city, state, and federal agencies and many other environmental stakeholder groups. DEP continues to update the 2007 Jamaica Bay Watershed Protection Plan (JBWPP) and has a scheduled update for October 2016. Of the original 127 strategies identified in the 2007 JBWPP, 72% have either been completed or are on-going. The greatest challenges to completing the rest of these programs are the ongoing acquisition of sensitive lands around the perimeter of the Bay and improvements in public access to the Bay.

Clifford S. Jones

Chief, Planning Division United States Army Corp of Engineers, NY District

The United States Army Corp of Engineers (USACE) is implementing engineering studies initiated in response to Hurricane Sandy. These studies are integral to USACE's construction projects and help implement change. Projects made possible by the Sandy legislation will help towns and cities prepare for the effects of climate change—storms, floods, droughts, rising sea levels—by creating greater adaptability and resilience. By the enactment of the Water Resources Development and Reform Act of 2014, the USACE is challenged to complete projects quickly, maintain quality, and also be cost effective. After Hurricane Sandy, the USACE conducted the North Atlantic Coast Comprehensive Study that addressed the vulnerability of populations, infrastructure, and resources at risk. They used models to help understand how sea level rise and climate change will affect the shorelines of the Hudson-Raritan Estuary, Jamaica Bay, Bronx River, and Hackensack River over the next 50 to 100 years. The results will aid in the development of ideas to respond to larger and more frequent coastal storm risks.

Liam Kavanagh

First Deputy Commissioner, NYC Department of Parks & Recreation

As far back as the Robert Moses era, Jamaica Bay has been largely left in public hands. The valued coalitions that now exist have not always been so. In the past, the NYC Department of Parks and Recreation (PR) was slow to respond to pressures from groups like Audubon, the American Littoral Society, and Ecowatchers. The Parks Department is now more equitable and responsive. However, it is still addressing issues of inaccessibility that affect some densely populated, low-income communities. It is among the goals of Commissioner Silver to remove barriers and make parks more accessible, welcoming, and fun to all New Yorkers. Most critical to this goal is the partnership with the Science and Resilience Institute at Jamaica Bay and the positive momentum created by SRIJB's establishment. Strategic investments are still needed and it is important to find ways to integrate the public into the momentum.

Recent projects initiated by Parks staff include: marine debris removal (post-Hurricane Sandy) in partnership with NYC Department of Citywide Administrative Services; and Marine Park Maritime Habitat Restoration with the Nature Conservancy and the Natural Areas Conservancy. In addition, the Parks Department is working with the NYC Department of Transportation on the construction of connectors along the Belt Parkway to improve access to parks and make the Bay more engaging. In cooperation with the American Littoral Society and Ecowatchers, the Parks Department is working on the Sunset Cove Park Coastal Habitat Restoration. These partnerships contribute to increased resilience and the long-term health of the parks.

SESSION:

Management Persepectives & Decision-Making Context for Healthy Ecosystem

9:45 AM - 11:05 AM

Senior leaders from federal, state, and city agencies provided overviews of their respective management goals and presented projects currently planned for or underway in Jamaica Bay. The presentations and subsequent panel discussion helped to identify critical gaps in knowledge and data. The aim is that these needs are addressed by additional research and monitoring of the ecosystem.

Co-Chairs

Robert Pirani, *Program Director, New York-New Jersey Harbor & Estuary Program, Hudson River Foundation*
Jennifer Greenfeld, *Chief, Forestry, Horticulture & Natural Resources, NYC Department of Parks & Recreation*

Presenters

John McLaughlin, *Director, Office of Ecological Services, NYC Department of Environmental Protection*
Patti Rafferty, *Chief of Resource Stewardship, Gateway National Recreation Area, National Park Service*
Marit Larson, *Director of Wetlands & Riparian Restoration, NYC Department of Parks & Recreation*
Stephen Zahn, *Acting Regional Director, NYS Department of Environmental Conservation-Region 2*
Peter Weppler, *Chief, Environmental Analysis Branch, U.S. Army Corps of Engineers-New York District*

PRESENTATION:

Jamaica Bay: We've Done a Few Things Right, Right?

John McLaughlin

Director, Office of Ecological Services, NYC Department of Environmental Protection

What do key stakeholders need to know about Jamaica Bay? A graphic re-visualization of Jamaica Bay can help define what key stakeholders need to know about the Bay's ecosystem. Jamaica Bay processes and ecological systems are completely different from what they were 100 years ago. Some of these changes are irreversible. Through science and research there is a greater understanding of how things have changed, and what is needed for restoration. For example:

- Tidal exchange with ocean has been altered as a result of filling in of inlets on the Rockaway Peninsula;
- Over 12,000 acres of the original 16,000 acres of wetlands have been lost, nearly a 93% reduction;
- Jamaica Bay was originally naturally shallow. Over the past 100 years, dredging for shipping channels and borrow pits have drastically changed the Bay's morphology and associated ecosystems;
- Changes to the land/water interface have had tremendous impact on the Bay's hydraulics (for example storm water attenuation) and living systems;
- The hardening of inland surfaces and the elimination of migration pathways have altered water quality and limited wetland migration;
- Approximately 75% of land cover in waterfront communities consists of impervious surfaces. There is severe water quality and habitat degradation in watersheds with over 25% impervious cover.

One of the primary difficulties with Bay management and conservation is that 20 different government agencies have jurisdiction over Jamaica Bay. Efforts for collaboration are underway.

Trial projects to improve water quality and restore the Jamaica Bay ecosystem include the development of floating wetlands and the installations of a half-acre of oyster beds. The trial projects will test the effectiveness of these natural systems in reducing wave energy during storm events. The restoration of existing creeks will create and rehabilitate acres of ecosystems, including parks and coastal wetlands.

PRESENTATION:

Managing for an Urban Natural Condition: How Science Informs National Park Service Stewardship of the Jamaica Bay System

Patti Rafferty
Chief of Resource Stewardship, Gateway National Recreation Area, National Park Service

Existing policies help the National Park Service (NPS) to research, monitor, and assess the state of the Bay. NPS recognizes the importance of partnerships and uses experience as a model for further collaboration. Gateway National Recreation Area (GNRA) includes coastal preserves in Sandy Hook, Staten Island, Brooklyn and Queens. Much of the Jamaica Bay watershed lies outside the Park Service boundaries and Jamaica Bay is only one part of GNRA. The mission of the NPS is to protect the cultural and natural resources in Jamaica Bay, maintain naturally evolving ecosystems, and manage the parks as part of larger ecosystems. They look to engage the public, as well as research, monitor, and restore physical processes.

Ecosystem restoration entails understanding the natural conditions that would occur in the absence of a human-dominated landscape. Restoration looks to minimize human impacts and determine what is achievable in working towards an urban natural condition. NPS restoration efforts integrate science to provide information, including data and statistics.

As a public entity, one of the key concerns is how to analyze, integrate, and disseminate information to key stakeholders. The NPS Inventory and Monitoring Program inventories natural resources, aids in understanding resource dynamics, monitors ecosystems, and establishes reference points for comparison with other altered environments.

The Inventory & Monitoring Program at GNRA focuses on salt marsh monitoring to track coastal geomorphology, estuarine nutrient enrichment, threatened and endangered species, water quality, etc.

The NPS Natural Resource Condition Assessment uses indicators and existing data to identify and develop useful reference conditions (Figure 1). The assessment takes a spatial approach to assessing conditions and describing the state of Jamaica Bay.

Included in the assessments are:

- Vital signs and metrics;
- Data availability and gaps;
- Framework for assessment over time;
- Identify end user formats.

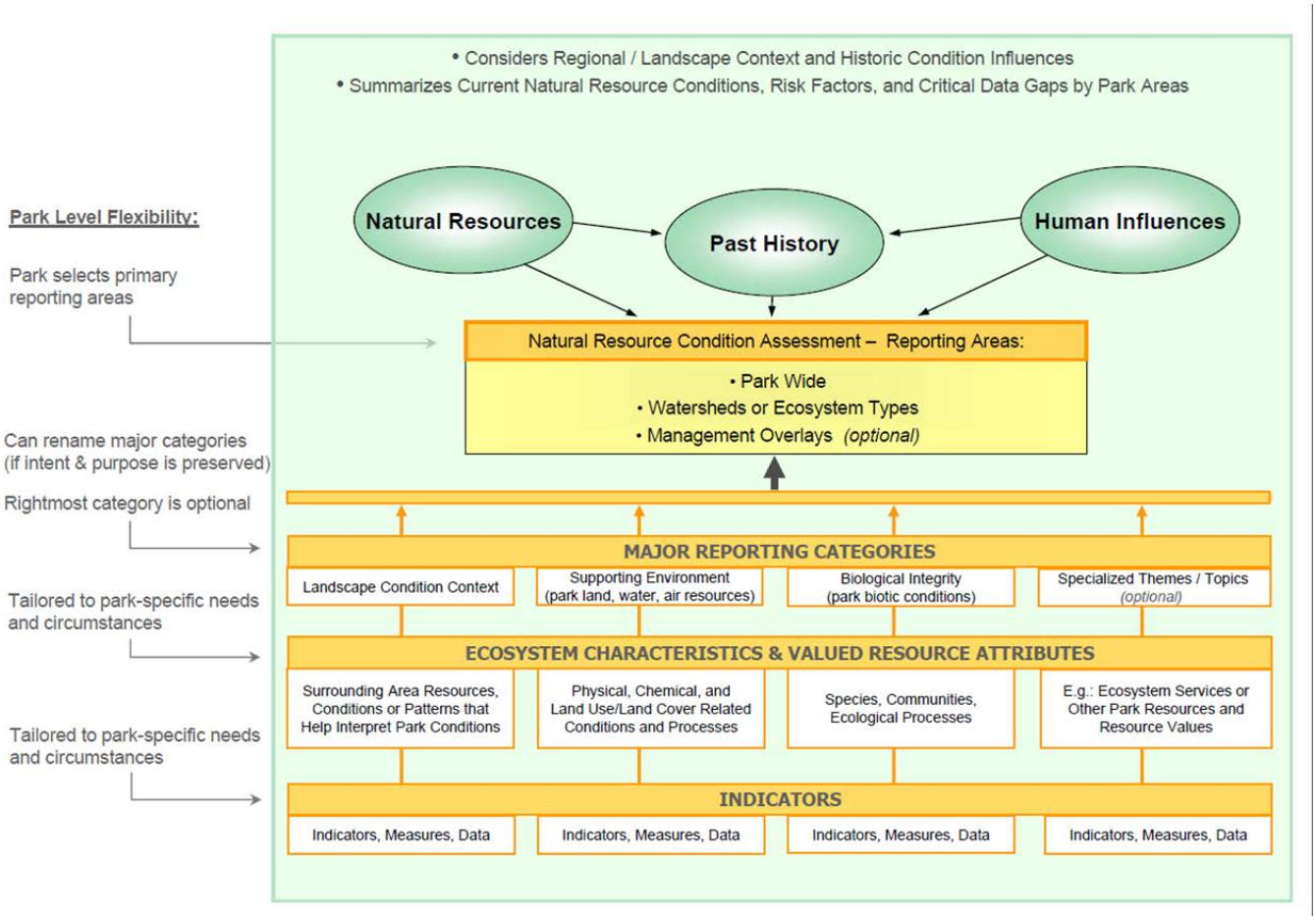


Figure 1. NPS Natural Resource Condition Assessment

PRESENTATION:

NYC Tidal Marsh Assessment & Strategies for Restoration & Protection

Marit Larson

Director of Wetlands & Riparian Restoration, NYC Department of Parks & Recreation

The NYC Department of Parks & Recreation (NYCDPR) seeks to maximize long-term viability of fringing salt marshes in New York City. This is accomplished by assessing the ecological conditions of marshes across the city and evaluating their vulnerabilities. With the collected data the team projects the possible impacts of future inundation and develops threat and conditions indices to identify opportunities for protection and restoration (Figure 2). Strategies for restoration and protection include:

- Use the Sea Level Affecting Marshes Model (SLAMM) to identify where marshes can migrate. This directs the acquisition and transfer of additional marsh properties; however opportunities for acquisition and transfer are limited;
- Restore flooded developed land, such as parking lots - not critical infrastructure, in a manner sensitive to the communities and stakeholders around the Bay;
- Enhance the elevation of low salt marsh by piloting the application of thin sediment layers;
- Rebuild the marsh edge, particularly where there has been marsh loss. Indexes identify the relative importance of marsh loss and where it might be of greater importance to rebuild.

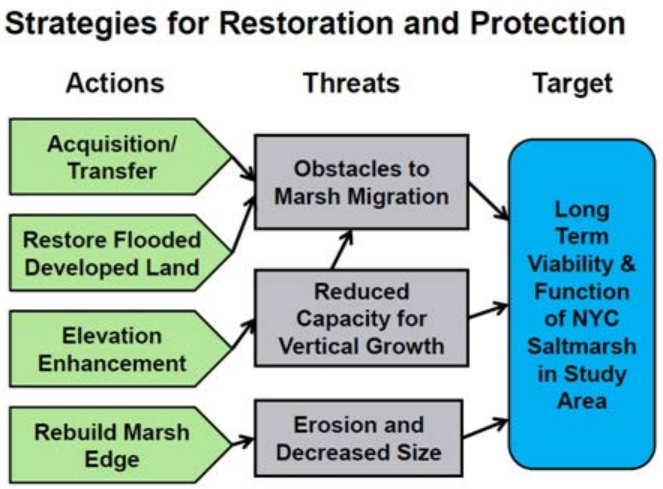


Figure 2. Strategies for Restoration and Protection

Continuing to conserve Jamaica Bay's fringe marsh requires the resolution of knowledge gaps. These gaps include:

- The socio-economic values of the stakeholders;
- Rates of and causes of vegetated shoreline retreat;
- Understanding and quantifying sediment supply and transport;
- Thresholds for ecosystem functions such as size and connectivity;
- The impacts of stormwater and CSO inputs.

Important metrics for the conservation of marshes are: key species data, habitat area's characteristics, and restoration actions areas by habitat.

PRESENTATION:

Coastal Restoration Activities within Jamaica Bay

Peter Weppler

Chief, Environmental Analysis Branch, U.S. Army Corps of Engineers, NY District

The U.S. Army Corps of Engineers, NY District's (USACE) mission is to manage coastal storm risk and restore degraded ecosystem structure, function, and dynamic processes to a less degraded, natural condition. USACE's planning process considers the anticipated sea level rise for all existing and planned projects and includes adaptive measures. The challenge is to provide an integrated solution that will manage coastal risks and increase human and ecosystem community resilience in an urban environment.

The Hudson-Raritan Estuary (HRE) Ecosystem Restoration Feasibility Study effort developed 12 Target ecosystem characteristics to focus restoration goals on distinct restoration actions. The actions were described in the HRE Comprehensive Restoration Plan (CRP) that identified 296 potential restoration opportunities, 275 of which are within the purview of the USACE ecosystem restoration mission. The Study's Draft Integrated Feasibility Report/ Environmental Assessment, released in February 2017, screened and identified up to 33 sites recommended for construction authorization, 12 of which are in Jamaica Bay.

