



**30 YEARS:** MAKING A  
DIFFERENCE FOR THE  
HUDSON RIVER ESTUARY



Department of  
Environmental  
Conservation

Hudson River  
Estuary Program



## ABOUT THE HUDSON RIVER ESTUARY PROGRAM

The Hudson River Estuary Program helps people enjoy, protect and revitalize the Hudson River and its valley. The program was created by state law in 1987, and its activities extend from the Troy dam to upper New York harbor. It is guided by the *Hudson River Estuary Action Agenda*, which establishes a shared vision for regional goals. The Estuary Program provides:

- Grants and restoration projects
- Education, research, and training
- Natural resource conservation and protection
- Community planning assistance

Implementation of the Action Agenda relies on partnerships with federal and state agencies, as well as local municipalities, non-profits, academic and scientific institutions, businesses, trade organizations, landowners and dedicated volunteers. The Hudson River Estuary Management Advisory Committee (HREMAC) provides guidance to the Estuary Program, helps the state define goals and evaluate progress, and provides a communication bridge to a wider group of partners and stakeholders. Numerous government partners participate as ex-officio members of the committee and help deliver Action Agenda results.

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Letter from Governor Andrew M. Cuomo	i
Letter from Commissioner Basil Seggos	ii
My Recollections and My Hopes For The Hudson	2
Water Quality	3
Signature Fisheries	5
River and Shoreline Habitats	7
Streams and Tributaries of the Hudson River Estuary Watershed	9
Natural Areas and Wildlife	11
Resilient Communities	13
Natural Scenery	15
Public Access	17
Education	19
Hudson River Estuary Management Advisory Committee Members	21



Governor Andrew M. Cuomo  
NYS DEC Commissioner Basil Seggos

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## Dear Fellow New Yorkers,

I'm pleased to deliver this 30th anniversary report of the Hudson River Estuary Program. In 1983, when my father began his first term as Governor, the Hudson River was beginning to recover from decades of abuse and neglect, but major challenges still remained. He believed a healthy environment was a basic right, and vital to our quality of life, our economy, and our future, and the revitalization of the Hudson was a priority.

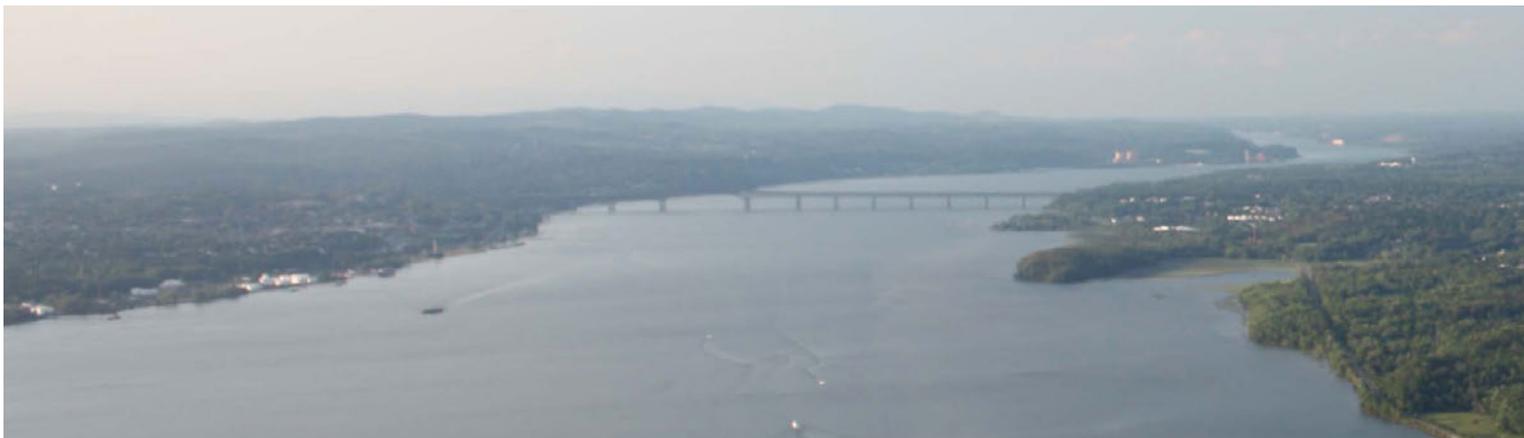
Over the past six years, I have been pleased to carry on this environmental legacy. We have provided record funding (\$300 million) through New York's Environmental Protection Fund (EPF), and this year created a new \$2.5 billion Clean Water Infrastructure Act to protect and manage our natural resources, upgrade aging water infrastructure that is causing impairments, and address new threats from unregulated contaminants. Our strong efforts will help continue the remarkable progress we have made in restoring the health and vibrancy of the historic Hudson.

For thirty years, the Hudson River Estuary Program—grounded in science, and committed to providing a healthy ecosystem for residents, businesses and visitors—has



been has been a major factor in every aspect of the recovery of this magnificent river and its surrounding environment. I commend the vision and leadership of my father and so many others who have been strong partners in this ongoing, essential effort. The Hudson River Estuary Program has given us a wonderful legacy to celebrate, and we look forward to expanding on its success in the years ahead.

*Sincerely,*  
*Governor Andrew M. Cuomo*



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## Dear Friend of the Hudson River,

It is an honor to present to you the 30th Anniversary Report for the Department of Environmental Conservation's (DEC) Hudson River Estuary Program. Since starting my career working to conserve the Hudson River in the early 2000s, it has been incredible to watch the environmental transformation that has taken place in the river, fueled in large part by the strong leadership of the Hudson River Estuary Program and the dedication of environmental leaders like Governors Mario and Andrew Cuomo.

With the launch of the Hudson River Estuary Program in 1987, Governor Mario Cuomo championed major new funding sources such as the Environmental Quality Bond Act that enabled DEC to implement a wide range of estuary projects and programs, including improved Hudson River fisheries management, expanded river access, and significant water quality improvements. Fast forward to today, and now Governor Andrew Cuomo has championed new, historic investments in environmental restoration and water quality protection, highlighting his unwavering commitment to a clean Hudson River and sustainable waterfront communities.

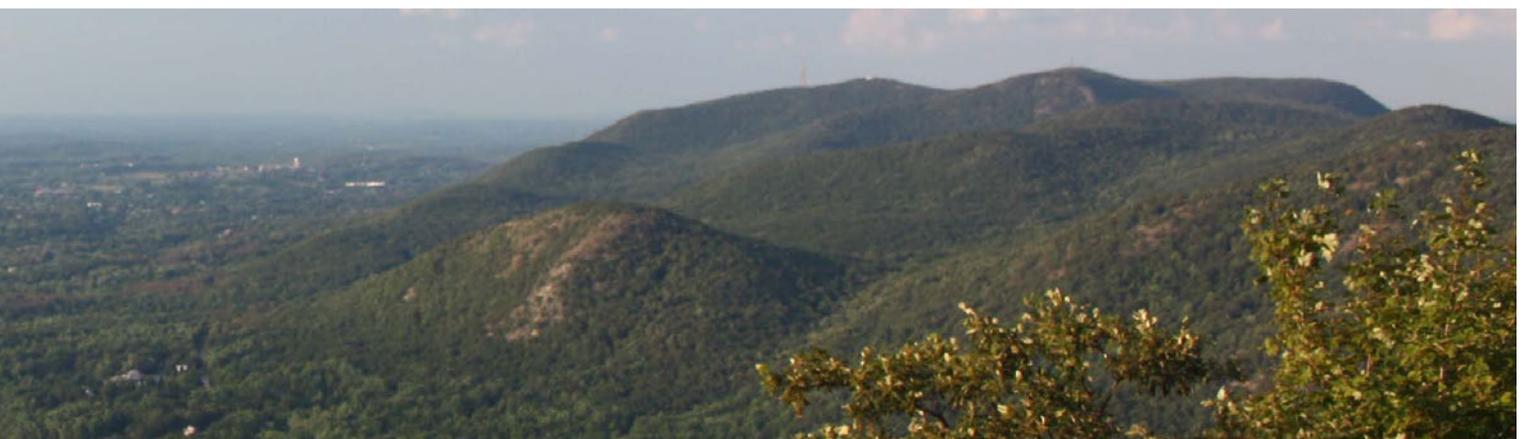
Through Governor Cuomo's leadership, the newly enacted \$2.5 billion Clean Water Infrastructure Act and the expanded \$300 million Environmental Protection Fund are providing direct support to upgrade aging infrastructure, advance waterfront revitalization and resiliency, promote river access, and launch green energy initiatives. In particular, the Hudson River Estuary Program has continued to expand science-based programs and

