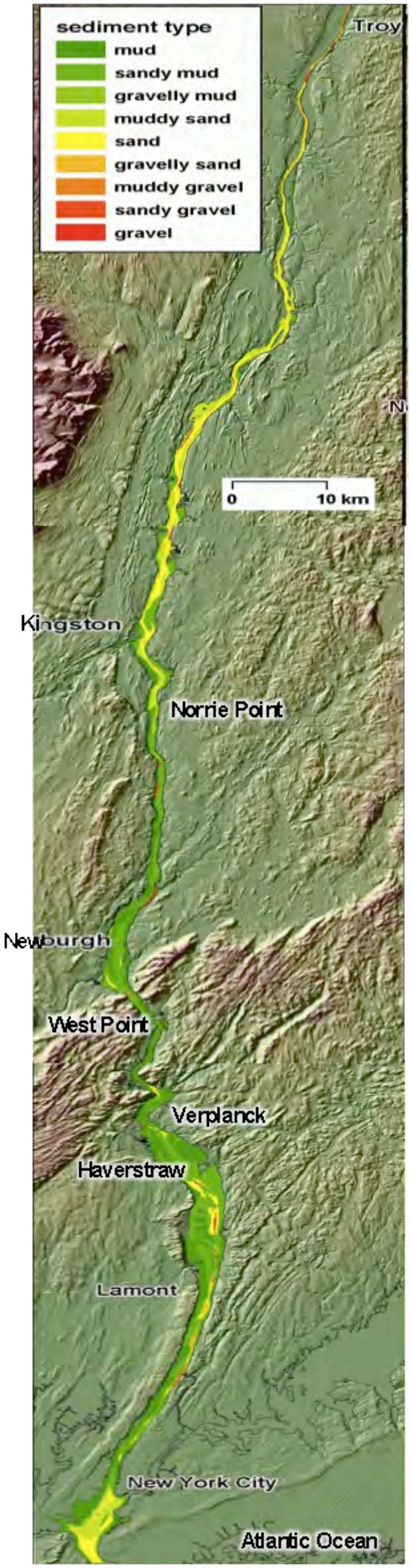
ANALAYZING YOUR SEDIMENT CORE: PULLING IT ALL TOGETHER



This activity is designed to be completed back in the classroom after day at the river.
Core Log: Start by examining your core, completing the push core log using the 'Day in the Life Push Core Sediment Log' (next page). This sheet will help you review what you see in your sediment sample.

Next combine this with observations you made when you were at your river site. Brick pieces, coal, slag, and shells, glass, sand etc. all collect along the waterfront and over time become part of the 'sediment story' as they break down.

Now Consider How the Pieces Got There: Complete the sheet labeled "Consider the Past" noting which parts of the river's story have added pieces to the sediments in your part of the river. Note how many are 'natural' and how many re added by humans by adding a 'N' or an 'H' in each box on the inventory sheet. Do humans influence our river bottom history?

Write the Story: Now write a 'story' or possible history of the sediments in your sample. Look over the information from the sections you have marked with a 'yes,' and write the story of sediments in your section of the river. Consider where the different items you found in your core might have come from. There is a sample below.

Sample Story: *We collected our core close to a marsh in a cove, it was filled with mud telling us the water is slow moving in this section of the river. The mud might have come from many other places in the river since it can travel long distances before it settles out, maybe it even came over the Troy Dam! We had some wood and plant pieces in the core probably washing out of the marsh. There were some small red flecks of brick that we think fell off a barge on its way to NYC 100 years ago when brick was being moved down the river to build in the city. Since we are near Haverstraw we expect these came from a brick company there. We also found some coal that we think started in Pennsylvania and made its was to the Hudson River through the D&H canal. The coal and brick were probably bigger and got broken into small pieces by tides and storms. Our sediment came from many places in the river! –Piermont*

DAY in the LIFE PUSH CORE SEDIMENT LOG

GRAB ID#	Site Name	DATE	FORM COMPLETED BY:	
			GROUP #	
TIME	LATITUDE	LONGITUDE	WATER DEPTH	LOCATION

	Yes	No			Descriptors - Please note additional observations
H_2S smell					H_2S smells of rotten eggs, suggesting anaerobic bacteria
Oil					Oil creates a slight smell, a slickness and a sheen
Oxidized top*					*oxidation (reaction with oxygen) creates a distinctly lighter colored layer of sediment.
					estimate dimensions of oxided layer, etc. and draw below
	Absent	**Rare**	**Common**	**Abundant**	**Additional Comments**
Clay					very fine material - grey color & rich dense feel
Mud					smooth feel between fingers - brown color
Sand					gritty feeling between fingers
Gravel					pea sized pieces of stone
Pebbles					pieces of stone larger than pea
Leaves					
Wood					
Shells Oysters (dead/alive?)					
Freshwater mussels (except zebra)					
Zebra mussels					
macroinvertebrates					
Brick					
Coal					
Slag					industrial byproduct - chunky look, light, air filled
Living vegetation:					
Length of Core:					Length of Oxidized core top (if present):
If Bagged - Number On Core Collection Bag					