Six perimeter sites (Dead Horse Bay, Fresh Creek, Hawtree Point, Bayswater State Park, Dubos Point, and Brant Point) are identified for restoration at a cost of $ 152,560,000. The plan also calls for the restoration of 5 marsh islands (Elders Point; Duck Point; Pumpkin Patch Marsh; and Stony Creek Marsh) at a combined cost of $137,020,000. An oyster restoration project is also proposed at a cost of $820,000. In addition to habitat restoration, species protection, improvements to infrastructure and added value for the general public are considered part of the overall recommendation.

The Hurricane Sandy General Reevaluation of the Atlantic Coast of New York City, East Rockaway Inlet to Rockaway Inlet project is being conducted with the study's non-Federal local sponsor New York State Department of Environmental Conservation, in cooperation with New York City Mayor's Office of Resilience & Recovery. Project partners include the NYC Department of Parks and Recreation, the NYC Department of Environmental Protection, and the National Park Service, Gateway National Recreation Area (NPS). The recommendations are based on a systems-based approach for coastal storm risk management for the entire area. The planning objectives of the Hurricane Sandy General Reevaluation of the Atlantic Coast are to:

- Reduce vulnerability to storm surge impacts;
- Reduce future flood risk in ways that will support the long-term sustainability of the coastal ecosystem and communities;
- Reduce the economic costs and risks associated with large-scale flood and storm events;
- Improve community resiliency, including infrastructure and service recovery from storm effects;
- Enhance natural storm surge buffers and improve coastal resilience.]

The Draft Integrated Hurricane Sandy General Reevaluation Report and Environmental Impact Statement (August 2016), recommends a tentatively selected plan consisting of installation of a storm surge barrier with associated tie-ins within Rockaway Inlet, at a cost of $2.8 billion. The main goals of this project are to reduce the risk to lives and property associated with coastal storms within the project area. Achievement of these goals includes formulating alternative plans that maximize contributions to National Economic Development (NED) and are consistent with protecting the environment. Integration of natural and nature-based features requires improved quantification of the value and performance of Natural and Nature Based Features (NNBFs) for coastal risk reduction. In order to fulfill the National Objective and the directives of the Disaster Relief Appropriations Act of 2013, the Draft Report:

- Evaluated NNBFs, not as stand-alone features, but as part of an integrated system and in combination with other measures; and
- Attempted to develop a consistent approach to valuing the benefits of NNBFs that contribute to coastal storm risk reduction and improved resilience.•

PRESENTATION:

NYSDEC Perspectives on Jamaica Bay

Stephen Zahn

Acting Regional Director, NYS Department of Environmental Conservation Region 2

Different players have different mandates, perspectives, and constituencies. The NYS Department of Environmental Conservation's (NYSDEC) goal is to conserve natural resources and the environment, while being mindful of public health, social wellbeing, and economic prosperity. NYSDEC provides for waste management, air and water quality, and coastal management to enhance the safety and welfare of people and environment. NYSDEC's numerous projects in and around Jamaica Bay include a 150-acre salt marsh restoration program and a $69 million project to provide flood protection and improve habitat at the 225-acre Spring Creek South.

A new role of NYSDEC is to manage sea level rise and develop interventions to reduce storm impacts and to promote nature-based solutions. The Draft Rockaway Reformulation Report produced by the USACE and NYSDEC was released in August 2016. It examines coastal storm risk management (CSRM) problems and opportunities, as well as social and habitat issues. The goal is not to offset one benefit (e.g. water quality) for the sake of another. Monitoring these programs is a key in understanding ecological sustainability and performance. NYSDEC hopes to learn:

- Will selected methods and technologies perform as predicted?
- Are levels of performance sustainable and affordable?
- Do the interventions avoid negative impacts?
- What is the cost-benefit for use of natural systems and island restoration?

SESSION:

Community Perspectives

11:20 AM - 12:40 PM

In this panel representatives from NGOs talked about community perspectives on the issues facing the Bay. Local communities experienced the effects of Hurricane Sandy first hand. This experience reshaped their responses to the effects of climate change. Communities are looking for ways to contribute to improved decision making, ask for better access to information, and to be included in the discussion about programs that may enhance protection of their neighborhoods and improve access to the Bay.

Co-Chairs

Marc Matsil, *New York State Director, The Trust for Public Land*
Michael Menser, *Assistant Professor of Philosophy, Brooklyn College*

Presenters

Dan Mundy Jr., *President, Broad Channel Civic Association & Jamaica Bay EcoWatchers*
Barbara E. Brown, *Chairperson, Eastern Queens Alliance*
Don Riepe, *Jamaica Bay Guardian, American Littoral Society*
Silaka Cox, *Chief Operations Officer, Rockaway Youth Task Force*
Holly Elwell Bostrom, *Senior Climate-Smart Cities Program Manager, Trust for Public Land*

PRESENTATION:

Successful Community Engagement & its Impact on Jamaica Bay Policy & Planning

Dan Mundy Jr.,
President, Broad Channel Civic Association & Jamaica Bay EcoWatchers

The Broad Channel Civic Association represents multigenerational families that have made Jamaica Bay their home (Figure 3). Hurricane Sandy was not the first storm experience by the community, but it was the worst. During Hurricane Sandy, first responders were not the Red Cross or FEMA, but regular New Yorkers who came and volunteered. Sandy flooded 100% of the homes on Broad Channel. Not everything has been repaired and the question still remains as to how much the neighborhood of Broad Channel needs to be elevated to minimize flood damage. There are now multiple agencies, including the New York City Build it Back (BiB) programs supported by federal and state expenditures, helping the Broad Channel community. Other projects that have been undertaken to improve the resilience of Broad Channel include:

- Elevating structures in a manner affordable for families;
- $28 million program to raise 9 streets in Broad Channel;
- The elevation of 227 existing homes;
- Rebuilding 50 homes;
- Acquisition of Sunset Cove, other plots of wetlands, and homes under the BiB program;
- Preservation of existing wetlands.

The Jamaica Bay Ecowatchers were the first to recognize and document wetland loss. In 1998 they spoke out about marsh degradation. Wetland loss was brought to the attention of the National Park Service in 2001 and has been a lobbying issue ever since. In 2005, research indicated that the tremendous increase in nitrogen loading was a significant factor in wetland loss, and a subsequent agreement that Ecowatchers negotiated with NYC led to a dramatic drop in nitrogen loading.

The residents of Broad Channel and the Ecowatchers' efforts also include tracking fish species, and the discovery that there are huge schools of striped bass, blue fish, fluke, flounder, and menhaden in Jamaica Bay. Community needs and scientific research goals can be divergent, making stakeholders input important when addressing research questions. The residents of Broad Channel and the Ecowatchers will continue to be active, ensuring that progress is made toward marsh restoration. Their goal is to protect and preserve Jamaica Bay for the enjoyment of future generations.

Figure 3. The neighborhood of Broad Channel

PRESENTATION:

Man With Nature/Man Against Nature in Idlewild

Barbara Brown

Chairperson, Eastern Queens Alliance, Inc.

The Eastern Queens Alliance is a coalition of civic associations in Southeast Queens. It includes the Idlewild Watershed Communities located just north of Head of Bay, including the communities of Brookville, Laurelton, Springfield Gardens and Rosedale, residential communities located just north of JFK Airport (formerly known as Idlewild Airport). The Idlewild Watershed Communities are also home to the large but somewhat degraded Idlewild Park Preserve, a 225-acre Forever Wild site that wraps around Thurston Basin and Head of Bay. The park includes freshwater (non-tidal) areas, a 100-acre landfill (open from 1970 to 1976), extensive salt marshes, and a recently constructed bluebelt system desiged to alleviate flooding in the watershed communities. It is the largest source of fresh water to Jamaica Bay and it serves as a buffer between the residential community and the airport. The freshwater and tidal wetlands of Idlewild Park are natural sponges and play a key role in reducing flooding during and after storms. During Hurricane Sandy, Idlewild Park experienced extensive flooding due, in part, to past practices of building on wetlands and in the floodplain.

Destruction of the wetlands at Idlewild continues. In 2001, the New York City Economic Development Corporation sold 25.4 acres of wetlands, located within the flood zone, for the construction of an industrial park. Then in 2014, against strong community objections, 315 trees in Idlewild Park were slated for removal by the Port Authority of New York and New Jersey (PANYNJ) to accommodate low-flying planes. More trees are slated for removal.

The Eastern Queens Alliance vision for Idlewild Park is to restore its role as an intertidal wetland and establish an Environmental Science Learning Center in the park. Further needs include: trail building, protection of open space similar to that given to Gateway properties, acquisition of privately-owned open land adjacent to the park, and large scale debris removal.

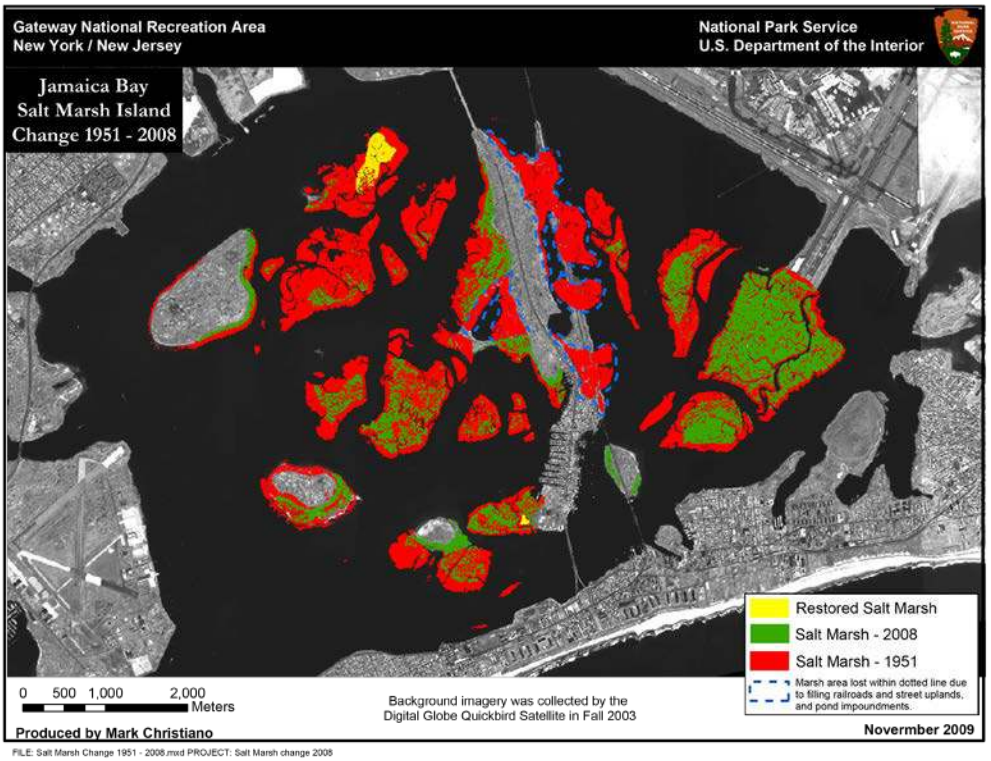


Figure 4. Jamaica Bay Salt Marsh Island Change (GNRA/NPS)

PRESENTATION:

Marsh Madness: Protecting the Edge for Wildlife & the Community

Don Riepe

Jamaica Bay Guardian, American Littoral Society

Evidence of extensive salt marshes in Jamaica Bay existed as early as the 1800s. By comparing historical maps to maps from the 1970s and current imagery, change over time can be seen in Jamaica Bay's fringe and island marshes (Figure 4). As can be seen in these maps, inundation from Hurricane Sandy mirrors the historical boundary of the Jamaica Bay tidal wetlands.

At Yellow Bar Hassock, maps were used to show marsh loss from 1951 to 2008. The USACE, NYS, and NYC agencies implemented a $19 million restoration project at Yellow Bar Hassock that has rebuilt the 40-acre marsh island. Engaging the American Littoral Society (ALS) and community-based volunteers has reduced the costs of similar projects. The Black Wall Marsh restoration project, done in collaboration with the NYS Department of Environmental Conservation and the American Littoral Society's Jamaica Bay Guardian Program, hired students to plant 88,000 Spartina alterniflora plugs in the first year. Spartina alterniflora, smooth cordgrass, is a perennial deciduous grass found in intertidal wetlands, especially estuarine salt marshes. Local seeds were harvested and delivered for thrashing to Pinelands Nursery, a South Jersey facility. The locally derived plants were sent back to Jamaica Bay. In another pilot project, rafts were deployed to deliver plugs to the planting sites.

Elders Point East, Yellow Bar Hassock, and Rulers Bar are a few examples of where eroded marsh has been successfully restored. As part of the restoration, debris was removed from the marsh islands. Several hundred abandoned boats were removed.

Using volunteers reduces the costs of marsh restoration and Spartina alterniflora plugs are more effective than using seeds when restoring salt marsh.

PRESENTATION:

Transportation Equity & Resilience

Silaka Cox

(Former) Chief Operations Officer, Rockaway Youth Task Force

Transportation equity is a problem throughout New York City. However, the Rockaway community is especially isolated due to inadequate and unreliable transportation modes. Rockaway Youth Task Force (RYTF) is working to propose solutions to address these issues. The lack of transportation exacerbates poverty and makes otherwise available resources inaccessible for our at-risk populations.

Projects are needed to address the isolation that limits student life. A ferry route in the Rockaways was initially implemented in the aftermath of Hurricane Sandy. The service was meant to provide relief to those impacted by the massive disruptions to the A train. The ferry service was meant to be a temporary, stop-gap measure. However the impact it had on residents was undeniably positive and showed the value and necessity of additional transportation in the Rockaways. Currently, the NYC Economic Development Corp. is in the process of restoring weekday ferry service to the Rockaway Peninsula. Rockaway, South Brooklyn and Astoria routes will connect to the Brooklyn Army Terminal and Wall Street. The plans underway are slated to provide full service in 2017 (Figure 5; please note that as of this report release city wide ferry service has been restored).

RYTF supports and advocates for a permanent ferry service. It would allow greater usage of the Jamaica Bay waterfront and make a real difference in students' lives. The addition of ferry and shuttle service would improve access to education, provide work opportunities, and more. Far Rockaway needs effective mass transit to enable residents to fully participate and contribute to the City. It would benefit tens of thousands of students, seniors and others who live in the underserved communities of the Rockaway. Effective mass transit would bring good students, good workers, and good consumers to the City at large.

