# THE STATE OF THE ESTUARY 2012

New York - New Jersey
Harbor & Estuary Program
www.harborestuary.org

ENVIRONMENTAL HEALTH AND TRENDS OF THE NEW YORK-NEW JERSEY HARBOR ESTUARY

# INTRODUCTION

ON THE COVER: Although largely urbanized, our estuary still includes many natural areas, home to a wide variety of wildlife.

## CONTENTS



## ACRONYMS USED IN THIS REPORT

CRP: Comprehensive Restoration Plan

HEP: New York-New Jersey Harbor & Estuary Program

NJDEP: NJ Department of Environmental Protection

NOAA: National Oceanic and Atmospheric Administration

NYCDEP: NYC Department of Environmental Protection

NYSDEC: NY State Department of Environmental Conservation

OASIS: Open Accessible Space Information System

USACE: U.S. Army Corps of Engineers

USEPA: U.S. Environmental Protection Agency

It is no coincidence that the New York–New Jersey Harbor estuary is home to one of the most vibrant and economically important metropolitan areas in the country and the world. Estuaries—where rivers meet the sea—are rich, productive, and diverse ecosystems where many plants and animals live. Our estuary's natural resources, beauty, and connectivity with the sea and inland waters have made it an ideal location for humans.

As more and more people were drawn to our estuary, resources were exploited, ecosystems were modified or eliminated, and wastes were disposed of in our waterways at an increasing rate. Growing environmental degradation prompted the enactment of legislation and action to bring the estuary back from the brink of collapse.

Today, our estuary's overall health is much better than it was 30 years ago. But many problems remain. This report on the State of the Estuary explores such topics as pollution, wildlife, and natural areas: How is the estuary doing? Are conditions improving?

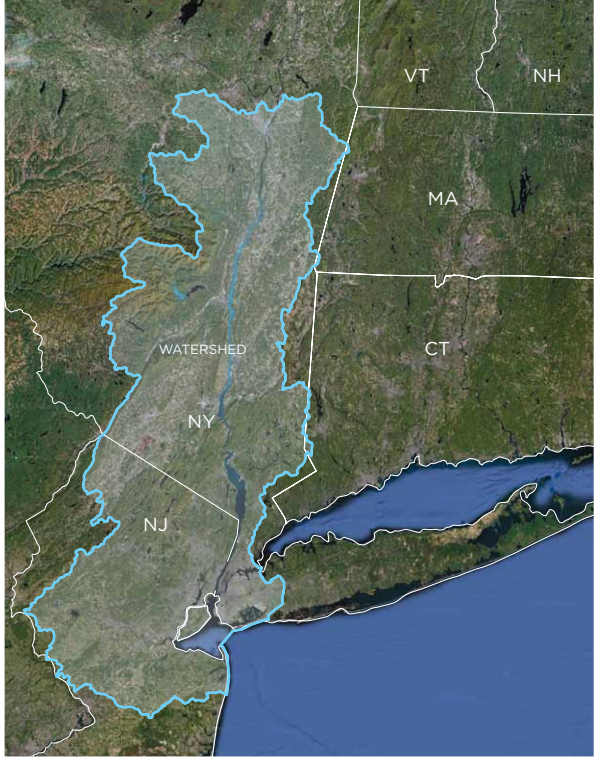
In many areas, further improvement will require a combination of large-scale efforts (such as upgrading wastewater collection and treatment infrastructure) and simpler actions that each of us can take (such as keeping streets litter-free). Throughout this report, you will learn about work being done by government agencies, community organizations, and other groups in our area, as well as examples of actions you can take to help. Additional information is available at www.harborestuary.org, including a summary of this report (in English and Spanish), a more detailed version with bibliographic citations, and the quality assurance project plan that guided the report's preparation.

We trust you will find this a valuable resource to discover how deeply connected we are to the waters we share. And we hope you will be inspired to contribute by doing your part to preserve the wonderful treasure that is our estuary so that we may enjoy its beauty and resources for generations to come.

OUR ESTUARY holds the third largest port in the nation and supports hundreds of thousands of jobs for New York and New Jersey communities.




Cover photos by Amriphoto/Istockphoto.com (helicopter flight approaching new york city), Don Riepe (JoCo Marsh and JFK runway) The Port Authority of NY and NJ (ship photo)


THE NY-NJ HARBOR & Estuary Program's geographic scope includes all areas draining into the harbor (the watershed) below the Troy Dam (right). The program currently focuses on the areas surrounding the waters in the core area of concern (in blue, left).

## About the New York-New Jersey Harbor & Estuary Program

The New York-New Jersey Harbor & Estuary Program (HEP) was established in 1988 under the Clean Water Act to protect and restore the estuary resources we depend on and share. Work groups and committees coordinated by HEP focus on improving the health of our water bodies and habitats, managing sediments, fostering community stewardship, educating the public, and improving safe access to our waterways.

HEP is a partnership program involving government, non-government, and non-profit participants:

- U.S. Environmental ProtectionAgency (USEPA)
- New England Interstate Water Pollution Control Commission (NEIWPCC)
- National Oceanic and Atmospheric Administration (NOAA)
- U.S. Army Corps of Engineers (USACE)
- The Port Authority of NY & NJ (PANYNJ)
- New Jersey Department of Environmental Protection (NJDEP)
- New Jersey Harbor Dischargers Group (NJHDG)
- New York State Department of Environmental Conservation (NYSDEC)
- New York City Department of Environmental Protection (NYCDEP)
- New Jersey Local Government
- U.S. Department of the Interior (USDOI)
- New York State Department of State (NYDOS)
- Interstate Environmental Commission (IEC)
- A Science and Technical Advisory Committee (STAC) representing the scientific community
- A Citizens Advisory Committee (CAC) representing concerned residents and community groups.

Partners carry out numerous projects and programs, working toward the common goal of a healthy and productive estuary ecosystem with full beneficial uses. Examples of these efforts are given throughout the report.

## PUBLIC PARTICIPATION

As residents, we use the estuary for fishing, boating, swimming, bird watching, transportation, commerce, and many other activities that bolster our quality of life and the economy. Better environmental conditions and access to the water and waterfront have contributed to a growing appreciation of our estuary's resources. As a result, increasing numbers of residents act as good stewards of our common resources. Two HEP groups offer community organizations and concerned estuary residents opportunities to actively help revitalize our waters:

- The **Citizens Advisory Committee** (CAC) provides citizen input to the HEP with a focus on education and stewardship.
- **The Public Access Work Group** (PAWG) works to improve access to the water and waterfront.

Working closely with the CAC and PAWG, HEP awards small grants for projects that promote estuary stewardship and public access by engaging and educating local communities. NEIWPCC helps manage these grants. To learn more about HEP and to contact us, visit w*ww.harborestuary.org*

HIGH SCHOOL STUDENTS plant a rain garden in Elizabeth, NJ with Future City, Inc, a local organization.

Future City, Inc. (rain garden photo); Lucy Reading-Ikkanda (maps illustration); Googlemaps (satellite image)
Source: USEPA Region 2 GIS (base map)

SECTION 1

# LIVING RESOURCES



OVER THE CENTURIES, our estuary's diverse habitats have been profoundly changed by development, as seen in the comparison of this rendering of what Manhattan probably looked like in the 1600s, with an actual current satellite image.

When Europeans started exploring the estuary, it had been little altered by the Lenape people who had lived in the area for over 400 generations. Extensive marshes and old-growth forests, streams, and other ecological communities teemed with life, including large mammals such as black bears and wolves, and countless fishes, birds, and reptiles.

Four centuries of human activities have profoundly changed the estuary as natural ecosystems have been degraded or lost:

- The harbor today is deeper and smaller. Navigational channels have been dredged to make way for ever-larger vessels entering the port (requiring in some cases drilling and blasting through bedrock), while dredged sediments (as well as trash and debris) have been used to expand land area at the expense of wetlands and shallow water habitats.
- Much of our coast has been hardened by artificial structures, such as bulkheads and piers, replacing gently sloping and vegetated natural shorelines and shallows.
- Many streams and creeks have been filled, channelized, redirected through storm sewers, or affected by polluted runoff.
- Eelgrass beds and oyster reefs have almost entirely disappeared.
- Freshwater and tidal wetlands have been severely diminished and damaged.

Although the natural resources remaining in our estuary today do not compare with the rich habitats it supported before European colonization, the remaining habitats still provide invaluable resources:

- Our waters are home to more than 100 fish species for some or all of their lifecycles, including 16 for which the estuary provides essential habitat.
- Shallow mudflats are home to algae, crabs, clams, and other invertebrates, providing food for many fishes, such as striped bass and bluefish.
- Wetlands provide habitat for resident birds, mussels, fiddler crabs, and many young fish, as well as overwintering areas for migratory waterfowl and breeding grounds for other birds.
- 68 islands, each over a quarter of an acre, support nesting populations of herons and other birds.
- Our tributaries provide a gradient of unique habitats, from saltwater to freshwater, and serve as conduits for migratory species.

Although many activities that damage habitats now are banned, threats remain. These include development pressure, pollution, climate change, and invasive species. In light of the extensive degradation that has already taken place and the immense value we derive from ecosystem services, it is essential to protect and restore remaining habitats. Restoring habitat is an investment that pays dividends—not only in healthier ecosystems that provide valuable services and functions, but in good local jobs for our communities. Recent progress has been encouraging. Since HEP's Health of the Harbor report in 2004, there has been renewed momentum to protect and restore habitats and the species they support. Significantly, in 2009, a large coalition of partners drafted a Comprehensive Restoration Plan (CRP) for our estuary.

In this chapter, we explore the status of a few key habitats and species, and highlight several ongoing restoration efforts. To learn more about existing habitats, planned improvements, and the wildlife of the estuary, visit *www.harborestuary.org*.

## ECOSYSTEM SERVICES

Healthy ecosystems offer many benefits, or **ecosystem services,** in a self-sustaining way: nourishment, clean water, protection from floods and erosion, and recreational opportunities such as fishing, bird watching, and sightseeing. When ecosystems are degraded or lost, the ecosystem services diminish or disappear. Artificial alternatives (such as levees to protect against flooding during storms) may replace some of these functions, but usually with a narrower scope and at great monetary cost.

# RESTORATION PLANS

## Hudson-Raritan Estuary Comprehensive Restoration Plan: A Blueprint to Bring the Estuary Back to Life

The Comprehensive Restoration Plan (CRP) is a master plan to guide ecosystem restoration and acquisition throughout our estuary. Development of this science-based plan was led by the U.S. Army Corps of Engineers and The Port Authority of NY and NJ, and involved many partners, including HEP's Restoration Work Group. Many of the sites included within the CRP were originally nominated through the Restoration Work Group and included in the 2001 Habitat Work Group Status Report.

The goal of the CRP is *to establish a mosaic of habitats that provides benefits for all estuary residents* (human and otherwise). It sets specific short- and long-term restoration and acquisition objectives for 11 ecosystem characteristics. All restoration and acquisition efforts are being mapped in the Open Accessible Space Information System (OASIS, *www.oasisnyc.net*), and efforts to enhance the tracking of progress towards achieving CRP goals are ongoing.

The CRP is intended to help all the communities, agencies, and institutions in our region work collaboratively toward the common goal of restoring the waters we share. Healthier habitats will benefit our communities in many ways by providing cleaner air and water, improved aesthetic value, and greater recreational opportunities. These improvements mean more livable and desirable communities, healthier families, and stronger local economies.

For more information on the CRP, visit *www.watersweshare.org*.

## Habitat protection and acquisition

An important goal of the CRP is to preserve remaining ecologically functioning areas and improve the connectivity between them. This is critical, given the extent of habitat loss and modification associated with the widespread urbanization around our estuary. By acquiring valuable habitats and establishing them as public parks and nature preserves, essential functioning ecosystems can be protected, restored, and enhanced, while also providing the public with opportunities to appreciate and enjoy nature.

Many groups in the region have been working ceaselessly to identify opportunities, form partnerships, and raise funds to acquire some of the remaining natural areas in our region. Since 1998, HEP partners have protected at least 50 sites totaling over 5,200 acres of valuable habitats, such as the forested wetlands at Mount Loretto Woods, freshwater wetlands in the Dismal Swamp, wooded uplands in the Pin Oak Forest, and salt marshes in the Hackensack Meadowlands and the Arthur Kill waterway. It is the goal of HEP and its partners to continue acquiring these precious areas.

Although land in our metropolitan area tends to be very expensive to purchase, it is much more cost-effective to preserve existing, self-sustaining ecosystems than to attempt to restore lost or degraded ecological communities (which may sometimes be impossible). The importance of land acquisition and protection cannot be overemphasized: intact habitats provide a myriad of ecosystem services, which can be translated into concrete economic benefits, in addition to advantages that are more difficult to quantify, such as aesthetic and other cultural values.