planning efforts and has continually provided grants to communities to preserve open spaces; protect the Hudson's unique natural heritage of fish, plants, animals, and habitats; and develop new recreational opportunities throughout the river.

This year, we celebrate the remarkable gains made through the program in the past three decades, while also recognizing the challenges and opportunities of a new era. New York State remains committed to meeting these challenges head-on by pioneering new solutions to emerging threats facing water quality and habitats, tackling climate change, addressing persistent sources of pollution, and strengthening the resiliency and unique character that define the communities up and down the river.

On this 30th anniversary of the Estuary Program, we celebrate the significant accomplishments of the dedicated network of agencies, organizations and volunteers who have advanced restoration of this vital waterway, and look forward to building on these successes to continue our efforts to ensure this magnificent river remains on the road to recovery.

*Sincerely,*  
*Commissioner Basil Seggos*





## MY RECOLLECTIONS AND MY HOPES FOR THE HUDSON

I was fortunate to grow up along the Hudson. Seeing the river at its worst, and participating in its ongoing recovery, has given me a tremendous sense of hope and optimism. We've come a long way, but there is still a long way to go.

In the 1950s, when I was a child in Poughkeepsie, NY, the river was an open sewer. Up and down the Hudson and its tributary streams, industrial pipes spewed paints, dyes, heavy metals, noxious chemicals and untreated butcher waste into the water. Migratory fish that made the journey from the ocean to their spawning grounds near Troy met a wall of pollution so severe that few survived. Biologists in Albany observed fish circling slowly and gasping for air. Fish caught in the Hudson tasted like petroleum products. Chemical studies showed that they were loaded with PCBs from General Electric's industrial discharges. Crabs were full of cadmium. Bald eagles and peregrine falcons were gone; pesticides like DDT had made their eggs too fragile to hatch. On top of all that, 150 years of dredging and filling had destroyed habitats and altered the ecosystem dramatically.

The 1960s brought a shift in the public mood and a period of activism for civil rights, including the right to a clean environment. New environmental groups tapped public sentiment to make enduring changes. They prevented construction of a power plant on scenic Storm King Mountain, built a sloop that would sail (symbolically) for clean water, and won citizen suits that stopped industrial pollution of the river and protected the environment. Nationally, Rachel Carson's famous *Silent Spring* raised awareness of toxic chemicals. This activism led to major state and federal environmental laws, as well as the creation of the Hudson River Foundation. Storm King Mountain is now preserved.

By 1987, when the Hudson River Estuary Management Act was enacted, and I became the Hudson River Estuary Coordinator, the river

was responding to clean-up programs. Even so, it is hard to imagine how different the river was then, compared to today. Though water quality was improving, and commercial and sport fisheries were rebounding, on average 300 million of gallons of untreated waste still flowed into the river every day. There were few places for the public to legally gain access to the river. Swimming was risky, kayaking was unknown. There was no Greenway Trail.

Abandoned industrial sites lined the river shore, leaving a legacy of "brownfields" full of cadmium, PCBs, dioxin and other hazardous materials. Contaminated sediments carpeted the river bottom. No one thought about climate change or sea-level rise or coastal storms. Power plants like Indian Point sucked in billions of gallons of river water daily, killing more than one billion fish annually. Communities put highways, jails and landfills on the river shore. The science of river ecology was in its infancy; there was little information to guide decision-making. Management of the river was fragmented by multiple agency jurisdictions.

That has all changed over thirty years. Indeed, this year, Governor Andrew Cuomo negotiated the closing of the Indian Point nuclear plant, which will end most of its damage to the river and fish. He has stepped up the pace of water quality improvement, investing millions in climate resiliency, promoting clean renewable energy policies, and announcing new plans to protect the ocean and the estuaries connected to it, including ours.

As we celebrate our successes and continue our work to manage and improve the Hudson estuary and its watershed for the benefit of nature and the people, these actions will put wind in our sails and help us tackle the new issues we face, as outlined in this report.

**Fran Dunwell, Hudson River Estuary Coordinator, NYSDEC, May 2017**

Scenic Hudson



Steve Stanne



*The Hudson River Sloop Clearwater a sailing 'classroom' where students examine river life, perform water-quality tests, and study plankton and other invertebrate life.*

Steve Stanne



*Fran Dunwell, Hudson River Estuary Coordinator.*



*Water quality in the 'Albany Pool' has improved since wastewater treatment plants began disinfecting effluent discharges in 2013.*

## WATER QUALITY

Because of the success of clean water legislation in the 1960s and 70s, New Yorkers began to expect that they might be able to fish, boat, and swim in the waters of the Hudson River. But while these waters looked much cleaner by 1987, additional work – and public awareness – would be necessary to achieve a healthy ecosystem.

Combined overflows of storm drains and sewer pipes (CSOs) discharged into the Hudson during heavy rains. Municipal treatment plants did not disinfect wastewater. Vessels also discharged waste into the river, and contaminants such as PCBs and cadmium from past industrial activity remained in river sediments.

Over the last 30 years, progress in all of these areas has been significant, though important work remains to be done. New York State has provided billions of dollars in funding for wastewater treatment plant upgrades, and now requires seasonal or year-round disinfection of discharges to the river. Long-term control plans to reduce or eliminate combined sewer overflows are in place for all but one community along the Hudson, and that one will be completed soon. The most notable of these efforts have been in New York City and in the northern reaches of the estuary known as the “Albany Pool.”

In 2008, DEC partnered with the Capital District Regional Planning Commission to address more than 100 CSOs in the Capital District. Updated permits now require municipalities in this area to achieve the goal of swimmable water quality, and \$15 million in grants has been provided to help achieve this goal. The Rensselaer sewer district began disinfection in 2013, and disinfection came online at two large Albany plants in 2014. The Albany Pool Plan, announced in 2014, includes \$5.8 million for green infrastructure projects and \$2.13 million for tributary enhancements to help reduce stormwater runoff and improve water quality.

On Manhattan’s west shore, 150 million gallons of raw sewage entered the river daily until 1986, when the North River Sewage Treatment Plant began operating on. Bacteria dropped significantly. More recently, New York City signed an agreement to develop ten waterbody-specific, long-term control plans, in addition to a citywide plan. This agreement specifies reductions of combined sewer overflow discharges into New York City waters by approximately 8.4 billion gallons annually when complete.

Several funding sources, including New York State Bond Acts, the NYS Environmental Protection Fund, and federal grants

Steve Stanne



*A group of fishers head out in the early morning to catch stripers.*

Darcy Salinger



have provided substantial dollars to support water quality improvements, including billions invested in municipal facilities and infrastructure, brownfield cleanups, and open space programs.