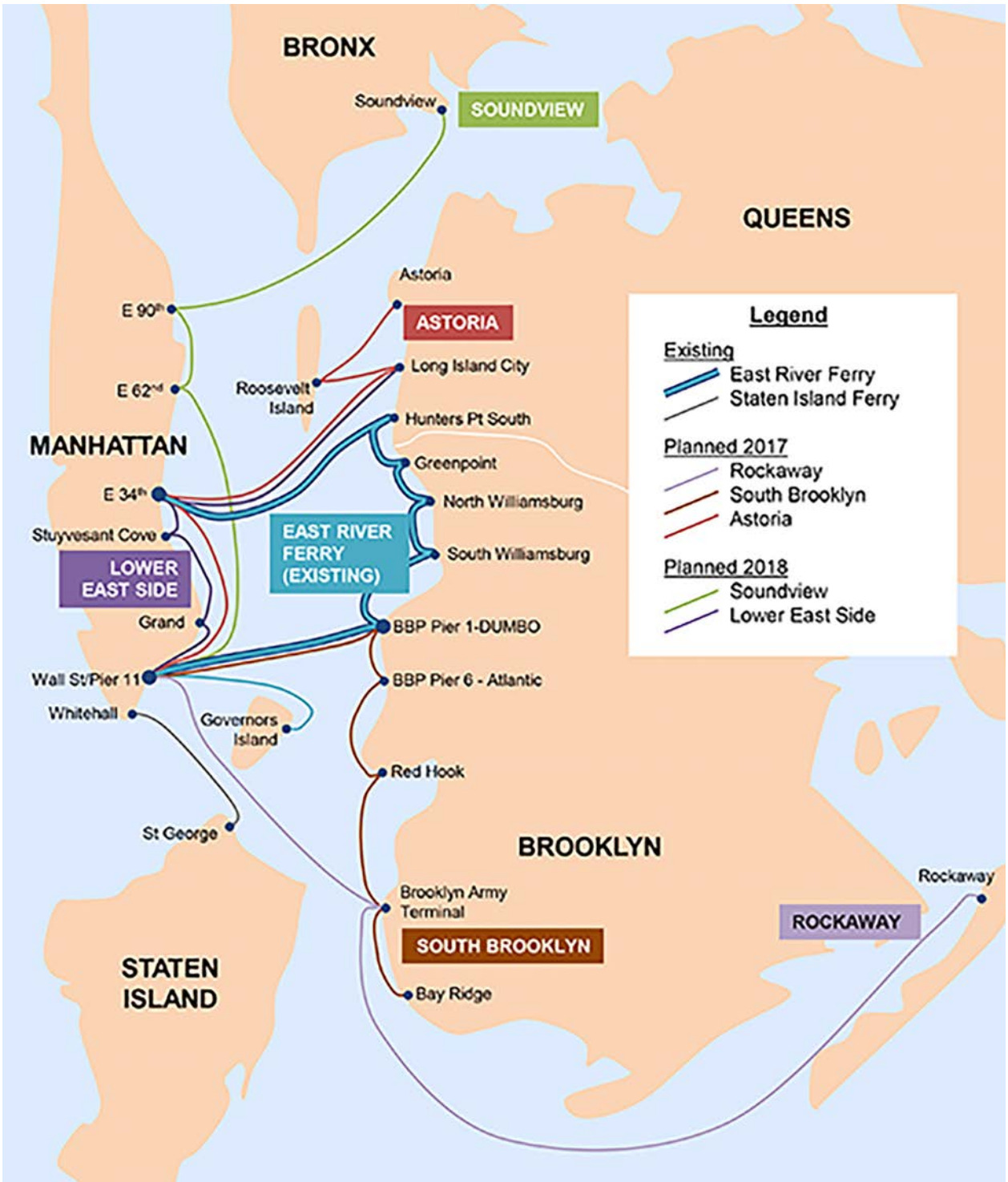


Figure 5. Proposed Ferry Service Expansion (NYCEDC). Geography has been modified to show services more clearly.

PRESENTATION:

Climate-Smart Cities - NYC Decision Support Tool: Harnessing Data for Climate Solutions Jamaica Bay Focus

Holly Elwell Bostrom

Senior Climate-Smart Cities Program Director, Trust for Public Land

Superstorm Sandy dramatized the importance of preserving low-lying coastal lands. The Trust for Public Land (TPL) has helped protect more than 1,800 acres in the New York Harbor region. TPL waterfront projects in Brooklyn and Staten Island provided flood protection during the storm, reduced storm surge, and helped protect adjacent property. TPL research seeks to determine how Green Infrastructure (GI) and social infrastructure mitigated the effects of Hurricane Sandy and how these efforts can be replicated elsewhere.

TPL partnered with Columbia and Drexel Universities to plan and implement GI in vulnerable waterfront areas. As part of these partnerships, TPL developed a GIS-based planning tool to identify priority conservation sites (Figure 6) called "Climate-Smart Cities." The tool evaluates multiple benefits derived from GI and allows users to assess opportunities to cool urban neighborhoods, absorb rainfall, and protect areas from extreme climate events.

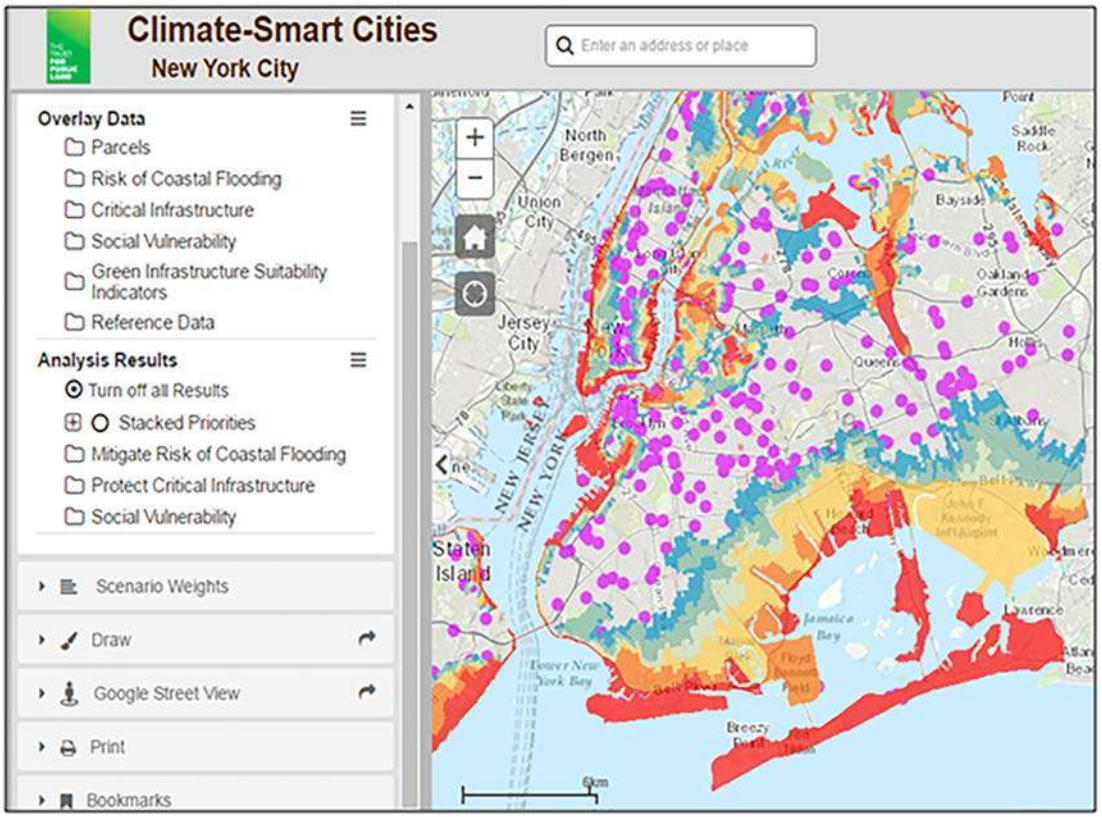


Figure 6. Climate-Smart Cities Planning Tool

Initial results of the Climate-Smart Cities Planning Tool applied to Hurricane Sandy research reveal the following:

- Middle income properties seem to be the most vulnerable and the least recovered group post Sandy; support mechanisms were lacking;
- Natural areas matter but to varying degrees in different places;
- Trees actually reduce damage to buildings during storms.

The TPL planning support tool is expected to be useful across many agencies and community groups.

KEYNOTE SPEAKER SUMMARY:

Lessons from the Left Coast

12:40 PM - 1:40 PM

Will Travis

Former Executive Director of the San Francisco Bay Conservation and Development Commission

Will Travis is a consultant, writer, teacher, and speaker on sea level rise adaptation. He received both a Bachelor of Architecture and a Master of Regional Planning from Penn State University. He has worked in the fields of architecture, local planning, private consulting, advertising, and public relations. In 1972 he was a consultant on the first master plan for the East Bay Regional Park District. From 1973 to 1995 he served in a number of staff positions at the California Coastal Commission. He was appointed deputy director of the San Francisco Bay Conservation and Development Commission in 1985 and was later appointed executive director of the Commission. Under his leadership it became the nation's first state coastal management agency to adopt development regulations for addressing sea level rise. In 2012 Travis served as the senior advisor to the Bay Area Joint Policy Committee, which coordinates the land use planning of four regional agencies.

The San Francisco Estuary

The San Francisco Bay and its Delta comprise the largest estuary on the west coast of the North and South American continents. Between 1850 and 1960, one third of San Francisco Bay vanished to landfill and neglect. In 1959, a report prepared by the U.S. Army Corps of Engineers was published to show the economic benefits of continuing to fill the Bay. The "Save the Bay" organization was established in response to the report. It convinced the California Legislature to create the San Francisco Bay Conservation and Development Commission (BCDC) to regulate new Bay fill projects and prevent the Bay from getting smaller.

A decade ago the BCDC began to deal with the impact of climate change. The average water level in San Francisco Bay has risen more than seven inches over the past century. Today, 240 square miles of filled land, which were filled just high enough to be above past sea levels, surround the Bay. Unless it's protected, San Francisco International Airport could be underwater by 2100. The Bay Area business community is working with government to develop coherent strategies for dealing with the impacts of climate change. Global warming is a game changer, and dealing with sea level rise (SLR) will require evolving ideas and governance. New forms of architecture will be needed, and, without question, the shoreline use that's most resilient to rising sea level is no development at all. Cultural, legal, and regulatory rules and customs have been built around the notion that the shoreline is fixed. These will have to change as SLR reshapes our coastlines.

A satellite photo of the San Fransisco Estuary

Session Summaries: Thursday, June 16th, 2016

SESSION:

Physical Systems of the Bay

9:10 AM – 10:40 AM

The physical systems of Jamaica Bay and its watershed provide the foundation on which living communities are built. These physical systems have changed and will continue to change in response to climate, urbanization, and management actions. This session provided new insights into past, present, or future physical system structure, function, response, and possibilities for adaptation.

Co-Chairs

Marit Larson, *Director of Wetlands and Riparian Restoration, NYC Department of Parks & Recreation*
Brett Branco, *Assistant Professor of Earth and Environmental Sciences, Brooklyn College*

Presenters

Vivien Gornitz, *Special Research Scientist, Center for Climate Systems Research, Columbia University Earth Institute*
Philip Orton, *Research Assistant Professor, Stevens Institute of Technology*
Bob Chant, *Associate Professor, Institute of Marine and Coastal Sciences, Rutgers University*
Neil Ganju, *Research Oceanographer, U.S. Geological Survey at Woods Hole*
Keith Mahoney, *Division Chief Regulatory Planning, NYC Department of Environmental Protection*
Miki Urisaka, *Engineer, Office of Green Infrastructure, NYC Department of Environmental Protection*

PRESENTATION:

Linking Global Climate Change to Local Hazards & Opportunities

Vivien Gornitz

Special Research Scientist, Center for Climate Systems Research, Columbia University Earth Institute

Global sea levels have been experiencing a rise since the last glacial era. The trend slowed down about 8,000 years ago. Since the 1990s, the main sources for sea level rise (SLR) include ocean warming (~30–40%), and melting glaciers (~30%) and ice sheets (>25%), the proportions varying over this period. On a global scale the rate of SLR has increased from 1.7 ± 0.2 mm per year between 1900 and 2010 to 3.3 ± 0.4 mm per year from 1993 to 2015.

The tide gauge in Battery Park has been recording SLR since the mid-1850s. Based on the observations from this gauge, sea level in New York has risen about 0.5m since 1856 at the rate about 2.84 ± 0.09 mm per year (Figure 7). Even with this breadth of information there is a need for even longer periods of record.

Observations and projections indicate that both the temperature and precipitation in the northeastern U.S. will increase over the next 100 years. The increase in temperature will be more obvious than the change in precipitation.

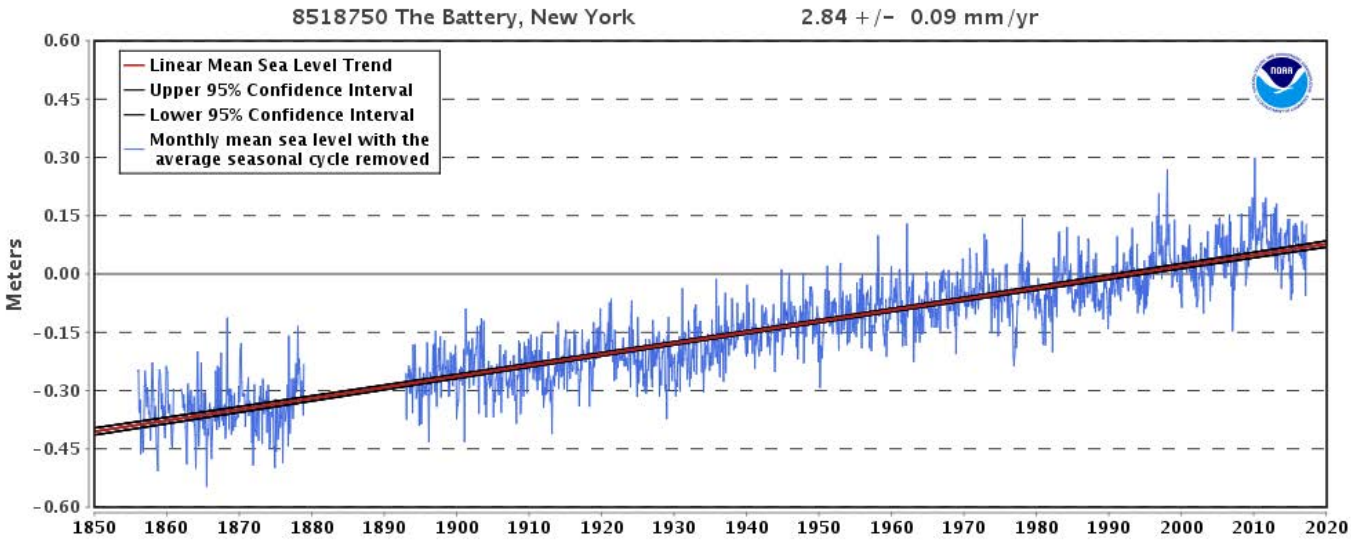


Figure 7. Observed Sea Level Rise, 1856–2014 The Battery, New York

The main causes of sea level change are thermal expansion, local water density changes, ice mass losses, vertical land motions, fingerprinting, and changes in land water storage. Land water storage encompasses processes such as groundwater mining, impoundment in reservoirs, runoff, deforestation, and seepage into aquifers. Subsidence and uplift, due to glacial isostatic adjustment and tectonics, comprise vertical land motions. The differential spatial pattern of sea level rise often referred to as a 'fingerprint' refers to the gravitational, rotational, and isostatic effects from changes in the mass of land-based ice. Thermal expansion and water density are affected by ocean water properties such as temperature, salinity and ocean currents.

Using 2000 to 2004 sea level as a baseline, sea level in NYC is projected to rise over the next 100 years and beyond. Mid-range estimates are 4–8" by 2020s, 11–21" by 2050s, 19–39" by 2080 and 22–50" by 2100. The high estimate 90th percentile projections of sea level rise through 2100 are 10" by the 2020s, 30" by the 2050s, 58" by the 2080s and 75" by 2100. As a result, more of the area around Jamaica Bay will be vulnerable to flood events.