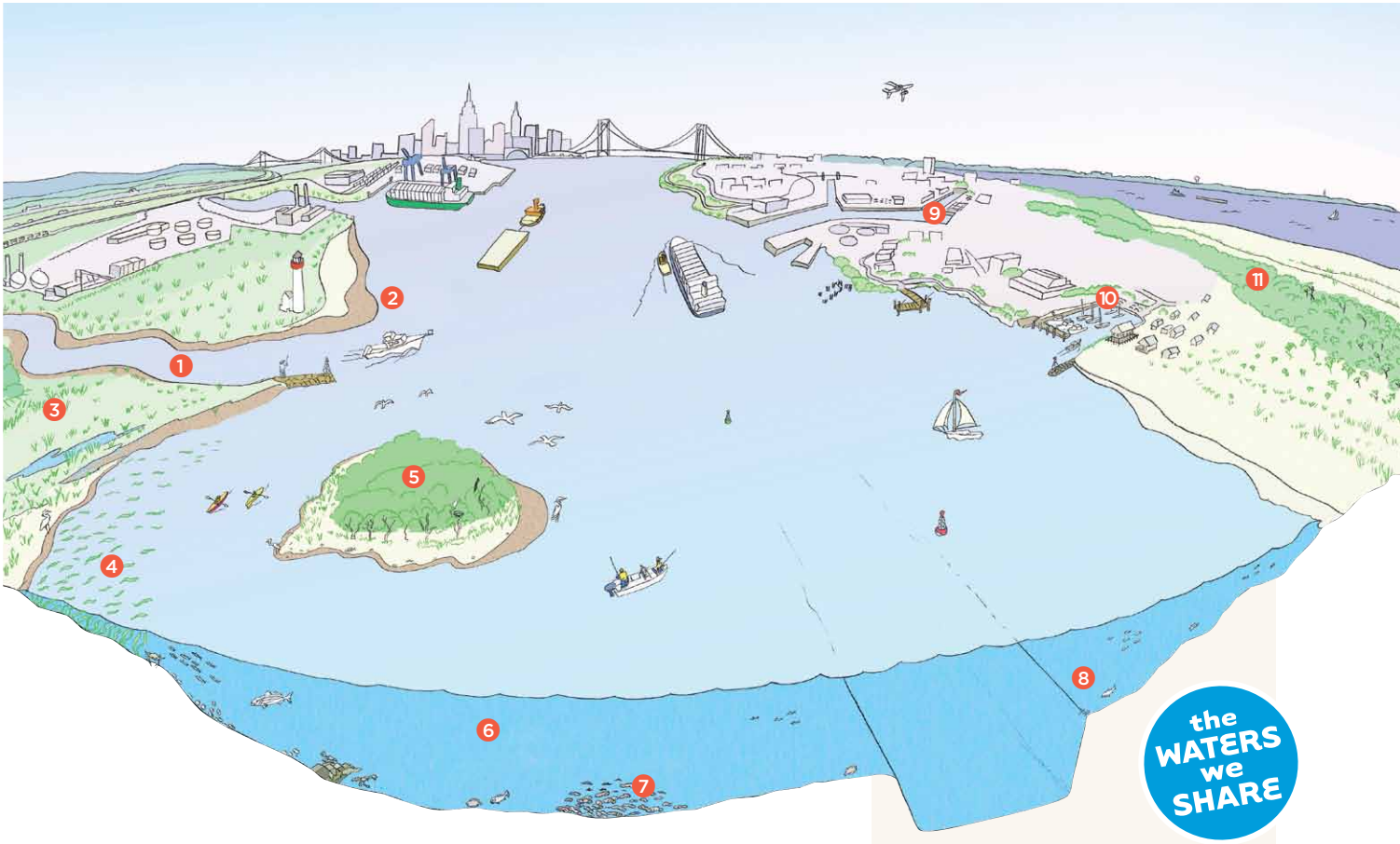
## HOW YOU CAN HELP

The health and prosperity of our communities depend directly and indirectly on the many resources and services we obtain from the estuary. It is critical that each of us do our part to preserve and improve the health of the estuary for the benefit of our families and future generations. Here are some ways you can help:

- Join a local group concerned with habitat protection to learn about issues affecting your community, participate in local protection and restoration efforts, or nominate a site for inclusion in the CRP (*www.watersweshare.org*).
- Learn about and enjoy our natural areas. For example, there are many opportunities to explore wetlands and their wildlife at parks in the metropolitan area. Many organizations also offer tours, activities, and lectures. Websites for the NYC Department of Parks & Recreation, Gateway National Recreation Area, and NJ Meadowlands Commission are good places to start your search.
- Join a community group engaged in oyster gardening and restoration, or contact one of the local organizations that offer oyster-related public programs for schools and community groups, such as NY/NJ Baykeeper, The River Project, The Rockaway Waterfront Alliance, and the Randall's Island Park Alliance.

VOLUNTEERS plant native species at Plumb Beach in Brooklyn, NY, as part of an Earth Day event in 2008.

Don Riepe (restoration photo)




the WATERS we SHARE

## Regional Sediment Management Plan

In a healthy ecosystem, there is a balance between the amount of sediment entering and exiting the system. Too little sediment can lead to erosion of coastal areas, wetlands, islands, mudflats, and other aquatic habitats. On the other hand, too much sediment can bury or stress aquatic organisms and communities, among other negative effects. Excessive sediment entering the estuary also increases the need for navigation channel dredging, adding to port maintenance costs.

Another important aspect of sediments is their cleanliness, or sediment quality. Many toxic chemicals stick to sediment particles, affecting the health of benthic organisms (those that live on the sediments) and the overall estuarine ecosystem. Polluted sediments sharply increase the cost of dredging, as they require expensive treatments. In contrast, clean sediments can be reused beneficially, for example, to restore disappearing wetlands.

HEP's Regional Sediment Management Work Group was established to develop a plan to address these complex issues in our estuary, bringing together many partners with a wide range of expertise. The group has completed a Regional Sediment Management Plan that centers on sediment quality, sediment quantity, and dredged material management. The Plan takes into account that sediment entering our estuary, and the pollutants that contaminate it, originate throughout the 16,300-square mile watershed. As a result, the Plan calls for cooperation among many groups throughout this entire region.

## RESTORATION GOALS

A team of estuarine scientists identified 11 measurable objectives for restoration, termed Target Ecosystem Characteristics (TECs), each of which defines specific goals for an important ecosystem property or feature that is of ecological and/or societal value.

1. Tributary Connections
2. Shorelines and Shallows
3. Wetlands
4. Eelgrass Beds
5. Habitat for Waterbirds
6. Habitat for Fish, Crab and Lobsters
7. Oyster Reefs
8. Sediment Contamination
9. Enclosed Confined Waters
10. Public Access
11. Coastal and Maritime Forests



U.S. Army Corps of Engineers, The Hudson-Raritan Estuary Comprehensive Restoration Plan

# WETLANDS

PIERMONT MARSH is part of the Hudson River National Estuarine Research Reserve and encompasses 1,017 acres of tidal marsh in the village of Piermont, NY.

Wetlands—such as coastal marshes, swamps, and bogs—are vegetated areas that are periodically flooded or saturated by water. Once considered mosquito-filled wastelands, we now know that wetlands are among the most productive ecosystems in the estuary, performing critical, irreplaceable functions.

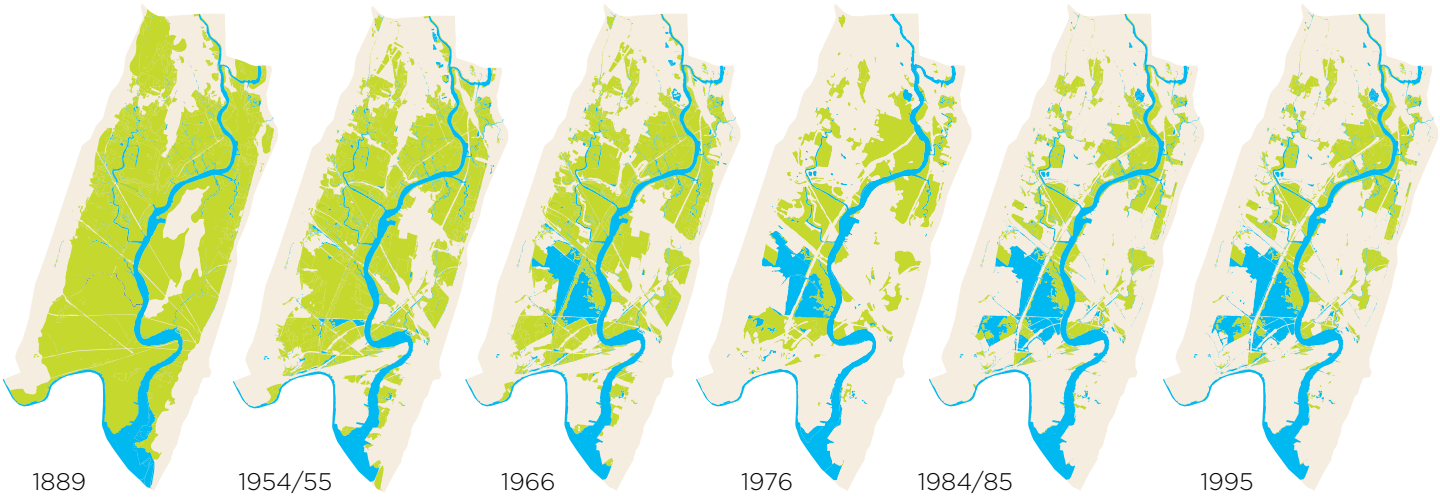
Healthy wetlands provide shelter and food for numerous species, from fishes and wading birds, to turtles, crabs, small invertebrates, and microbes. A great diversity of plants forms the basis of these rich ecosystems. Wetlands purify our waters by trapping sediments and pollutants in runoff, absorb stormwater and decrease flooding in inland areas, protect coastal land from damage by slowing down storm surge waves, and provide "cultural services" such as natural areas for enjoyment. The value of ecosystem services provided by the remaining coastal wetlands in our estuary is roughly estimated to be over $50 million per year.

MORE THAN 70 PERCENT of the wetlands that existed at the turn of the 20th Century in the Hackensack Meadowlands has been lost. Still, this is the largest expanse of tidal wetlands in our Estuary.

## Loss of Wetlands in our Estuary

The NY-NJ Harbor Estuary has lost the vast majority of wetlands that were present when the Dutch began colonizing the area. Roughly 80 square miles, or 85 percent, of the coastal wetlands that existed in the 1800s have been filled or drained. The remaining wetlands have been degraded to varying degrees by pollution, disconnection from tidal waters, fragmentation, takeover by invasive species, loss of natural vegetated buffers, and other causes.

Overall, the rate of wetland loss has slowed in the past four decades as protective measures and regulations have taken effect. For example, in the Hackensack Meadowlands—the largest expanse of tidal wetlands remaining in our estuary—losses have diminished markedly since the late 1980s, and about 2,200 acres are now protected and off-limits to development.




Laurie Fila, NYSDEC, Hudson River NERR (wetland photo); Lucy Reading-Ikkanda (maps illustration)
Map data source: U.S. Fish and Wildlife Service

## Restoring and Protecting Our Wetlands

As we begin to better understand and appreciate the immense value of our wetlands, the need to protect and restore them is becoming ever more apparent. The many efforts at preservation and restoration include several large-scale projects:

- An ongoing partnership led by the U.S. Army Corps of Engineers has restored several acres of marshes in Jamaica Bay, including 20 acres in Gerritsen Creek and 80 acres in Elders East and West. Future restoration is expected to add 42 acres of marsh at Yellow Bar Hassock and 35 acres at Black Wall and Rulers Bar.
- Just south of the Hackensack Meadowlands, Lincoln Park restoration was completed in Jersey City, NJ in 2011. Led by the National Oceanic and Atmospheric Administration (NOAA) and involving many partners, this project reestablished 24 acres of tidal marsh at a former landfill site. The project also restored mudflats and other ecosystems and created paths for public access.

Although small in comparison with the magnitude of historical losses, these are first steps toward larger-scale restoration. Scientists are also studying the effects of sea level rise to understand how it may affect future restoration efforts.

LINCOLN PARK, Jersey City, NJ, before and after restoration of a tidal wetland.


## THE CHALLENGES AHEAD

The protection and restoration of wetlands are confronted by many challenges, including:

- **Development pressure:** While several laws protect wetlands, exceptions exist and the possibility of new development continues to threaten remaining habitats. Some protected wetlands can be filled or modified if the developer improves or creates wetlands elsewhere. Although this is intended to prevent overall loss of wetlands, net losses may still result if projects are not carefully planned and carried out. Human-made or restored wetlands are also less likely to fully perform all the functions of natural wetlands, especially in the short term.
- **Climate change:** To keep up with sea level rise, coastal wetlands must increase their elevation by trapping sediments or expanding inland as the seaward edges erode. This is often not possible in highly urbanized regions like ours, and many wetlands will likely be inundated and disappear altogether. Marsh losses due to sea level rise are estimated at 1 to 2 percent per year in New York City.
- **Unexplained ongoing losses:** The marsh islands in Jamaica Bay have been declining at an alarming and accelerating pace since well before the 1970s, even after they were protected from development. The causes of these losses are not well understood and likely involve a combination of factors, including sea level rise, insufficient sediments available to increase the height of the marshes, increased erosion caused by dredged channels in the bay, and excessive nutrients from sewage treatment plants adversely affecting marsh vegetation. While local scientists continue to look for definitive answers, efforts to halt and reverse these losses are already underway.



NJDEP Office of Natural Resource Restoration (Lincoln Park before and after photos)

# OYSTER REEFS & EELGRASS BEDS

PARTICIPANTS in the Oyster Restoration Research Program monitor oyster growth and survival at the Soundview experimental oyster reef in the Bronx, NYC (left). Initial planting of eelgrass (top right) and established plants (bottom right).

Oyster reefs were once prevalent in our estuary, covering the bottoms of many shallow waters, providing important habitat for fish and other creatures, and filtering the water. The Eastern oyster (*Crassostrea virginica*) was an important food source for Native Americans and European settlers alike, a staple enjoyed by rich and poor, and a part of the local culture. In fact, the estuary was once famous worldwide for its fine Eastern oysters.

