



Estuary Education

TEC Significance

Education is a critical entryway for community members to engage with the Hudson River, providing the relevance, context and personal connection needed to develop a sense of stewardship. As people experience and learn about the places in which they live, and their own interconnectedness, they become inspired and empowered to manage and protect the ecosystems and assets discussed in this report.

This habitat restoration document is the result of a long history of human use, and in some cases abuse. For thousands of years humans have been leaving their mark on the environment, in many instances because they did not understand their own impacts. Today human interactions with the river continue to be those exerting the strongest and longest lasting effects. It is vital that researchers work in partnership with educators to inform river use decisions at every level, to minimize negative influences as we work to restore and improve this historic waterway. The estuary is guided by natural boundaries, and estuary education should cover this full extent and not be restricted by artificial limits. Governance, economic, and recreational choices must be well grounded in a full understanding of the complexity of the estuary system; a complexity best understood through focusing broadly on the full estuary. Partnerships and products are often stronger when they freely connect across political borders, encompassing the Hudson from its source in the Adirondacks and tributary headwaters to its mouth at the Atlantic Ocean.

A Comprehensive Restoration Plan (CRP) for the Hudson River begins with an improved understanding by the public, and decision makers, of the naturally occurring ecological functioning of the system. Accomplishing this requires Hudson River education and stewardship programs for the public, municipalities, waterfront businesses and all riverfront partners. Meaningful education programs are multidisciplinary, multimodal and multi-cultural allowing them to connect to a range of learners, learning styles and cultures. At the core of these education programs are field experiences that bring participants into direct contact with the estuary; there is no virtual substitute for direct personal experience with the water, and no better way to build an understanding of the river, its benefits and its current condition. Providing physical access to the river is a point of synergy with both the Water Access and Navigation Safety and Natural Resource Interactions TEC, and the Resilient Waterfront and Community Shorelines TEC.

Along with public education, we need to build a relationship between our local adult decision makers, such as our municipal officials, planning and zoning board members, and the river as an asset and a resource to their communities. Additionally, we need to develop materials for the technical training of our workforce. To effectively accomplish these goals, education partners need access to the researchers and the research developed through estuary restoration projects. All education and training require well-crafted and carefully vetted material, which is best distributed through a designated clearinghouse.

Goal

Residents in all Hudson River watershed communities engage in estuary education opportunities available through a variety of public river access sites and facilities, which employ a range of media to deliver information resources, outreach and training programs.

TEC Context

Historical Context

Our current level of Hudson River environmental education began in earnest in the 1960s after ongoing water contamination resulted in significant ecological degradation. Several grassroots groups launched outreach programs centered on educating and informing the public as a way of protecting and revitalizing the Hudson estuary as a critical resource. In 1987 the Hudson River Estuary Program (Estuary Program) was created within the New York State Department of Environmental Conservation. Since its creation, the Estuary Program has had a leadership role in developing and connecting education partners along the estuary. Just as education alone cannot bring back the health of the river, no one agency can provide the full breadth and reach of education for the Hudson River estuary. Partnerships are critical for both assessing and researching the needs of the complex system, and for developing and delivering the education and training needed to support the necessary actions. Numerous education providers exist and have grown through partnerships that each year provide several hundred thousand individual education interactions. Educators range from national, state, and local government agencies, to colleges and universities and national, regional, and local environmental and community groups.

Current state

Providing education on and about the river requires access. Currently, public waterfront access to the Hudson is present in most of riverside communities from the Governor Mario M. Cuomo Bridge to the Federal Lock and Dam at Troy, NY, with over 85 existing locations, excluding port facilities, and several new ones becoming available soon. The sites vary in management structure, including state, county, municipal and non-profit facilities. Of the existing facilities, fewer than half (38) have public restrooms available making educational use of these sites difficult to impossible. Some sites include constructed facilities while others are just a simple pathway ending at the river. Where facilities exist they range from picnic tables and natural areas (Mine Dock Park, Fort Montgomery; Papsanee Nature Preserve) to constructed launches for power and non-motorized boats (Ulster Park, Saugerties; Schodack Island State Park, Schodack Landing; Ulster Park), to covered gazebos (River Park, Green Island; Sparta Park, Ossining; Esopus Meadows Preserve, Ulster Park) to parks with dedicated education buildings (Cohotate Preserve, Athens; Kathryn Davies Center, Sleepy Hollow; Norrie Point Environmental Center, Staatsburg). Private waterfront access opportunities exist through partnering with marinas and/or yacht clubs to support boater education related to water restoration projects.