Large-scale dredging of PCB-laden sediments in the upper Hudson from 2009 to 2015 removed 2.7 million cubic yards of material at a cost of \$2 billion. Though this is an excellent step in the cleanup of the Hudson, the job is not done, and DEC has requested that EPA require the polluter, General Electric, complete the cleanup. Though PCB (polychlorinated biphenyl) levels in Hudson River fish have gone down since the discharge was banned in 1977, fish continue to show unacceptable levels in their flesh. These are expected to decline further as a result of dredging. Superfund clean-ups have removed cadmium at Foundry Cove in Cold Spring, and more are planned for removal of dioxin, heavy metals, and pesticides from the Passaic River, whose waters flow into the estuary from New Jersey.

For the future, wastewater infrastructure and both separated and combined sewer overflows along the estuary and its tributaries require significant investments to continue water quality improvements. Aging infrastructure is a problem DEC will address.

On a larger scale, climate change and new weather patterns are affecting all aspects of water management, including the impact of sea-level rise and flooding on water treatment plants in the floodplain in many shoreline communities.

Although water quality in the Hudson will never be as unblemished as it was when the region was a wilderness, we don't have to turn back the clock to have a drinkable, swimmable, and fishable Hudson. By protecting and restoring streams that replenish the estuary and nourish its web of life, and through continued investment in managing wastewater, we can continue restoring the water resources critical to the health and well-being of the state's residents.

## SELECTED MILESTONES

**1987:** Water quality in the Hudson along the west shore of Manhattan began to dramatically improve after the North River Sewage Treatment plant began treating pollution in 1986.

**2003:** Vessel Waste No Discharge Zone (NDZ) adopted for the entire Hudson River. New York State established new pump-out facilities in marinas and other recreational high-use areas. New rules required a range of best management practices (BMPs) to reduce stormwater runoff into waterbodies.

**2008:** Hudson River Environmental Conditions Observing System (HRECOS) was established by a consortium of academic, governmental, and nonprofit institutions to conduct monitoring of the Hudson River from New York Harbor to the upper Mohawk River. Water quality, hydrological, and weather data are continuously collected from 14 monitoring stations and fed to hrecos.org in near-real time.

**2009:** Remediation of historical sources of PCB contamination in the upper Hudson River began, continuing for six years. In 2016, DEC challenged the effectiveness of EPA's remedy for PCB cleanup conducted by GE, noting that unacceptably high levels of contamination still remain in river sediment.

**2012:** Municipal wastewater treatment plants began to disinfect effluent to reduce pathogen levels in the river near Albany. Rensselaer sewer district was the first to institute disinfection.

**2017:** Governor Andrew M. Cuomo and the legislature adopted a \$2.5 billion fund for clean water statewide.

Steve Stanne



*Families cool off in the Hudson at the Croton swimming beach.*

Steve Stanne



D. Tromp/DEC



*Large-scale dredging of PCB-laden sediments in the upper Hudson from 2009 to 2015 removed 2.7 million cubic yards of materials at a cost of \$2 billion.*



*DEC biologists will tag this adult Atlantic sturgeon to monitor its movements. The fish is then released back into the Hudson.*



## SIGNATURE FISHERIES

More than 200 species of fish have been recorded in the Hudson. Most are resident species, but a few are migratory fish that spend only part of their life cycle in the Hudson and its tributaries. Atlantic sturgeon, striped bass, and American shad range along the Atlantic coast, then return to the Hudson—the estuary of their origin—each spring to reproduce. Thus, their management requires coast-wide perspective and cooperation. Unfortunately, such interstate action is often insufficient or is delayed.

In 1987, there was an active commercial fishery for shad, herring, and sturgeon in the Hudson. The commercial fishery for striped bass closed in 1976 due to PCB contamination, although recreational fishing continued. Interstate management of the size and number of fish that could be caught in coastal waters allowed the number of striped bass to increase in the 1980s. However, overfishing in the ocean and the estuary took a toll. In the estuary, the number of Atlantic sturgeon and later, American shad, dropped. New York State closed its sturgeon fishery in 1996, and ocean fishing for shad ended in 2005. Continued declines forced shad fishing in the Hudson River to end in 2010. Sturgeon are now showing strong signs of recovery, but progress for shad is very slow.

Without good data to assess trends in fish populations, sensible management decisions are impossible, because the status of stocks can change rapidly from year to year in response to new fishing technologies and new management measures. DEC's annual sampling of spawning fish and their surviving young provides some of the best information available on the Atlantic coast and allows DEC to detect population trends in time to take management action when necessary. With the baseline understanding gained since the 1980s, stock condition can now rapidly be assessed and regulatory changes recommended to the Atlantic States Marine Fisheries Commission (ASMFC). For example, DEC's monitoring in the Hudson provided an early indication of trouble for shad and sturgeon up and down the Atlantic Coast.

The Hudson River Estuary Management Act directed DEC to manage the Hudson as an ecosystem. This means identifying sources of mortality, understanding where fish move from season to season, and learning what they eat (and what eats them). DEC has mapped key fish habitats in the Hudson, enabling biologists to develop a better understanding of food webs and habitat use by Atlantic sturgeon, river herring, shad and striped bass. Projects funded by the Hudson River Foundation, as well as techno-



*A student helps net a herring in Black Creek, the site of an annual spawning run. An in-stream fish counting device helps DEC better understand how herring use this tributary for spawning.*

logical advances, have transformed the way fisheries information has been collected in the past thirty years. Fisheries and marine habitat experts have used sonic tags, satellite tags, tracking devices, digital maps and traditional net-fishing methods to identify the links between fish movement and important fish habitat in the river.

In 1987, managing fisheries took a lot of guesswork. Now we know more about what affects their survival and are making progress on the goal of restoring the signature fisheries of the estuary. This will ensure future generations the opportunity to make a seasonal living from the Hudson's bounty, to fish for recreation, and to consume their catch without concern for their health.

## SELECTED MILESTONES

**Striped Bass:** By 1987, striped bass and striper fishing were increasing substantially in the Hudson. Over the past decade however, relatively low young-of-year production has caused concern for future spawning stocks. In 2015, the ASMFC acted to stem the decline in coastal migratory spawning stock females, including the Hudson stock. Coastwide, there are about six times more spawning striped bass than in the mid-80s.

**Atlantic Sturgeon:** After commercial fishermen noted a decline in young sturgeon, researchers found, in 1993, that Atlantic sturgeon were overfished. New York closed its Atlantic sturgeon fishery in 1996. New York's leadership led the (ASMFC) to close all Atlantic sturgeon fisheries coastwide in 1998. In 2013, NOAA listed Atlantic sturgeon as endangered.

DEC started monitoring Atlantic sturgeon populations in 2006. In 2015, the number of juvenile Atlantic sturgeon was the highest since monitoring began, and the trend shows increasing abundance, which may indicate the start of a recovery.

**River Herring:** DEC began monitoring herring numbers in 2008, with support from Cornell University and the state's Ocean and Great Lakes Program. An increase in recreational striped bass fishing resulted in an overharvest of herring for bait. DEC restricted the harvest of herring in the Hudson and its tributaries in 2012. Estuaries up and down the Atlantic coast are now concerned about the river herring's status, with runs disappearing from small tributaries throughout the coast. Fortunately, the Hudson has a wide variety of habitat for herring. The Estuary Program's work has so far demonstrated that the current herring fishery is sustainable. DEC's Sustainable Fishery Management Plan was adopted in 2017.

