THE HUDSON'S AQUATIC HABITATS

The Hudson's web of life knits together aquatic habitats in light-filled shallows and dark, deep channels, brackish water and fresh water, wide main stem reaches and narrow, winding tributaries. These habitats affect water quality, water supplies, fisheries, recreation, resilience to storms, and our quality of life. Among them, four are especially important to the estuary's health and resiliency.

SHALLOWS AND SUBMERGED PLANTS

In shallow water habitats, the river bottom is below the low tide line but less than six feet down. In fresh and slightly brackish shallows, submerged aquatic vegetation (SAV) may grow. Photosynthesis by SAV produces life-giving oxygen; the plants also contribute to the river's food web. Inhabited by diverse and abundant crustaceans, insects, and other invertebrates, SAV beds offer nursery, feeding, and refuge habitat for fish, birds, and turtles.

Inventories in 1997, 2002 and 2007 each found over 5,000 acres of such plant beds in the estuary (approximately 40% of the available shallow water habitat). Water celery, a native plant, accounted for nearly two-thirds of this acreage. However, after 2011, water celery beds virtually disappeared from the Hudson. Scientists think this was due to flooding and sediment deposition associated with Tropical Storms Irene and Lee.

TREND: Submerged aquatic vegetation surveys from 2003 to 2011 found plants in 43.3% of sites checked, on average. In 2012-2013, plants were found at only 10% of sites checked.

Steve Stanne/DEC

Water celery is predominant in the Hudson's beds of submerged aquatic vegetation. Its near absence in 2012-2013, likely due to impacts of tropical storms, coincided with low counts of young-of-the-year fish, for which these vegetation beds provide important nursery habitat.

HABITATS HALF IN, HALF OUT

More than 6,000 acres of Hudson wetlands flood and drain on rising and falling tides. Intertidal wetlands include mud and sand flats, marshes, and swamps. Once prime sites for garbage dumps, these habitats began receiving protection under the Clean Water Act as awareness of their ecological value grew. These wetlands support a wealth of species, from small fish such as the banded killifish, to predatory birds like the great blue heron.

Mud and sand flats are important feeding areas for wildlife, especially birds. Plants, including some globally rare species, grow on many freshwater tidal flats. Currents, wave action, and high salinity can leave other flats bare. Either way, tidal flats protect adjacent shorelines from erosion by dissipating waves and slowing river currents.

Marshes and swamps occupy more sheltered sites. In the brackish lower estuary, the Piermont and Iona Island marshes contain grass-like, salt-tolerant plants. The diverse plant communities of freshwater tidal marshes north of the Bear Mountain Bridge are often dominated by cattail and spatterdock. Tidal swamps are characterized by shrubs or trees that can tolerate regular flooding.

Steve Stanne/DEC

Spatterdock commonly grows on tidal flats in freshwater.

NATURAL SHORELINES

Vegetated natural shorelines resist erosion, reduce wave energy, and support fish, invertebrates, birds and amphibians. Wrack (natural debris) that washes up on beaches provides sustenance to many creatures. Riverbanks with a gradual slope facilitate migration between land and water. Vertical shores, particularly seawalls and bulkheads, support fewer plants and animals.

From Troy to the Tappan Zee Bridge, 58% of the Hudson's shoreline is "natural," ranging from steep rock faces to gentle mud slopes. The rest has been altered with revetment, bulkhead, cribbing, and riprap during construction of railroads, industrial sites, docks, and erosion control structures. Comparisons of modern and historic maps suggest that 71 miles of shoreline were eliminated during channelization of the upper estuary.

Ellen Edmonson/DEC

TRIBUTARY STREAMS

The Hudson's tributaries deliver water, nutrients, and sediment to the estuary while providing habitats for wildlife and for resident and migratory fish. Swimming into the estuary from the ocean, most alewives continue into tributaries to spawn. Hatched in the mid-Atlantic Ocean, American eels enter tributaries as tiny, transparent glass eels. There, they grow to adulthood, some staying over 20 years before swimming back out to sea to spawn.

Cody Yeakel

Like dams, some culverts are also barriers to fish.

Dams and culverts now block access to much of the tributary habitat once used by herring and eels. This is likely one of the factors contributing to steep declines in their populations. When feasible, dam removal is preferred over facilitating fish passage with fish ladders, which don't always work. Dam removal may improve in-stream habitats, sediment and nutrient transport processes, and water quality. Water temperatures are typically higher and oxygen levels lower in ponds above dams. These impoundments also trap sediment, disrupting the supply to shallows and wetlands downstream.