Estuary education has increased exponentially over the last several decades. Teachers are actively looking for place-based education to use in delivering their curriculum. Informal education venues have surfaced, including nature centers, children's museums, historic sites and science camps that serve distinct audiences based on geography, age level, content or program focus. New curricula are being developed regularly by environmental educators, teachers, non-profit groups, scientists and community members. Education efforts benefit from an extensive array of products and audiences as well as partnerships to share and leverage their resources, a trend that is expected to continue.

Currently the Estuary Program delivers Hudson River education resources and programs to about 58% of school districts along the river and in the lower Hudson watershed, including NYC, the nation's largest

school district with more than one million students. In 2016, the Estuary Program’s curriculum resources were downloaded nearly 47,000 times, more than 500 classroom and informal educators attended professional development (PD) opportunities, and 17,500 people participated in Hudson River education events. The digital Hudson River Almanac delivered natural history news weekly to over 22,000 subscribers, and close to 600 individuals participated in Estuary Program citizen science projects. 75 Estuary Program presentations have reached over 2300 people, including more than 500 decision makers, such as municipal officials, watershed group members, agency staff and conservation partners, who received training on topics from land-use and watershed planning to sea level rise and water resources. An additional 200 local officials received training on field assessments, environmental review and land-use conservation principles.

Today grassroots groups continue to have a significant impact on Hudson River education. Clearwater annually reaches over 35,000 with Hudson River programs for both adult and school age groups, including their student education programs that reach 40 school districts, as well as adult volunteers through educator sail program participants and their annual Hudson River Revival festival. Riverkeeper organization educates through their Hudson River microbial water quality monitoring. Website pages related to the findings annually receive some 57,000 unique visitors. Groups like Scenic Hudson and Hudsonia fill a critical role by providing regular training for municipal planning boards and community groups on climate impacts, waterfront development, sea level rise and protecting regional biodiversity.

38 academic institutions are in the estuary, along or close to the river, with 50% of these deeply engaged in Hudson River research and education with their faculty and students. Several research institutions like Cary Institute of Ecosystem Studies and Lamont-Doherty Earth Observatory provide teacher training through pre-service courses, in-service professional development programs, and regular conferences and workshops reaching 68 school districts in the estuary. Student Conservation Association (SCA) annually places close to 3 dozen post-college members at sites in the estuary who educate a range of residents through their positions.

The education audiences are varied including adults interested in the natural world, boaters needing water education as well as boaters helping with data collection, and teachers looking for workshops and professional development opportunities. Student groups include K-16 audiences learning about the estuary, research science students hoping to find a project about the estuary system and college students participating in service learning projects as they give back to the community. Training opportunities for estuary residents include sessions for planning and zoning board members on watershed protection, and sessions for workforce members looking for technical training on restoration or sustainable practices.

Programs and resource sharing often link together a range of partners. Teaching the Hudson Valley provides a curriculum bank for teachers as well as workshops and conferences that annually reach several hundred teachers and educators through a partnership of agencies in the Hudson Valley. “Day in the Life of the Hudson River,” is a program that brings over 5000 students, educators and teachers to the river to sample and share data. Serving approximately 100 student groups, the event is annually supported by over 40 partnering groups including colleges, non-profit groups, government organizations and individual educators. Resource sharing is evidenced in the Hudson River Environmental Conditions Observing System (HRECOS), a real-time water quality monitoring system, managed by approximately a dozen science research institutions and education partners to provide real time data for both research and education.

Trends and Drivers

To establish 'reach' and breadth in education offerings, partnerships will continue to be crucial. Many workshops and teacher training programs are offered through the collaborative partnership efforts of two or more groups that include Estuary Program, other state or national agencies, universities and colleges, and research groups. Service providers and business partners are a growing sector in these partnerships, and in some instances will be best suited to provide the technical content and training. An evolving focus on sustainable planning, resilient shorelines, waterfront planning for sea level rise and green infrastructure projects has opened the door for new technical training and job force education. This growing need will continue to provide a unique opportunity for industry/research/education partnerships. Additionally, with limited grant support money available for education, some of the small community business grants might generate new and unique partnerships between industry or business groups and educators.

The expanding role of digital technology and the Internet in educational settings and in the personal lives of audience members will present challenges and opportunities. A recent study found that American children spend an average of 53 hours a week indoors using electronic media of some sort. Technology creates new ways of questioning, learning and interacting with the Hudson River environment; [Hudson River Environmental Conditions Observing Stations](#) (HRECOS) is an example. Moving forward, educators will need to consider opportunities to link electronic media to an exploration of the real Hudson River to enhance the learning. Creating interest, understanding, and attachment to the physical estuary through the application of virtual technology can build a stronger connection to the Hudson in our audience. Additionally, on-line classes and other resources can expand the reach of education to individuals with either time or physical limitations.