**American Shad:** Despite extensive measures taken to conserve them, American shad populations had declined dramatically by 2005. In 2008, DEC adopted a shad recovery plan, which is continuing to be implemented. The fishery closed in 2010; however, recovery has been a slow process. DEC monitors of young-of-year abundance and spawning stock characteristics annually to detect trends in recovery. The 2014 and 2015 young-of-year index values were among the highest seen in fifteen years, although far below historical averages.

In 2017 New York played a key role in ensuring that the updated Sustainable Fishing Plan for the Delaware Basin limits the expansion of shad fisheries there, as fishing is currently allowed. Genetic studies have shown that up to 40% of the fish that are harvested are on their way to the Hudson to spawn. DEC continues to work with partner agencies within the ASMFC and the Mid-Atlantic Fishery Management Council as well as Cornell University to identify and minimize sources of mortality for American shad.



*DEC fisheries biologists monitor the population of spawning striped bass such as this one caught near Catskill.*



DEC



## RIVER AND SHORELINE HABITATS

The 1972 federal Clean Water Act ended 150 years of widespread destruction of the Hudson River estuary's tidal habitats, including vital wetlands, natural shoreline, and submerged aquatic vegetation (SAV) beds. However, in the 1980s, as the Estuary Program began to develop, there were many unanswered questions about these habitats: What lives in them? How are they changing? How do they contribute to the rest of the ecosystem? Are they sufficiently protected? The program recognized the need to map and monitor these habitats, and saw the opportunity for a science-based conservation and restoration program.

In 1982, DEC and the federal government (NOAA) jointly designated the HRNERR, which provided funding for education, research, and conservation programs. When the Estuary Program was established in 1987, an ideal partnership emerged to study, conserve and restore the tidal habitats of the Hudson. New research programs of the Hudson River Foundation, a river-focused research team at

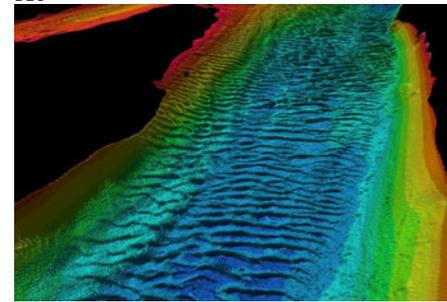
the Cary Institute of Ecosystem Studies, along with expertise at Columbia University, the State University of New York, and other academic institutions, enabled the Estuary Program to assemble an extensive biological survey and habitat mapping effort.

From 1987 to the present, the Estuary Program has studied river habitats and environmental conditions, identified ecosystem trends, and shed light on how those changes affect food webs and fish reproduction in the estuary. Starting in 1995, mapping began for all key aquatic habitats, including deep and shallow river bottom areas from the Verrazano-Narrows Bridge to Troy, and tidal wetlands, SAV beds, and natural shoreline. This work was overseen by HRNERR and used aerial photography, digital mapping, and advanced technology such as side-scan sonar.

The mapping data and products are available online to ensure that proposed projects avoid damage to these habitats.

*Engineering plans are underway to restore a side channel at Gay's Point to improve aquatic habitat and water quality.*

DEC



*River bottom mapping revealed sand waves, some as high as three meters, which are used as habitat by adult Atlantic sturgeon.*

Steve Stanne



*Tidal marshes provide nursery habitat for fish and crustaceans, such as this young blue crab.*

The Estuary Program also supports citizen scientist research under the direction of professional scientists to augment its river-wide habitat inventories, such as documenting yearly changes in SAV. The importance of this work was evident after 2011, when Tropical Storms Irene and Lee deposited 1.75 million tons of sediment from tributaries into the estuary. The maps revealed a 90% loss of SAV. The aerial photography and citizen science maps now show a process of slow but steady natural recovery.

With other partners, including the Army Corps of Engineers, NOAA, OPRHP, the Thruway Authority, Scenic Hudson, and The Nature Conservancy, the Estuary Program identified potential habitat restoration opportunities, assessed their feasibility, and began to carry out a wide range of projects. They include fish passage, tidal marsh and SAV restoration, side channel restoration, and shoreline enhancements.

The Hudson River Estuary Training Program, established by HRNERR with NOAA support, provides local decision makers, community leaders, environmental groups, local land trusts, natural resource managers and regulators with high-quality training on habitats, resource management, technical skills and process skills. All of this work has been supported by the New England Interstate Water Pollution Control Commission (NEIWPCC).

The Estuary Program's goal is to conserve, protect and enhance river and shoreline habitats to ensure that life cycles of key species are supported for human enjoyment and to sustain a healthy ecosystem.

Future challenges that must be addressed include the threats presented by the spread of invasive species, sea level rise, and coastal storms. The program's science-based, adaptive approach and many partnerships for protecting, managing, and restoring river habitats will serve us well in facing the challenges.

Laura Heady



*This juvenile heron finds a home at Piermont Marsh.*

## SELECTED MILESTONES

- **1982:** Hudson River National Estuarine Research Reserve (HRNERR) was designated. Its 35<sup>th</sup> anniversary is this year.
- **1987:** The Research Reserve and the Estuary Program began collaborating on the many projects and programs described below.
- **1998:** Aerial photography was used to inventory all Hudson River estuary tidal wetlands up to the Troy dam, as well as Jamaica Bay. The inventory provides a basis for assessing change in Hudson River tidal wetlands due to sea-level rise, storms, and invasive species, and helps DEC make decisions about managing marine resources.
- **1998-2016:** Advanced technology such as side-scan sonar was used to map the river's bottom, revealing sand waves, deep holes, underwater stream deltas, relict oyster reefs, and areas of deposition and erosion.
- **2005-2017:** The first inventory of Hudson River shoreline conditions from the Tappan Zee to Troy was undertaken. HRNERR launched the Sustainable Shorelines Project to develop guidance on shoreline management practices, releasing a handbook with the Cary Institute of Ecosystem Studies, *Managing Shore Zones for Ecological Benefits*, in 2015. Sustainable Shorelines is also developing a network of demonstration projects at several locations along the estuary.
- **2014:** The Hudson River Estuary Habitat Restoration Plan identified actions to restore tidal shorelines, vegetated shallows, and natural shorelines, and to facilitate fish passage up the Hudson's tributaries. The plan builds on work started in the 1980s by the Estuary Program and HRNERR and has launched a major restoration program, now underway.

Chris Bowser



*Iona Island in the Hudson Highlands, a state park and HRNERR site, is bordered by two large tidal marshes.*



## STREAMS AND TRIBUTARIES OF THE HUDSON RIVER ESTUARY WATERSHED

DEC began monitoring stream water quality in 1972 by collecting data on the organisms that live in streams. Treatment of wastewater and industrial discharges following the passage of the Clean Water Act resulted in immediate water quality improvements, but problems still persisted. By the 1980s, DEC determined that roughly one-third of assessed streams were relatively high quality while the remaining two-thirds showed some level of impact whether significant, moderate or slight. By 2000, it became apparent that water quality in some of the best streams was declining, even as lower quality waterways were improving.

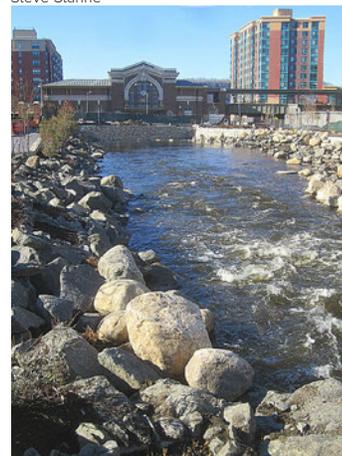
DEC recognized that stormwater and non-point source pollution were having a measurable and meaningful impact on stream and river water quality. These sources originate from changes in watershed land use as communities grow and develop. Given the complex sources of degrading water quality, the Estuary Program realized the need for a new model to address persistent, remaining impacts to water quality affecting Hudson River tributaries and the downstream Hudson estuary.