Local oysters were decimated by a combination of overharvesting, pollution, navigational dredging, and disease. In the early 1880s there were an estimated 220,000 acres of oyster reefs in the estuary, even though the oyster population had already declined substantially from nearly three centuries of intensive harvesting. No reefs remain in our waters today, and oysters are considered functionally extinct (more than 99 percent lost), with only occasional individuals found in a few scattered patches.

However, our estuary is cleaner now, and there is a growing awareness of the value of oyster reefs. Thanks to the tireless efforts of many estuary stewards, the reestablishment of self-sustaining oyster reefs is starting to look like a possibility.

## EELGRASS BEDS

Eelgrass is a plant adapted to growing completely under water. Among other functions, eelgrass beds provide habitat and nursery grounds for fish and shellfish, supply oxygen and food for fish and waterfowl, and stabilize bottom sediments. Our estuary once supported vast areas of eelgrass beds, or meadows, including an estimated 420 acres in the waters surrounding Manhattan in the 1600s. Virtually all of these beds were destroyed by water pollution, dredging and filling, damage by boats and fishing gear, and a mold infection that wiped out approximately 90 percent of the eelgrass population in the early 1930s.

The absence of eelgrass beds in our waters represents a loss of key ecosystem services. To reverse this, one of the objectives of the CRP is to create several meadows throughout the estuary. As an important first step, HEP partners have been planting eelgrass at various test plots in Jamaica Bay. In 2011, a larger-scale planting (8,000 plants) was installed at the most promising site, Breezy Point in Queens. Initial results are encouraging, and ongoing monitoring will help to determine overall success.

Kate Boicourt (Soundview Park photo); Biohabitats (eelgrass seedlings photo); Chris Pickerell (established plant photos)

## WHY ARE OYSTERS IMPORTANT?

Oysters and other native bivalve shellfish are both economically and ecologically valuable. In the late 1880s, hundreds of people in northern New Jersey alone made a living by planting, harvesting, and handling oysters. In New York, oysters were the most profitable fishery, employing more than 7,000 men by 1885. Ecologically, oysters are keystone species, which means they play a critical role in maintaining the structure of the ecosystem. This, in turn, supports many other organisms and helps determine the types and numbers of other species in the community. Oysters are the ecosystem engineers of bays and estuaries.

## Resources To Learn More About Oysters

NY-NJ HEP:
*www.harborestuary.org/oysterrestoration.htm*

NY/NY Baykeeper:
*www.nynjbaykeeper.org*

River Project:
*www.riverprojectnyc.org/research_07Oyster.php*

Hudson River Foundation:
*www.hudsonriver.org*

## Can We Bring Oysters Back to the Estuary?

HEP is one of roughly 30 partners currently supporting the local Oyster Restoration Research Project. Six small experimental reefs have been established in the estuary and are being monitored closely. The main goal of the project is to determine the conditions and locations that could support self-sustaining reefs. A second goal is to measure the ecosystem services provided by oyster reefs. Bringing together diverse partners who share a wide range of expertise makes the project much more effective. This project is an important first step in achieving the CRP goal of restoring oysters to the estuary.

NY-NJ Harbor waters do not meet public health standards for consumption of many types of shellfish, including oysters. Thus, the NJ Department of Environmental Protection has a ban on shellfish gardening any in New Jersey waters of the harbor to protect public health and the shellfish industry in New Jersey. This ban includes commercial growing as well as research and gardening. However, because this location is well guarded, a small research project has been allowed in Raritan Bay near the Naval Weapons Station Earle Pier. All other current restoration research is taking place in NY waters and incorporates measures to minimize the risk of illegal harvesting (poaching). Given the benefits to be gained and the widespread interest in oyster restoration in many bays and estuaries throughout the country, a variety of national, state and local agencies could play a key role identifying sensible solutions for protecting human health while restoring oyster habitats.

OYSTER REEF COMMUNITY:
1. Fan worms, 2. Sea anemone, 3. Barnacles,
4. Mud crab, 5. Whip mud worms, 6. Hooked mussel,
7. Sea squirts,8. Oyster spat, 9. Skilletfish

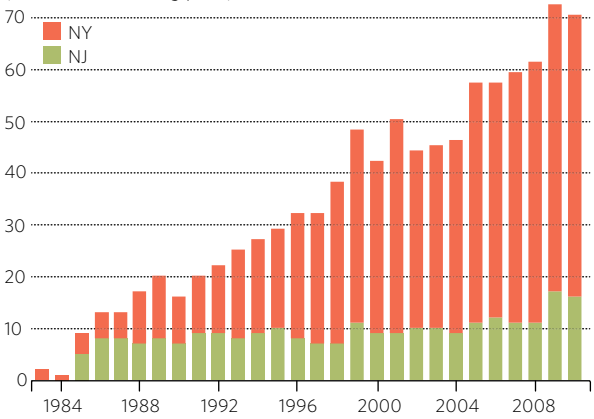

Alice Jane Lippson, from *Life in the Chesapeake Bay*,
by Alice Jane Lippson and Robert L. Lippson (Oyster reef community illustration)

# BIRDS

BANDING A PEREGRINE falcon chick in Jersey City (left). Peregrine Falcon in New York City (right).

We can find a great variety of birds in our estuary, from majestic herons foraging in our wetlands, to songbirds in urban parks, to shorebirds on our sandy beaches. In addition to their aesthetic value, birds perform crucial functions of enormous economic value, such as pollinating plants and controlling pests. Birds are very sensitive to environmental conditions, and tracking their populations can tell us a great deal about the overall health of the estuary. Here we focus on a few of the estuary's avian residents.

PEREGRINE FALCONS, NY & NJ STATEWIDE
(Successful breeding pairs)




## Peregrine Falcons

Peregrine falcons were considered locally extinct in our region by the early 1960s, mainly because pesticides like DDT affected their ability to reproduce. After DDT was banned, and thanks to conservation efforts (such as the release into the wild of captive-bred falcons in the 1970s and 1980s), peregrines started nesting in our area again in the early 1980s. Since then, the number of peregrines in the estuary has increased steadily. Today, many make their home both in urban areas like New York City and Newark and in cliff sites like the Palisades.

Peregrine falcons have adapted well to a changing environment. Of the 72 successful breeding pairs in 2009 in all of NY and NJ, 19 made their home in our metropolitan area, which holds one of the world's largest peregrine falcon populations in an urban setting. Bridges, buildings, towers, and other tall structures are favorite locations for falcon nests. From these sites they can spot and hunt prey such as doves, pigeons, and sparrows as they would from the cliffs of their traditional habitats. But although they are recovering, peregrine falcons are still an endangered species in NY and NJ and need extra help from all of us. Peregrine falcons do not build nests, and eggs may roll and fall when laid on flat surfaces. Scientists, birding organizations, bridge owners, and community members have all contributed by building nest boxes, checking the status of birds and nests, taking care not to damage or disturb nests when maintaining bridges, and helping birds in trouble. You can provide valuable information by reporting the locations of new nests and the identification numbers of banded birds to the NYSDEC (fwinfo@gw.dec.state.ny.us) or NJDEP (http://njfishandwildlife.com/ensphome.htm). Just be sure not to approach the birds too closely! To see peregrines in action, visit one of the many "falcon cams" on the Internet.

LOCALLY EXTINCT in the 1960s, peregrines are coming back to our region (left).

NJDEP (tagging baby falcon photo); Barbara Allen Loucks (falcon photo)
Chart source: NYSDEC Endangered Species Unit and NJDEP, Div. of Fish & Wildlife

A SCIENTIST attaches a radio tag to a great egret

## Harbor Herons

Herons, egrets, and ibises in our estuary—known informally as the **Harbor Herons**—are some of the most visible and strikingly beautiful wildlife in our region. These social birds nest in large communities, or *colonies*. They arrive from the south each spring and nest on several uninhabited islands (especially in the East River, Western Long Island Sound and Jamaica Bay) to lay their eggs and raise their chicks. Harbor Herons spend much of their time wading in the shallow waters of our remaining wetlands in search of food. As top-level consumers in the food web, they depend on healthy fish and crustacean populations to support them as they feed and rear their nestlings. Once the young birds are fully independent, they start dispersing northward, around early to mid August, before heading back south for the winter.

## How Have Changes in Our Estuary Affected Harbor Herons?

These birds were once abundant in our region, but disappeared in the second half of the 19th Century because of hunting, egg collecting, pollution, and habitat loss due to urbanization. Their overall numbers increased significantly in the 1980s and 1990s, then declined slightly, and have remained more-or-less stable since.

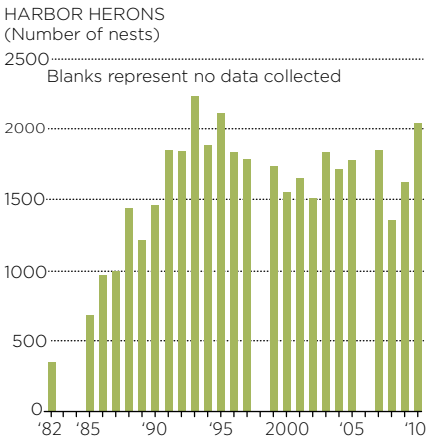
Cleaner waters and legal protection from hunting are likely responsible for the return of the Harbor Herons. Many small islands that had once been cleared and developed were later abandoned, allowing vegetation to return and creating favorable sites for nesting. The degradation of other habitats outside of our estuary may also have contributed to their return. Now that Harbor Herons are once again making our estuary their home, it is critical to protect and improve environmental conditions in the region, especially as their populations throughout the northeast U.S. are in decline.

Remaining threats to herons, many of which are related to human activity, include:

- Illegal visits to nesting islands that are closed to the public, with disturbance of nests.
- Development and wetland loss, reducing the availability of feeding sites.
- Invasion of nesting islands by raccoons, opossums, and rats, who eat Harbor Heron eggs.
- Damage to nesting habitat by invasive species such as Asian longhorned beetles.
- Climate change-associated impacts, which increase flooding, breaking up islands and wetlands where Harbor Herons roost (sleep), nest, and feed; disconnect the timing of food availability with breeding or migration cycles; and favor the proliferation of invasive species.

### HOW YOU CAN HELP

- Avoid disturbing Harbor Heron nests by staying away from nesting areas that are closed to the public.
- To view these birds, join a guided tour or become a citizen scientist and help collect data with groups such as NYC Audubon or NJ Audubon.
- You may also be able to spot Harbor Herons while visiting one of the estuary's natural areas, such as Gateway National Recreation Area or the NJ Meadowlands, or while participating in a paddling event.




HARBOR HERON populations have increased significantly since the 1980s.

## Helping Harbor Herons

Dedicated scientists and community members formed a Harbor Herons Subcommittee to better understand how these birds interact with the environment, what they need to thrive, and which factors threaten their livelihood. The subcommittee has prepared a plan to improve conditions for wading birds in our estuary and is now putting that plan into action. In addition, HEP and its partners have started working to restore habitats for Harbor Herons, following guidelines in the CRP.



NYC Audubon (heron photo)
Chart source: NYC Audubon annual Harbor Herons Surveys

# FISHES

Our waters are home to a diverse array of fishes, from small forage fishes such as menhaden, to larger fishes that prey on them, such as bluefish. Some are yearlong residents, like silversides, and others are migratory, like summer flounder. Many highly valued species are *diadromous*—they inhabit salty, brackish, and fresh waters at different life stages. *Catadromous* species, like the American eel, spend most of their lives in fresh water and release their eggs (spawn) in the ocean; the young eels migrate very long distances to enter fresh waters to complete their growth and development. *Anadromous* fishes, like the Atlantic sturgeon, live mostly in the ocean and enter estuaries, to reproduce; the young remain in these areas until ready to venture to sea. Diadromous species spend their first and most vulnerable year in estuaries—thus known as the "nurseries of the ocean."

A STUDENT CATCHES a striped bass during Battery Park City Parks Conservancy's Marine Education class.

## How Have Changes in Our Estuary Affected Fishes?

Many factors have contributed to the decline and virtual disappearance of local commercial fisheries and the restriction of sport fishing, affecting the region's employment, economy, and recreational opportunities:

- Overfishing from targeted fisheries within the estuary or offshore, or from bycatch (fish caught unintentionally along with targeted species).
- Dams and other structures in rivers create barriers to fish migration and decrease available habitat.
- Remaining habitats have been degraded.
- Human activities have polluted our waterways. In particular, nutrient pollution can deplete much needed oxygen in the water.
- Climate change and invasive species pose new challenges.

These problems are common in rivers and estuaries around the world, and the oceans have also been affected by human activities. Diadromous fishes are particularly affected because they depend on multiple habitats, each of which may be degraded. Their protection thus requires cooperation among states and countries.

### HOW YOU CAN HELP

- Help collect much needed data by participating in citizen science fish surveys.
- Join a fishing event to connect with our waters and learn about our many fishes.
- If you fish, comply with all regulations on fishing seasons, size limits, quotas, and catch-and -release requirements, and protect your health by following all fish consumption advisories.
- Do not pollute the estuary. Throughout this report you will find many things you can do to protect and improve the health of our estuary.

