

The Hudson River: From The Adirondacks to the Atlantic

-slide show script-
(fourth edition, Oct 2004)

1. Title Slide: Title slide
2. Opalescent River flume Rivers come in many sizes and patterns: small and swift, with rushing rapids and waterfalls...
3. Hudson River at George Washington Bridge ...broad and flat, with just a hint of powerful currents under the surface,...
4. Hudson River in winter, Adirondacks ...and everything in between. Often one river has all of these characteristics, changing as it makes its way across the land.
5. Opalescent River in rain All rivers have one thing in common - they are formed as water is pulled downhill by the force of gravity, water from rain and melting snow and ice.
6. Catskill Mountains The course that the water follows is determined by the landscape. A watershed is an area of land that drains into a body of water. Its boundaries are the highest points of land around the body of water. Through studying the heights and slopes around a given river, one can show from what area the river will get its water.
7. Hudson watershed map A large part of eastern New York State lies in the watershed of the Hudson River. The Hudson river watershed also includes parts of New Jersey, Connecticut, Massachusetts, and Vermont. The water in all of the streams that flow through this area eventually ends up in the Hudson river. Streams that flow into a larger river or body of water are called tributaries.
8. Adirondack High Peaks from Mt. Marcy Much of the fresh water that enters the Hudson comes from the Adirondack Mountains in northern New York. It is here that the Hudson river begins.
9. Lake Tear of the Clouds & Mt. Marcy At the top of New York's tallest mountain, Mt. Marcy, there is a small pond called Lake Tear of the Clouds. There are no roads that go to Lake Tear, in order to get there you have to hike up about seven miles through the mountains. Rain that falls into this little pond is beginning a journey that will one day take it past the skyscrapers of Manhattan.
10. outlet of Lake Tear At Lake Tear's outlet, its waters flow over a tiny waterfall, the first in Feldspar Brook. This is one of several names this water will have before taking the name Hudson River. The

waters of Feldspar Brook join those of other cold, clear streams, plunging swiftly downhill and growing in size and strength.

11. Hudson River at Blue Ledge Narrows By the time these rapids receive the name Hudson River they have become a powerful stream, cutting deep valleys through mountains. This stretch of rapids, called the Blue Ledge Narrows, is a favorite of white-water rafters and kayakers.
12. Paper mill at Glens Falls As the Hudson flows south, one starts to see many factories and small cities along its banks. In the late 1800's many industries depended on the energy of flowing water to run machinery. Water power from the Hudson was a major factor promoting industrial growth around Glens Falls and Fort Edward. Also, during this time the river was an important mode of transportation.
13. GE capacitor plant in Hudson Falls In the Twentieth Century the Hudson River became less important as a direct source of energy for industry. However, many industries, such as this GE factory, remained along the banks of the river. This factory, located in Hudson Falls, discharged PCBs into the river for almost thirty years. It was easier and cheaper for companies to let waste be washed away by the river, than to dispose of them properly.
14. man with striped bass PCBs, or poly-chlorinated biphenyls, are a group of toxic chemicals suspected of causing health problems. Once in the river, PCBs, entered the food chain. This meant that they also found their way into fish, including those that people liked to eat.
15. striped bass Since it became dangerous to eat Hudson River fish the New York State Department of Environmental Conservation (DEC) made it illegal to catch and sell fish with high levels of PCBs. Striped bass are one example of Hudson River fish that can no longer be caught and sold commercially. There were many families along the river that made a living from commercial fishing.
16. Thompson Island pool Now that the PCBs are in the river they will not simply go away. They do not dissolve in water, rather they attach themselves to the mud or the sediments. The Thompson Island pool is one of many places in the Upper Hudson river where there is a "hot spot" of PCBs. This means that buried under the sediment at the river bottom there is a large pocket of PCBs.
17. Troy dam Even though most of the PCBs stay at the bottom of the river

they are slowly leaking into the water column. It is estimated that about 5 lbs. of PCBs flow over the Troy dam every day.

The Troy dam is very important to the river for another reason. Once the Hudson River flows over the dam it is affected by a force that originates more than one hundred and fifty miles away in the Atlantic Ocean, a force that twice daily pushes the waters from the Adirondacks back upriver against the base of the dam.

18. high tide

This force is the tide. When a high tide occurs in the Atlantic Ocean at the mouth of the river, the water level there rises above the water level of the river. Ocean water begins to pour in and flow upriver, raising the water level in the Hudson.

19. low tide

The process is reversed when the ocean reaches its low tide level. Now, the water level in the Hudson is lower than that of the ocean and water begins to flow downriver into the Atlantic.

20. moonrise over Hudson in Esopus

The primary cause of the tides is the gravitational pull of the moon. As the moon orbits the earth there is an attraction, or pull, between ocean waters and the moon that causes high tide on the side of the earth closest to the moon. As the moon continues to orbit around the earth this attraction will fade and water levels will decrease and result in low tide. This is why it is high tide on one side of the earth while it is low tide on the other side.