Maintaining and managing water quality in tributaries requires a watershed approach. In 2000 the Estuary Program began to cultivate

and support watershed management through community-based local and regional partners, and to better understand the ecological links between the estuary and its watershed. The program provided leadership, training, conservation tools, and grants to encourage municipalities and local stakeholders to work together on tributary management and stewardship. This resulted in the establishment of watershed groups that could coordinate local water resource conservation efforts across town boundaries. The Estuary Program created community-based citizen science projects like Water Assessments for Volunteer Evaluators (WAVE) to allow community groups to prioritize their monitoring needs and understand their watersheds better.

Simultaneously, the Estuary Program built its own watershed management capabilities, including streamside and in-stream restoration, stormwater management, land use conservation, and drinking water resource protection. The Program launched “Trees for Tribs” (tributaries) in 2007 to improve stream buffer habitats and protect water quality by planting native trees and shrubs along streams. In 2005, partnering with Soil and Water Conservation Districts, municipalities, and community groups, the program began

Steve Stanne



*Starting in 2012, the Saw Mill River in Yonkers was uncovered (daylighted) and has become a draw for residents and visitors alike. Formerly a parking lot covered the river.*

Mike Adamovich



*Fish and other aquatic organisms are unable to move upstream when they encounter “perched culverts” such as this one.*

supporting land use planning for better site design and green infrastructure projects to manage stormwater runoff. The program also supports the Riverkeeper's citizen science program and efforts to inform people of local water quality concerns by identifying possible impacts to public recreation.

In 2012, the Estuary Program partnered with The Nature Conservancy to identify culverts and dams throughout the watershed and its tributaries. After Tropical Storms Irene and Lee, the Estuary Program, in partnership with Cornell University, began assessing stream-road crossings for flooding risk. This resulted in an interactive map of priority sites for stream restoration projects.

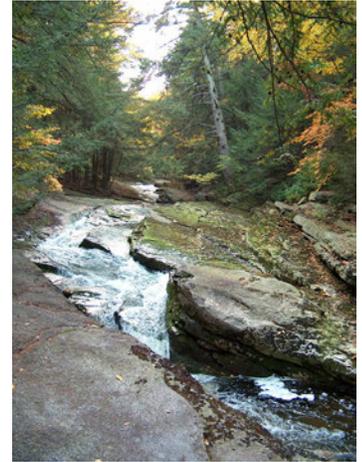
## SELECTED MILESTONES

- **2000:** The Estuary Program expanded into the watershed with outreach and conservation.
- **2005:** The Estuary Program helped form the Hudson River Watershed Alliance to assist local groups.
- **2007:** The Trees for Tribs program, now celebrating its tenth year, was launched in the Hudson estuary watershed. 7,000 volunteers have planted 43,000 shrubs, trees, and grasses on 100 acres at 280 streamside sites. Trees for Tribs now has expanded into a statewide program.
- **2010:** The daylighting of the Saw Mill River in Yonkers began. The project is a collaboration of several state agencies and the city of Yonkers.
- **2011:** The Mohawk River Basin Program was established to promote integrated and coordinated management of the environmental and cultural resources of the river and its watershed. The Mohawk River is the largest tributary to the Hudson River. The development of the *Mohawk River Basin Action Agenda* and Governor Cuomo's subsequent formation of the Mighty Waters Working Group, were integral to a "Whole Hudson" approach to natural resource management. Mirroring the Hudson River Estuary Program model, the Mohawk River Basin Program coordinates watershed-wide activities, bringing together stakeholders and creating partnerships with programs and organizations throughout the watershed.
- **2012:** Water Assessments by Volunteer Evaluators (WAVE) was initiated to train and equip volunteers to monitor water quality in Hudson River watershed streams and tributaries. WAVE is now a statewide program.
- **2013:** In partnership with Cornell University, the Estuary Program began assessing road-stream crossings for fish passage and flood risk.
- **2015:** DEC began funding projects to remove dams and to restore habitat connectivity for fish. To date, the Estuary Program has helped fund the removal of dams on the Wynants Kill in Troy and East Branch Wappinger Creek in Clinton Corners. The Estuary Program also initiated outreach on source water management, focusing support in places such as Newburgh in 2016.
- **2017:** To date, the Estuary Program has helped create and cultivate 15 tributary watershed groups. Eighteen watershed characterizations or plans have been developed, or are underway, on Hudson River tributaries.

With Cornell University and others, the Estuary Program has supported research to better understand the importance of Hudson River tributaries to the estuary ecosystem. The program has gained important insights into the benefits to coastal species, delivery of sediment for marsh building, and the movement of nutrients to the estuary ecosystem.

The Hudson River Estuary Program continues to help local watershed groups, municipalities, and conservation advocates address remaining water resource challenges, while preparing them to explore future needs, such as emerging contaminants.

Laura Heady



*The Peters Kill flows through Minnewaska State Park Preserve and the Shawangunk Ridge before joining the Rondout Creek.*

Beth Roessler



*Volunteers plant native trees along Monhagen Brook to help prevent erosion along the stream bank.*



## NATURAL AREAS AND WILDLIFE

In 1996, the Estuary Program expanded its work into the watershed with a new focus on conservation of biodiversity and natural resources in the Hudson Valley through land use planning. The Estuary Program first partnered with Cornell University and The Nature Conservancy to identify, understand, and map important elements of the region's biodiversity. It then developed a framework that identified the region's most significant areas for conservation and identified conservation strategies for local and regional partners, emphasizing voluntary measures and using local home rule. At that time, the state did not have a technical assistance program to help land-use decision makers consider natural resources during the planning process, so the Estuary Program created such a program.

By 2001, Cornell's high-resolution land cover maps and predicted range of 308 native animals revealed much about wildlife habitat in the Hudson River estuary watershed. For example, the Hudson Valley is a "biological hotspot" in New York State: though the Hudson Valley makes up only 13.5% of the state's area,

it is home to nearly 85% of the state's bird, mammal, reptile, and amphibian species.

In 2001, the Estuary Program worked with Cornell University and others to establish an innovative outreach program to directly assist planning boards, conservation advisory councils, land owners, and land trusts. Partners included the Wildlife Conservation Society, which developed intermunicipal conservation plans in Putnam (2004), Westchester (2002), Orange (2005), and Ulster (2007) counties. The program partnered with Hudsonia, Ltd. to publish the *Biodiversity Assessment Manual for the Hudson River Estuary Corridor* (2001) and created training for volunteers to map habitats in their community.

The partnerships made information about Hudson Valley natural resources easier to find, understand, and use. The New York Natural Heritage Program mapped areas important for rare species and significant ecosystems and shared it with the public (2005). They developed guides to help people understand how to conserve rare plants and animals and significant ecosystems in their communities (2006).

Laura Heady



*Conservation Advisory Councils (CACs) can play an important role in documenting habitats in their communities.*

Dave Moore/USFS



*Mohonk Preserve records dating back to the 1930s show that some woodland flowers, such as this bloodroot, are blooming earlier in spring*



*The Estuary Program trains local leaders to use natural resource maps and data to inform land-use planning.*

From 2008 to 2015, the Estuary Program's work gradually shifted focus from biodiversity to improving community resiliency through natural resource protection at the local level. The program created natural resource summaries for use in local planning, easy-to-read guidebooks to improve local stewardship, and an online mapper so that communities can easily access natural resource data. It also trains local leaders and offers technical assistance to communities working on local plans and procedures, including developing customized natural resource summaries.