## Bringing Fish Back to the Estuary

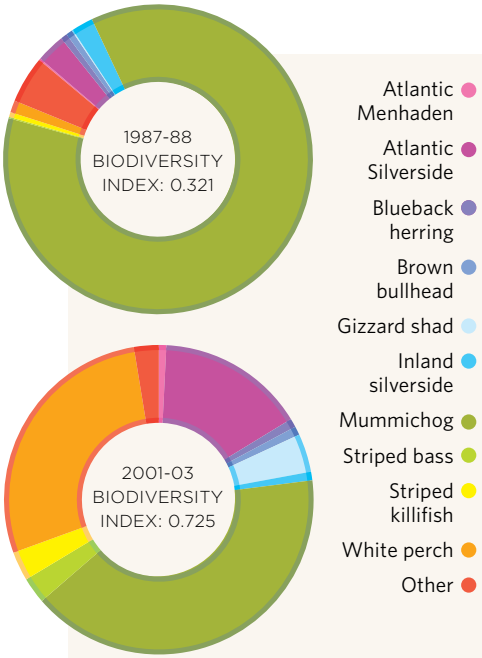
Ongoing efforts aimed at reversing damage to fish populations include:

- Management plans to aid in the recovery of several species. The Atlantic States Marine Fisheries Commission coordinates conservation and management efforts for sustainable use of the shared fishery resources along the East Coast.
- Regional fish surveys and research by scientists to better understand fish life cycles and factors affecting fish populations.
- Protection and restoration of habitats throughout the estuary, including removal of barriers to fish migration.

Local success stories—such as increased diversity in the Hackensack River and striped bass recovery—are encouraging, but much remains to be done. In addition to creating jobs and providing recreational opportunities, fishes are essential in controlling algae growth and transporting nutrients within the ecosystem. Researching and implementing effective actions to protect and restore the fishes in our estuary will have enormous benefits for our communities.

Projects underway or recently completed include dam removals on the Raritan River, improved fish passage on the Bronx River, and a study of a potential fish passage on the Lawrence Brook, a tributary to the Raritan River. The U.S. Army Corps of Engineers is also assessing other opportunities, with recommendations from HEP's Tributary Connections Subcommittee.

Battery Park City Parks Conservancy (fishing photo)




FISH SPECIES BIODIVERSITY in the Hackensack river has increased since 1987.

## HACKENSACK MEADOWLANDS

The Hackensack River teemed with fishes before urbanization-related changes became prevalent. Marshes were filled or drained, eliminating essential habitat. Human activities polluted the waters, and the Oradell dam blocked access to key breeding areas. Industrial plants began using river water for cooling processes, returning hot water to the river and injuring or killing fishes that were pumped into the turbines. Not surprisingly, fish populations plummeted, and some species disappeared entirely.

Today, however, there are signs of recovery. In the late 1980s, most fishes found in the Hackensack River were mummichog, a pollution-tolerant species. By the early 2000s, the fish community was more diverse and included larger fishes valued as game species, such as white perch and striped bass. These positive changes are likely the result of improvements in wastewater treatment, proper closure of several landfills, wetlands restoration, and less use of water for industrial cooling processes. Still, conditions are far from ideal, and some species such as bluefish continue to be affected.

## Hudson River

The Hudson River shares a similar storyline with the Hackensack and many of our region's waterways. Centuries of use and abuse of the river's natural resources took a toll on once-thriving fish populations. Ongoing efforts are contributing to the recovery of some species, but additional measures are needed. Below, we look at the status of a few Hudson River fishes.

- **Diadromous fishes** populations, such as sturgeon, American eel, and river herring, are of concern because they are generally on the decline throughout the Atlantic.
- **Striped bass,** or **"stripers,"** have historically been fished commercially and recreationally from North Carolina to Maine. The Atlantic coastal population declined sharply from overfishing in Chesapeake Bay, but recovered after the implementation of fishing restrictions throughout the East Coast. Annual surveys in the Hudson River suggest that striped bass populations have been relatively stable over the past 20 years.
- **American shad** are currently at historic lows in the Hudson River. While habitat degradation played an important role in shad decline up to 50 years ago, overfishing is thought to be the main factor in more recent years. It is hoped that recent closures of fisheries along the Atlantic coast and on the Hudson River will help shad recovery over the next few decades.
- **Resident Fishes:** Species such as **white perch** and **banded killifish** seem to be declining, while the **spottail shiner** population seems to be stable. Because these fishes spend their whole lives in the Hudson River (mostly in freshwater areas), declining populations may be a sign of poor conditions in the river, increased predation or competition, or other environmental changes, such as those caused by zebra mussel invasion.

MANY DIADROMOUS FISHES are declining but striped bass have experienced recovery due to protection measures (top). Trends for resident fish populations are mixed (bottom).

**ABUNDANCE OF HUDSON RIVER FISHES (FISH PER SAMPLE)**

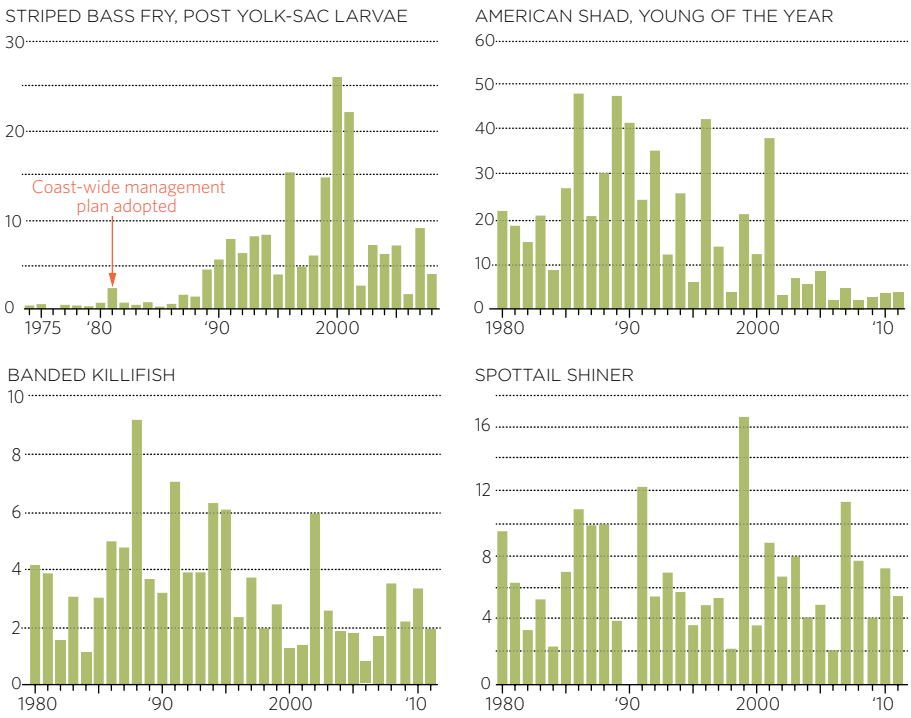





Chart Source: NJ Meadowlands Commission, Meadowlands Environmental Research Institute (Hackensack Meadowlands); NYSDEC, Hudson River Alosine Beach Seine Survey (American shad, banded killifish and spotted shiner: Newburgh to Troy, geometric means); Hudson River power generating companies (Striped bass)

# EXOTIC SPECIES

THE INVASIVE TUNICATE *Molgula manhattensis* was found at Great Kills Park Marina during the Northeast Rapid Assessment Aquatic Invasive Species Survey in 2003.

Species that are not original to our local environment and that were introduced by humans (purposely or accidentally) are called exotic, non-native, alien, or introduced species.

## What's the Problem with Exotic Species?

While the majority of introduced non-native species do not become established in significant numbers, a few thrive. Because they seldom have natural predators or diseases in their new environment, these new arrivals may spread and reproduce rapidly. Species that spread uncontrollably and cause harm to human health, the environment, and/or the economy, are considered invasive. Invasive species can damage an ecosystem by competing with other species for shared resources, and by taking over, altering, or degrading entire habitats. The result may be reduced biodiversity and displaced or eliminated species, especially those that are already threatened or endangered. Certain invasive species damage piers and other infrastructure, increasing maintenance and replacement costs. Others may carry and spread new diseases.

Once an invasive species is established and has spread, it can be extremely difficult and costly to manage or eliminate.

## How Are Exotic Species Introduced?

Exotic aquatic species enter a new habitat typically aided by human activities that remove natural barriers to dispersal. The many possible routes include:

- Intentional means, such as importing non-native shellfish to restock local beds.
- On ship hulls and anchors fouled by colonizing organisms such as tunicates and barnacles.
- In ship ballast water, which can contain millions of planktonic organisms, including larvae of barnacles, crabs, mussels, and fish.
- On or in devices that move between different water bodies, such as boats, dredging equipment, nets, and snorkeling gear.
- When anglers discard live bait in the water.
- When exotic pets or aquarium plants are released by their owners.

## CONTROLLING AQUATIC INVASIVE SPECIES

Ongoing efforts include:

- Regulations and guidelines to reduce invasions through transport in ship ballast water. There is a similar need to address introductions through attachment to ship hulls ("fouling").
- Management plans for invasive species developed by committees, councils, and partnerships at the state, national, and international level.
- Education and outreach efforts to a variety of audiences on stopping the spread of invasive species.
- Research and monitoring, including early detection/rapid response (ED/RR) programs, mapping tools, sighting databases, and research to better understand, prevent, and manage invasive species.

Initiatives in our region are focused largely on land-based plants and plant pests, and those directed at aquatic species are concerned mostly with freshwater invaders. Although this is beginning to change, coastal water invaders call for more attention. Preventing the introduction of non-native aquatic species is critical to avoid potentially costly damages in the future, especially as our globalized economy—with ever-increasing regional and international trade and travel—makes it easier for species to move beyond their native habitats.

ASIAN SHORE CRAB

Cathy Yuhas (tunicate photo); USGS (Asian shore crab photo)

THE NON-NATIVE channel catfish is becoming more abundant.

## What Exotic Species Have Invaded Our Estuary?

The following are a few examples:

**Channel catfish** is a predatory fish that has become increasingly abundant in the Hudson River in recent years. It has likely contributed to the decline in small fish species in tributaries.

**The oriental shrimp** was first found in the Bronx, East, and Harlem Rivers in 2001. Data suggest that this newcomer has become established but is not yet invasive. It should be monitored and studied to confirm it does not pose a threat.

**The Asian shore crab** was first seen in western Long Island Sound in 1994, and by 2000 had displaced native crabs—particularly the flatback mud crab—and greatly decreased species diversity.

**Zebra mussels** first appeared in the Hudson River in 1991 and quickly became dominant. By consuming massive amounts of phytoplankton (microscopic water plants), they alter the location and availability of food for many other species. Although zebra mussels live only in freshwater, they have changed the abundance and distribution of many fishes throughout the estuary.

**A shipworm** and a small crustacean known as **gribble** have caused extensive structural damage in our harbor by boring into wood structures such as piers and bulkheads.

### HOW YOU CAN HELP

Stop the spread of invasive species:

- In the water:
  - Stay away from aquatic plants.
  - Dispose of bait, seaweed, and packaging in the trash—*never* in the water.
  - Before leaving a waterway, clean and dry your boat.
  - If your dog gets into the water, clean and wash its coat.
- Do not bring animals, plants, or food into the country illegally.
- Be a responsible pet owner—*never* release an unwanted pet.

Report sightings of invasive species.

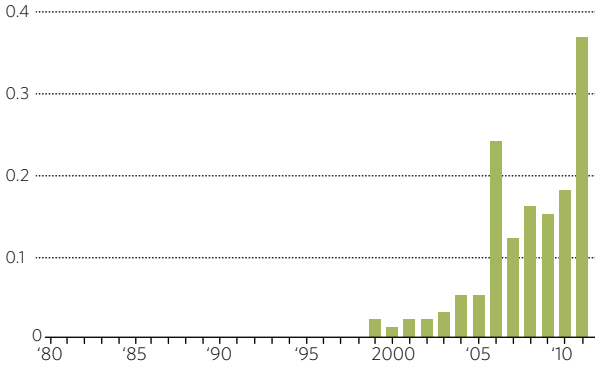
- In NJ: *www.njisst.org*
- In NY: *http://imapinvasives.org/nyimi/report_invasives*
- Or become a trained volunteer (contact *iMapInvasives@nynhp.org* for details).

Volunteer with natural resource agencies or with a community group to control invasive species.

For more ideas, visit:

- U.S. Fish & Wildlife: *www.fws.gov/invasives/what-you-can-do.html*
- Protect Your Waters: *www.protectyourwaters.net*
- The 100th Meridian Initiative: *www.100thmeridian.org*

CHANNEL CATFISH ABUNDANCE, HUDSON RIVER
(Fish per sample, Geometric Mean)




Though the **common reed** is a native marsh grass, a non-native subspecies is credited for taking over Northeast wetlands towards the end of the 20th Century. Disturbances caused by urbanization likely favored this variant over the native one. The non-native reed can dominate large areas, displacing native plants, altering the ecosystem, and reducing plant biodiversity.

In many coastal marsh restoration projects, large sums have been spent to eradicate reeds. Both native and non-native reeds, however, have been found to provide important ecosystem services and to support a variety of wildlife, including many rare or vulnerable species. Studies in the Northeast have shown that common reed can have both negative and positive effects on habitats and biodiversity, and, in some cases, may be better able than other marsh grasses to cope with accelerating sea level rise. Importantly, common reed invasions are often an indicator, rather than the cause, of habitat degradation. Unless underlying problems are addressed, removal is ineffective, as reinvasion is likely, consuming ever-diminishing monetary resources without realizing any gains.

These and other factors and tradeoffs need to be considered carefully when planning management actions. In some cases, it may be less expensive and environmentally risky to keep the existing mixture of native and invasive species together within the ecosystem they support, rather than attempting to create or re-create a community that may no longer be viable under current and changing environmental conditions.

The common reed invasion illustrates the expense and difficulty of controlling certain invasive species once they have taken over, and the complex decisions that confront us. This example highlights how critical and cost-effective it can be to prevent the introduction of exotic species, rather than to risk potentially devastating invasions.