Sketch of your core below with measurements for each section & total core (be sure to label the top and bottom):

<--BOTTOM TOP -->

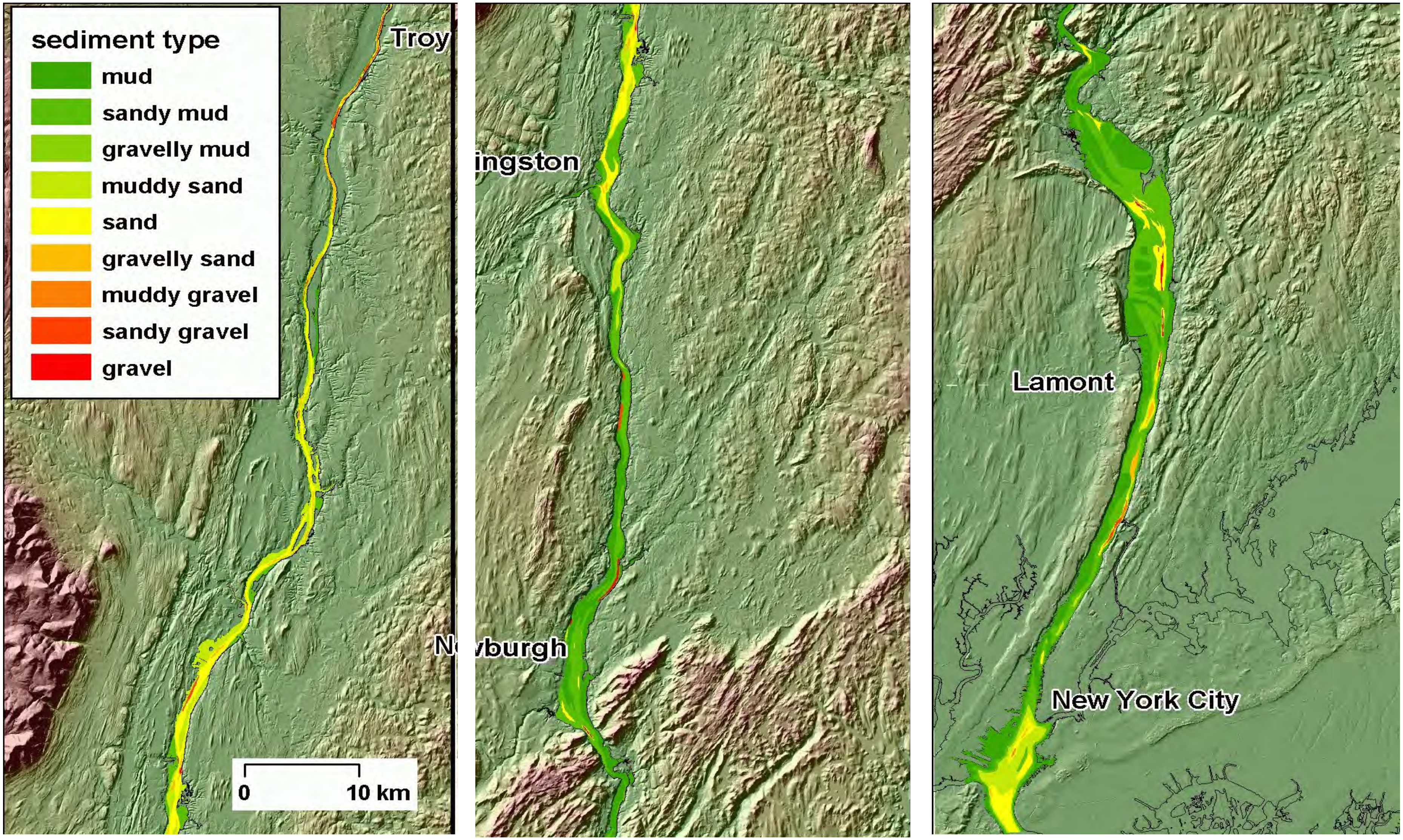
ANALYZE YOUR SEDIMENT USING THE HISTORY OF THE HUDSON RIVER

CONSIDER THE PAST – Analyze your core sample to discover its past!