In addition to delivering hundreds of presentations and training thousands of local land-use decision makers, the program uses citizen science to help people understand how natural processes are affected by human activity. One such program, the Amphibian Migrations and Road Crossings program, focuses on the annual spring migration of amphibians to their woodland pond (vernal pool) habitats. This program built awareness small, unregulated wetlands and vernal pools and brought the issue to local conservation and planning discussions.

## SELECTED MILESTONES

- **1996 - 2017:** The Estuary Program began to understand and map important elements of the region's biodiversity and initiated conservation outreach. To date, the program has provided technical assistance to 138 of the 260 towns, cities, and villages throughout the Hudson Valley and trained nearly 7,000 land use decision makers.
- **2001:** The Estuary Program, with Hudsonia, Ltd. published the *Biodiversity Assessment Manual*. As of 2017, more than 500 volunteers have been trained to map habitats in their communities. About 130,000 acres of Hudson Valley habitat have been mapped.
- **2006:** The *Hudson River Estuary Wildlife and Habitat Conservation Framework* was published in partnership with Cornell University. It identifies 23 subregions of the Hudson Valley that are particularly important for conservation, including the Hudson River shoreline, the Rensselaer Plateau, the Shawangunk Ridge, the Hudson Highlands, and the Helderbergs—all places where the Estuary Program has provided conservation assistance.
- **2008:** *Conserving Natural Areas and Wildlife in Your Community* was published with Cornell University. The publication introduces local leaders to their role in habitat conservation and provides tools and techniques for local land planning.
- **2014:** The Estuary Program, with Cornell University, published *Creating a Natural Resources Inventory*, which gives communities a step-by-step guide to creating their own natural resource inventory using widely available data.

Fran Dunwell



*Hundreds of volunteers have participated in the Amphibian Migrations and Road Crossings Project since it started in 2009.*



*The Poughkeepsie Children’s Museum pavilion was flooded after heavy rains from Tropical Storm Irene.*

## RESILIENT COMMUNITIES

When the Estuary Program was first created, climate change was not recognized as a concern for the health of the Hudson River. The extent of potential temperature change and the effects of a warmer earth were poorly understood and not well publicized. However, by 1988, with record heat and drought in the U.S. and Congressional testimony by NASA’s now-famous climate scientist, Jim Hansen, press attention began to focus on global warming.

The Hudson River Estuary Program began developing a program to address climate change in 2006. From the start, the goal was to understand the best available science on the effects of climate change. In partnership with Cornell and Columbia universities and other academic institutions and agencies, the Estuary Program supported state efforts to develop science-based climate information for the public, and launched the Hudson Valley Climate Change Network.

It became apparent that shoreline communities and natural resource managers would need better maps to show where sea-level rise and flooding might occur under various scenarios. In 2012-2013, the Estuary Program collected and released

high-resolution elevation data, or LiDAR (Light Detection and Ranging), for the entire estuary shoreline. LiDAR technology helped determine shoreline elevation at one-foot contour intervals, in contrast to standard topographical maps, which show ten-foot intervals. Partners such as Scenic Hudson and Columbia University developed the raw information into online tools to help Hudson River communities map their flood risk. The resulting sea level rise maps are now being used by many communities for planning purposes. The Estuary Program also provided services in support of the NYS Sea Level Rise Task Force in developing its report, completed in 2010.

Tropical Storms Irene and Lee (2011) and Hurricane Sandy (2012) sharpened the Estuary Program’s focus on helping vulnerable shoreline communities adapt to and reduce the impacts of climate change. Irene caused ten deaths in New York State and \$1.3 billion in damages. Sandy caused 48 deaths and \$32 billion in damages. Both caused major flooding on the river and its tributaries. In response, Governor Andrew M. Cuomo convened the NYS 2100 Commission and has since implemented many of its recom-



*Coastal storm surge in the Hudson during SuperStorm Sandy pushed boats from their moorings onto the shoreline in Rockland County.*



*A Cornell student explains her climate-adaptive design for the waterfront during a project open house at city hall.*



*The Catskill Waterfront Resilience Task Force was created after extensive flooding and coastal storm surge damaged waterfront homes and businesses in the village of Catskill. The task force made 24 recommendations, including conserving the Ramshorn-Livingston Marsh, Catskill Point, and undeveloped land along Catskill Creek, which all serve as natural storm buffers.*

recommendations, including creating the NY Rising Community Reconstruction Program to help communities develop flood resiliency plans.

To help meet the Governor's objectives, the Estuary Program supported the NYS 2100 Commission report and the implementation of the Community Risk and Resiliency Act. The program worked with partners, including Scenic Hudson, to help the city of Kingston, the town of Stony Point and the villages of Piermont and Catskill plan more resilient waterfronts. These four communi-

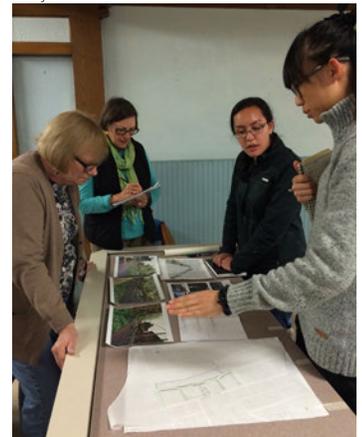
ties now meet regularly to learn and work together on climate-adaptive strategies.

Climate-Adaptive Design (CAD) is an innovative initiative with Estuary Program staff and Cornell landscape architecture and engineering students helping Kingston, Catskill and Hudson reimagine and reinvent their flood-prone waterfronts. The ability to visualize innovative solutions to sea-level rise and flooding has proven to be a powerful force to encourage flood-resilient design.

## SELECTED MILESTONES

- **2006:** The Estuary Program hosted a conference on Climate Change and the Hudson Valley, which drew more than 350 participants and launched our new program emphasis on this topic.
- **2008:** The Estuary Program and DEC's Office of Climate Change developed the Climate Smart Communities (CSC) program, which outlines priority actions to reduce greenhouse gases and adapt to climate change. Nearly 200 communities now participate; 81 are in the Hudson Valley. In 2014, the Estuary Program developed a CSC certification process and manual, funding its implementation in six pilot communities: Orange County; the cities of Watervliet, Kingston and Albany; the village of Dobbs Ferry, and the town of Cortlandt.
- **2014:** DEC collaborated with New York City stakeholders to research and understand the ability of natural and nature-based features, such as wetlands, dunes, and floodplains, to reduce flooding and erosion. More certifications are now underway statewide.
- **2016:** Governor Andrew Cuomo created an annual grant program to fund Climate Smart projects. Nearly \$11 million in projects were funded last year.
- **2017:** NYS adopted official sea-level rise projections for the state, and Governor Cuomo accelerated his ambitious greenhouse gas reduction programs.

Libby Zemaitis



*The Catskill Waterfront Flooding Task Force members discuss options for businesses and infrastructure likely to flood as a result of sea-level rise.*



*The view of Cornwall Bay in the Hudson from Storm King Mountain, northern gateway to the fabled Hudson Highlands, is worth the hike.*

## NATURAL SCENERY

The Hudson River is the centerpiece of a landscape stretching from the Adirondack Mountains to New York Harbor. The Hudson Valley's varied topography—the Wallkill River's flat floodplains, Westchester's steep hills and valleys, the Highlands, and Catskill's peaks—was shaped by geological events hundreds of millions of years ago. Glaciers further sculpted the landscape, establishing the Hudson's present course.