Chart source: NYSDEC, Hudson River Alosine Beach Seine Survey (Newburgh to Troy)

# HARBOR SEALS

JUVENILE HARBOR
Seal in Raritan Bay

Seals are mammals that were once common in our region but disappeared by the late 1800s because of hunting and other human activities. In recent decades, seals (also known as "sea dogs") have been seen in increasing numbers in our estuary, thanks to improvements in water quality and protection from hunting.

The most common species in our area, the **harbor seal**, winters in our estuary. Harbor seal habitat ranges from the Canadian Arctic to the Carolinas. When not swimming, they can be seen lying on sandbars, sandy and rocky beaches, or ice floes. These "haul-outs" are crucial, as they provide an opportunity for seals to rest and warm themselves in the sun, among other essential functions.

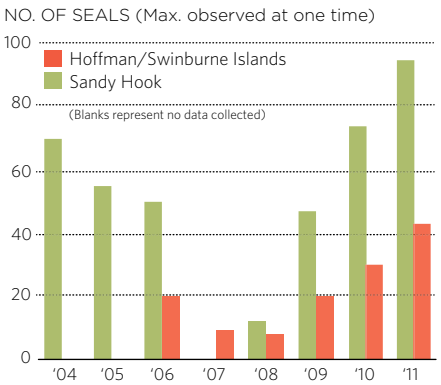
Over a century ago, seals were so abundant in our estuary that they were considered a nuisance. Even when not hunted for their meat, fur, skin, or oil, they were often killed because they were seen as competition for fishermen. In the end, seals became locally extinct.

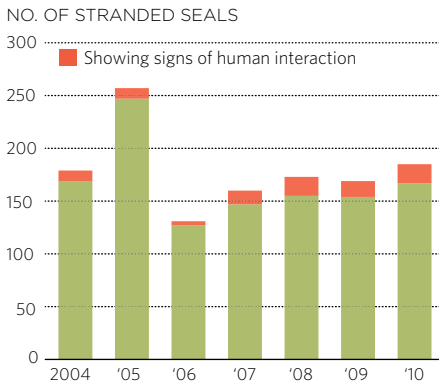
## Are Seal Populations Increasing in the Estuary?

The Marine Mammal Protection Act of 1972 made it illegal to hunt or harass marine mammals in U.S. waters. Twenty years ago, it was very uncommon to see a seal in our waters or on our shores. But since then, seals have appeared in increasing numbers throughout the estuary.

Although seals are not currently considered to be threatened, they still face a number of difficulties. Seals are wary of humans and are easily disturbed by boaters, pedestrians, and dogs. In addition to natural threats such as predation by sharks, they can become entangled in fishing gear—which may lead to serious injury or death—and are sometimes killed intentionally by humans. It is especially important to protect remaining seal haul-outs from development and pollution, as these areas are crucial for their survival.

SEALS HAVE MADE a comeback to our estuary (left). Approximately 5-10 percent of stranded seals show signs of human interaction, such as collision with boats, entanglement in fishing gear, and shooting (right).




## HOW YOU CAN HELP

- Avoid disturbing seals:
  - Always stay at least 150 feet away.
  - Keep your pets leashed.
  - While boating, travel slowly when near haul-out sites where seals rest, and avoid making loud, sudden noises.
- Do not attempt to come into contact with seals. Despite their friendly appearance, seals have a strong bite and will defend themselves if they feel threatened.
- If you fish, dispose of or recycle fishing line and other gear properly.
- Remember, a seal on a haul-out is behaving normally. If you find a seal (or other marine species) that you think may be stranded, distressed, or injured, call a marine mammal stranding network:
  - NY: Riverhead Foundation for Marine Research and Preservation, 631.369.9829
  - NJ: Marine Mammal Stranding Center, 609.266.0538
- For more information, visit NOAA's National Marine Fisheries Service web site at *www.nero.noaa.gov*

Joe Reynolds (seal photo); Chart sources: Sandy Hook (shore-based counts), Michael Davenport (Conserve Wildlife Foundation of NJ); Hoffman/Swinburne islands (boat-based counts), Paul Sieswerda (New York Aquarium curator, retired), NOAA Fisheries Service, Northeast Regional Office and Northeast Region Marine Mammal Stranding Network

SECTION 2

# POLLUTION

After the first Europeans settled in this region, the population grew rapidly and little attention was paid to environmental impacts. As a result, increasing amounts of sewage, trash, and industrial wastes were disposed of into estuary waters. Our waterways and landscape were also profoundly changed, altering water flow patterns and slowing down the flushing of pollutants in confined areas. These factors combined to cause a steady increase in pollution, including toxic chemicals, disease-causing pathogens, nutrient-rich wastes, and floating debris, with numerous negative effects on all estuary residents and the environment.

By the early 1900s, pollution was widespread, and efforts were started to improve the sewage system and build treatment plants. Later, several national laws and regulations to control the discharge of pollutants into the environment were passed, including the Federal Insecticide, Fungicide, and Rodenticide Act; the Clean Water Act; the Marine Protection, Research, and Sanctuaries Act (often referred to as the Ocean Dumping Act); the Marine Plastic Pollution Research and Control Act; and the Toxic Substances Control Act. These and other measures gradually helped to restore cleaner waters.

Today, our estuary is much cleaner, but further improvements are still needed. Now that the largest pollution sources have been addressed, the ones that remain are harder to tackle and will require ongoing efforts and collaboration among numerous agencies, scientists, environmental organizations, and all the good stewards of our estuary.

## WHAT'S NEW

Since our 2004 report on the Health of the Harbor, the NJ Harbor Dischargers Group has launched a new water quality monitoring program to provide adequate coverage in New Jersey waters and complement data collected by the NYC Department of Environmental Protection.

Water quality data generally show that after significant improvement in the 1980s, harbor-wide average concentrations of pathogens and dissolved oxygen have remained more-or-less stable. Data at a local scale can show improvements in individual water bodies over the same timeframe, depending on specific water quality improvement projects undertaken. Some of the more confined waterways, however, continue to be degraded. Remaining sources of nutrients and pathogens are much more difficult and costly to address than the larger sources already eliminated, and progress is expected to be slower. However, there are many ongoing large-scale projects to improve wastewater treatment plants, as well as efforts to implement green infrastructure widely, especially in New York City, and the resulting improvements are expected to be seen in the coming years.

Data indicate a possible decrease in floatable debris pollution, but it is too soon to tell if this is a real trend. This is an area that requires everyone's cooperation and a good deal of education, as much of the unsightly debris is caused by littering and the large amount of trash we tend to generate.

Finally, regarding toxic pollution, there has been progress in the removal, or remediation, of historical contamination. Most notably, the long-awaited cleanups of two of the most prominent sites in our region—the Hudson River PCBs and the Passaic River's Diamond Alkali site—have finally begun. Although these are just initial stages and extensive work is still needed, these first steps bring renewed hope and get us closer to the ultimate goal of a clean and healthy estuary.

WORKERS USE EXCAVATORS with environmental clamshell buckets to remove contaminated sediments and empty them into a "hopper barge." Tugboats move the barges to an upstream processing facility (left). Stormwater runoff carries motor oil and other pollutants from impervious surfaces (center). Debris on Staten Island shore by the Kill Van Kull (right).




USEPA Region 2 (dredging photo), Susan Donaldson, University of Nevada (motor oil photo), Kate Boicourt (debris photo)

# FLOATABLE DEBRIS


GANNET ENTANGLED in fishing line found off Rockaway Beach (top left). Decaying structures such as these abandoned boats are a source of floatable debris (bottom left). USACE's drift collector vessel Gelberman (right).

Floatable debris is a form of pollution caused by waste material suspended in our waters and can accumulate on shorelines and beaches. Most of the debris on our shores and in our waterways comes from littering—either on the water, in parks, on city streets, or at the beach. Litter can be carried by wind or water right into our estuary. Other sources include decaying structures, such as old piers and abandoned boats.

## How Does Floatable Debris Affect Us?

Garbage is not only an eyesore, but has many other negative impacts:

- It harms animals that get entangled in it or mistake it for food.
- It can cause dangerous accidents and costly damage for boaters.
- It can clog storm drains and cause or worsen floods.
- It may contain sharp items that can injure beachgoers.
- It has economic impacts as it affects recreational activities that depend on the public's appreciation of coastal natural resources.
- Cleaning up litter is expensive for our communities and consumes funds that could otherwise be spent on schools, parks, community projects, helping businesses, and creating jobs.

## Is Floatable Debris Pollution Decreasing?

The amount of debris collected appears to be declining in recent years. Although this is encouraging, it is too soon to tell if this trend is real or the result of normal fluctuation from year to year.

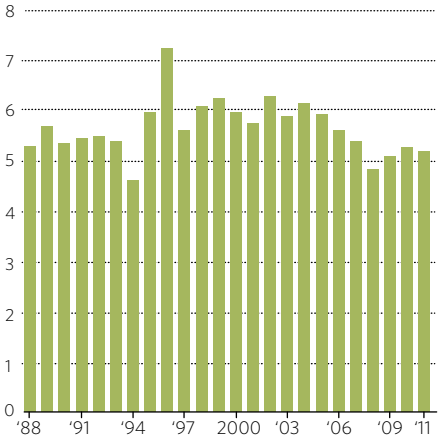
## DEALING WITH FLOATABLE DEBRIS

The economies of New York and New Jersey lost billions of dollars in 1987 and 1988 after a series of trash wash-ups caused beach closings and generated strong public reaction. As a result, both states collaborated with many agencies in the region to develop a Floatables Action Plan for the estuary and the shorelines of Long Island and New Jersey. Implementation of this plan began in 1989 and currently involves:

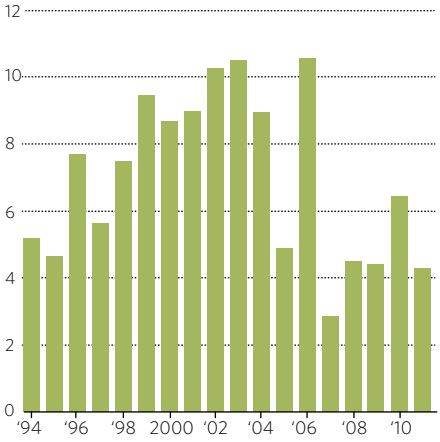
- **Helicopter surveillance** to spot large masses of floatable debris before they reach shore.
- **Skimmer vessels** to routinely collect floating debris.
- **Shoreline clean-up programs** conducted by numerous organizations and groups throughout the estuary, commonly engaging community members.
- **Booms**, or floating barriers, to contain debris from large storm and waste water outfalls.

Beth Perkins (bird photo); Jamal Kadri (derelict boats photo); U.S. Army Corps of Engineers (collector vessel photo)

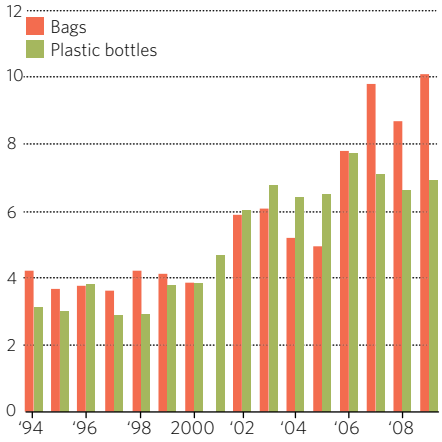
FLOATABLE DEBRIS COLLECTED
BY SKIMMER VESSELS AND BOOMS
(Tons of Debris, Thousands)




DEBRIS COLLECTED BY INTERNATIONAL
COASTAL CLEANUP IN 8 NY COUNTIES
(Pounds per Mile, Hundreds)



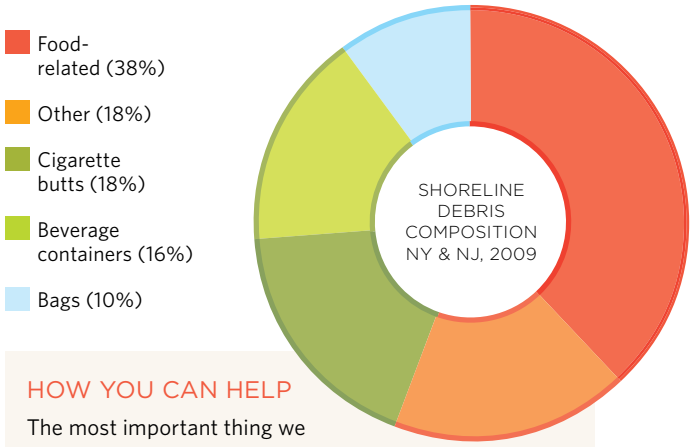

BAGS & BOTTLES COLLECTED
DURING COASTAL CLEANUPS IN NY AND NJ
(Percentage of total debris items collected)




THE AMOUNT OF FLOATABLE debris in our estuary seems to be declining in recent years (left, center) but it is too early to tell whether this is a trend. The most common type of debris is food-related (bottom right) and the percentage of bags and plastic bottles seems to be increasing (upper right).

## What are the most Common Types of Debris?

Food-related garbage (for example, food wrappers, straws, and cups) is the most common type of debris found during shoreline cleanups in our region. The proportion of bags and plastic bottles seems to be on the rise. Plastics are particularly problematic because most never fully degrade and thus have long-lasting impacts on ecosystems. Plastics typically break up into smaller and smaller pieces—often not visible to the naked eye. Animals that mistake these bits of plastic for food can suffer greatly and even starve to death.