The frequency as well as the extent of flooding is likely to increase. The projected likelihood for the occurrence of a 100-year flood could increase from 1% to 1.1%-1.5% by the 2020s, to 1.4%-3.6% by the 2050s and to 1.7-12.7% by 2080s (80% confidence interval). The corresponding flood heights for a 100 year returrn period event are projected to be 11.6-12' by 2020s, 12.2-13.1' by 2050s, and 12.8-14.6' by 2080s.

Increasing Jamaica Bay and Rockaways resilience to higher sea levels requires:

- Identifying high risk flooding areas;
- Incorporating SLR data into ecosystem management and preservation planning;
- Creating "soft" surge barriers—restore and raise beach dunes;
- Creating "soft edges" to dampen wave and tide energy—planting native vegetation, reducing land-sea slope;
- Restoring/creating new wetlands, beaches, and offshore reefs;
- Providing buffer zones for landward salt marsh migration.

PRESENTATION:

Sediment Budgets & Salt Marshes: A Zero-Sum Game

Neil Ganju

Research Oceanographer, U.S. Geological Survey at Woods Hole

Wetland systems include marsh plains, mudflats, and channels. A "stable" system means elevation and the areal footprint of all components are constant. Sea-level rise represents a relative decrease in the elevation of the marsh, which means that more sediment is needed to keep the account balance stable. If there are no additional sources of sediment, the balance becomes depleted and the marsh is "in debt." The sediment-based definition of a wetland's "lifespan" is the time left until a marsh is in debt and the marsh plain is scavenged to feed mudflats and channels.

There is a strong correlation between the ratio of unvegetated-to-vegetated area (UVVR) and the net sediment budget. Vegetation acts as a frictional constraint on flow in tidal marshes and increases the deposition of sediment within the estuary. The increase in open water reduces the deposition of sediment within the marsh. The sediment budget refers to the balance between sediment added to, and removed from, the coastal system. When more material is added than is removed, there is a surplus of sediment. When more material is removed than is added, there is a deficit. Deposits of sediment can come from rivers, estuaries and the ocean; withdrawals are caused by currents, waves and dredging.

Measuring sediment flux is critical when estimating sediment budgets. Measurements have been conducted at multiple sites on the east and west coasts in the U.S. These studies are useful in predicting sediment budgets.

As mentioned there is a correlation between the sediment budget and open water coverage. Previous wetland studies focus on the vertical integration of marshes to establish marsh health. It is suggested that the unvegetated/vegetated marsh ratio (UVVR), an excellent indicator of the sediment budget, is used instead. UVVR can be measured and tracked through time with aerial imagery/satellites.

Jamaica Bay-wide sediment budgets are still unknown. There is only one sediment flux site in Jamaica Bay. It was established in 2014 on the Marine Parkway Bridge. The limited data suggests that Jamaica Bay's sediment budget is in deficit and that the wetlands will disappear in less than 200 years. It is critical to quantify the Bay-wide sediment budget and the lifespan expectation of the wetlands to plan for sediment replenishment and establish a habitat provision plan.

PRESENTATION:

Sediment Flux through Rockaway Inlet: Mechanisms & Implications

Bob Chant

Professor, Institute of Marine and Coastal Sciences, Rutgers University

Wetland models suggest that marshes are rarely in equilibrium but rather grow or erode. Based on eight month moored observations of currents and suspended sediment concentration in Rockaway Inlet, the flooding tide at Rockaway Inlet imports more sediment into Jamaica Bay than is exported during the ebb. The dominance of sediment flux during the flood tide is related to the velocity of tides which are stronger on the flood vs. ebb. This "tidal asymmetry" is a common feature in estuaries and the tidal asymmetry is augmented on spring tides when sediment flux into the bay is dominant. The input of sediment to the bay persisted throughout the year and appears to be augmented during storm events.

Assuming sea-level rises at a rate of 3-4mm/yr, Jamaica Bay needs a supply of about 100,000-200,000 metric tons of sediment per year, to maintain depth. The latest data shows about 50,000 metric tons/yr sediment input, which indicates Jamaica Bay is starved for sediment. Since not all the sediment flux at the inlet goes to marsh platforms, it is also necessary to understand the sediment transport inside the Bay.

Human engineering activities, such as hardening of the watershed and shoreline, reducing overtide, and increasing channel depth, have added to the sediment starvation of marshes in Jamaica Bay.

PRESENTATION:

Growing Tides & Surges, & Possible Sandy Solutions

Philip Orton

Research Assistant Professor, Stevens Institute of Technology

A monthly high tide map shows that Jamaica Bay is a flood risk area because of the amplification effects that increase tidal range, in addition to low elevation of the neighborhoods around the Bay and rising sea levels.

To understand the changes in Jamaica Bay, an 1877 land elevation map was used as a control to compare with current elevations (Figures 8a and 8b). Modeling of the 100-year flood event indicates that the landscape changes since 1877 have led to a 45cm increase in flood elevation in addition to mean sea level rise. This increase was caused mainly by the deepening and widening of Rockaway Inlet.

Two possible natured-based adaptation scenarios have been modeled to reduce water flow and flood levels/ area during storms. The first is inlet narrowing off eastern Coney Island and Floyd Bennett Field using sand (a sand engine), living shoreline wetlands, or breakwaters. The second is sand replenishment (gradual, over several years) in over-dredged channels to shallow them to a 20-foot depth, the permitted depth for the federal shipping channel. This could also improve the sediment supply for marshes in the Bay.

The AdaptMAP Dynamic Flood Mapper tool can be used to visualize changes in the flood zone by the addition of different adaptation techniques. Ongoing work includes:

- A cost-benefit analysis for inlet narrowing and sand replenishment;
- More detailed modeling on other adaptation options and metrics related to flood reduction, water residence time, and oxygen;
- Storm/wave simulations, and vegetation drag impacts for reducing storm/wave impacts

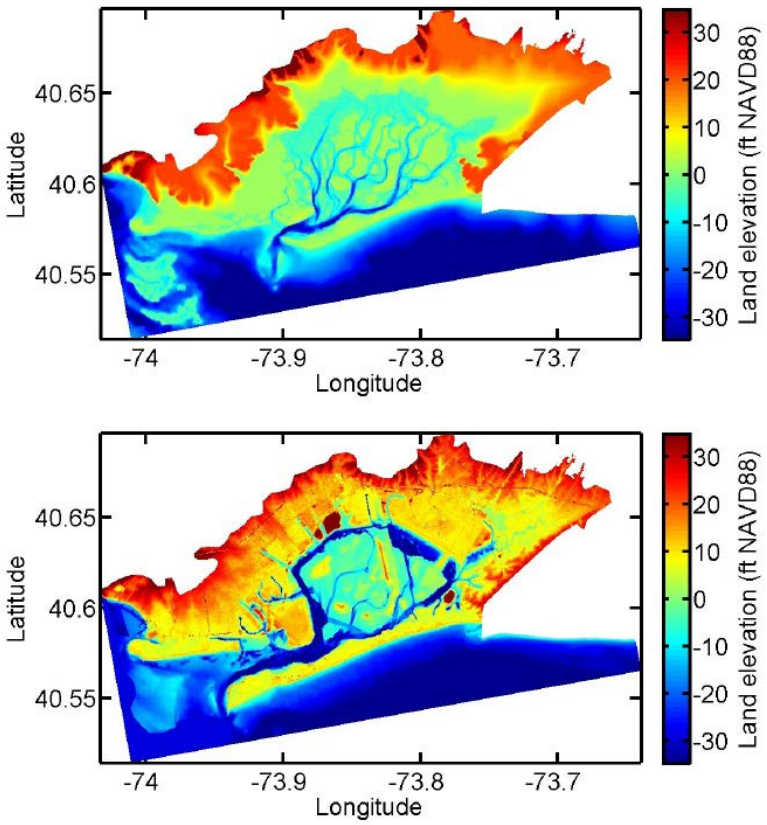


Figure 8a and 8b.
Land elevation in 1877 (8a top)
land elevation in 2013 (8b bottom),
http://adaptmap.info/jamaicabay/technical_report.pdf

PRESENTATION:

Development & Evaluation Criteria for NYCDEP for Jamaica Bay Landside Models

Keith Mahoney

Division Chief Regulatory Planning, NYC Department of Environmental Protection

On March 8, 2012, the New York State Department of Environmental Conservation (NYSDEC) and NYCDEP signed a groundbreaking agreement to reduce combined sewer overflows (CSOs) using a hybrid green and gray infrastructure approach. As part of this agreement, DEP will develop 10 waterbody-specific Long Term Control Plans (LTCP) plus 1 Citywide/ Open Waters LTCP to evaluate alternatives to reduce CSOs and improve water quality in NYC's waterbodies and waterways. The goal of each LTCP is to identify appropriate CSO controls necessary to achieve waterbody-specific water quality standards, consistent with the Federal CSO Policy and the water quality goals of the Clean Water Act. The CSO LTCP is due June 2017.

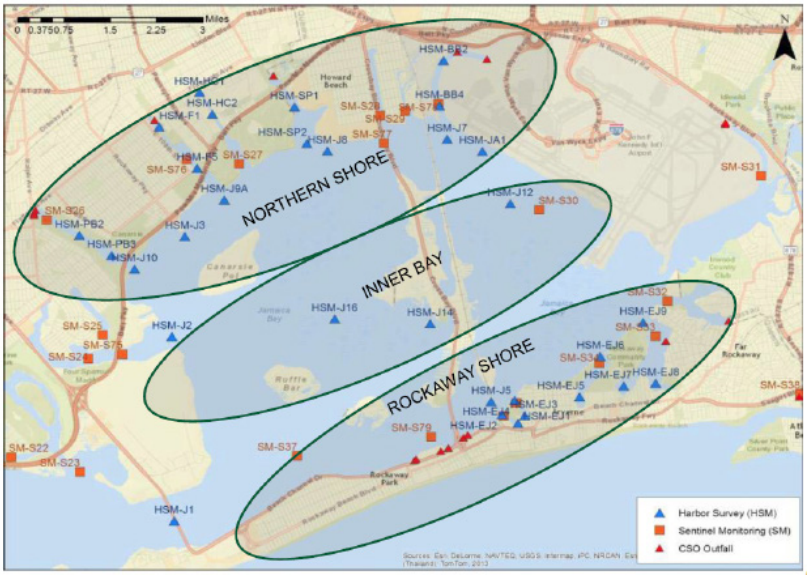


Figure 9. NYCDEP Jamaica Bay Survey Areas for Water Quality

In CY 2015 DEP conducted an extensive flow monitoring and sampling program to supplement existing data sets to better quantify water quality conditions and calibrate the landside and water quality models. To assess water quality conditions, Jamaica Bay was divided into three survey areas: Northern Shore, Inner Bay and Rockaway Shore (Figure 9). The sampling data indicates that bacteria levels near the Rockaway Shoreline and Inner Bay were very low even following a wet weather event. Levels on the Northern Shore were elevated following wet weather events indicating some degree of wet weather impairments. Both fecal coliform and enterococcus were used as pathogen indicators and the enterococcus, a bacteria common in the feces of warm-blooded animals, including humans, seemed to correlate better to the CSO and stormwater loadings. The U.S. Environmental Protection Agency (EPA) recommends using enterococci in place of fecal coliform bacteria as the preferred pathogen indicator for marine recereational waters.

DEP is using a calibrated InfoWorks CS model to simulate its collections system to evaluate various CSO control alternatives to reduce the volume and frequency of CSO discharging into the bay. These modeled CSO loadings will then be input into the water quality models to simulate the water quality responses for the various CSO controls and assess attainment with applicable water quality standards. In conjunction with this extensive modeling, DEP needs to conduct constructability analysis and cost estimating of the various retained alternatives to select most viable alternative(s) to be recommended as part of the Jamaica Bay LTCP.

The NYCDEP is also focused on nitrogen removal and both the 26th Ward and Jamaica Wastewater Treatment Plants (WWTPs) have been upgraded for Step Feed Biological Nitrogen Removal (BNR). Supplemental carbon addition to enhance nitrogen removal has recently been placed into operation at the 26th Ward WWTP and will soon be in operation at the Jamaica WWTP. The Step Feed BNR upgrades for the Coney Island and Rockaway WWTPs are currently in design phase with construction anticipated to begin in the near future. Amended water quality sampling parameters will be detailed in a forthcoming letter to the NYSDEC. The water quality sampling of the Phase 1 Post-Construction Monitoring is expected to start by August 1, 2016.

PRESENTATION:

Green Infrastructure Implementation in the JB Watershed

Miki Urisaka

Engineer, Office of Green Infrastructure, NYC Department of Environmental Protection

Jamaica Bay is surrounded by large Combined Sewer Overflow (CSO) watersheds. Green Infrastructure (GI) storm source control methods are designed and implemented to catch stormwater and reduce CSOs. The combined sewer system watersheds in both Queens and Brooklyn are currently planning for prioritized GI application. The DEP Green Infrastructure Program Map was developed to identify Green Infrastructure sites in NYC. It can be accessed at www.nyc.gov/dep/gimap.

Monitoring protocol development is currently in the experiment stage. Other current research and development programs include a 5-year program of data collection and the development of CSO performance metrics modeling. The models will assess the role of Green Infrastructure in CSO reduction. Cost benefit analysis has begun to establish baseline program costs and then will expand for larger analysis. Current operations and maintenance are focusing on manual and workforce training and will potentially include optimization and standard operating procedures.

Monitoring protocols:

- Review Previous/existing protocols;
- Establish experimental procedures;
- Develop a schedule for research targets and experimental time lines;
- Create a data management plan;
- Refine and update procedures throughout project.

Some sample monitoring data was shown for existing implementation but the monitoring period is too short to make conclusions.

SESSION:

Ecological Studies

10:55 AM - 12:25 PM

Ecological studies increase our understanding of the health (biodiversity and function) of Jamaica Bay ecosystems, and their resilience to ongoing stressors and potential perturbations. They help develop appropriate management actions to conserve or improve the health of the Bay. Research addresses gaps that limit our understanding of Bay organisms and processes, and hinder our ability to make important management decisions. Jamaica Bay has a broader context as the relevance of local research contributes to regional questions and demonstrates opportunities for knowledge exchange.

Co-Chairs

Christina Kaunzinger, *Senior Ecologist, Center for Urban Restoration Ecology at Rutgers University*
Patti Rafferty, *Chief of Resource Stewardship, Gateway National Recreation Area, National Park Service*

Presenters

Chris Gobler, *Professor, School of Marine and Atmospheric Sciences, Stony Brook University*
Chester Zarnoch, *Assistant Professor of Environmental Studies, Department of Natural Science, Baruch College*
Jim Vasslides, *Program Scientist, Barnegat Bay Partnership*
Russell Burke, *Professor of Biology, Hofstra University*
Christina Colón, *Assistant Professor of Biological Sciences, Kingsborough Community College*

PRESENTATION:

Acidification & Hypoxia in Jamaica Bay: Implications for Bivalve Populations

Chris Gobler

Professor, School of Marine and Atmospheric Sciences, Stony Brook University

The discharge of nutrients into coastal zones stimulates algal blooms. The respiration of the corresponding phytoplankton and the decay of algae take up the dissolved oxygen (DO) in the water and cause high carbon dioxide and low pH.