Constraints

Several stressors are impacting Hudson River field education programs. Time is a major limit for teachers due to both the increasing amounts of curriculum they must cover and mandatory testing requirements. Added to the stress of limited time are funding challenges for buses and program fees. Dwindling public school funding appears to be a trend that is not expected to change. In addition to limited funding being available for school groups for Hudson River education, there are limited grant opportunities for education providers to develop place-based Hudson River materials.

Outside programs bring a host of additional challenges. Many teachers lack both content knowledge and familiarity with outdoor investigations, causing them to shy away from the experience. The limited number of waterfront sites able to accommodate groups of students for field experiences limits the ability to offer programs on the river in some communities. Additionally, many waterfront sites are unable to be used by schools for lack of cover, restrooms or portable toilets. Increasingly there are environmental factors to consider including ticks, high heat index days, weather uncertainties, and more extreme weather events. Sea level rise is an additional concern for centers that sit close to the water and are vulnerable to both rising water levels and elevated storm surge. All these impacts are expected to increase through the target reporting periods identified in this project, some can be addressed through shared actions in the Hudson River CRP.

Action Table

Objective	Action	Completed by
Objective 1: Every K12 student in the Hudson River watershed receives meaningful watershed education experiences about the Hudson River ecosystem including its tributaries.	1A. Complete an assessment of what other watershed and basin groups are doing throughout the state, and in other states to infuse local watershed education into the state education standards.	2020
	1B. In counties with Hudson River waterfronts, on a rotating basis, provide at least 2 new annual PD opportunities for teachers & informal educators on topics connected to the restoration projects from the Hudson River CRP.	2020
	1C. Work with experts to develop education materials on Hudson River topics, including specific case studies on restoration project topics for inclusion in instruction at multiple education levels, in multiple languages & with cultural sensitivity.	2030
	1D. Develop a portal with a review process for curating and sharing Hudson River curriculum resource materials for materials distribution.	2030
	1E. Work with the 'Connect Kids to Parks' program to develop a 'Connect Kids to Rivers' program for all students in NYS at a specified grade level, focused on providing transportation and access for school groups. This would work in coordination with Action 1F.	2030
	1F. Work with partners to include watershed education at the state level through learning standards that encourage a focus on local natural resources and experiences and includes a direct personal field experience for every K-12 student in the Hudson River watershed on the river or one of its tributaries.	2030
Objective 2: High school, undergraduate and graduate students, and local residents as Citizen Scientists, have robust opportunities for meaningful research related to the Hudson River.	2A. Work with the restoration priorities to identify and promote meaningful research opportunities that are available for informal education opportunities with Citizen Scientists, and formal education for high school science research students.	2020
	2B. Based on expert reports, develop a formal student 'Research Agenda' that links prospective students with real research needs, professional advisors and funding for undergraduate and graduate students providing a mechanism for a win/win relationship with the community.	2030
Objective 3: Every riverside community will have a point of public access to the Hudson River for education for all community	3A. Complete the inventory of existing Hudson River access facilities and infrastructure in and around the river, with a focus on which are usable for education and what is American Disabilities Act compliant. This action is mirrored in Public Access and Navigation Safety and Natural Resource	2020

members, including ADA and diverse community members.	Interactions (4B), and the Resilient Waterfront & Community Shorelines (2C).	
	3B. Use the Harbor Estuary Program Public Access Report as a template for analyzing communities' water facilities, signage, American with Disabilities Act compliant, public education programs and socio-economic standing and needs, as well as assessing any site modification necessary to address sea level rise. Determine if there are gaps in coverage and how to address those gaps and develop a prioritized list of improvements for funding and grant opportunities.	2020
	3C. Where facilities or improvements are needed, work with local communities to provide listening sessions to best develop usable centers or parks on their riverfronts with amenities that support use by community members, school and youth groups (toilets, shelter), with a goal of upgrading/adding 2 facilities every 3 years until every waterfront community has been reached. This action is mirrored in Public Access and Navigation Safety and Natural Resource Interactions Team work on their kayak/canoe launch goal [3A]. Full consideration will be given to protecting riparian areas.	2070
	3D. Ensure access locations are sensitively located to protect undisturbed shorelines and natural areas. To ensure access locations are sensitively located and protect shorelines and natural areas a guidance document for municipal planners will be developed.	2030
	3E. Ensure access locations are adequately posted and communicated to the public, ideally through online mapping tools as well as signage, with a goal of improving online mapping by 2020 and signage at a rate of 5 a year until completed. This action is mirrored in Public Access and Navigation Safety and Natural Resource Interactions [3B]	2030
Objective 4: To effectively achieve the goals of the Hudson River CRP, materials and trainings on the Hudson River will be available for non-formal education for all ages and stages of life to all NYS residents.	4A. Using the dynamic and interactive chesapeakebay.net communication tool as a model, establish a team to oversee the development of a balanced assortment of education, stewardship and outreach materials designed to reach all residents, through a range of media such as apps, online resources, signage and community partnerships and events.	2030
	4B. Provide outdoor public events along the waterfront for riverside communities to promote river education, including festivals, fairs and celebrations with a goal of supporting 1 such event annually in each riverfront county.	2020
	4C. Work with the leaders of the Hudson River CRP groups like the biological communities, sediment and submerged	2030