A GROUP of dedicated volunteers cleaned up debris at Rocky Point on a rainy Earth Day in 2011, helping bring the marshes back to life.

## HOW YOU CAN HELP

The most important thing we can all do to reduce floatable debris is to prevent litter in the first place. You can make a big difference, save money, and help build safer and healthier communities:

- **Reduce** your garbage. Think before you buy, and choose items with less packaging.
- Choose **reusable** items (shopping bags, food containers, water bottles, etc.)
- Be responsible for your trash—including cigarette butts! Use trash bins or take garbage back home with you.
- **Recycle** everything you can.
- Recycle or dispose of all fishing and boating waste properly.
- Participate in cleanup events in your area.



Shervin Hess, Rocky Point Marsh Makers, http://marshmakers.blogspot.com (clean up photo)
Chart source: The NY Bight Floatables Action Plan Assessment Report 2011 (USEPA)/
Debris composition data (statewide NY & NJ): Ocean Conservancy, International Coastal Cleanup

# PATHOGENS

Pathogens are a variety of microorganisms that can cause diseases such as gastroenteritis (or "stomach bug") or more serious and potentially lethal illnesses, such as typhoid fever, cholera, and hepatitis. Pathogen pollution is commonly the result of contamination by human or other animal feces.

Both actual and suspected pathogen pollution can result in beach closures, restrictions on other activities involving contact with water, and restrictions on shellfish harvest and consumption. This limits our recreation choices, and affects tourism and shellfishing, all of which impact the local economy.

## How do Pathogens Enter Our Waters?

A large portion of the estuary is serviced by combined sewer systems, which use the same pipes to transport stormwater and sewage to wastewater treatment plants. When it rains, the stormwater may add more volume than a plant can handle, and the excess mixture of stormwater and sewage is discharged into our waterways untreated. These discharges are known as "combined sewer overflows," or CSOs, and are the single largest source of pathogens in our region.

Stormwater itself may carry pathogens from pet and wild animal feces. In areas with separate sewer systems, most stormwater enters storm drains and is carried directly to nearby waterways. Boats can be another source of sewage if toilet wastes are dumped directly into the water instead of at pumpout stations.

## What are We Doing to Make Our Waters Safer?

Numerous organizations and groups are working to make our waters cleaner and safer. Although this is a daunting task, cooperation among partners who are implementing actions, large and small, is bringing us closer to the ultimate goal of a healthy estuary that can be enjoyed by all at any time. Ongoing efforts to address pathogen discharges include:

- Plans and programs to implement green infrastructure practices.
- Educational campaigns to encourage water conservation by individuals, commerce, and industry, thus reducing the amount of water entering combined sewer systems.
- Substantial investments to increase the capacity of combined sewer systems and wastewater treatment plants.
- Development and implementation by New York and New Jersey of long-term plans to control CSOs and evaluate options to address this problem.
- Designating areas as "no discharge zones," where dumping sewage from boats into the water is prohibited, including Jamaica Bay and the Shrewsbury River.
- Steps by municipalities to reduce pollutants in stormwater; for example, street cleaning, pet waste management, and anti-littering campaigns, as well as developing best management practices to control stormwater under the Municipal Separate Storm Sewer System program.
- Water quality monitoring programs throughout the estuary to track improvements and ensure that the water is clean.

THANKS TO SUBSTANTIALLY cleaner waters, many people enjoy swimming in our estuary and local groups organize numerous swimming events during the summer months.

## Are Waters in our Estuary Safe to Swim in?

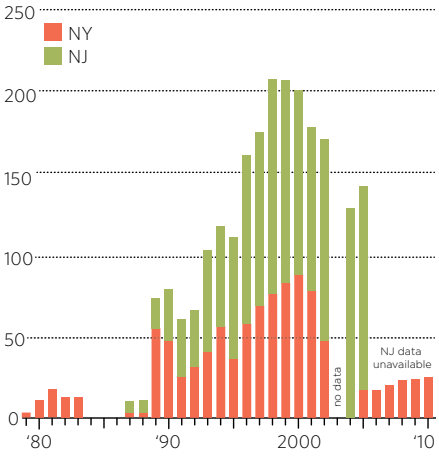
In general, and as long as it has not rained recently, most of our waters are safe for swimming, and many people do enjoy visiting the estuary's beaches or paddling in our waterways. But during storms, some amount of raw sewage and stormwater is commonly discharged and may make waters temporarily unsafe for direct contact. Swimming beaches are monitored during the summer season and will be closed if the conditions are known, or suspected, to be unsanitary. When it rains, some beaches are closed automatically; for others, a wet weather advisory is issued, meaning that swimming is not recommended.

### GREEN INFRASTRUCTURE

Green infrastructure is a set of approaches and technologies to infiltrate or use rain water as a resource while keeping it out of the sewer system, thus reducing polluted runoff and helping decrease discharges of untreated sewage from combined sewer systems. Examples range from relatively simple solutions, such as rain barrels, to more complex systems, such as green roofs. Green infrastructure methods that use vegetation are particularly appealing because they provide other community benefits, including cleaner air, decreased urban temperatures, and more enjoyable landscapes.

Manhattan Island Foundation (swimming photo)

CLAM HARVEST IN THE NY-NJ HARBOR
(Thousands of bushels harvested)




## HOW YOU CAN HELP

We can all do our part by adopting some of these actions:

- Conserve water
  - Fix water leaks, turn off faucets when not in use, and take short showers.
  - Consider purchasing low-flow fixtures or inserts.
  - Whenever possible, avoid large uses of water during a rainstorm (such as doing laundry, running the dishwasher, or taking showers).
  - For more tips, visit *www.epa.gov/WaterSense.*
- Always clean up after your pet
- If you are on a boat, never discharge untreated sewage; use pumpout stations whenever possible (check *www.state.nj.us/dep/fgw/cvadir.htm* and *http://bit.ly/HtkQNl for locations*).
- Consider installing rain barrels or other green infrastructure on your home or property.
- Report combined sewer overflows during dry weather.
  - In NJ, call (877) 927-6337 or go to *www.nj.gov/dep/warndep.htm.*
  - In NY, call (518) 402-8111 or visit *www.dec.ny.gov/chemical/48595.html*

## Are Shellfish from Our Estuary Safe to Eat?

Shellfish accumulate pollutants from their environment as they filter water to gather nourishment. Local clams, mussels, and oysters constituted a large portion of our region's economy and diet until the early 20th Century, when pollution and overharvesting devastated the local shellfishing industry.

Today, some of our waters (in Raritan and Sandy Hook Bays and Shrewsbury and Navesink Rivers) are clean enough that hard clams are safe to consume after undergoing a purification process to remove any pathogens. Subject to water quality monitoring, small areas of the Shrewsbury and Navesink Rivers are open seasonally from November to April for direct harvest.

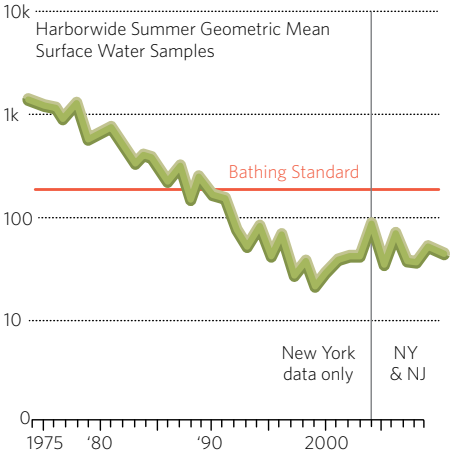
Local clam harvesting increased until the late 1990s and, at its peak, was estimated to contribute $54 to $66 million to the local economy. Unfortunately, in 2003 a parasite known as QPX infected some clams in the Raritan Bay. Although harmless to humans, some harvest programs were suspended to avoid spreading the disease. It is unclear how this setback will affect the local shellfishing sector, but as our waters keep getting cleaner, the prospect of reviving a sizable local shellfishing industry seems possible and has the potential to create much-needed local jobs.

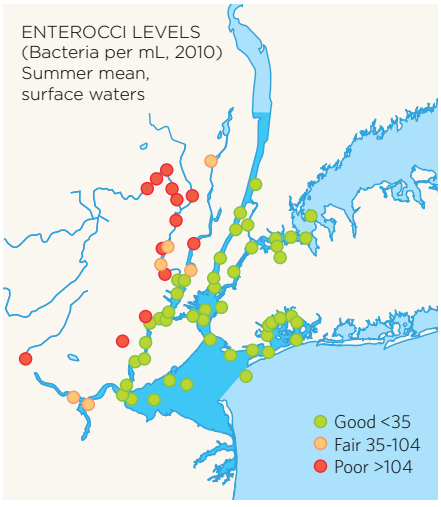
## Are Conditions Improving in Our Estuary?

Thanks to substantial investments in wastewater treatment infrastructure made by municipalities around our estuary, the average harbor-wide level of fecal coliform bacteria (an indicator of possible pathogen pollution) in our waters decreased dramatically from the early 1970s until the mid-1990s, and has remained stable since.

Although all areas of the estuary have improved, pathogen contamination can still occur, especially during and after rain events. Open waters are generally in better condition than enclosed bays and tributaries that receive combined sewer overflows and stormwater discharges. In addition, a more sensitive indicator of pathogen contamination (enterococcus) suggests that some areas (notably New Jersey tributaries) still need substantial improvements to be considered safe for swimming. Ongoing efforts should bring further improvements to our waters.

FECAL COLIFORM BACTERIA
(Bacteria per 100mL)




THE MEAN LEVEL of bacteria indicating possible presence of pathogens has decreased significantly (left) but some areas still need further improvements (right). Hard clam harvest peaked in the late 1990s but plummeted after some harvest programs were suspended in Raritan Bay (top left).



Data sources: NJDEP and NYSDEC (clam harvest), NYCDEP and NJHDG (fecal coliform and enterococci), USEPA Region 2 GIS (base map). Lucy Reading-Ikkanda (map illustration)

# NUTRIENTS & DISSOLVED OXYGEN


USING PUMPOUT STATIONS to dispose of sewage from boats helps keep pollutants out of our waterways. Sewage collected by pumpout facilities is transported to on-land wastewater treatment plants.

Except for aquatic mammals, who breathe in oxygen from air, most aquatic animals take in the oxygen that is dissolved in the water around them. Too little dissolved oxygen (a condition called hypoxia) or none at all (anoxia) can cause aquatic animals to suffer greatly or even die, much as we would without enough oxygen in the air we breathe.

## What Causes Low Dissolved Oxygen?

Nutrients such as nitrogen and phosphorus occur naturally in water bodies. They come from decaying plant matter and organisms, and provide nourishment to other living beings. However, too many nutrients may allow microscopic algae to grow out of control, causing an algal bloom. When these algae decay, bacteria feast on them, using oxygen much faster than it can be replenished and thus depleting dissolved oxygen. Conditions typically worsen during the summer, when warmer water can hold less dissolved oxygen, and when both algae and bacteria are more active.

Wastewater treatment plants started coming on-line in our region toward the end of the 19th Century, and today treat sewage from millions of people. Although these facilities have reduced nutrient discharges, the treated wastewater still contains large amounts of nutrients and organic matter, that may lower dissolved oxygen levels.

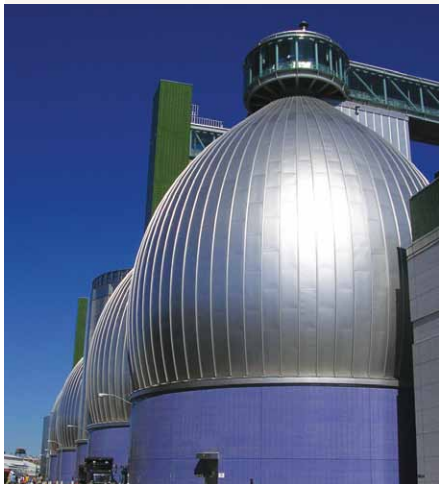
Other sources of nutrients include combined sewer overflows, sewage from boats, surface runoff that can carry animal wastes and fertilizers, nutrients conveyed from watersheds further upstream, and direct deposition from the atmosphere.

## WHAT ARE WE DOING TO IMPROVE DISSOLVED OXYGEN?

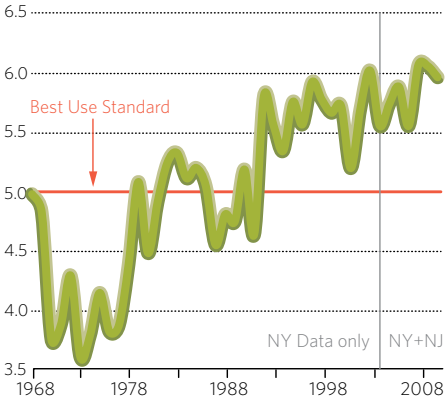
HEP partners are working to find the most effective ways of ensuring our waters are clean and safe for all of the estuary's inhabitants. They also continue to monitor water quality to track progress towards this goal. Other actions include:

- Completed, ongoing, or planned improvements for all wastewater treatment plants in our region, as well as exploration of innovative technologies to further reduce nutrient discharges.
- In 2000, a "total maximum daily load" (TMDL) for nutrients was established for Long Island Sound that, when implemented, will result in the waterbody meeting water quality standards. As a result, all four plants in the East River are upgrading their treatment to include nitrogen removal.
- Water quality monitoring programs in NJ and NY, including a few high-frequency locations.
- Recent passage of a New Jersey fertilizer law that is expected to reduce nitrogen inputs to NJ waters.

