Hudson River Shorelines and Riparian Areas

TEC Significance

Riparian areas and floodplains occur immediately adjacent to the river (above the mean high-water level), host near-river processes that directly affect the riverine habitat and form the connections between riverine and non-riverine habitats. Floodplains, which are a specific subset or type of riparian area, are low-lying zones which inundate during flood events (and are typically delineated for regulatory purposes by the return frequency of flood events, e.g. 100-year or 500-year flood zones). Riparian areas vary widely in their dimensions throughout the Hudson River estuary due to geomorphic settings, with many reaches featuring steep shores and cliffs that constrain the floodplain areas. While there is no one standard definition or delineation of a riparian area, the lands immediately adjacent to the estuary's waters host various types of upland forest types, upland early successional habitats (such as shrublands and meadows), floodplain communities, cliff and rocky summit communities, supratidal wetlands, a variety of non-tidal wetlands, dredge spoil habitats, and working agricultural lands. A wide array of human uses and impacts in these areas (both current and historic) also leads to great variability in their character and habitat quality throughout the estuary.

Intact, vegetated or naturally unvegetated riparian areas and floodplains function to provide habitat for a great diversity of plants and animals (including a variety of natural community types and rare and uncommon species of plants, insects, reptiles, birds, and mammals); to improve water quality through infiltration of rainwater and floodwater; to sequester carbon; to supply organic and mineral materials to the river; to serve as buffers from human impacts; and to host public access to the river shore. Floodplains provide the greatest opportunity for tidal wetlands to move horizontally ("migrate") in response to sea level rise, trap sediment, host side channels that provide low energy refuge areas for aquatic plants and animals, dissipate wave energy, and store flood waters. Riparian and floodplain habitats are an extension of the riverine and tidal habitats of the estuary, representing a critical transition zones between these aquatic habitats and the non-riverine habitats beyond. Many of their functions are dependent on their uninterrupted connectivity to riverine habitats. Collectively, the Hudson River estuary's habitats include both species and habitat types that are ranked as rare or vulnerable in the state (and some even globally) and provide critical resources to many species of fish and birds that migrate annually to or through the estuary from other locales.

Riparian and floodplain habitats represent a nexus among many of the Target Ecosystem Characteristics of the Hudson River estuary. They are extensions of the shallow water and intertidal wetland habitats, hosting rich biological communities with both wetland and upland affinities. Physical processes such as sediment deposition and erosion directly impact floodplain and riparian areas, and in turn are impacted by them. Human waterfront communities exert great influence in these areas via the historic and ongoing impacts of waterfront development (including residential, commercial, and industrial land uses), wastewater and stormwater infrastructure, industrial contaminants, water access infrastructure,

and shoreline hardening. Conversely, these areas provide important benefits to waterfront communities, including protective buffers that improve flood resilience and opportunities for access to the river.

Goal

Floodplain and riparian habitat is further protected, and where possible restored, to support diverse communities of plants and animals, effectively drive ecological processes, buffer the river from human disturbance and runoff, provide unimpeded pathways for the horizontal movement of tidal wetlands in response to sea level rise, and host low impact public access to the river.

TEC Context

Historical Context

The current floodplain areas of the Hudson River estuary are a combination of natural and man-made habitats: dredge materials from the construction and maintenance of the river's navigation channel in the northernmost portion of the estuary (north of Catskill) were historically deposited along the shore and in side and back channels, converting tidal wetlands and riverine shallows to floodplain areas. This practice dramatically decreased the extent of wetland estuarine habitats while adding to the extent of the floodplain, and likely resulted in changes to flood hydrology (e.g. frequency and extent of inundation), sediment deposition regimes, and floodplain habitat character. The largest natural floodplains are also located in the northern reaches of the estuary, where the river was historically shallow, and great portions of those floodplains have been developed (i.e. converted into impervious surfaces or cleared of vegetation for industrial uses). The largest natural, undeveloped floodplain areas have long been used for agriculture.

Current state

The combined riparian areas and floodplains of the Hudson River estuary encompass approximately 29,500 acres (as delineated by the combination of current and end-of-century projected 500-year floodplain and the Active River Area), of which approximately 49% is in a natural state. Natural communities in these habitats are variously dominated by herbaceous, shrub, or forest cover, and riparian areas may include topographic features such as ravines and bluffs. The undeveloped floodplain area currently measures on the order of 9,000 ac (based roughly on a 100-year floodplain) and is disproportionately located in the northern most reaches of the estuary. Approximately 44% of the estuary's shoreline is engineered (i.e. with built structures, including shoreline treatments along railroad tracks), while the remainder is a combination of soft and hard (rock) natural substrate. Public and private access to the river occurs in the riparian and floodplain areas throughout the estuary, with a wide range of low to high impacts to the resource from the associated infrastructure.