	aquatic vegetation groups, to enhance their efforts by providing at least 1 annual outdoor work event a year. These could include river clean ups, invasive species removal, riparian plantings etc., to support a wide range of CRP action items.	
	4D. Establish a program to reach groups traveling on the Hudson River through a range of site-specific materials for ferries, boats and trains on the river.	2030
	4E. Review NOAA’s B-Wet program and the EPA Great Lakes National Program to look for ways to expand grant funding for estuary education to include the Hudson River watershed area of NYS.	2030
Objective 5: There will be a range of technical and general information developed in coordination with leaders of the other sections of the Hudson River CRP specifically focused on professionals and decision makers.	5A. Work with other teams to develop initial set of materials with unique content and materials for a target audience like NGOs, regulators and new workers in the field, to ensure they support the goals of other teams in the broader CRP as the programs are being rolled out.	2030
	5B. Work with NGOs, educators and decisions makers focused on topics such as the public trust doctrine, stewardship, civics and other avenues of conservation action. Developing this into a capacity building program where those who are trained in turn train others, like a Hudson municipal leadership group.	2030
	5C. Continually update materials mentioned in 5A by working with the CRPs so that the information matches the state of the project.	2070
	5D. A toolkit will be developed for communities to assist identifying viable funding opportunities for projects, as well as ‘how-to’ plans.	2030
Objective 6: Each objective’s actions produce expected and desired outcomes.	6A. Design evaluation protocols and evaluate on a regular basis all actions under each objective, including developing a summary annual scorecard/report card.	2020

Action Narrative

Education about the full Hudson River, its tributaries, and the watershed, is accessible to any resident and any educator of the wider Hudson Valley on a range of platforms that includes digital apps, interactive websites, clear signage, a portal of resource documents (maps, one pagers, curriculum, fliers, posters), field and classroom programs and a list of suggested teaching tools and where to access or purchase them. Education sites should be located with direct Hudson River access wherever possible.

Objective 1: In order to provide the broad-based education in diverse communities that is needed for ongoing protection of the Hudson River, and to ensure that every student in the watershed receives not only instruction that focuses on the Hudson River ecosystem, but a personal field experience on the

river, and teachers receive adequate professional development to support this, we will need to work with the other watershed and basin groups to address the State Department of Education on including watershed education in state education standards. The 'Connect Kids to Parks Program', which provides passes to all 4th grade students to NYS parks is an interesting model that could be explored. Materials will need to be developed and delivered for teacher trainings and classroom use. Topics should range from estuary basics to restoration specific topics like sediment impacts, wastewater/ storm water impacts, the role of Submerged Aquatic Vegetation in the estuary, commercial and recreational fishing, contaminant movement and residency timetable, and the range and role of biologic communities in the estuary. Additional teacher PD opportunities will be needed to address specific restoration project content. Instruction should focus on the Hudson as an integrated system. Providing accurate, targeted and up-to-date educational materials will require the material to be reviewed by a team of educators and scientists.

Objective 2: Authentic research opportunities on the Hudson River system benefit the wider community and provide meaningful educational experiences for students at the high school, undergraduate and graduate levels, as well as Citizen Scientists. A network of researchers and topics will be developed to support students and adults in researching the Hudson River, and outlets will be identified for promoting this information.