 **Course Grain___** **Fine Muds & Clays __**	**SEDIMENT GRAIN SIZE – Natural _____ Human ______** **We find sand in dynamic high-energy sections of the river:** • Dropped at the mouths of many creeks and streams where they enter the Hudson, like in the Catskill and Kingston regions. • In NewYork Harbor where it enters on the tide, carried from the 'long shore' current moving along the New Jersey and Long Island coasts. • Lining the upper Hudson shipping lane from which it is dredged. **We find muds and clays in slower moving stretches of the river:** • Settled out in wider reaches like Haverstraw and Newburgh Bays. • Close to marsh areas where plants help settle the sediments.
 **Oyster Shells in the area** **Yes______ No______** **Other Shells** **Yes______ No______**	**OYSTERS & OTHER SHELLS – Natural ____ Human ____** • Oysters were abundant in salty sections of the estuary at least 6000 yrs. ago when native tribes feasted on them. Piles of cast-off oyster shells (middens) lined the shallows like garbage mounds up to Verplanck. • Early European settlers noted that oyster beds covered the harbor bottom until pollution killed them. Restoration efforts are now underway. • Shells of native mussels, clams, and blue crabs are found throughout the estuary - sometimes whole shells, sometime just pieces.
 **Zebra** **Rangia** **Yes ______ No______**	**ZEBRA MUSSELS & RANGIA CLAM – Natural ____ Human ____** • Zebra mussels are limited to the freshwater Hudson, Rangia clams to the brackish section. • These non-native species arrived in the Hudson late in the 20th century. • Zebra mussels attach to hard surfaces, Rangia clams live in the sediments. • They eat large amounts of phytoplankton, food that other species rely on. • They outcompete native mussels for food, killing them off.
 **Yes ______ No______**	**BRICKS – Natural ____ Human _____** • Starting in the 1800s the Hudson's shores began to fill with brickyards, with almost 100 of them producing 500 million bricks a year at one time! • Haverstraw was the most famous location for brick making, with over 40 brickyards, but brick kilns lined the shores all along the estuary. • Brick was moved by barge. Until 1941, when the last Haverstraw yard closed, the main run was from Haverstraw to New York City. • Brick was in high demand as a building material in early New York since fires were a threat, especially in the cities.

ANALYZE YOUR SEDIMENT USING THE HISTORY OF THE HUDSON RIVER

 **Yes ______ No______** (note slag is generally black when wet and at first glance can look like coal. Coal has a luster or sheen and slag has a lumpiness)	**SLAG – Natural _____ Human _____** • Metal ores (iron, copper, lead, etc.) found in nature are not pure. They are heated to separate the metal from impurities, which form a waste called slag. • In early American history the Hudson Valley was a leader in iron-making with several mines and foundry operations located close to the ore deposits, water power, and transportation. • Located across the river from West Point in Cold Spring, West Point Foundry was one of the region's most prominent iron foundries, making guns, locomotive trains, steam engines, boilers, water pipes, etc. • Slag ended up in the Hudson directly from foundry waste and from the loading of ships moving the iron on the river.
 **Yes ______ No______**	**EURASIAN WATER CHESTNUT PODS – Natural ___ Human ____** • The Eurasian water chestnut is an invasive plant, not native to the Hudson River but brought here in the late 1800s from Eurasia. • The plant prefers shallow, still, freshwater areas of the river like the cove at Norrie Point, where it forms dense plant beds or mats on the water surface. • Pictured is a seed pod of this plant – often called 'devil heads' due to their sharp spikes. The seeds float, moving and spreading this plant throughout freshwater, and can sprout and grow up to 12 years after forming!
 **Yes______ No______**	**COAL – Natural ____ Human _____** • Pennsylvania coal came to the Hudson on the Delaware and Hudson Canal along the Rondout Creek to Kingston, New York. • At its peak in the 1860s-1870s one million tons of coal entered the Hudson Valley via the canal. • Barges moved coal both upriver to Albany and downriver to New York City to heat homes and businesses and power factories and steamboats. It is part of our industrial history.
 **Yes ______ No______**	**WOOD DEBRIS & PLANT MATERIAL – Natural ____ Human _____** • Small pieces of wood and plant debris enter the river from the forests and fields that border the river and can be moved great distances by the water. • Phragmites, cattails, reeds, and other marsh plants drop large amounts of this material into the river. • Storms can knock trees and plants into the river and into tributary streams, where currents, winds, and tides move it from place to place.