Impervious surfaces associated with development, man-made modifications such as sills/dikes/ditches, resource extraction (e.g. gravel quarries), and shoreline hardening exert negative impacts on the riparian area and floodplain's function as buffer and material contribution source, water filter, contiguous wildlife habitat, flood water storage site, and as a zone for horizontal movement of tidal wetlands. In floodplains, various land uses are likely having negative impacts on undeveloped habitat areas, including contaminated stormwater runoff, sewer overflow, and unremediated industrial and agricultural contaminants in the soil. Historic and current agricultural uses in the largest floodplains have also led to the construction of drainage features (such as ditches and tiling). Invasive plant species with a tolerance for hydrologic disturbance regimes are found throughout riparian areas and floodplains in the estuary.

Trends and Drivers

The main climate change trends that impact these habitats include an accelerating sea level rise rate and the projected increased frequency of high-intensity storms (with their associated storm surge and/or heavy precipitation). Sea level rise is expected to push the river (and intertidal wetlands) to expand into the floodplains (and to a lesser degree into other, steeper riparian areas). At the same time the upward edge of naturally-formed floodplains will be constrained by steeper slopes, resulting in a dramatic net loss of as much as 50% or more of the total undeveloped floodplain by the end of the century, even assuming no additional developments. This will likely have a negative impact on the floodplain's ecological functions over time but given successful colonization of the current floodplains by tidal wetlands this projected transition would represent a shift rather than a total loss of ecological function and habitat. More extreme precipitation events may increase erosion and surface water runoff, reducing rainwater infiltration through the soils of riparian areas.

River access continues to be an important part of economic growth and revitalization in many waterfront communities (e.g. the Port of Albany expansion), which exerts development pressure on riparian areas and floodplains. New development along the river generally degrades or eliminates riparian habitats, but re-development (or re-purposing) of old estates and brownfield remediation may include habitat restoration components.

Constraints

The National Flood Insurance Program and additional state standards dictate local floodplain regulations in the estuary, which guide development in floodplains. These regulations focus on safety considerations and floodwater storage capacity, and do not explicitly prohibit any specific uses nor aim to protect critical habitat functions or habitat connectivity in the floodplain. They are based primarily on areas defined by flood return frequencies (e.g. the 100-year floodplain) and do not account for the dynamic boundary of tidal waters given sea level rise, nor are the regulations or boundary maps updated regularly. Other riparian habitats have few, if any, overarching protections. Municipalities can impose additional regulations in these non-floodplain riparian areas, and there are some waterfront municipalities that require additional permitting or development review within a defined distance from the river. However, there are no regulations akin to the state or federal freshwater wetland regulations that aim to protect riparian habitats in the Hudson River estuary. Thus, the most effective conservation tool for these habitats currently is fee or conservation easement acquisition, which is dependent on willing private landowners. Such transactions can be expensive and time consuming and thus are also constrained by the fiscal and human resource capacity limitations of private conservation entities and state conservation agencies (such as the Department of Environmental Conservation and the Office of Parks, Recreation and Historic Preservation).

Action Table

Objective	Action	Complete by
Objective 1: Tidal wetland expansion areas (and their buffers) are conserved	1A. Inventory all New York State Office of General Services (NYS OGS) lands and prioritize them based on their potential to host new tidal wetland	2020
	1B. Transfer the two highest priority NYS OGS parcels to NYS Department of Environmental Conservation (NYSDEC) or Office of Parks, Recreation and Historic Preservation (OPRHP)	2020