Objective 3: Connecting with the river is critical for developing a relationship leading to ongoing stewardship, and a special focus needs to be placed on ADA and diverse community members in planning for this. Many communities would benefit from additional guidance on partnerships and models for effective waterfront protection. The Harbor Estuary Program Public Access Report should be evaluated as a template or framework for assessing waterfront community facilities, signage, public education programs and socio-economic standing and needs. Additionally, partners should be identified to work with communities developing waterfront plans. As waterfront access is developed and improved, future sea level change should be a critical consideration. The Resilient Waterfronts and Community Shorelines and Public Access & Navigation Safety and Natural Resource Interactions TECs should be partners in delivering this action item to best assist the communities in providing and protecting waterfront access, protecting sensitive shoreline regions, with a goal of minimizing our overall footprint while we develop wider access. Listening sessions for the community should be a central piece of the waterfront access plans.

Objective 4: A wide range of Hudson River information and education resources should be available for interested groups and individuals, including apps, signage, online resources, and trainings. Attention must be paid to creating platforms for reaching the public. The chesapeakebay.net web resources hub is an example of a multi-layered education base that also includes research and stewardship and can be used as a model. A portal should be established along with a clearinghouse for Hudson River education materials. A team of teacher and scientist reviewers should be established so that materials can be assessed for inclusion. Materials accessible via the portal should include digital, paper, apps, signage and links to education organizations for use in diverse communities, or by any demographic. In addition to materials, additional opportunities for stakeholders to interact with the Hudson and the education materials should include more geographically distributed festival and education events as well as work or stewardship events.

Objective 5: Each of the restoration focus areas has initiatives that can be developed working with the education initiatives. Together the experts should specifically identify the content and target audience, case studies & education pieces, technical training or specific data to be used. The education leaders can

then effectively support delivery of information and materials in formats adapted to audiences in schools, non-formal education programs, and river access sites such as marinas and parks. A toolkit will be developed for communities focused on identifying funding for their finalized waterfront projects.

Objective 6: To ensure that their goals are being achieved, education or training plans need some type of evaluation or assessment. This goal can best be achieved through a blend of internal and external evaluation, consisting of an annual internal review supported by an external evaluation every three to five years. Additionally, an annual report should be produced, like that of the Chesapeake Bay group or the Hudson Basin River Watch tributary reports.

Bibliography

Boicourt, K. et al. (2016). Connecting with public waterways, public access and its stewardship in the New York-New Jersey Harbor Estuary, New York-New Jersey Harbor & Estuary Program, Hudson River Foundation, New York, NY, 27 p. <http://harborestuary.org/aboutestuary-rec.htm>

Changing Hudson Project, Cary Institute of Ecosystem Studies,
<http://www.caryinstitute.org/educators/teaching-materials/changing-hudson-project>

Chesapeake Bay Program: Science-Restoration-Partnership <http://www.chesapeakebay.net/>

Clough, M. P. (2011). The story behind the science: Bringing science and scientists to life in post-secondary science education. *Science & Education*, 20(7-8), 701-717.

Coyle, K. (2010). "Back to School, Back Outside: Create high performing students", National Wildlife Federation. 40 p. http://www.peecworks.org/peec/peec_research/01798BF4-001D0211.1/Coyle%202010%20Back%20to%20School%20web.pdf

Day in the Life of the Hudson River, Project website, <http://www.ldeo.columbia.edu/dayinthelife>

Dillon, J., Rickinson, M., Teamey, K., Morris, M., Choi, M. Y., Sanders, D., & Benefield, P. (2006). The value of outdoor learning: evidence from research in the UK and elsewhere. *School Science Review*, 87(320), 107.

Hudson River Estuary Action Agenda 2015-2020 <http://www.dec.ny.gov/lands/5104.html>

Hudson Raritan Estuary Comprehensive Restoration Plan, (2016), 1:1, 222 p.

Hudson River Access Map, Created for the Comprehensive Restoration Plan,
<http://upstategis.maps.arcgis.com/apps/View/index.html?appid=6ddfc5da8d184a6083486c8cef84ab58>

Hudson River Estuary Public Fishing and Boating Access,
http://www.dec.ny.gov/docs/remediation_hudson_pdf/hrefba.pdf

National Research Council. (2009). *Learning Science in Informal Environments: People, Places, and Pursuits.* (P. Bell, B. Lewenstein, A. W. Shouse, & C. on L. S. in I. Feder, Eds.). Washington, DC: National Academies Press.

NOAA Bay Watershed Education Training (B-WET) <http://www.noaa.gov/office-education/bwet>

Smith, G. A. (2014). Place-Based Education. In R. B. Stevenson, M. Brody, J. Dillon, & A. E. J. Wals (Eds.), International Handbook of Research on Environmental Education. Routledge.

Teaching the Hudson Valley, <http://www.caryinstitute.org/educators/teaching-materials/changing-hudson-project>

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