Ecologically, this landscape is the Hudson's watershed. Culturally, it is a world-renowned scenic area and a beloved home to millions of people. The natural scenery of the valley inspired the Hudson River School of painting in the 19<sup>th</sup> century, and today it draws tourists from around the world.

For over a century, state and national leaders, as well as conservationists and business leaders have supported land acquisition to permanently protect the natural scenery of the Hudson River shoreline and the outstanding vistas in the valley. In the last 30 years, there has been a sustained focus on continuing this tradition and combining it with programs to conserve lands for the other benefits they provide.

Since 1987, open space conservation by DEC; Office of Parks, Recreation and Historic

Preservation; the Office of General Services; Department of Agriculture and Markets; and land trusts have protected thousands of acres in the Hudson Valley. More than 60,300 acres have been preserved in perpetuity. Using land acquisition and easements, the Estuary Program, agency partners, and non-profit land trusts have conserved more than 19,500 acres of land along or in sight of the Hudson. They include properties in the Hudson Highlands, along the Palisades, in the Mid-Hudson Shorelands Scenic District, and in the upper estuary. With our grants, communities have completed or are developing open space plans, and several have adopted funding mechanisms to conserve local open space and scenery. The program also helped cities conserve and increase access to urban parks where city dwellers can enjoy the river's scenic views.

Agencies have also recognized the value of scenic resources through designations of "scenic areas." In the 1980s, DEC used its authority under Article 49 of the Environmental Conservation Law to document and designate scenic areas. The NYS Department of State used its authority in the 1981 NYS Waterfront Revitalization of Coastal Areas and Inland Waterways Act to designate Scenic Areas of Statewide Significance along the Hudson.



*The Bear Mountain Bridge spans the river in the Hudson Highlands.*



*Constitution Marsh Audubon Sanctuary is a unique tidal marsh in Putnam County that provides vital natural habitat for birds and wildlife.*



*Preservation of the Palisades along the Hudson in New York and New Jersey has continued for a century.*

Preservation of our scenic resources requires regional awareness and appreciation of the effect of local land-use decisions on our shared scenery. Estuary grants have supported scenic vista projects that range from a viewshed analysis at Olana

to removal of derelict utility poles along Metro-North's Hudson Line railroad tracks. A joint project with the Greenway and the Hudson River Valley National Heritage Area assists localities with a vista conservation effort, beginning with inventories and maps.

## SELECTED MILESTONES

- **1980 - 1993:** DEC designated "Scenic Districts" under Article 49 of the Environmental Conservation Law, including the Mid-Hudson Shorelands Scenic District (1980); Tappan Zee West (1988); Tappan Zee East (1993); and the Olana Scenic District (1989).
- **1993:** DOS designated four Scenic Areas of Statewide Significance (SASS), including selected Hudson River shoreline areas from Westchester County to Rensselaer County. The SASS for the area around Hudson, NY was instrumental in identifying the full impact of the St. Lawrence Cement company's proposed plant on the shores of the Hudson River, which later led to denial of the project.
- **2002 - 2004:** Estuary grants were awarded to conserve the viewshed from Wilderstein Historic Site in Rhinebeck (2002); map the Olana Viewshed in Hudson (2002); and remove unsightly, unused utility poles along the Metro-North railroad tracks (2004).
- **2012 - 2017:** Partnerships with the Thomas Cole National Historic Site and Hudson River Valley National Heritage Area supported the Hudson River School Art Trail, which interprets historic vistas painted by the Hudson River School artists and compares them with current vistas.
- **2015 - 2017:** A scenic resource database project, developed in partnership with the Hudson River Valley Greenway, has identified more than 1,700 scenic vistas, roads, trails, rivers and other areas. The database is available through an online mapping platform. This project has led to the completion of scenic resource inventories by five regional land trust organizations. With the Hudson Valley Greenway, the Estuary Program is providing funds to land trusts to identify and map locally important scenic areas.
- **1987 - 2017:** State programs and partner land trusts conserved more than 60,300 acres of scenic vistas, habitats, and pastoral landscapes in the ten Hudson Valley counties that border the estuary. More than 19,500 acres of this land is along or in sight of the Hudson. Partners include OPRHP, the National Park Service, local communities, and land trust organizations such as Scenic Hudson and the Open Space Institute.

Steve Stanne



*The scenic vista from Olana, home of Frederick Church, was mapped through an Estuary Program viewshed grant. The view inspired many of Church's paintings.*

Chris Bowser



Fran Dunwell



*The Harlem River Boat Club received an Estuary grant to purchase boats for its community rowing program.*

## PUBLIC ACCESS

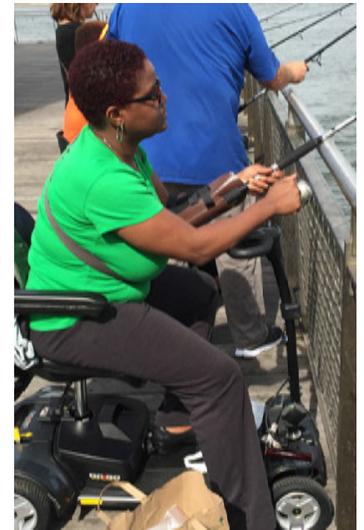
In 1987, boat launches that accommodated boat trailers were few and far between, and they were not well-maintained. It was not uncommon to hear of trucks hanging up their rear axles or losing their transmissions on boat ramps. It was apparent that, for long-term boating access to the river, existing access points needed maintenance and improvement, and new ones were also needed. In 1998, the Estuary Program developed a plan to improve boating access on the river, and began upgrading old launch sites and creating new ones, a project which continues to this day. Since 1987, the program has helped fund new or improved launches at 10 riverfront locations, including in Yonkers, Haverstraw, Bethlehem, Athens, and Newburgh. The Estuary Program also helped fund access to Schodack Island State Park, where there is now an accessible boat launch.

Meanwhile, water quality improvements led to a resurgence of residential and commercial developments on the waterfront that often restricted or precluded public access. The NYS Coastal Management Program, created by state law in 1982, began supporting Local Waterfront Revitalization Plans (LWRPs) that required public access as a prerequisite for state funding. To date, 24 shoreline communities along the Hudson have adopted LWRPs, and most have subsequently implemented plans which include access improvements.

The presence of the railroad along both shores of the Hudson has been another factor that has limited public access to the river. There are few places where there is land on the river side of the tracks, and in 1987, most of them were privately owned. The Estuary Program and the Heritage Task Force (now the Hudson River Valley Greenway) gathered a group of agencies including DEC, OPRHP, and the National Park Service to map and assess lands on the river side of the tracks and identify those suitable for public access. Since then, many of the identified sites have been purchased for public use, greatly expanding the opportunities to use and enjoy the Hudson.

Most recently, the Estuary Program is focusing on the resiliency of access sites to coastal storms and using universal design principles to improve recreational access for people of all abilities. The Northeast ADA Center and Cornell University are lending their expertise to help regional partners understand and assess ADA features at access sites on the estuary. The program is developing a handbook for the design of kayak and canoe launch sites and providing technical assistance and grants to site owners who wish to improve their facilities along the river. The New England Interstate Water Pollution Control Commission has facilitated much of this progress with the support services it provides.