Growth and survival of shellfish is negatively related to carbon dioxide concentration. The growth rate of bay scallops and hard clams was significantly affected by the presence of both hypoxia and acidification in their early life stage. Those that had greater carbon dioxide exposure were smaller and had weaker shells.

The research team used field surveys of water quality and continuous measurements of carbon dioxide and pH to quantify the temporal and spatial dynamics of hypoxia, acidification and bivalve growth in Jamaica Bay.

Water quality analysis revealed that dissolved oxygen levels and pH are higher during the day in surface waters. Based on surveys in 2015, monthly carbon dioxide concentration peaked in September when DO was also at its lowest level. Spatially, the concentration of DO is low at the north shore area of the Bay and high in the Bay's inlet. The carbon dioxide concentration is negatively related to DO. In the area near Kennedy Airport, pH and DO generally decreased with a large diurnal variability from July to October. The bottom waters had a significantly lower level of pH and DO, and experienced three months of hypoxia. Overall, pH and DO are positively correlated throughout the Bay.

The growth and survival experiment on bivalves revealed that the water quality in June is more suitable for bivalve growth and survival than during the month of September. Spatially, the bivalves' life condition improves closer to the inlet. Although the data showed ideal levels of food and temperature in September, the hypoxia and acidification during this period slowed the growth rate of bivalves (Figures 10 and 11).

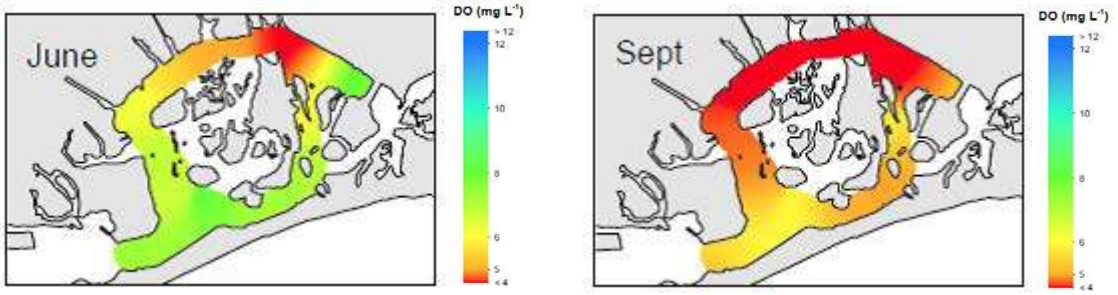


Figure 10. Dissolved oxygen (mg/L)

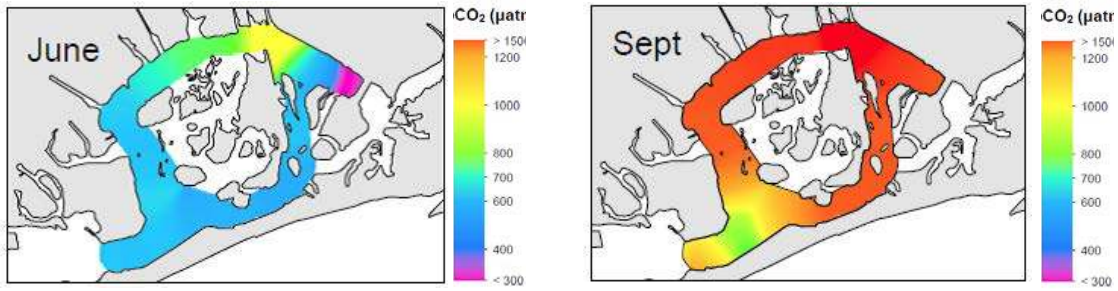


Figure 11. Acidification (pCO2), Wallace and Gobler, in prep.

PRESENTATION:

Assessing Ecosystem Processes & Services in Jamaica Bay's Restored Salt Marshes

Chester Zarnoch

Associate Professor of Environmental Studies, Department of Natural Science, Baruch College, CUNY

Government agencies across all levels have spent $200 million on 25 salt marsh restoration sites in New York City, including four in Jamaica Bay. The restoration projects took place on Big Egg, Elders East, Elders West, and Yellow Bar marshes from 2003 to 2012. Black Bank marsh served as a degraded reference.

In 2015, surveys were performed at the Yellow Bar and Elders East sites to study the role of the restored marsh in nitrogen removal and determine if they became nitrogen sinks or sources. There are three nitrogen pathways: retention, removal and recycling. Retention and removal decrease the amount of available reactive nitrogen in an ecosystem, while nitrogen recycling maintains the amount of reactive nitrogen available.

The results showed that an older marsh removes nitrogen from the water faster than a newly restored marsh. After several years of growth, the restored marsh had a similar nitrogen removal rate as compared to natural marshes. Based on the data collected in 2015, the marsh biomass, carbon, and nitrogen storage increased over time in the restoration sites resulting in increased stability and productivity.

A challenge for restoration is that it takes a restored marsh many years to be as effective as a natural marsh. None of the restoration sites have yet reached natural nitrogen and carbon thresholds. Denitrification rates are high at older restored marshes, so there needs to be a balance between denitrification and carbon accumulation in restored wetlands.

PRESENTATION:

Using Ecosystem Models to Understand Complex Estuarine Interactions

Jim Vasslides

Program Scientist, Barnegat Bay Partnership

Estuaries are complex, highly productive ecosystems with many habitats and anthropogenic stressors. Ecosystem models need to integrate the interaction between complex ecosystem components and the cumulative impacts of a full range of management activities. Ecopath/Ecosim is a quantitative two-part modeling system that balances production and consumption within groups of species. An Ecopath model uses the following data to model each species within an existing ecosystem:
Monitoring protocols:

- Biomass;
- Production/Biomass;
- Consumption/Biomass;
- Other mortality (proportion);
- Diet information (proportion) (trophic link between groups);
- Catches (both commercial and sport);

A simulation using Ecopath produced a static, mass-balanced snapshot of the system of Barnegat Bay, NJ. It incorporated forcings (commercial catches, environmental factors, etc.) and demonstrated the model fitting process using observational data from routine monitoring and independent fishery surveys. A simulation using Ecosim, a time-dynamic simulation module for policy exploration, demonstrated that the impact of a management scenario on an ecosystem can vary from species to species.

In a trophic model, which captures feeding habits or food relationships of different organisms in a food chain, non-fishing impacts can be creatively incorporated. The models are data driven making the reliability of the results highly dependent on the quality of the data used to construct the model.

PRESENTATION:

Long Term Population Trends in Jamaica Bay Terrapins: Comparison with Regional Trends

Russell Burke

Professor of Biology, Hofstra University

This study focused on the Jamaica Bay Diamond Back Terrapin populations and compared them with regional trends of other terrapin populations along the Atlantic coast (Figure 12). Terrapins live in coastal, brackish marshes. They are sexually dimorphic and only females venture onto land. The study found that a female terrapin lays 1–3 clutches per year with an average of 13 eggs per clutch, and that raccoons eat 93-98% of the unprotected eggs.

The study, which began in 1998, examined female terrapins to understand basic population ecology. Terrapins' diets include crabs, periwinkles and clams. The Jamaica Bay population of terrapins eats significantly more plants than do other populations.

Since 1998, the number of nests has declined across all populations. Possible causes of their decline are: nitrogen pollution, changes in clutch size, diet change, habitat loss, and endocrine disruptors. Much is still unknown. What is the population of terrapins in Jamaica Bay? What other factors affect population size? Why does the Jamaica Bay terrapin population's diet differ from others? In what other ways might Jamaica Bay terrapins differ from non-urban population?

Some possible research needs include regular surveys of indicator species, long-term data collection of Ulva abundance, and standardized annual surveys of major invertebrate species.

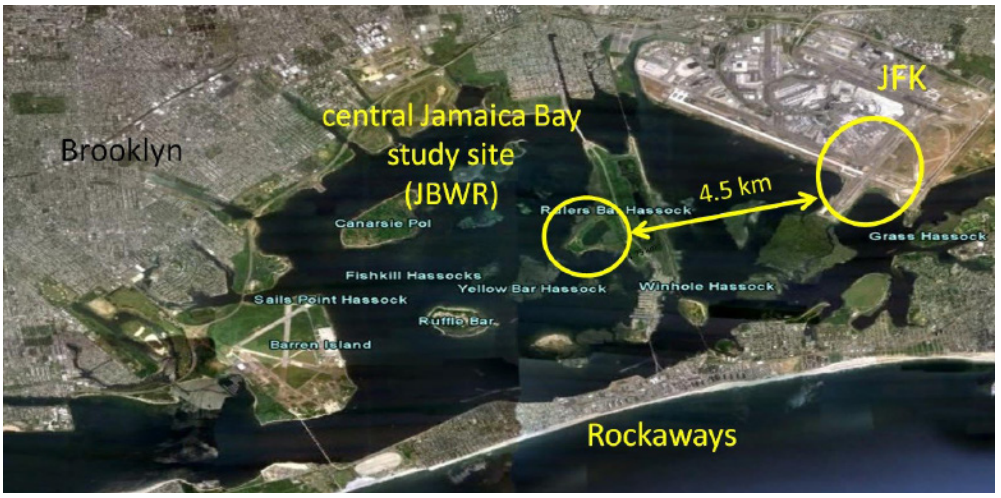


Figure 12. Jamaica Bay diamond back terrapin study area

PRESENTATION:

Beach Nourishment & Restoration of Horseshoe Crab Spawning Habitat in Jamaica Bay

Christina Colón

Associate Professor of Biological Sciences, Kingsborough Community College

A study was performed to see if beach replenishment supported increases in horseshoe crab populations. Two beach sites on Plumb Beach were selected: West beach, which was re-nourished just before Hurricane Sandy, and East beach, a natural/reference site. What was the effect of beach replenishment on horseshoe crab populations on the West beach after Hurricane Sandy? Would the replenished beach support increasing numbers of horseshoe crab nests? The number of horseshoe crabs was measured at both sites for four years (2013 to 2016) during high tide full and new moons, from May through June.

Large populations of horseshoes crabs were observed at high tide and full moon on the East beach. Egg counts remained low on the restored West beach, and surprisingly, egg counts also started to decrease on the East beach. Much of the restored sand remained on the West beach after Hurricane Sandy providing what was thought to be suitable habitat for horseshoe crab breeding.

A hatching event was observed on West beach, a more recent population decline was observed on the East beach site. Concurrently, juvenile populations increased in a nearby eastern tidal creek, which seemed to have become a refuge. The initial deposition of sand added finer sediment to West beach. During Hurricane Sandy coarse grains were washed up on the East beach. Both West beach and East beach sediment became harder after Hurricane Sandy. Is it the hardness of the beach that is affecting horseshoe crab nesting patterns? Additional data is needed to understand why there are changes in spawning patters at all three locations.

KEYNOTE SPEAKER SUMMARY:

The Historical Ecology of Jamaica Bay: A Context for the Future

12:25 PM - 1:25 PM

Eric W. Sanderson

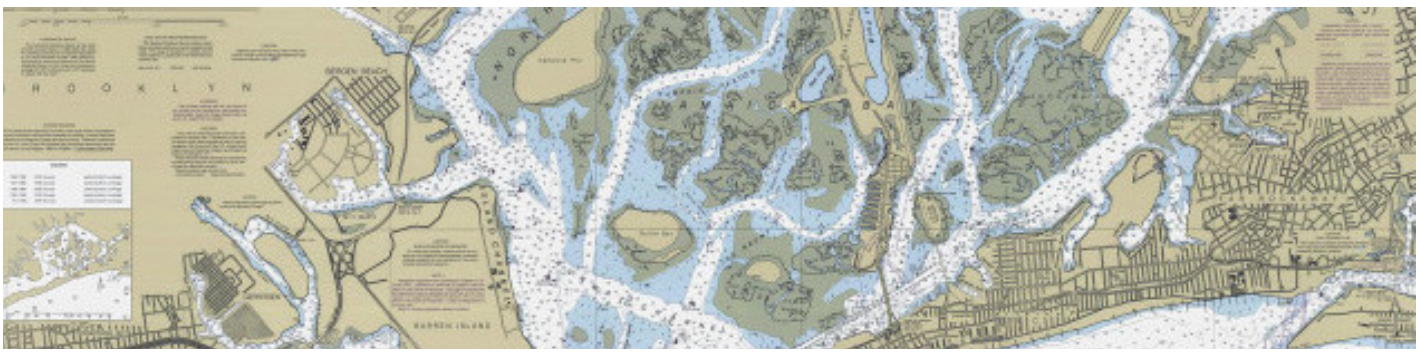
Senior Conservation Ecologist, Wildlife Conservation Society, (Bronx, NY)

Eric W. Sanderson is the author of the best-selling Mannahatta: A Natural History of New York (Abrams 2009). Subsequently he developed the Welikia Project (formerly Mannahatta Project) which explores the historical ecology of the five boroughs. Sanderson's other books include Terra Nova: The New World After Oil, Cars and Suburbs (Abrams 2013), which focuses on the prospect for an American landscape beyond oil, cars and suburbs, and Prospects for Resilience: Insights from New York City's Jamaica Bay (Island Press, 2016), which he co-edited with three others. Visionmaker.nyc (AKA Mannahatta 2409) is an online forum to help the public envision climate-resilient designs for New Yok City. In his conservation work, Sanderson helped create the human footprint map of the global impact of anthropogenic activity, the landscape species approach to conservation, and the range-wide priority-setting for wide-ranging wildlife species. Sanderson holds a Ph.D. in ecology, with an emphasis in ecosystem and landscape ecology, from the University of California, Davis.

Cartographic Evidence for Historical Geomorphological Change & Wetland Formation in Jamaica Bay, New York

Natural history is concerned with how organisms and ecosystems change through time. Coastal landscapes are particularly fascinating because their spatial and temporal dynamics require the naturalist to resolve the combined effects of climate change, geomorphological processes, and ecological interaction. A comprehensive collection of historical maps from the 16th century through the mid-19th century was assembled to study the barrier islands, wetlands, and general shape of Jamaica Bay. These maps suggest that Jamaica Bay was formerly much more open, and without the marsh islands that are today the subject of intense scrutiny and restoration. A cartographic-driven hypothesis regarding the east-to-west progression of the Rockaway Peninsula, which in turn led to salt marsh formation, suggests that the development of the marshes occurred approximately 200–230 years ago, much earlier than had previously been suggested. This hypothesis is supported by the discussion of independent observations from soil cores taken in the Jamaica Bay marsh islands. Further details can be found in Sanderson, EW (2016) "Cartographic Evidence for Historical Geomorphological Change and Wetland Formation in Jamaica Bay, New York", Northeastern Naturalist 23(2): 277-304.

Begun as an inquiry into the evolution of Jamaica Bay's marsh islands, the value of this research may lie in its ability to provide context for current decisions about flood protection and coastal ecology. Future modifications to the Bay should take into account the geomorphological and ecological factors that have shaped the Bay and its ecosystems for centuries. Historical factors, rather than being made irrelevant by climate change, may in fact become even more important in the future, because coastal environments like Jamaica Bay are dependent on tides, storms, winds, and other aspects of the climate system.



SESSION:

So, What is the State of the Bay?