	1C. Conduct a comprehensive inventory of dikes and other barriers to tidal wetland migration and floodplain expansion outside of the immediate shoreline	2020
	1D. Conserve 400* acres of tidal wetland expansion area by means including fee purchase, conservation easement, or advocacy to public or private entities (e.g. utility companies, higher education institutions, municipalities) (this action is mirrored in the Shallow Water and Intertidal Habitats TEC)	2030
	1E. Transfer three additional high priority NYS OGS parcels to NYS DEC or OPRHP (for a total of 5)	2030
	1F. Conserve 450* additional acres of tidal wetland expansion by means including fee purchase, conservation easement, or advocacy to public or private entities (e.g. utility companies, higher education institutions, municipalities) (For a total of 850 acres*) (this action is mirrored in the Shallow Water and Intertidal Habitats TEC) *This number was reduced in the printed version of Hudson River CRP due to changes in planning horizons.	2070
	1G. Transfer all remaining priority NYS OGS parcels to NYSDEC or OPRHP	2070
Objective 2: Hudson River shores provide connectivity between upland and riverine habitats	2A. Inventory all locations and the condition of hardened/engineered shorelines which are not protecting critical facilities or other vital community infrastructure, and identify and prioritize opportunities for their restoration with ecological enhancement	2020
	2B. Replace hardened/engineered shores with natural designs in places identified as high priorities for shoreline restoration (in places that are not protecting critical facilities or other vital community infrastructure); specific goals (e.g. number of projects) will be based on the inventory and prioritization (see 2A above)	2030/2070
Objective 3: Hudson River riparian habitats are conserved and restored to promote their biodiversity and ecological functions	3A. Inventory, compile existing surveys, and conduct new surveys at Hudson River estuary riparian areas and floodplain locations to better characterize the natural communities, species, and management needs of their biological communities	2020
	3B. Prioritize riparian habitats for conservation or restoration based on 1) their habitat quality, 2) their potential to create an intact habitat continuum with riverine and upland habitats as well as other adjacent riparian areas, and 3) their function as buffers from development to the most critical riverine habitat areas	2020
	3C. Conserve or restore high priority riparian habitats based on the inventory, surveys, and prioritization (see 3A and B above)	2030/2070

Action Narrative

Objective 1: Tidal wetland expansion areas (and their buffers) are conserved

- *Actions A, E, and G: The transfer of NYS OGS lands to NYS DEC or OPRHP*. There is no current comprehensive inventory of all the lands owned by New York State Office of General Services (OGS). In particular, "made lands" formed by the deposit of dredge materials are important components of floodplains in the upper Hudson River estuary (and of projected tidal wetland expansion areas) and must be inventoried and prioritized for conservation. NYS OGS-owned lands can (and have) legally been conveyed either to private landowners or state agencies such as the Department of Environmental Conservation (DEC) or Office of Parks, Recreations and Historic Preservation (OPRHP), depending on specific circumstances. Completion of an inventory and prioritization will facilitate the most efficient investment of effort to transfer "made lands" from OGS to DEC or OPRHP, which in turn will lead to their conservation and management to accommodate new tidal wetlands and other floodplain functions. These actions are supported by the findings of the 1994 report by Scenic Hudson and The Nature Conservancy and by the 2015 study of tidal wetland response to sea level rise by Scenic Hudson. As of 2016, two high priority areas for transfer have been identified, while at least two other opportunities are known to exist. The goal of three transfers by 2030 (additional to the two by 2020) should be updated depending on the findings of the inventory. It may be necessary to increase the staffing at NYS DEC and/or OPRHP to facilitate these goals, as staff capacity has been noted as a constraint on these transfer transactions.
- *Action C: Inventory of dikes and other barriers*. A complete inventory of dikes and other barriers to tidal wetland migration and floodplain expansion will allow for planning restoration actions that maximize the area of new tidal wetland and functional buffers, as well as the creation of more accurate region-wide and site-specific models of wetland response to sea level rise. This information was not available for the Scenic Hudson study on tidal wetlands conducted in 2015, but future studies can integrate such data into the models to improve projections.
- *Actions D and F: Conservation of tidal wetland expansion areas*. A 2015 study by Scenic Hudson found that wetland expansion into floodplain and other riparian areas is a necessary component of long-term tidal wetland resilience to SLR in the estuary. Such expansion areas must be kept undeveloped, and possibly managed, to enable such expansion. Conservation measures include fee acquisitions, conservation easements that are adaptable to SLR conditions (e.g. rolling easements), and successful advocacy to private and public (non-conservation) landowners to voluntarily allow tidal wetland expansion. The acreages of actions were estimated based on a tax parcel analysis that prioritized parcels based on their total size (> 10 acres) and on the projected size of future tidal wetland (existing and new by year 2100) within those parcels, as well as their location within delineated tidal wetland areas. Four hundred acres (the goal for 2030) represent just below 50% of the total projected new wetland within these parcels, which combined with an additional 450 acres (the goal for 2070) represent the total acreage within these parcels. The parcel analysis should be considered an estimate, as data on land ownership status (e.g. conserved, public, private) are known to have significant inaccuracies. Conserving tidal wetland expansion areas is also a goal of the Hudson River Estuary Program, as stated in the 2015-2020 Action Agenda.