SEDIMENT TYPE/GRAIN SIZE MAP FOR THE HUDSON RIVER ESTUARY
Source Frank Nitsche, Lamont-Doherty Earth Observatory

Lamont-Doherty Earth Observatory
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What Can You Learn from Cores from the Bottom of the River?

BRICKS

Fire was a huge threat to early builders in the new world, especially in the cities, so brick was in high demand as a building material. The Hudson River was filled with brickyards with almost 100 of them lining the shores producing 500 million bricks a season. In New York City brick or stone walls were required between attached buildings, brick was used in water tunnels and sewer lines and for the sidewalks, in fact, many called New York the brick city.

The most famous location for brick making was Haverstraw, with over 40 brickyards! Brick was loaded onto barges and moved on the river from Haverstraw down to New York City until the last Haverstraw yard closed in 1941.

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What Can You Learn from Cores from the Bottom of the River?

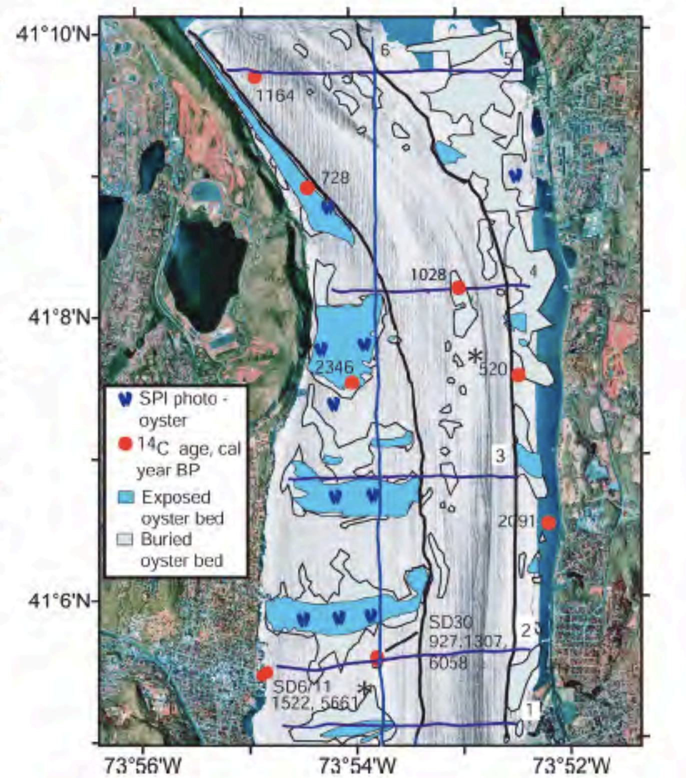
COAL

Pennsylvania coal made its way to the Hudson River through the D&H Canal by way of the Rondout Creek in Kingston. At its peak in the 1860's and 1870's one million tons of coal entered the Rondout to move into the Hudson Valley. Coal traveled from the canal into the Rondout Creek and into the Hudson, moving both upriver to Albany and downriver to New York City on barges to heat home, businesses, factories and steamboats. Another important use for coal was in brickmaking. In 1829 James Wood designed a way to make more brick from Hudson River clay by adding crushed coal, reducing both brick firing time and fuel needs. Hudson River brick makers used 22 ½ tons of coal a year.

What Can You Learn from Cores from the Bottom of the River?

OYSTERS

Fig. 5 Side-scan sonar mosaic with locations of oyster beds (*Crassostrea virginica*) mapped from geophysical data delineated. Oyster beds exposed on the river bottom or buried by up to a few centimeters of sediment (approximate depth penetration of 100-kHz sonar) are detected in the side-scan imagery and are shown in *darker blue*. Beds buried in the shallow subsurface as mapped from chirp sub-bottom data are shown in *light blue*. *Red dots* show locations of cores with dated oyster shells. Ages of oysters are given in cal. years BP. (Table 2; cf. Fig. 1 and Table 1 for core identification numbers); *asterisks* denote dates from McHugh et al. (2004) and Pekar et al. (2004). Shells chosen for radiocarbon dating are primarily from in-situ oyster beds as interpreted from the sub-bottom data. *Bold black lines* mark boundary between marginal flats and channel. Track lines for the chirp profiles in Figs. 3 and 4 are shown as *thin blue lines*. Locations of sediment profile imagery (SPI) data where oyster shells were observed on the river bottom are from NOAA (2000)



The history of oysters in the Hudson River stretches back some 6000 years to when the native settlers feasted regularly on the oysters that stretched from the harbor up to where the salt influence in the water is lost. Oyster Middens (large stacks of empty shells) lined the shallows like garbage mounds up to Verplanck. More recently, but still in our past, in the early days of European settlement the harbor was covered in oyster beds like a carpet beneath the water – plentiful AND large, some reference them to be as big as dinner plates! In 1911 twenty-five million pounds of oysters were harvested from the Hudson and NY waters, but then water pollution caused oysters to die off. With the cleaning of the river water and oyster reseeding projects by many groups, oysters have been returning to the saltwater section of the river.