12:25 PM - 1:25 PM

The objective of this break out session was to solicit input from symposium attendees on what they believe are the main priorities, challenges, and opportunities in the Bay. The results provided useful feedback that will aid future planning and research efforts and the dissemination of knowledge of Jamaica Bay.

Co-Chairs

Jessica Fain, *Program Director for Policy, Planning, and Engagement, Science and Resilience Institute at Jamaica Bay*
Lesley Patrick, *Program Director for Assessment and Modeling, Science and Resilience Institute at Jamaica Bay*

The attendees were divided into 12 groups. Each group had a facilitator who directed the group as they answered three questions:

1. *Reflect on the symposium panels so far. What is the most salient finding(s) about the State of the Bay that you have heard? What findings seem to be most certain?*

2. *What is missing from the conversation? What are the other most pressing needs? Some examples include, by are not limited to, data gaps, research gaps, information sharing needs, and education linkages.*

3. *What are the big opportunities that exist to improve the environmental and social conditions of the Bay?*

A number of ideas placed SRIJB in an important role within Jamaica Bay. There was a growing consensus that one of the most important roles for the SRIJB is to foster and structure dialogue and aid in coastal resilience projects. Other suggestions were that SRIJB should engage in research and community outreach, be a clearinghouse of information and an incubator of ideas, identify different perspectives of stakeholders, facilitate a comprehensive monitoring plan, and provide a matchmaking service between research and programs, and the communities that they affect.

1. *Reflect on the symposium panels so far. What is the most salient finding(s) about the State of the Bay that you have heard? What findings seem to be most certain?*

The answers to this question included established science about the Bay as well as outstanding research and information needs. Since Hurricane Sandy, government agencies and foundations have made significant investments into research and resiliency in and around Jamaica Bay. Research of the physical systems has been extensive, including measures of water quality, the importance of sediment budgets and transport, and the geomorphology of the Bay. Much of the research on the Bay and its wetlands identify areas of concern including sea level rise, wetland loss, inadequate sediment budget and changes in wildlife populations.

The symposium offered many opportunities for participants to talk about the issues of social and ecological resilience. The Bay as a system will continue to be a place of ongoing dynamic change. We need to understand the goals for restoration, social and environmental resilience, and how they are to be balanced. There is still much that is unknown about Jamaica Bay.

2. *What is missing from the conversation? What are the other most pressing needs? Some examples include, by are not limited to, data gaps, research gaps, information sharing needs, and education linkages.*

The lack of integration of data and coordination between interested parties were overwhelmingly identified as problematic. For example: exchanging and sharing information; coordination of data collection; and a need for standards and agreed upon methodology. Setting goals was also seen as an area of need, including the kind of resilience that should be achieved, the targets that should pursued, the necessity of a unified vision for the Bay.

Specific data gaps that were identified include long term monitoring and the long term data it would produce, stronger links between modeling and physical knowledge, determination of desirable states, and an overarching analysis of the big picture.

Lack of species data was also seen as a need, including spatial distribution of species, an understanding of the changes of populations, and the effects of water quality on crustaceans, including mussels, clams and oysters. Physical data gaps included nighttime water quality assessments, sediment budgets for the entire Bay, information about ground water, and studies of sediment cores.

It was felt that there were important players in the Bay that were not included at the Symposium including: non-bay front communities, and business interests such as industry, real estate, and insurance. Policy makers, as well as those involved with planning and zoning, were also not well represented.

The social research that was also found to be missing included an analysis of funding, agency jurisdiction, civil infrastructure, and private actors. The research also needed a better framing of management questions and an overall need for improved integration of the social sciences.

Community engagement was also a main topic. Questions such as how to engage non-Bay front communities that live within watershed were raised, and challenges such as the inability of stakeholders to attend weekday meetings were identified. Early childhood education, stewardship programs and citizen science projects were suggested as ways to overcome some of these obstacles.

3. *What are the big opportunities that exist to improve the environmental and social conditions of the Bay?*

Data gaps on ecosystem services and the positioning of Jamaica Bay within a global context were identified as future subjects for discussion. Workshops, forums, outreach and engagement, interagency and community meetings, as well as additional symposiums like State of the Bay, were suggested as ways to move forward. It was seen as important to include other decision makers in future conversations, including business interests, and political and governance organizations.

A portion of this discussion focused on assessing retreat and adaptation options, and ways to increase stakeholder participation in the conversation. Embedded within the retreat and adaption conversation were the subjects of environmental justice, community vulnerability, land appropriation, and policies such as requiring the inclusion of open space with future developments around the Bay.

SESSION:

People, Place & Social Meaning

3:10 PM - 4:40 PM

The social science session focused on communities living adjacent to Jamaica Bay. It addressed communities in transition, including socio-economic aspects related to Hurricane Sandy, abiding social and cultural norms related to place attachment, and the socio-cultural benefits of public space. The session also addressed projects that seek to integrate and operationalize both social and ecological data. It concluded with a discussion and suggestions for future areas of social science research.

Co-Chairs

Erika Svendsen, *Research Social Scientist, U.S. Forest Service, New York City Urban Field Station*
Helen Cheng, *Coastal Resilience Specialist, New York Sea Grant in partnership with the Science & Resilience Institute at Jamaica Bay*

Presenters

Gretchen Ferenz, *Partner, Tom Fox & Associates; retired Senior Extension Associate, Urban Environment, Cornell University Cooperative Extension*
Malgosia Madajewicz , *Associate Research Scientist, Columbia University*
Heather McMillen, *Postdoctoral Research Social Scientist, U.S. Forest Service, NYC Urban Field Station*
Justin Bowers, *Public Engagement & Restoration Manager, Natural Areas Conservancy*

PRESENTATION:

Community Resilience in Jamaica Bay: Understanding Research & Extension Needs

Gretchen Ferenz

Partner, Tom Fox & Associates; retired Senior Extension Associate, Urban Environment, Cornell University Cooperative Extension

There is a need to engage communities in research in order to build social science capacity. It is the people who live, work, and utilize Jamaica Bay that determine resilience. For many people, Hurricane Sandy and its aftermath shaped public understanding of resilience. There is a diversity of relationships with the Bay based on historic, economic, and cultural connections.

The Rockefeller Foundation sponsored a research project on resilience practices in Jamaica Bay. The first task was to conduct a community needs assessment and design a community resilience extension service program. The Community Needs Assessment was conducted from March through August 2014. It examined the following communities in Brooklyn: Bergen Beach, Brighton Beach, Canarsie, Coney Island, East NY, Georgetown, Gerritsen Beach, Manhattan Beach, Marine Park, Mill Basin, Mill Park, Paerdegat Basin, Sea Gate, Sheepshead Bay, Spring Creek. It examined the following communities in Queens: Arverne, Breezy Point, Broad Channel, Far Rockaway, Howard Beach, Neponsit, Roxbury, Rockaway, and Rockaway Park.

The assessment included interviews of 33 key stakeholders and nine focus groups. The discussions focused on existing community resources, community needs in order to maintain resilience, how communities weather disruptions, their relationship with the Bay, and best practices.

The results of the study identified lack of accessibility and mobility as problems that make residents feel cut off from the rest of the city. Residents had limited public transit, limited points of ingress and egress, limited routes for evacuation, and felt underserved by city services. Yet at the same time, isolation was also seen as a benefit. Residents chose their more isolated communities because they wanted to live in a

safer environment, be close to water and to have a sense of being close to, but not in, the city. While isolated communities are vulnerable to environmental fluctuations, isolation leads to greater social resilience because they are better able to manage resources, communicate, etc.

Perceptions of community resilience appear to change over time, presenting a challenge for researchers. Recommendations are for the development of data collection tools that can capture data quickly and accurately across different points of time, additional efforts to reach and engage vulnerable populations, translating scientific knowledge, engaging communities in research, and applying that research at local levels.

PRESENTATION:

Resilience to Coastal Storms in Urban Neighborhoods

Malgosia Madajewicz
Associate Research Scientist, Columbia University

The research objectives were threefold:

1. Identify factors that contribute to the vulnerability of populations in urban neighborhoods to coastal storms. Who and what are vulnerable, and why?
2. Identify strategies that can help to build resilience to coastal storms in urban neighborhoods.
3. Establish a baseline against which progress in building resilience can be measured.

Populations experience vulnerability to climate risks in different ways. It is important to determine the vulnerabilities for each risk and their cause. Which strategies can aid in building resilience to coastal storms and how can we establish a baseline against which we can measure building greater resilience over time? In this study, resilience refers to the susceptibility of people to suffer a loss from an event, and their ability to recover from that loss. Loss and the ability to recover depend on an individual's assets and resources, their access to information, local organizations and social networks, and the types of assistance available.

A comparative case study examined the Rockaways and southeastern Staten Island, two communities that were heavily damaged by Hurricane Sandy. Both neighborhoods had very similar exposures to the storm, but had different socio-economic characteristics and institutions. Data were collected at each research site through in-depth interviews with community leaders and others who had helped with the recovery, and a household survey of 250 residents.

The findings were that loss and the ability to recover depended on an individual's assets, their access to information, social networks, and the types of assistance available. Low and middle-income homeowners seem to be the most vulnerable and the least recovered group. Many have not yet been able to fully repair the damages to their homes. Low-income populations, who were more likely to be renters, were vulnerable in different ways from homeowners. They tended to recover more quickly and completely. Recovery proceeded more quickly on Staten Island than in the Rockaways because established non-profits existed on Staten Island before the storm and were able to take on the task of rebuilding homes. Social networks, volunteer groups, local community groups, and non-profits played a major role in relief and recovery.

Much of the post Sandy rebuilding is not resilient, which, together with the expense of the recovery borne by neighborhood residents, has increased vulnerability to future storms. Even some of the less expensive methods such as elevating electrical equipment are not being incorporated in rebuilding homes and communities.

Building resilience is likely to be faster if communities that are at risk are more involved in the process and better informed about future flood risk, ways to prepare, and resources for recovery. Partnerships between government agencies and community, volunteer, and non-profit groups can pair local knowledge and responsiveness that exist at the community level with the greater resources, technical expertise, and regulatory ability that government agencies possess.

PRESENTATION:

The Nature of Social Resilience: Psycho-Social-Spiritual Benefits of Jamaica Bay

Heather McMillen
Postdoctoral Research Social Scientist, U.S. Forest Service, NYC Urban Field Station

In 2013–2014, the NYC Urban Field Station conducted a social assessment in NYC parks with the goal of improving the quality of life in urban areas by conducting and supporting research about social-ecological systems and natural resource management. Adaptation planning must include ecological and social science with global and local perspectives, and cultural values. Indicators of social resilience are place attachment, social networks, social cohesion, and spirituality. Psychological-social-spiritual benefits refer to connections with self (identity), others (social ties), and the larger reality (connections beyond limitations of one's own physical body and time, and connection with the divine in nature).

What are the uses of natural areas as conveyed though human behaviors and descriptions? And how can the findings inform adaptations and management of parks and natural areas? Research methods included direct human observation, observed signs of human use, and conducted rapid randomized interviews.

The results found that visitors use parks for recreation, socializing with others, connecting with themselves, and for refuge (Figure 13). People are adapting the natural spaces where they make these connections. They utilize space to connect with a larger reality through prayer and meditation. Often you will encounter memorials or shrines, indicating how people use areas to connect with loved ones beyond their lifetimes and engage with deities.

A bio-cultural approach to resource management considers both social and ecological factors in resource management. Place attachment is important for resource managers because higher attachment is associated with pro-environment behaviors. Spirituality can promote community resilience to cope with disturbances. Communities are more resilient when they respect a diversity of values and views in regard to engaging nature.

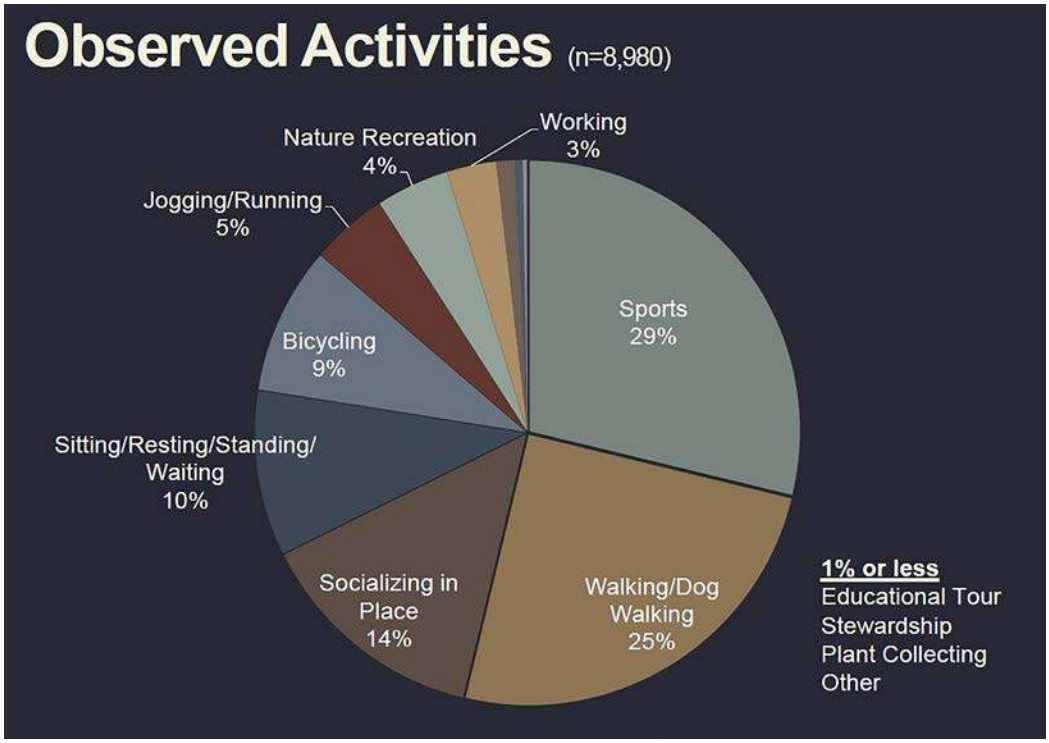


Figure 13. Observed activities in NYC Parks

PRESENTATION:

Changing Public Perception & Improving Access: Marine Park, Brooklyn

Justin Bowers

Public Engagement and Restoration Manager, Natural Areas Conservancy

The Natural Area Conservancy's (NAC) goals are to ensure healthy forests, promote costal resilience, cultivate and nurture community engagement and create resources to inform planning and articulate needs. Ecological assessments were conducted over the five boroughs to identify the composition of natural areas, and to identify health and threats.

The 800 acres of Marine Park, established in 1917, comprise the largest park in Brooklyn (Figure 14). Of the 800 acres, 315 located on the western side of the park comprise a preserved natural area. Formerly a wetland, it was landfilled in 1935 and has developed into maritime forest and shrubland, containing both rare and valuable ecological communities in New York City. The NAC's trail restoration project in Marine Park aims to create a formalized trail system at this site. Currently there are nearly 12 miles of trails. The goal is to replace these 12 miles of trail with a large loop that will have shore access at several locations.