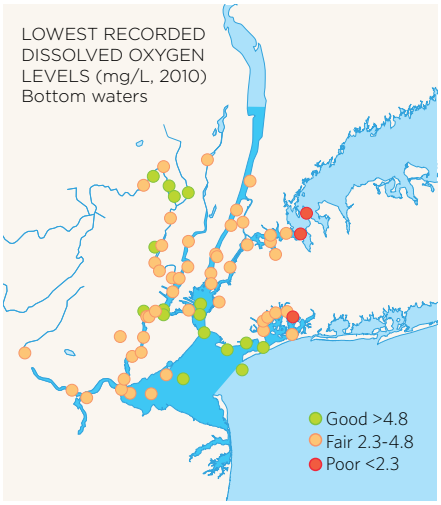
THE NEWTOWN CREEK wastewater treatment plant is undergoing dramatic improvements.



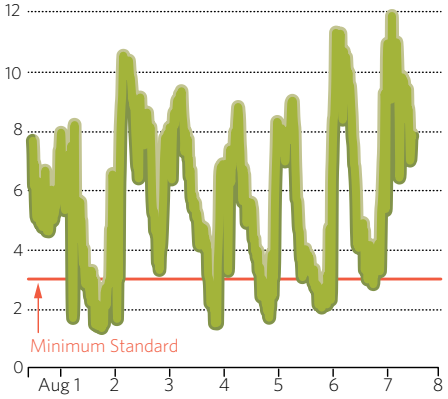
DISSOLVED OXYGEN IN BOTTOM WATERS
(mg/L) Harbor-wide summer averages




LOWEST RECORDED
DISSOLVED OXYGEN
LEVELS (mg/L, 2010)
Bottom waters




HIGH FREQUENCY DISSOLVED OXYGEN
(mg/L) Broad Channel, Jamaica Bay 2010




MEAN DISSOLVED oxygen levels have improved since the 1970s (top) and the overall condition in our waters in 2010 was fair to good (center). Dissolved oxygen levels, however, can vary widely, even throughout the day (bottom).

## Why Should We Care about Nutrients?

Excess nutrients in our waters can have many negative impacts, including:

- Nuisance algal blooms—explosive growth of algae that may cause noxious odors, excessive accumulations of foams, and discoloration of the water, decreasing the beauty of the water body.
- Low dissolved oxygen that can harm or suffocate fish and other aquatic species, resulting, in severe cases, in large-scale fish kills.

## Is There Enough Dissolved Oxygen in the Estuary's Waters?

For the past 20 years or so, the *average* level of dissolved oxygen in estuary waters over the summer has consistently been above what is considered safe for marine life, even at bottom depths, which tend to experience lower levels. Although this is encouraging, it does **not** mean that there is *always* enough oxygen *everywhere* in our waters, as dissolved oxygen can vary greatly over time and space.

While the open waters of the estuary are generally in good shape, there are still times and locations where dissolved oxygen can be too low, stressing or harming fish and other aquatic species. This problem is more severe in areas that receive discharges from wastewater treatment plants, such as the East River and western Long Island Sound. Dissolved oxygen can be particularly low in tributaries and bays with limited circulation, and in areas where treatment plants are the main source of fresh water, such as the tributaries of Jamaica Bay and the Hackensack and lower Passaic Rivers.

High-frequency monitoring at selected locations in the estuary shows how concentrations change throughout the day as they are influenced by tides, light, and other factors. For example, during the night, aquatic plants cannot produce oxygen via photosynthesis, and dissolved oxygen drops.

## Is Dissolved Oxygen Increasing in the Estuary?

Up until the early 1990s, dissolved oxygen levels increased dramatically, thanks to reductions in wastewater treatment plant nutrient discharges. Since then, average harbor-wide dissolved oxygen has fluctuated from year to year because of rainfall and other conditions, but has remained relatively stable.

Wastewater treatment plants do not fully remove all nutrients. Further reducing nutrient discharges requires additional and expensive investments to incorporate advanced treatments. Although much remains to be done, some of these upgrades are being carried out and others are being planned.

Other causes of low dissolved oxygen are more difficult to tackle, such as altered waterways that do not allow proper water mixing and circulation; polluted runoff from roads and sites on land; loss of wetlands that used to trap nutrients and other pollutants in runoff; and combined sewer overflows.

### HOW YOU CAN HELP

- *Always* clean up your pet's waste. Carry a newspaper or plastic bag to pick up the waste and dispose of it properly in the trash or toilet.
- Avoid unnecessary use of fertilizer on your lawn or garden, and do not apply when rain is in the forecast, as it can be washed into the estuary.
- If you boat, *never* dump sewage into the water.
- Do not feed wildlife such as geese, pigeons, ducks, and deer. Feeding results in more pollution from their wastes.



Chart source: NYCDEP (high frequency DO), NYCDEP and NJHDG (harbor-wide average DO)
Map source: NYCDEP and NJHDG (data), and USEPA REGION 2 GIS (base map)
Lucy Reading-Ikkanda (map illustration)

# TOXIC CHEMICALS


FISH ADVISORY sign in the Hackensack River (left). The Gowanus Canal is one of the nation's most extensively contaminated water bodies and was added to the Superfund National Priorities List in 2010 (right).

Many toxic chemicals, or toxics, entered our estuary over decades of industrial and other human activities. Substances known as "persistent and bioaccumulative toxics" are of particular concern because they are long-lasting and build up in human and wildlife tissues (bioaccumulate), causing a wide range of harmful effects. This accumulation is amplified (biomagnified) as contaminants move up the food chain. Examples of persistent and bioaccumulative toxics include heavy metals such as mercury, and human-made substances such as certain pesticides, industrial chemicals, and combustion byproducts.

Federal laws and regulations have banned or restricted the production and use of several toxic chemicals, and their environmental levels have decreased nationwide. But long-lived toxics still persist in varying amounts in our estuary's living organisms and sediments, including some heavily contaminated "hot spots."

Sources of ongoing toxic pollution include, among others, improper disposal of items that contain toxics (such as old lighting ballasts that may contain polychlorinated biphenyls—PCBs), mercury from coal-burning power plants throughout the U.S. that is carried by wind and deposited in our estuary, erosion from historically contaminated sites, and toxics that are still used legally (such as coal tar sealants containing polycyclic aromatic hydrocarbons—PAHs). In addition, there is growing interest in "contaminants of emerging concern," including pharmaceuticals, personal care products, and newer chemicals used in manufacturing and industry, many of which are widely used. Although these chemicals have not been regulated historically some are known, and others suspected, to have adverse effects on aquatic life.

## How Contaminated is Our Estuary?

Our estuary includes numerous sites contaminated with a wide range of toxic pollutants—a legacy from an industrial past. Many of these are "Superfund" sites, part of an Environmental Protection Agency program to clean up past contamination. As part of this program, cleanup actions have started in the upper Hudson River PCBs and Passaic River Diamond Alkali sites, two of the most polluted sites in our region. Progress in some of these highly complex, historically contaminated sites is often slow, as is the case in Berry's Creek in Bergen County, NJ, which is highly polluted with mercury and many other toxics. Two other extensively contaminated sites—Gowanus Canal and Newtown Creek—have recently been added to the Superfund site list.

There are also many other contaminated sites in our region, including state Superfund and brownfield sites. Brownfields are former industrial or commercial sites that have potential for redevelopment but may be contaminated by past activities.

USEPA (advisory sign); Jim Henderson/Wikimedia Commons (Gowanus Canal)


TRY TO REDUCE your purchase of products that contain hazardous ingredients, which can be harmful to our health and the environment. These products require special care when you dispose of them.

## HOW YOU CAN HELP

- Focus on **Pollution Prevention**. Think before you purchase, use, or dispose of any product. Does it contain toxics? Is there a safer alternative? How should you dispose of it? Remember that nothing we throw away truly "goes away."
- Avoid products that contain toxic substances as much as possible.
- Visit *www.earth911.org* for ideas on how to safely recycle or dispose of items that may contain toxic substances, including waste and debris from remodeling (such as old thermostats and appliances), household hazardous wastes (such as electronic devices, pesticides, and paints), motor oil and car fluids, rechargeable batteries, and more.
- Take unwanted or expired medicines to a collection event (check *www.dea.gov*). If this is not possible, dispose of medicines in the trash. Never flush them down the toilet!
- For more ideas, visit *www.epa.gov/dfe* and *www.epa.gov/safepestcontrol*

## The Problems

Toxic contamination is one of the most serious issues in our estuary. Among other problems, it causes:

- A wide range of adverse effects throughout the ecosystem.
- Restrictions or bans on fish consumption.
- Costly maintenance of navigation channels, since polluted sediments require expensive treatments.

## The Challenges

Addressing toxic contamination is challenging because:

- Cleaning up and disposing of contaminated sediments is complex and very expensive.
- Cleanups often need to cover vast areas, as many contaminants are toxic at very low levels and contamination is commonly widespread.
- In addition to historical contamination, ongoing inputs need to be addressed to avoid re-contamination.

All of the above and additional factors need to be considered when planning for sediment cleanup, which requires thorough study that can delay action.

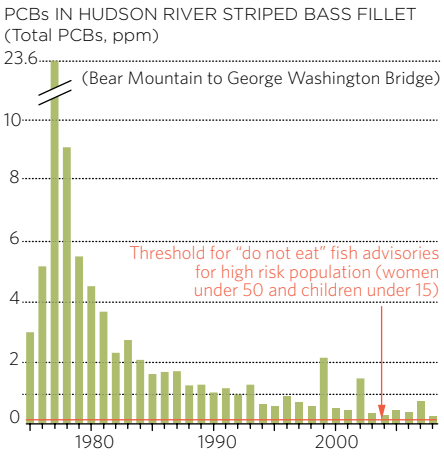
## Are Fishes from Our Estuary Safe to Eat?

Many fishes and crustaceans in our estuary are contaminated with a variety of toxic chemicals. Species that are fatty or high in the food chain may contain more toxics than others. New York and New Jersey periodically measure the level of toxics in fish, and issue consumption advisories to protect people who fish in our local waters from specific contaminants, including PCBs, dioxins, mercury, and cadmium.

Although consumption advisories vary according to who you are, where you fish, and what you catch, both states advise that:

- Children and women who may become pregnant should generally not eat any fish or crabs caught from water bodies where there are advisories. Toxic contaminants can have a greater effect in developing children and fetuses, and some chemicals may be passed on in breast milk.
- Fish fat and skin should always be removed, and any cooking juices or drippings should be discarded because many toxic compounds concentrate in the fat.
- If eating crabs, the tomalley or "mustard" (hepatopancreas) should be removed before cooking because this is where many toxic substances accumulate. Note that it is prohibited to eat, catch, or sell crabs from Newark Bay and tidal Passaic and Hackensack Rivers.

For specific advisories and more information, please visit *www.health.ny.gov/fish* or *www.FishSmartEatSmartNJ.org*.




TOXIC POLLUTANTS have decreased markedly in many species' tissues but the levels that remain still warrant several fish and shellfish consumption advisories.



Chart data by NYSDEC
Gabriela Munoz (household hazardous waste photo)

## WHAT ARE WE DOING TO REDUCE TOXIC CHEMICALS IN OUR ESTUARY?

Several efforts over the years have addressed the complex problem of toxic sediments.

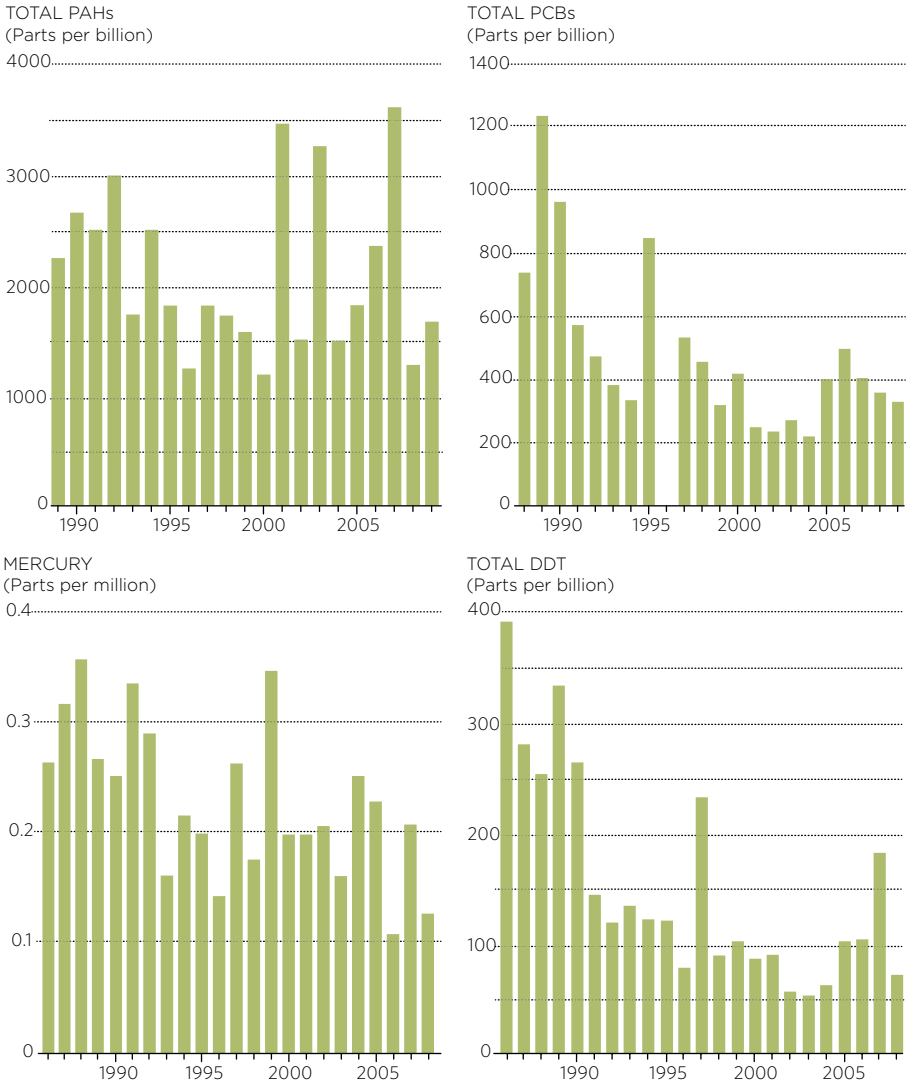
**Completed work includes:**

- The assessment phase of the estuary's Contamination Assessment and Reduction Project (CARP) to better understand historical contamination.
- Tracking down sources of contaminants still entering the estuary (for example via stormwater runoff), as carried out by HEP partners.
- Testing of innovative sediment decontamination processes for dredged materials.
- Identification by The Harbor Project of a series of actions to curb ongoing inputs of five groups of contaminants into our estuary (www.nyas.org/harbor).