CLIMATE CHANGE IMPACTS

As the estuary rises with sea level, wetlands and flats now flooded and drained by tides may find themselves under water continuously. If rising water levels are balanced by sediment deposition on the river bottom, then marshes may survive in place. Alternatively, as higher water floods wetlands and adjacent low-lying shores, marshes may shift shoreward to stay in the intertidal zone. However, this will only be possible where the bordering terrain and land use allow.

If sedimentation fails to keep pace with rising sea level, then increasing water depth will reduce light penetration, limiting the growth of submerged plants. In addition, increasingly severe storms and flooding may physically damage or uproot plants and mobilize sediments to further reduce light penetration or smother SAV beds.

Rising sea level and flooding threaten both natural shorelines and human communities. Commonly proposed engineering remedies sometimes protect property in ways that severely degrade habitat. The best solutions are those that reduce flooding and erosion while protecting or enhancing habitat.

EXOTIC AND INVASIVE SPECIES

Exotic and invasive species have dramatically altered estuary habitats. Research in the freshwater Hudson suggests that about seven new species arrive per decade, one of which is likely to have serious ecological impacts. Among recent arrivals, *Hydrilla* might be that one. Discovered in 2013 in the tidal Croton River, this plant is known to displace native water celery in other ecosystems.

Where feasible and ecologically justified, controlling exotics can be an important part of habitat restoration. An invasive variety of *Phragmites*, the common reed, has displaced native cattail in some marshes. At Iona Island, its exponential expansion coincided with significant declines in nesting marsh birds. A project to control ten acres of *Phragmites* began in 2008; follow-up surveys show that cattail is returning, and along with it, birds such as marsh wren and Virginia rail. In addition, Iona's population of salt marsh asters, an endangered plant, has grown from a handful to the largest in the state.

A FRAMEWORK FOR HABITAT RESTORATION

DEC's Hudson River Estuary Habitat Restoration Plan, released in 2014, lays out five actions to improve the ecosystem's health and resiliency.

- Preserve existing estuary habitats and adjacent uplands where wetlands may become established as sea level rises.
- Restore side channels, vegetated shallows, backwaters and other habitats altered by dredging and other human activity.
- Implement fish passage, dam removal, and culvert right-sizing projects in Hudson tributaries.
- Promote use of ecologically enhanced shoreline stabilization methods of protecting property, infrastructure, and other assets.
- Implement programs to control and prevent introduction of invasive species.

Differences in natural landscapes and development along the river call for diverse restoration strategies. For example, wetland and SAV restoration is a priority in the upper estuary, where these habitats — once very extensive — were lost when the navigation channel was deepened.

Projects to fulfill Restoration Plan goals are underway. An example is the Hudson River Sustainable Shorelines Project, which is developing stabilization techniques that preserve natural benefits while meeting engineering needs. Its cooperative engagement of stakeholders and decision-makers to build consensus offers a template for habitat restoration along the estuary.

BASELINE: From Troy to the Tappan Zee Bridge, 58% of the Hudson's shoreline is in a natural state; the rest has been altered with revetment, bulkhead, cribbing, and riprap.

Steve Stanne/DEC

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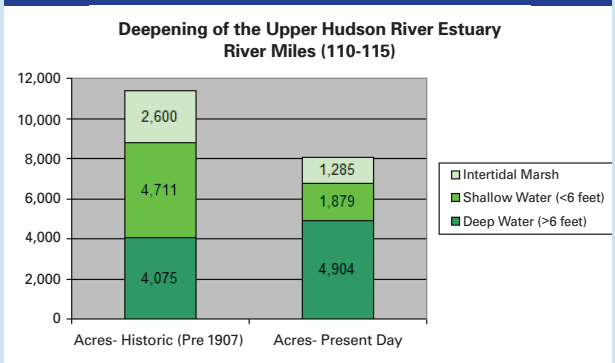
BASELINE: From Catskill north to Troy, there are at present 1,285 acres of intertidal marsh and 1,879 acres of shallow water habitat, compared to 2,600 and 4,711 acres respectively before the channel was deepened early in the 20th century.



Dan Miller/DEC

This portion of the river, which offers important spawning, foraging, and refuge habitat, was converted from a river dominated by shallow and intertidal areas to one that is dominated by deep water. The total river acreage decreased as shallows became land — filled in with sediment from the channel.