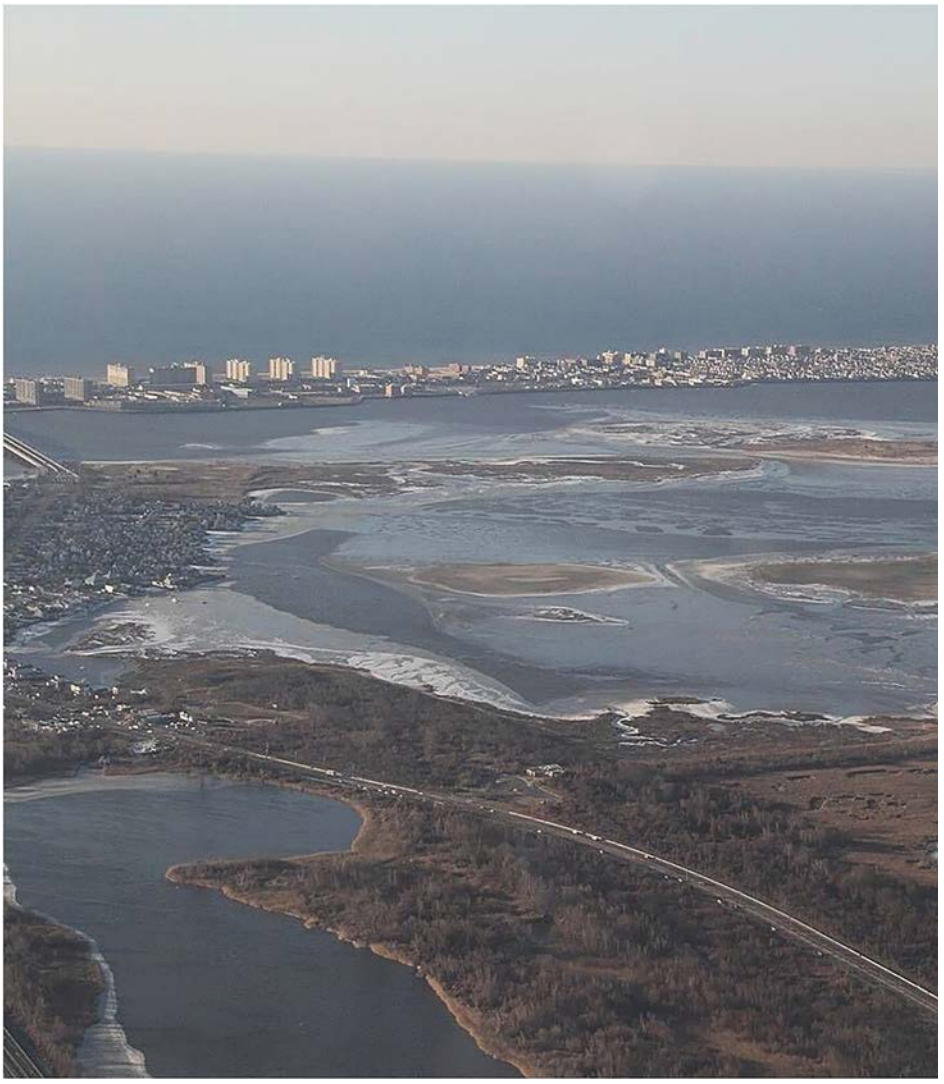
Gerritsen Beach is a geographically isolated community that abuts the preserved natural area. Together they occupy a small peninsula creating a close and private relationship. The community has a small town feel with longstanding historical roots, and values its isolation.

Pre- and post-project monitoring will help to understand the distribution of ecological assets and threats and engage stakeholders. Two public meetings have been held and 20 groups including city council, community boards, and law enforcement have been included in the process. At the first meeting that was held in Garretson Beach, the project was met with opposition. The community's major concern was that improvements to the park would attract outsiders. A second meeting held off-peninsula with surrounding Marine Park communities garnered a much more positive response.

The challenges to the project are the community's ambivalence, and managing the park without maintaining a permanent presence. The public engagement process benefits from addressing issues across scales (such as community levels). Changing long term patterns of use in a short time frame requires active engagement. Future events will engage volunteers to clean up the shoreline. Another project will have students engage visitors with a questionnaire and monitor trail usage.

Participant Feedback

Following the symposium, Science and Resilience Institute at Jamaica Bay sent a survey to all the participants via email. Thirty percent of the attendees responded. An analysis of the survey identified a number of items that the majority of the respondents agreed upon. The first set of questions was about the organization of the event, venues, cost, etc. The second set of questions asked if the symposium met its goals. The third set of questions asked about the value of the symposium, what people liked best, and invited suggestions for future events.



Did the symposium meet it's three goals?

1. Provide information and content that participants can use freely.

2. Provide the opportunity to interact with other professionals in your field.

3. Offer a broad array of issues involving Jamaica Bay.

Section 1: Event Logistics, Organization, & Cost

The Day 1 venue, Aviator Sports Center at Floyd Bennett Field, was not reviewed very highly. The problem with acoustics made hearing the day's proceedings difficult. However the Day 2 venue, Brooklyn College Student Center, was reviewed favorably by more than 75% of respondents. When asked about the cost/value of the event 77.5% thought that the Symposium was well valued. The afternoon boat tour onboard the American Princess was appreciated by all. It was very satisfying to SRIJB to see that 100% of the attendees thought the event was well organized.

Section 2: Symposium Goals

The goals of the Symposium were:

1. To provide information and content that participants can use freely.

2. To provide the opportunity to interact with other professionals in your field.

3. To offer a broad array of issues involving Jamaica Bay.

The variety of topics (91.8%), the breadth of issues presented (93%), and the professional values of the content (97.5%), all received positive responses. The information presented was viewed as valuable to the respondent's organization (72.5%). Participants felt they had learned and gained a greater understanding of current research (77.5%). Many thought there could have been more information on policy and management. The Symposium offered a good opportunity to meet with other professionals (97.5%).

Section 3: Symposium Value & Suggestions for Future Events

There were requests for more focus on the social sciences and, as mentioned in Section 2, more information on policy and management. A significant number of people commented that they would prefer an approach that integrates science and policy rather than have them as separate sessions. In general, attendees expressed an interest in not only knowing about the different subjects, but also how they relate and interact with each other.

The following are some of the comments provided by the respondents:

- "Breakout sessions were good because they brought together people from different disciplines."
- "The variety of panels provided a perspective of the different kinds of science being performed around the Bay as well as the different management and policy issues."
- "I appreciated the policy, science, and community themes, but would have liked to hear more about their intersection."
- "I would have liked more interaction with communities including community boards, civic associations, community based organizations (CBO) and recreational groups. "
- "More focus on politics (which goes beyond policy); Don't treat social science as an afterthought."
- "In the future, include real estate, land development, and the housing industry."
- "Better coupling of science and policy. In particular, how are policymakers taking into account scientific understanding of the Bay in the decisions they are making?"
- "I really enjoyed the small group discussion and hope that we continue to do that in future meetings."

Discussion

The primary objectives of the State of the Bay Symposium were to engage and connect a variety of audiences in a discussion of relevant knowledge, strategies, and practices in Jamaica Bay; to link science and research with decision-making; and to inform management efforts. The symposium programming addressed these objectives through a diversity of representation and content, as well as a deliberate pairing of science and management topics.

With respect to the first objective, a tremendous amount of new and synthesized information was packed into this two-day event, with presentations from four NYC offices and departments, five state and federal agencies, nine community groups and organizations, and researchers from ten different institutions. Attendees appreciated the breadth of topics spanning human, physical, and ecological components of Jamaica Bay, and felt the content was professionally valuable. The diversity of groups that attended, as well as the interaction fostered among participants (particularly during the afternoon boat tour and the small breakout groups) indicated success in connecting audiences with one another and also with the subject matter.

The second objective was to connect relevant science and research information with decision-makers and managers, and inform them of resilience-based strategies and practices in Jamaica Bay. To highlight this connection, the planning committee developed a paired researcher-practioner session co-chair model to bring both research and management perspectives to their topic. Session co-chairs developed speaker formats that emphasized the utility of their research and the needs of stakeholders in Jamaica Bay, and also developed targeted questions for discussion. Despite these strategies, some attendees indicated a preference for even greater emphasis on policy and management strategies and a more targeted discussion of the intersection of policy, science, and community in future events.

Historically, the State of the Bay Symposia have been held every two years, though the frequency has now been scaled back to every three years, to sync with the Jamaica Bay Watershed Protection Plan updates. With less frequent symposia, it may be valuable to increase the venue capacity and allow for greater and broader attendance. Despite an increase in size, the event would need to target a portion of the programming for small groups to allow for more voices to be heard through participant engagement and interaction, and to provide a forum for new and creative ideas.

Below is a list of priority needs for Jamaica Bay as well as knowledge gaps identified by participants during the symposium. This list will inform SRIJB's strategic planning discussions and the development of their long-term research agenda.

Research Needs & Data Gaps

- Sediment transport inside the Bay as well as sediment flux in and out of the Bay, with an emphasis on quantifying the sediment budget and lifespan expectation of the wetlands
- Impacts and consequences of shallowing areas of the Bay, such as the borrow pits and channels, as well as bay-wide shallowing;
- Effective water quality indicators and metrics, and more robust water quality datasets that include diurnal sampling. Groundwater contamination also needs to be better understood;
- Nitrogen cycling and the nitrogen budget;
- More sediment core data;
- Process and mechanisms that affect island and perimeter marsh health, including eutrophication impacts;
- Trial projects to test the effectiveness of natural and nature-based features in reducing wave energy during storm events;
- Rates and causes of vegetated shoreline retreat;
- Thresholds for ecosystem functions such as size and connectivity;
- Studies of finfish, bird, terrapin, and horseshoe crab populations to understand the abundance and distribution of fish and marine invertebrates;
- Long term monitoring of the Bay's systems and processes, including social and ecological indicators of resilience.

Management & Other Needs

COMMUNITY ENGAGEMENT:

- Develop means to include and engage residents, community groups, and faith organizations in the decision making process.
- Host information events and engagement activities during both the daytime and the evening hours to allow for maximum participation
- Engage volunteers and citizen scientists in clean ups and plantings to help reduce the cost of restoration.
- Train them in Bay monitoring and extend this work to upland communities
- Identify audiences that are not being engaged and determine how to engage them.

COMMUNICATION:

- There is a need for constant communication between agencies, stakeholders, and community groups about activities in the Bay, such as research efforts, capital projects, and public engagement events. This kind of dialogue reduces duplicative efforts and encourages a collaborative approach to funding opportunities, ensuring science and policy are co-produced through the participation of stakeholders and communities.
- Also, community needs and scientific research goals can be divergent making stakeholders input particularly important when addressing research questions.

Management & Other Needs

EDUCATION:

- Make sure residents understand the current science and the challenges facing the Bay.
- Develop programs for stewardship and early childhood education, and for educating residents and homeowners about property rights and flood insurance.
- Ensure residents have a solid understanding of the political process through which decisions are made in their community about the health and vitality of the Bay.

DATA SHARING:

- Coordinate and integrate data from researchers, agencies, and other workers in the Bay
- Standardize methodologies, data measurements, and dataset formats and establish protocol for quality control
- Increase accessibility to datasets by providing a common centralized platform for access
- Make investments to expand the availability of data such as LiDAR images and high resolution land cover maps
- Make publications available with links to research.

COMMON GOALS:

- The federal government and the City of New York publicly own Jamaica Bay and multiple agencies have jurisdiction in the Bay, each representing different constituencies. These agencies have similar missions, such as mandates to protect, conserve, restore, and reduce risk and ecosystem degradation, but they also differ in emphasis, process, and priority. For example the National Park Service (NPS), NYC Department of Parks & Recreation, and U.S. Army Corps of Engineers (USACE) all advocate ecosystem restoration but the NPS seeks to engage the public in restoration efforts while the USACE targets engineered solutions and gray infrastructure. Each agency has their own process for determining targets for restoration as well as indicators and metrics to evaluate restoration performance. We need consensus as to the desirable future states of the Bay, and alignment among agencies with respect to restoration and management benchmarks and targets.

OTHER

- Establish permanent ferry service for the Rockaways to allow greater usage of the Jamaica Bay waterfront, improve access to education, provide work opportunities, and enable residents to fully participate and contribute to the City.
- Ensure housing is resilient and affordable in the face of sea level rise.

Appendix I. Acknowledgements

The 2016 State of the Bay Symposium would not have been possible without the dedicated efforts of the Planning Committee: Elizabeth Alter (York College, CUNY) and Brett Branco (Brooklyn College, CUNY), Samuel Carter (Rockefeller Foundation), John McLaughlin and Qi Long Chen (NYC DEP), Bram Gunther (NYC Parks), Dan Mundy Jr. (Ecowatchers), Adam Parris and Lesley Patrick (SRIJB), Rob Pirani (HRF), and Patti Rafferty (GNRA NPS).

The committee would like to thank the session co-chairs for developing the intellectual content of their topic, identifying relevant speakers, and facilitating their respective session. We thank the presenters for sharing their research and experience, and we thank the invited speakers for enriching the discussion by bringing historical and national context to our experience of Jamaica Bay.

We would like to thank Thomas Pallidino and American Princess Cruises for an incredible afternoon on the Bay. We thank and Aviator Sports Complex and Brooklyn College for hosting and servicing the event in their facilities.

Many thanks to Symposium Rapporteurs Rebekah Breitzer, Ellen Hartig, Hildegaard Link, Ziwen Yu, and Cari Shimkus for their thorough and careful notetaking of each session.

We thank Emily Fano of the National Wildlife Federation Eco-Schools USA, Dan Meharg of the Gateway National Recreation Area (NPS), Luis Gonzalez of the City Parks Foundation, Juli Schroeger of the Rockaway Waterfront Alliance, and Lisa Scheppke of the American Littoral Society for educating symposium attendees at their resource tables.

We are very grateful to our Small Group Discussion Facilitators Kate Boicourt, Helen Cheng, Nerissa Moray, Brett Branco, Bryce DeBois, Adam Parris, Maya Buchanan, Helen Forgione, Lesley Patrick, Kathy Bunting-Howarth, Melissa Herlitz, Courtney Worrall, Lindsay Campbell, and Mike Menser for leading their groups though thoughtful and directed discussion and for capturing the main outcomes.

SRIJB Core Staff including Adam Parris, Lesley Patrick, Jessica Fain, Helen Cheng, and Sandra Clarke were instrumental in moving the event from planning to execution. Our 2016 SRIJB Science Management Fellows Rebekah Breitzer and Joy Cytryn and Intern Christopher Wassif rolled up their sleeves and did a tremendous amount of work in the days leading up to and during the symposium. They really pulled the final pieces together.

Finally, special thanks to SRIJB SMF Joy Cytryn for her tireless work in integrating the session notes to draft and continuously edit this comprehensive report.