DEC



*A 'strong arm' adaptive fishing device provides extra support for this angler during a day of fishing on the Hudson in New York City.*



*Tivoli paddlers enjoy a beautiful day canoeing through a tidal marsh at Tivoli North Bay.*

## SELECTED MILESTONES

- **1987 - 2017:** A network of new and upgraded parks, boat and hand launches, fishing piers, and other access sites was developed along the entire estuary from the city of Troy at the head of tide to the Battery in Manhattan. State agencies, riverfront municipalities, and organizations such as Scenic Hudson, the Open Space Institute and others collaborated in this effort accelerating past progress.
- **1990:** DEC and several other agencies collaborated to produce *Between the River and the Railroad*, a report which identified 61 parcels that could be purchased or developed to create new river access points. Of the 61 sites identified, 24 have now been developed for public access.
- **1998:** The Hudson River Park in Manhattan was created. Encompassing nearly 550 acres, it has transformed four miles of decaying piers and parking lots along Manhattan's West Side into an urban recreation oasis, attracting 17 million visits annually. The park plays a critical role in protecting the Hudson River environment. Its 400 acres of water is a designated Hudson River Estuarine Sanctuary.
- **2005:** The Estuary Program set a goal to provide new or improved access in every shoreline community, and DEC created a grant program to fund such improvements. As of 2017, the Estuary Program has awarded 101 grants for docks, hand launches, fishing piers, riverfront trails and maps, swimming, and access planning studies. Additional access has been developed by DOS, OPRHP, the Hudson Valley Greenway, and municipalities, many through DEC cooperative agreements.
- **2009:** The longest elevated pedestrian bridge in the world opened over the Hudson River between Highland and Poughkeepsie. The Walkway Over the Hudson State Park now welcomes more than 200,000 visitors annually. The Estuary Program provided one of the earliest grants in support of the project.
- **1991 - 2017** The Greenway Trail was launched by Governor Mario Cuomo. It provides access to many natural areas throughout the valley. The trail has been expanded to include the Greenway Water Trail, which offers recreational paddlers 100 designated access and camping sites along the river from Saratoga County to New York City. In 2017, the Greenway Trail was included in Governor Andrew Cuomo's proposed Empire State Trail to stretch from New York City to Canada and from Albany to Buffalo.



*Paddlers are discovering the enjoyment of kayaking on the Hudson.*



*The Estuary Program provided a grant for this accessible, storm-resilient fishing dock in Bethlehem.*



On one day each autumn, thousands of students from New York City to Troy participate in the annual “A Day in the Life of the Hudson River.” These students pose with a blue crab that will be released back into the harbor.

## EDUCATION

Like many other aspects of the Hudson’s environmental movement, river education gathered steam in the late 1960s and early 1970s. The Hudson River sloop Clearwater, launched in 1969, soon became an environmental education ‘classroom’. The hands-on programs developed on the sloop became the standard for field-based learning on the estuary.

Other non-profit educational organizations sprouted along the Hudson through the 1970s and ‘80s, among them the Beczak Environmental Education Center in Yonkers (now the Sarah Lawrence Center for the Urban River at Beczak). Audubon’s Constitution Marsh Sanctuary offered canoe trips on a tidal marsh in the Hudson Highlands. In 1986, the River Project in Manhattan turned a warehouse on a dilapidated dock into an ‘estuarium’, revealing the diversity of life under the West Side’s decaying piers. And municipal parks like Wave Hill in Riverdale and Croton Point Park in Croton-on-Hudson added river education to their programs.

From its start, the Estuary Program has recognized education’s value. To define a course of action, DEC and the Hudson River

Foundation commissioned the development of an interpretive strategy. *The Nature of the Hudson* (1998) made three recommendations – grants, state-sponsored technical assistance, and interpretive signage – underlining the importance of collaboration among the Hudson Valley’s interpretive, education, and advocacy groups.

The Estuary Program began to implement the recommendations the following year. In 1999, the first round of estuary grants funded 14 education projects with awards totaling \$420,000, highlighting the Estuary’s Program commitment to building capacity for river education. To date, the estuary grants program has contributed over \$5 million to river education projects, with long-lasting results. Exhibits at the Children’s Museum of Science and Technology (Troy), the Hudson River Maritime Museum (Kingston), the Hudson River Museum (Yonkers), and the River Project in Hudson River Park (Manhattan) have educated thousands of visitors about the estuary. Lesson plans built around cutting-edge Hudson River research by Cary Institute of Ecosystem Studies have been downloaded thousands of times by high school science teachers. The larger-than-life



A student checks salinity using a hydrometer during Day in the Life of the Hudson River Estuary.



DEC and partners are piloting a citizen science project to grow water celery (native aquatic vegetation) in classrooms throughout the Hudson valley. The stock is then planted underwater at Norrie Point in Staatsburg.

puppets and pageantry of the Arm of the Sea Theater's productions have entertained and educated large audiences at riverfront festivals, combining compelling narratives with accurate science about topics such as river food chains and PCBs.

In 2000, the Estuary Program began partnering with the Hudson River National Estuarine Research Reserve (HRNERR) to offer education programs and develop exhibits. Those efforts strengthened when HRNERR moved into the Norrie Point Environmental Center in 2007. Together, the programs support lesson plans and curricula for students from kindergarten through college, citizen science projects such as the glass eel migration study, and teacher training initiatives. Program educators lead workshops for teachers and other educators at conferences such as those of the Science Teachers Association of NYS and the NYS Outdoor Education Association.

With the National Park Service, the Hudson River Valley National Heritage Area, and Marist College's Institute for the Hudson

River Valley, the Estuary Program promotes Teaching the Hudson Valley, which offers lesson plans, grants for field trips, and professional development opportunities, including a three-day summer institute.

The program's education team collaborates on teacher training, citizen science and field programs with entities including the Lamont-Doherty Earth Observatory, Cary Institute for Ecosystem Studies, Sarah Lawrence Center for the Urban Environment at Beczak, and DEC's Bureau of Environmental Education. The field programs cover a wide range of settings, from canoe explorations of tidal wetlands to community fishing events along the piers and beaches of New York Harbor.

The Estuary Program and its partners continue to implement the vision for the Hudson as an integral and valued part of river communities, its accessible natural resources providing place-based educational, recreational and inspirational experiences.

Chris Bowser



*Poughkeepsie High School students check an eel net in the Fallkill Creek during the spring eel migration.*

Chris Bowser



*Real-time water quality data from a nearby HRECOS monitoring station is used in education programs at Norrie Point Environmental Center in Staatsburg.*

## SELECTED MILESTONES

- **1998:** *The Nature of the Hudson* provided a strategic guide for the Estuary Program's new focus on education.
- **1999:** The Estuary Grant program began and supported numerous local sites, projects, and programs.
- **1999:** DEC partnered with the Student Conservation Association's Hudson Valley AmeriCorps to provide education and outreach programs about river resources; since its inception, 216 AmeriCorps members have served at DEC host sites from New York City to Albany.
- **2003:** The first "Day in the Life of the Hudson River Estuary" was held. Now an annual event, students visit the estuary each fall to catch fish, track tides and currents, measure water quality, and share their data online. From 341 participants at 14 sites, the event has expanded to 80 sites and nearly 5,300 participants, 4,635 of them students. More than 39,000 students, teachers, and parents have participated over the years. Similar events are now held on Long Island rivers and on the Buffalo River.
- **2008:** Urban high school students began participating in the American Eel Citizen Science Migration Study. The study provides DEC and HRNERR with data needed to conserve the species. It also builds awareness of the need to restore passage for fish and other animals in the Hudson's tributaries. In 2016, more than 500 volunteers netted and released 142,770 young glass eels in 12 tributaries; more than 450,000 have been counted over the course of the study.
- **2017:** To date, more than 30 Hudson River lesson plans for elementary students have been created by the Estuary Program's education team. Posted on DEC's website, they were downloaded 47,000 times in 2016.

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Steve Stanne



*The Tivoli Bays Wildlife Management Area is a freshwater tidal marsh that is home to a wide variety of fish, birds, and mammals.*

Tivoli Bay