21. high tide/ low tide at Poughkeepsie

Along the Hudson the tides change about every six hours. That means that in twenty-four hour time period there would be about two high tides and two low tides. At high tide the water is typically three to five feet higher than it is at low tide.

22. ebb current/flood current at Kingston Point

The currents in the Hudson change direction according to the tide. When the tide is falling, the current flows downriver toward the ocean; this is called the ebb current. When the tide is rising, the current flows upriver towards the Troy dam; this is called the flood current.

23. aquatic vegetation

All living things in the Hudson below Troy must adapt to life with the tides. For example,

24. banana boat unloading at the Port of Albany

Humans must also adapt to tides and tidal currents as they go about their business on the Hudson. At the Port of Albany, only a few miles south of Troy, ocean-going ships unload

cargoes brought in from all over the world.

25. gypsum carrier at city of Hudson

Many parts of the Hudson are barely deep enough for these huge vessels. Captains must time their ships' journeys to take advantage of high tides.

26. Esopus Meadows Lighthouse

But still, the Hudson is a key transportation corridor. Lighthouses were originally built to warn vessels of shallow areas.

27. Tivoli Bay

Wetland areas, such as marshes, swamps, and tidal mudflats are very important for the health of the Hudson river ecosystem. There are several large wetland areas in this stretch of the river.

28. Tidal wetlands

Wetlands provide a breeding ground and nursery for many different species of animals, provide an abundant supply of plant life for river food chains, and help to filter out pollution before it enters the river.

29. green-backed heron

Many kinds of wildlife can be seen in these marshes: birds, muskrats, deer and turtles are a few examples. If one looks even closer they will be able to see the abundance of plankton, insects, and macroinvertebrates.

30. cement plant in Cementon

Also set beside the river near the Catskills are several cement plants. Much of the rock along the Hudson here is limestone that can be used in manufacturing.

31. Atlantic cement barge at loading dock

The cement industry benefits from finding this limestone next to a major river. The Hudson provides an inexpensive transportation route for the industry's heavy, bulky cargoes.

32. limestone bed in Marlboro

The Hudson also benefits from the presence of limestone. This rock contains a chemical substance that can neutralize acid. Do you know of a current pollution problem involving acids?

33. Hudson river looking south from Poughkeepsie

Acid rain can be dangerous to living things in lakes and streams; its known to have killed fish in many ponds. But since the Hudson flows over limestone here, its water contains the substance that can neutralize acid, protecting fish and other forms of life in the river.

34. Haverstraw Bay

As the river winds further south, one can detect in its waters another chemical substance in greater and greater amounts - a chemical usually associated with the oceans. Can you guess what it is?

35. diagram of salt & fresh water entering the Hudson

Like the tide, salt water from the Atlantic Ocean penetrates far up the Hudson. How far depends on how much fresh water flows off the watershed and into the river. If there's lots of fresh water coming in, then the salt water is pushed downriver towards the ocean. If little fresh water is coming in, then salt water creeps further upriver. Can you guess which season the salt comes furthest upriver? (Hint: what part of the year usually has the least precipitation?)

36. Hudson River at Storm King

Summer and early fall are usually the driest times of the year in this region. In September one can often detect salt as far north as Newburgh, some sixty miles north of New York City. It may be hard to imagine that the river could contain sea salt so far away from the ocean. Of course, even in the summer the water here is not nearly as salty as water in the Atlantic. It is called brackish water, a mixture of salt and fresh.

37. blue crab

But there is enough salt in the water that animals usually associated with the ocean can live in the river. Animals, such as this blue crab,

38. Piermont marsh

The part of a river or bay where fresh water and salt water mix is called an estuary. Estuaries are very productive environments that provide food for fish and other animals...

39. fisherman with boxes of Hudson River shad

...and for humans as well. Two thirds of the fish that are caught by the commercial fishing industry depend on estuaries for survival at some point in their lives.

40. herring run in Falkill creek, Poughkeepsie

Many of these fish are anadromous, like the herring here. Anadromous fish spend most of their adult lives in the ocean, but they swim up rivers to lay their eggs in fresh water. Their young will stay in the estuary for protection and because of the plentiful supply of food before heading back out to sea.

41. nutrient trap

In many estuaries, salt and fresh water form layers. Salt water is denser than fresh water and therefore pushes upriver under the fresh water, which remains at the surface. Nutrients necessary for plant growth wash into the river with the fresh water. The nutrients are then often caught in the layering of salt and fresh water. This is called the nutrient trap and is one of the reasons that estuaries are such productive systems.

42. water close-up

However, in the Hudson the nutrient trap does not play a big

role in plant growth. There are plenty of nutrients in the Hudson, but what is often in short supply is sunlight. Hudson river water is very muddy which makes it hard for light to penetrate more than a few feet below the surface.