Appendix II. Research Posters

Assessing the Microbial Biodiversity from Salt Marsh Sediment at Various Stages Post-Restorationy

Nathan Morrris
Advisor: Elizabeth Alter, York College, CUNY (New York, NY)

Abstract
The salt marshes of Jamaica Bay provide an important role in both the ecosystem function and in the resilience of the bay. Restoration projects have begun in order to mitigate loss and rebuild due to rapid salt marsh loss over past decades. A broader understanding of the impact restoration has on underlying ecological processes and biodiversity found within these marshes is greatly needed. One aspect of Jamaica Bay's salt marsh ecology that is not currently understood is how the biodiversity of microbial communities from sediment vary in salt marshes that are in different states of health. Understanding this biodiversity is key to understanding salt marsh ecosystem function and resilience as a whole. Here, using the 16S barcoding gene we describe microbial community diversity and taxonomic composition found within sediment taken from five salt marsh locations within Jamaica Bay. Four of these sites exhibit a post-restoration gradient ranging from three to twelve years, and one from a site that remains unrestored. By comparing the microbial community structure and levels of diversity found in restored marshes to those found in unrestored or degrading marshes, we hope to begin to link community composition with ecosystem health. This will help to complete our understanding of a healthy salt marsh and how they relate to the resilience of the bay.

Calculating the Rate of Natural Beach Growth from U.S. Coast Survey Charts

Mario Giampieri[1]; Eric W. Sanderson[2]
[1]Massachusetts Institute of Technology, (Cambridge, MA)
[2]Wildlife Conservation Society (Bronx, NY)

Abstract
Since the 1920s several interventions have been employed to stabilize the Rockaway Peninsula, including a jetty and groins; however, the peninsula remains part of the coastal barrier beach system of the south shore of Long Island, and as such is affected by longshore sediment transport and extreme weather events. This research aims to quantify the natural rate of sediment transport and beach accretion for the Rockaway Peninsula portion of the Long Island barrier beach system. High-resolution U.S. Coast Survey charts from the 19th and early 20th centuries were georeferenced and digitized using ArcGIS 10.2 to create digital elevation models of Rockaway Inlet at five different time points. A grid system was employed to quantify the change in sediment volume across the study area per unit area. Results show that the peninsula moved westward across Rockaway Inlet at a rate of 77 m/year throughout the 19th century, towards its present-day position. Understanding the natural rate of sediment transport and beach accretion will inform efforts to maintain beach health both on the Rockaway Peninsula and on Coney Island, the historical recipient of sediment travelling westward from the Rockaway Peninsula.

Coastal Storm Response: Surge, Wave, & Tide Hydrodynamic Network (SWaTH)

William Capurso
U.S. Geological Survey

Abstract
Four years ago, Hurricane Sandy made landfall in southern New Jersey. In its immediate aftermath, the storm left a path of destruction that communities are still working to overcome. The massive size of the storm created a wind field that pushed ocean waters inland and caused significant flood damage.

The U.S. Geological Survey (USGS) embarked on an effort to build a new monitoring network that provides emergency managers and hurricane scientists with vital coastal storm-tide information during and after major storms affecting the Atlantic Coast.

Teams from USGS Water Science Centers from North Carolina to Maine pinpointed specific sites along the Atlantic Coast, determined their elevations and installed receiving brackets that will hold a network of sophisticated hydrological sensors that can be installed days-to-hours before a storm makes landfall. The network will include approximately 700 locations from North Carolina to Maine.

Determining the Most Suitable Habitat for Ulva Blooms in Jamaica Bay Using a Geospatial Model

Kristine Erskine; Rebecca Boger
Advisor: Rebecca Boger, Brooklyn College, CUNY (Brooklyn, NY)

Abstract
This research project is aimed at creating a Habitat Suitability Model for Ulva species in Jamaica Bay. Because extreme Ulva growth is an indicator of a eutrophic ecosystem, the model will be used to predict where Ulva can be found so that better management strategies can be employed. Parameters for the model include water quality measurements, i.e. average nitrate concentration, dissolved oxygen, temperature, pH, salinity, conductivity, depth of the water column, secchi depth, Photosynthetically Active Radiation (PAR), light transmissivity, and bathymetry. Because model validation will use remote sensed data and historical aerial photographs taken at low tide (for 2014 and 2015 models), and predictive validation for 2017 models will be based on low altitude Unmanned Aerial Vehicle Photography (UAV), these databases will be made public through CUNY Academic Commons. It will serve as an initial data sharing forum for estuarine researchers and students who study Ulva blooms in Jamaica Bay. The most innovative aspect of this research is publicizing of the template of the final validated model, again through the CUNY Academic Commons. As part of the Commons, it can be accessed by similar communities wishing to monitor aquatic ecosystems for suitable Ulva habitats, as an indication of increased eutrophic and unhealthy aquatic conditions.

Groundwater Monitoring by the U.S. Geological Survey on Long Island, New York

Michael D. Como; Simonette Rivera; Ronald Busciolano
U.S. Geological Survey

Abstract
The U.S. Geological Survey (USGS), in cooperation with State and local agencies, systematically collects groundwater data at varying measurement frequencies to monitor the hydrologic conditions on Long Island, New York. Each year during April and May, the USGS conducts a synoptic survey of water levels to define the spatial distribution of the water table and potentiometric surfaces within the three main water-bearing units underlying Long Island: the Upper Glacial, Magothy, and Lloyd aquifers, and the hydraulically connected Jameco and North Shore aquifers. These data and the maps constructed from them are commonly used in studies of Long Island's hydrology and are utilized by water managers and suppliers for aquifer management and planning purposes.

Maps and geospatial datasets were recently published for the 2013 synoptic. These products included water-level data surrounding Jamaica Bay and indicate the direction of groundwater flow and areas prone to groundwater flooding. Understanding the nature of groundwater flow into Jamaica Bay is important because groundwater can be a significant source of nitrogen loading to estuaries. Long-term hydrologic monitoring by the USGS is ongoing in Nassau and Suffolk Counties, but was suspended for New York City at the end of 2013 due to a lack of cooperator funding.

Impact of Salt Marshes on Residence Time in Jamaica Bay, NY

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Abstract
Eutrophication—overabundance of nutrients in estuarine and coastal waters—depends not only on the supply of nutrients but also on the transport time scales, such as residence time. Coastal wetlands can influence their surrounding hydrodynamic regime and, in turn, the residence time, by changing circulation and flushing patterns. The sheltering effect of emergent vegetation influences the wind shear stress on the water surface and consequently the wind-driven mixing and circulation. Vegetation slows water movement and redirects currents into the tidal channels, influencing circulation and flushing patterns. Despite the significance of wetlands to water circulation and thus residence time, their effect on these processes has rarely been quantified. Here, we report on a series of model experiments that aims to quantify the influence of salt marshes on the residence time of water in Jamaica Bay, NY. As part of a project funded by the National Park Service, we have already implemented a vegetation module within the Stevens Institute of Technology Estuarine and Coastal Ocean Model (sECOM), considering the three-dimensional affects of vegetation on flow and turbulence quantities (Marsooli et al. 2016). We use sECOM and its conservative tracer-transport module to quantify the influence of Jamaica Bay's present-day salt marshes on the residence time of several subdomains in the Bay (e.g. Grassy Bay, Pumpkin Patch Channel, North Channel, and Beach Channel), as well as the Bay as a whole. In this presentation, the experiment results will be presented and discussed.

Modeling Pathogens for Oceanic Contact Recreation Advisories in the New York City Area Using Total Event Simulations

Bin Wen; Nickitas Georgas
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Abstract
A simulation of transport and fate of pathogen indicators in the New York City (NYC) open waters was run using a coupled model for four different four-month periods. Combined Sewer Overflow (CSO) discharges into NYC were simulated as the main source of pathogen pollution using RCA-Pathogens and the New York Harbor Observing and Prediction System (NYHOPS).

Modeled concentrations for enterococci in receiving waters were extracted from the model and compared with NYC beach observations and NYC Harbor Surveys to validate and bias-correct the result. Results showed that model has well simulated the growth and die-off process of pathogens. Receiving water Enterococci concentrations grew responsively to rainfall, and decreased notably after rainfall. Comparing the model results to observations, the average deviation coefficient is -0.27 throughout all NYC beaches, and -0.19 throughout all NYC waterbodies.

Bias-corrected results were then used to calculate model-based contact recreation advisories and compare to existing rainfall-based advisories: NYCDEP advisory guidance for waterbodies, DOHMH advisory guidance for NYC beaches. The calculated model-based advisories have involved consideration of complexity of local circulation, and the advisory results are conservative in most cases. The total number of modeled advisory days is 1.3 times of the total advisory days based on current DOHMH guidance for NYC beaches, and is 2.5 times of the total advisory days based on NYCDEP guidance for NYC waterbodies.

Monitoring & Evaluation of Recovery & Resilience: Dune-Beach Geomorphology of Breezy Point Tip and West Pond, Jamaica Bay

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Abstract
Coastal ecosystems and their associated geomorphological formations are in a state of flux; sediment availability, coastal processes, and anthropogenic influences all have an effect on the dynamics of dune-beach systems at multiple scales, evidenced by erosional and depositional forms. Particularly in highly populated areas such as New York City, detailed knowledge of the state of these coastal systems are of high value to a variety of stakeholders including scientists, managers, and the public.

Using geodetic GPS units, we mapped the surface elevation of ten dune-beach systems throughout Jamaica Bay. These sites were chosen not only for their characteristic geomorphologies, but also represented locales exposed to different wave energies, sediment availabilities, and varying degrees of anthropogenic influence. Here, we describe the geomorphological evolution at Breezy Point Tip and West Pond from July 2010 through May 2016, and how both have recovered after Hurricane Sandy.

Since Hurricane Sandy, the beach at Breezy Point Tip has accumulated. There are also several erosional bands throughout the upper berm and dune portions of the site. Together, these changes result in a total volumetric gain of 91,000 m3 for the November 2012–May 2016 time period. The changes at West Pond are characterized by erosional zones in the eastern and western portions of the site and one major area of deposition in the center, resulting in a total volumetric change of 2,800 m3 for the July 2010–May 2016 time period.

Recovery of Ecosystem Services Following Wetland Restoration in Jamaica Bay

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Advisor: Chester Zarnoch, Baruch College, CUNY (New York, NY)

Abstract
Coastal wetlands provide multiple ecosystem services including shoreline stabilization, flood and storm protection, and water purification. In Jamaica Bay, over 92% of historic wetland area has been lost over the past century. Currently, it is unclear if wetland restoration in eutrophic environments such as Jamaica Bay is sustainable over the long term, or if restoration will provide ecosystem services used to justify their construction costs. Because restoration efforts are ubiquitous and ongoing, it is important to assess the capacity for wetland restoration to provide ecosystem services. Past and ongoing restoration efforts in Jamaica Bay provide a unique opportunity to study nitrogen-removal ecosystem services in natural and restored wetlands in an urban, eutrophic environment. Here we present results of an ongoing study that seeks to determine the restoration age and environmental conditions under which salt-marsh restoration may become effective at providing ecosystem services such as nutrient sequestration in highly urbanized environments. Preliminary results, obtained using flow-through core incubations, indicate that restored marshes remove a significant amount of nitrogen via denitrification and that total nitrogen removal increases as restored marshes age. Across a chronosequence of restorations, ranging in age from 3 to 12 years, we detected increases in plant root mass, indicating that restored marshes also become more stable over time.

Spatial and Temporal Analysis of Water Quality in Jamaica Bay: Detecting Changes and Establishing Zones of Similar Influence

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Abstract
Jamaica Bay is an urban shallow estuary that receives high nitrogen loads from wastewater inputs. During the urbanization of New York City, changes in land use and wastewater inputs have likely contributed to changes in water quality. Long term monitoring in Jamaica Bay presents an opportunity to identify spatial and temporal water quality changes. Both the NYC Department of Environmental Protection (NYCDEP) and the National Park Service (NPS) have been monitoring a range of water quality parameters as early as 1909, providing a rich dataset. We obtained, formatted, and wrote metadata for the two data sets and used them to evaluate trends. There are no significant differences in mean water quality values between the agencies for co-located sampling stations. Additionally, a preliminary data analysis (at three sampling sites) indicates that while there are statistically significant trends in several parameters, no significant water quality shifts were identified indicating a regime shift. A cluster analysis of mean summertime values for two different time periods (1995–1999, 2009–2013) resulted in the spatial aggregation of 13 sampling areas into four zones of similar influence.

The Nature of Social Resilience: Psycho-Social-Spiritual Benefits of Jamaica Bay

Heather McMillen; Erika Svendsen; Lindsay Campbell; Novem Auyeung; Michelle Johnson

Supervisor: Erika Svendsen, New York City Urban Field Station, U.S. Forest Service (New York, NY)

Abstract

From remote villages to cosmopolitan megacities, people rely on nature. While the value of provisioning and regulating ecosystems services are well documented, cultural ecosystem services and their contributions toward well-being and social resilience are less understood, especially in densely-populated, urban areas.

Drawing from a larger study on the social value and meanings of NYC parklands and natural areas, we focus on Jamaica Bay and nature's role in social resilience. We find that it supports well-being for a range of people who engage in practices that reflect personal desires to connect with nature and a larger reality, as well as via a broader set of practices focused on connecting with self and with others. To illustrate these concepts, we present a typology of spiritual symbols and materials and photographs of examples.

This research is a step toward better understanding interactions in complex social-ecological systems, specifically the intrinsic and intangible values of urban nature as they are co-created by parklands and park users. Our findings illustrate multiple intangible values of nature in an urban context which underscores the idea that human progress and nature conservation are not mutually exclusive. It is expected that resource managers and planners will expand their thinking about how to better manage Jamaica Bay and other parklands by making them accessible to and appropriate for populations that are diverse in culture, ethnicity, socio-economic status, and faith; but share a common need for exposure to and engagement with nature.

The U.S. Geological Survey's Sediment-bound Contaminant Resiliency & Response Strategy: A Tiered Multi-metric Approach to Environmental Health and Hazards in the Northeastern USA

Timothy J. Reilly; Michael J. Focazio, Peter S. Murdoch; William M. Benzel; Shawn C. Fisher; Dale W. Griffin; Luke R. Iwanowicz; Daniel K. Jones; Kieth A. Loftin
U.S. Geological Survey

Abstract
Enhanced dispersion and concentration of contaminants such as trace metals and organic pollutants through storm-induced disturbances and sea-level rise are major factors that could adversely impact the health and resilience of communities and ecosystems. As part of the response to Hurricane Sandy, the U.S. Geological Survey collected data on the effects of contaminant source disturbance and dispersion. A major limitation of conducting pre- and post-Hurricane Sandy comparisons was the lack of baseline data in locations proximal to potential contaminant sources and mitigation activities, sensitive ecosystems, and recreational facilities where human and ecological exposures are probable. To address this limitation, a Sediment-bound Contaminant Resiliency and Response (SCoRR) strategy with two operational modes, Resiliency (baseline) and Response (event-based), has been designed. In Resiliency Mode, sites are identified and sampled using standardized procedures prioritized to develop baseline data and to define sediment-quality-based environmental health metrics. In Response Mode, a subset of sites within the network is evaluated to ensure that adequate pre-event data exist at priority locations. The first set of baseline data collection (180 sites from Maine to Virginia) began in July 2015, and in October 2015, crews suspended baseline sampling and deployed in response to Hurricane Joaquin. Select sites were resampled, allowing direct evaluation of impacts and to redefine baseline conditions for these areas. Results will identify vulnerable human and environmental receptors, quantify contaminants present, and evaluate biological activity and potential effects of exposure to characterized sediments. Data and metrics are being provided via the SCoRR Web site and mapper (http://toxics.usgs.gov/scorr/index.html).

Aerial Photo of Jamaica Bay by Joe Mable

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