What Can You Learn from Cores from the Bottom of the River?

SLAG

John Ferguson Weir, early Hudson River Painter, grew up at West Point directly across from the iron foundry that inspired his Forging the Shaft 1874-1877 and Gun Foundry (1866; Cold Spring, NY, Putnam County Hist. Soc.).Both are set in the West Point Iron and Cannon Foundry, that established Weir as one of the most important 19th-century American painters of industrial themes.

When metal ore (iron, copper, lead, aluminum etc.) is found in nature it is impure, mixed with other metals and silicates. Slag refers to the left over material created during the 'reduction' or heat separation of a metal from its ore. During production (smelting) the metal is heated very hot and the impurities, or slag, separated and removed. The famous paintings below show the hot smelting fires of early industrialization (shows West Point Foundry located in Foundry Cove across from West Point). For ~100 years (1818-1912) the West Point Foundry site manufactured guns, locomotive trains, steam engines, boilers, water pipes etc. all of this created slag that ended up in the Hudson River.

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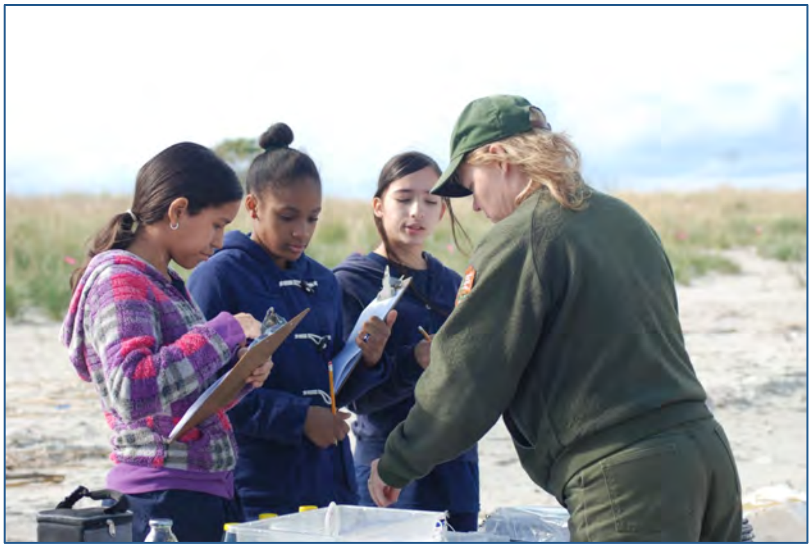
What Can You Learn from Cores from the Bottom of the River?

SEDIMENT GRAIN SIZES



Sands and gravel are large grain sizes and take a lot of energy to be moved by water, while smaller particles like muds and clays are easily swept along with the water until they reach a quiet slow moving section of the river. In the river we find sand in sections that are high energy or dynamic. Sand is found dropped at the mouths of many creeks and streams where they connect to the Hudson, like in the Catskill and Kingston regions.

Sand also dominates the NY harbor where it enters from the ‘long shore’ current moving water and sand along the New Jersey and Long Island coasts. Traveling in on the tide it settles in the harbor. Gravel and sand appear in the upper Hudson from Kingston to the Troy Dam, reminding us of the dredging that has occurred in that area, and the story of a high energy environment, where smaller easily moved particles like muds and clays, are swept by the water and moved on to be deposited downriver. Can you believe an average of 2200 tons of sediment a day enters the estuary from upriver!

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EURASIAN WATER CHESTNUT PODS

Water Chestnut is not native to the Hudson River but moved into the estuary around 1900. This aquatic plant needs shallow, still, freshwater sections of the river like that found at Norrie Point. The plant has become invasive in the upper Hudson wherever there are shallow protected coves. The plant forms dense mats that shade and lower the oxygen levels in the water underneath them. The seed heads are called 'devil heads' and float on the water moving and spreading through the freshwater sections. The seed pods are able to reproduce for up to 12 years!!

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