Conservation of new riparian areas and floodplains (i.e. those areas which may not currently be in the floodplain or immediately adjacent to the shore, but which will become so with future sea level rise), is an equally important goal. Due to the geography of the Hudson River estuary, these areas are not expected to extend significantly beyond the projected tidal wetland migration areas (i.e. there is very little additional low-lying and relatively flat land beyond the current floodplain extent), and no analysis

specific to floodplains and other riparian area expansion was available at the time of this report. The inclusion of potential tidal wetland expansion areas based on a range of SLR scenarios and projecting out to year 2100 in the parcel analysis maximizes the likelihood that parcels prioritized for conservation of future tidal wetlands will also conserve future floodplains within the time frame of this plan.

Objective 2: Hudson River shores improve connectivity between upland and riverine habitats

- *Shoreline restoration projects*. In places that are not protecting critical facilities or other vital community infrastructure, replacing engineered shoreline treatments (which were most commonly installed to retain dredge spoil from the shipping channel, and some of which are failing) with naturally designed shorelines will improve the habitat and the connectivity of riparian habitats to riverine habitats, and likely better facilitate tidal wetland resilience to sea level rise (through accretion and horizontal migration). An initial inventory of shoreline types was completed by NYSDEC in 2008. A more detailed inventory of the location of hardened shoreline types in relation to adjacent land uses and their condition (including change over time) is needed to inform subsequent restoration goals. There are a wide variety of options for integrating nature-based features into shoreline designs, and some shorelines that do protect vital community infrastructure can also benefit from nature-based features without loss of protective function (but are not the focus of this TEC). Improving the conditions of shorelines is also a goal of the Hudson River Estuary Program, as stated in the 2015-2020 Action Agenda.

Objective 3: Hudson River riparian areas are protected

- *Action A: Inventory and surveys of biological communities*. A complete inventory of locations, compilation of existing surveys, and execution of additional surveys are needed to better characterize the natural communities, species, and management needs of Hudson River estuary riparian areas and floodplains. These habitats are not currently mapped nor classified in a manner like tidal wetlands or the state's natural community classification, which limits the capacity for understanding their ecological functions and for effective conservation planning.
- *Actions B and C: Prioritization, conservation, and restoration of important riparian areas*. Riparian habitats can be prioritized for conservation and/or restoration based on habitat quality, connectivity value, and buffering function; a prioritization by 2020 will allow goals (based on extent or number of projects) to be set for 2030/2070. Conservation and restoration sites may be prioritized based on the occurrence of exemplary habitats, locations where they would ensure a habitat continuum between riverine and upland habitats extending further from the river, and where their buffering function (i.e. moderating the impacts of human activities) will likely have the greatest positive impact on known important riverine habitat areas (as identified by Significant Coastal Fish and Wildlife Habitat, rare species occurrences, and other designations or information). Gaps in otherwise intact stretches of riparian habitat may also be prioritized. This objective and the associated actions are based in part on the assumption that riparian areas directly adjacent to important riverine habitats have the greatest impact on them.

Specific Project Example

The floodplain of the Binnen Kill, in the Towns of Bethlehem and Coeymans (Albany County) is largely undeveloped and has the potential to transform into one of the four largest tidal wetland complexes in the estuary by the end of the century (through horizontal tidal wetland expansion). Dredge spoil deposits connect former islands in the river to the naturally formed floodplain in a ca. 235-acre swath of "made land" owned by the NYS Office of General Services. Other portions of the floodplain are privately owned, with a significant portion conserved by the Scenic Hudson Land Trust through fee ownership and

conservation easements. Transfer of this OGS-owned property to the NYS Department of Environmental Conservation would ensure the continued public ownership of this land and facilitate the management and restoration of a significant habitat complex including tidal wetlands and shallows, riparian areas, floodplain, and a tidal tributary.

Research Needs

- High resolution impervious surface data the estuary's floodplain and riparian areas
- A complete inventory of NYS OGS-owned lands in the current and future floodplain*
- A complete inventory all locations and the condition of hardened/engineered shorelines which are not protecting critical facilities or other vital community infrastructure, for use in identifying and prioritizing opportunities for their restoration with natural or nature-based features*
- An inventory of barriers to tidal wetland migration into floodplains and riparian areas (e.g. dikes) *
- Biological inventories and site-specific maps of Hudson River estuary floodplains and other riparian habitats (as opposed to the generalized, model-derived extent generated for this report) *

*The research need is also included as an action.

Beyond Scope Ideas

The type and relative effects of a suite of floodplain and riparian area ecological functions vary along the river continuum (from headwater streams, through tributary mouths, and to the main stem of the estuary), and most are better studied and documented along smaller order streams than the Hudson River estuary. Conceptually, some functions play a more significant role in certain parts of this continuum (e.g. shading by riparian area trees is more significant for smaller, narrower streams), and better understanding the independent and cumulative effects of these functions on the Hudson River estuary's main stem would allow for more focused conservation and restoration.

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