**Ongoing actions include:**

- Remediation of contaminated sites in the upper Hudson and lower Passaic Rivers, recently begun after decades of careful study and planning.
- State and federal programs dealing with other contaminated sites, including Superfund, brownfield, and voluntary cleanup programs.
- Assessment by New York and New Jersey, in coordination with HEP, of which combination of sediment cleanup, reductions in direct discharges, and other measures are needed to achieve water quality standards.
- The CRP goals for the estuary to remove or cap contaminated sediments and restore ecological conditions.
- The Regional Sediment Management Plan proposal to develop a map of sediment contamination in the estuary to prioritize areas for cleanup.
- New mercury and air toxics standards to reduce emissions of mercury and other toxics from coal-fired power plants.

**HARBOR-WIDE MEAN CONCENTRATION OF SEVERAL TOXICS IN MUSSEL TISSUE**




TOXIC POLLUTION in our estuary has generally decreased, as shown by concentrations in mussels (above) and striped bass tissue (opposite page).

### Is Toxic Pollution Decreasing in Our Estuary?

Our 2004 report on the Health of the Harbor showed pronounced decreases in conventional toxic pollution from the 1960s through the 1990s. In this report, we focus on more recent changes.

Many conventional toxic contaminants in fish and mussel tissue have declined, a sign that our estuary is getting cleaner. But, in general, rates of decrease slow as pollution diminishes, meaning that low levels of toxics can remain in the environment for decades. PCB concentrations in striped bass have declined since these chemicals were banned in 1976, but are still above the level of concern that triggers fish consumption advisories for high-risk populations (such as children and pregnant women). Removal of highly contaminated sediments, some of which is happening now, is expected to speed up further reductions in toxic chemicals.

Chart data by NOAA Mussel Watch Program

SECTION 3

# CLIMATE CHANGE

The climate of the earth has generally been stable for the past 10,000 years. But the conditions we evolved under are now changing so rapidly that human and natural communities may not be able to adapt successfully. Scientists agree that the earth's temperature has risen over the past century—at an accelerated pace in the last several decades—and have concluded that this has very likely been caused by human activities, primarily the increasing use of fossil fuels. Burning coal, oil, and other fossil fuels releases carbon dioxide ($CO_2$)—a heat-trapping or "greenhouse" gas—into the atmosphere, causing average temperatures to increase.

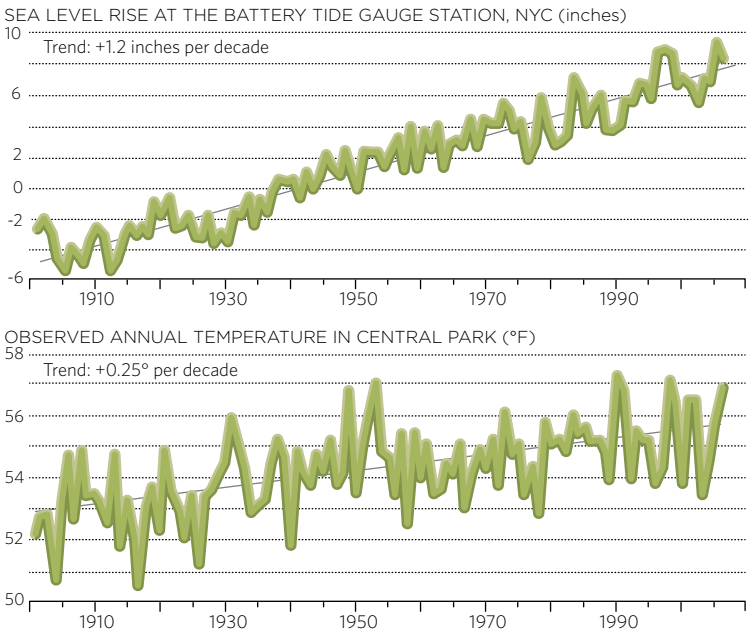
Dramatic changes in our climate are affecting humans and the environment we depend on for sustenance. We are already experiencing these changes, some of which can be very disruptive and costly and are expected to worsen if no action is taken: more frequent and severe storms, flooding and sea level rise, more frequent heat waves, and accelerated loss of, and shifts in, species and habitats.

## Our Climate Is Changing and Sea Level Is Raising

Average temperatures in the NY-NJ metropolitan region have risen and are expected to continue increasing. What this potentially means for our region is not just warmer weather, but a profound disruption of our climate, with certain extreme weather events becoming more common. Changes that are expected for our region include:

- Summer heat waves that are very likely to become more frequent, more intense, and longer lasting.
- Sea level rise will continue and accelerate.
- Increases in intense precipitation events that cause inland flooding, and droughts that are more likely than not to become more severe.

SEA LEVEL and mean temperature are increasing in our region.




## WHAT CAN BE DONE?

Climate change can be addressed in two main ways:

- Decreasing greenhouse gases in the atmosphere by reducing current emissions and by mitigating past emissions (for example, by planting trees that absorb $CO_2$).
- Adapting to climate change. This includes a wide variety of measures, such as planning for flood evacuation, designing buildings that can withstand more severe storms and flooding, and increasing green infrastructure to reduce demands on our wastewater treatment plants.

Both approaches are needed because we are already experiencing the effects of climate change. Several large-scale local, state, and regional initiatives of both types are currently in progress.

On a smaller scale, HEP is:

- Helping the North Hudson Sewage Authority to use a toolkit to prepare for climate change as part of the USEPA's Climate Ready Water Utilities program.
- Assessing how sea level rise will affect public access sites in NJ as part of the USEPA's Climate Ready Estuaries program.

## How Are Our Surrounding Ecosystems Affected?

The effects of climate change are many and varied:

- Important habitats (such as many coastal wetlands) and the species that live in them could decline or disappear because of rising sea levels.
- Certain species (including more than 175 migratory birds) have shifted or will shift northward to escape warmer conditions. Some, like rainbow smelt in the Hudson River, may disappear altogether.
- We may gain species that require warmer temperatures, such as ghost crabs, and see an increase in exotic species.
- Parasites and disease-carrying organisms that were once rare are now thriving. For example, "Dermo," a disease that affects oysters, has entered our region recently as temperatures have increased.
- As the oceans absorb large quantities of the extra $CO_2$ in the atmosphere, seawater turns more acidic, decreasing the amount of carbonate, a mineral that shellfish, corals, plankton, and mollusks need to make their shells. Scientists predict that the growth of the Eastern oyster may slow as ocean acidification increases.

These and other changes combined are expected to cause profound ecological transformations in our estuary.



Chart source: http://tidesandcurrents.noaa.gov (sea level rise); Columbia Center for Climate Systems Research (temperature in Central Park)

CLIMATE CHANGE will increase the frequency and severity of flooding, as normal high tides become higher and extreme weather events become more common. Increasing temperatures are driving many species northward (chart below).

## How Does Climate Change Affect Us?

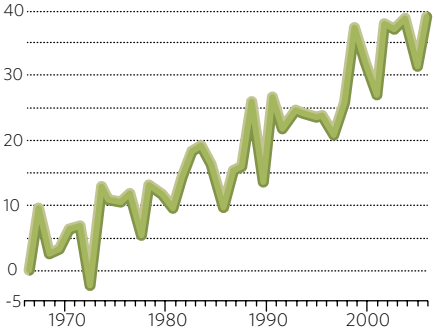
Climate-related changes could severely impact our daily lives, affecting the basic services we have come to rely upon, including transportation and the availability of water and electricity.

More frequent and intense rainstorms will increase flooding of low-lying areas, affecting our homes, buildings, and other infrastructure, and disrupting transportation. Throughout the estuary, this will increase water pollution from runoff and combined sewer overflows. Coastal storms combined with rising sea levels will cause beach and shorefront erosion and the loss of wetlands, among other negative effects.

Heat waves are not just unpleasant and distressing, but pose a serious and potentially deadly health risk, particularly for children and the elderly. Although milder winters will mean less energy used to heat buildings, increased energy use in the summer to cool our homes and businesses will stress our energy infrastructure and could lead to more frequent blackouts. If we continue to rely on fossil fuels, increased energy use will release even more carbon dioxide into the atmosphere, intensifying climate change.

Greenhouse gases already in the atmosphere will remain for a long time and cause some amount of climate change, no matter what we do. But these changes will worsen if we do not act. Though it will be expensive for our communities to reduce the impact of climate change and to adapt our current structures and systems to cope, we need to act NOW to minimize the negative effects for our families, businesses, and ecosystems.

SHIFT IN BIRD MIGRATIONS IN N. AMERICA
(Average distance moved north, miles)




## HOW YOU CAN HELP

Conserving energy is important for reducing fossil fuel consumption and greenhouse gas emissions. It is good for the environment—and your wallet! No single action will get the job done, but here are a few suggestions:

- Avoid wasting energy. For example, turn off lights and appliances when not in use.
- Choose Energy Star products, which consume less power.
- Insulate your home so you'll spend less on heating and cooling.
- Reduce, reuse and recycle.
- Conserve water. It takes lots of energy to produce safe drinking water and to treat waste water. Saving water has other benefits as well.
- Whenever possible, use public transportation, walk, bike, or carpool.
- If you have to drive, try to choose a car with good fuel economy, and keep it well tuned.

Other things you can do:

- Be informed about climate change.
- Plant a tree. Trees and shrubs help absorb $CO_2$.
- Volunteer with a community group or get involved in your local government.

For more ideas, visit *www.epa.gov/climatechange/wycd* and *www.energysavers.gov*

Mike Fedosh (Keyport, NJ flood photo)
Chart source: National Audubon Society (shift in bird migrations)

SECTION 4

# PUBLIC ACCESS

Historically, much of our estuary's shoreline was used for port operations, industrial activities, waste disposal, railroads, and roads, blocking public access to many areas of the waterfront. High levels of pollution in the past also made the waterways unattractive for recreation.

Today, our waters are cleaner, waterfront use and development patterns have changed, and our cities are reconnecting with the estuary, resulting in a growing desire for more access to the waterfront and the water itself. Still, there are long stretches of waterfront that remain inaccessible to the general public, a problem that many people are working to change. Examples of large-scale, successful projects that provide public access include NJ's Hudson River Waterfront Walkway and the Brooklyn Greenway Initiative's Waterfront Greenway.

### HOW YOU CAN HELP

- Nominate a site in your neighborhood for transformation into a public access site, or identify one that needs maintenance. Go to *www.watersweshare.org* or contact *habitat@harborestuary.org*
- Get involved in a community group working to improve public access, or participate in a public access event.

## Why does Public Access Matter?

Access to the water and shoreline is a great way to get in touch with nature, especially in our highly urbanized estuary. Increased access can provide many benefits, including education, recreation, health and fitness, and an overall better quality of life. And the more people feel connected to the water, the more they will want to become actively involved in protecting and restoring our estuary. It is also part of public law: according to the Public Trust Doctrine, public waters, lands, and living resources are held by the State in trust so that all people can enjoy and benefit from these resources.

## What are We Doing to Improve Public Access?

- With partners and its Public Access Work Group, HEP has undertaken several projects, such as creating paddling and access point maps, identifying sites suitable for public access, promoting access and waterfront events through small grants, and assessing the projected impact of sea level rise on public access sites in NJ.
- Creating and upgrading access points to make our waters accessible to all residents within a short walk or public transit trip is a goal of the CRP for our estuary. An HEP-sponsored Public Access Inventory is used as a baseline for existing access, which are included on the OASIS interactive web-based map (*www.oasisnyc.net/map.aspx*).
- HEP partners have acquired and/or restored numerous sites, most of which provide public access opportunities.

## Challenges

As the population continues to grow, the need to maintain existing access and create new opportunities also increases. Conflicts may arise between different waterfront uses. Although industrial activity and public access coexist in places such as the Hackensack Meadowlands and Newtown Creek, access may be limited around airports and other secure areas, as well as environmentally sensitive areas such as nesting habitats.

Meeting public access needs and minimizing waterfront use conflicts requires planning and the education of all users. Additional challenges come from emerging issues such as the impact of climate change and sea level rise on access sites.

THE HARBOR AT HASTINGS State Superfund site blocks access to the Hudson River at the Village of Hastings-on-Hudson, NY (above); Students from *City As School,* an alternative public high school in the West Village, row at Pier 40 in Hudson River Park as part of a regular afterschool program at the Village Community Boathouse (right).

Gabriela Munoz (Hudson river); Rob Buchanan (boating photo)

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