43. Tappan Zee from the air
This means that the conditions for plant growth are best in the wide, shallow sections of the river, such as the Tappan Zee. In these areas there are lots of shallow areas with enough sun for plants to grow. As a result, great quantities of tiny drifting plants can be found here in the spring and summer.
44. Scenedesmus, a green algae
These plants belong to a group of organisms called plankton. Plankton drift in the water, they are unable to swim, or to swim strongly enough to move against the current. Plant plankton are called phytoplankton. Phytoplankton, such as this green algae, are very important because they give off oxygen.
45. Pediastrum, a green algae
With its rich crop of phytoplankton, the Hudson becomes a pasture for creatures that eat these tiny plants. Of course, these animals don't look much like cows.
46. grazing crustaceans
In this slide there are at least four kinds of planktonic animals, known as zooplankton. They can swim, but they are not strong enough to swim against the current.
47. copepod, female with eggs
This is a copepod, one of the many kinds of zooplankton that feed on the tiny plants we have just seen. This female copepod has eggs sacs attached to its tail. How big do you think it is in real life?
48. detritus
Another important source of food in the river is decaying vegetation from marshes and from the forest and fields of the Hudson's watershed. Great numbers of tiny animals eat this material...
49. amphipod
...such as this amphipod, also called a scud. It's related to shrimps and crabs. With phytoplankton, zooplankton, and other tiny creatures available in great supply, the Hudson becomes a well-stocked delicatessen serving other animals. You can probably guess what they are.
50. DEC seining for young of the year survey
Many species of fish have evolved life cycles that allow their newly hatched young to take advantage of the abundant food supply within the estuary.
51. Haverstraw bay
Haverstraw Bay and the Tappan Zee thus become important

nurseries for young fish in spring and summer.

52. largemouth bass

Where there's little fish, there's often larger fish on the lookout for a meal. The Hudson has healthy populations of bigger fish like this largemouth bass.

53. shad fisherman hauling in net

And of course, where there's big fish you are likely to find people trying to catch them. Ever since humans arrived in the Hudson Valley, they've benefited from the rich fisheries of the river.

54. shad fisherman doing something interesting

At one time in the river's history people fished commercially for striped bass, sturgeon, shad, blue crabs, and even eels. However, as we heard earlier it is not safe to eat most of the fish from the Hudson river because of PCB contamination.

55. American Shad

Shad, the largest of the herring family in the Hudson, have become a very important and valuable catch for those commercial fishermen left on the Hudson. Shad come up the river to spawn in early spring and because they spend most of their lives in the ocean they have only low levels of PCBs.

56. sturgeon fishing print -

In years past, other sorts of fish were just as important as the shad. Sturgeon were so commonly sold in the Hudson Valley markets they were called "Albany beef". Do you think the artist who drew this picture exaggerated the size of the fish a little bit?

57. fisherman with sturgeon

Sturgeon are the largest fish in the Hudson river and can grow to be longer than six feet. The fish in this picture was caught more than twenty years ago. Few people catch sturgeon anymore, there don't seem to be as many as there once were.

58. striped bass

Striped bass were once a valuable catch for commercial fishermen, and there are still great numbers of them in the river. This fishery was closed due to the PCB contamination.

59. New York Harbor

Toxic chemicals such as PCBs are only one of the problems affecting the Hudson's health. New York Harbor used to be an excellent fishing area, with plenty of healthy shellfish and finfish. One authority says that oyster beds in N.Y. Harbor once "constituted more than 50% of the world's available supply of oysters." Pollution from the city- including trash, sewer runoff, and illegal dumping negatively effect water quality in the Harbor.

60. seahorse
A number of fish still can be found here. In fact, the Hudson has not lost any of its over 200 species of fish (that's 250 if you include New York Harbor). The Hudson is one of the only rivers on the East Coast that can claim that.
61. Battery Park City landfill
Much of the land that used to be the New York Harbor is now dry land. As the city increased in size, more land was needed for buildings, roads, and other structures. Filling in the shallow parts of the harbor was an easy way to make more space.
62. Water St. near South Street Seaport, Manhattan
Many of Manhattan's busiest streets are laid out where water used to be. These shallow areas were the harbor's most productive natural areas. Filling them in has meant that the harbor can no longer support the abundance and diversity of life it once did.
63. raw sewage outfall, Brooklyn
Several decades ago, one of the biggest environmental problems in the Hudson was the dumping of raw sewage directly into the river. New York City was a huge contributor to this problem with its growing population, but small towns all along the river also put their sewage into the Hudson.
64. No swimming sign
Dumping untreated sewage is more than just disgusting. Water polluted by such waste can contain germs that cause serious human diseases.
65. DEC fish in tub
Fish can also be effected by such pollution. In large amounts, untreated sewage can lower the amount of oxygen dissolved in the water. Low DO can kill fish.
66. Pollution in Albany
While New York City's size made such problems more serious here than in other places, it wasn't (and isn't) alone in facing them Toxic chemicals, sewage, and filling of valuable shallows have been concerns along rivers throughout the country.
67. Newburgh sewage treatment plant
The problem of raw sewage was not unique to the Hudson. To deal with such issues across the country the United States Congress passed the Clean Water Act in 1972. Among other things, this law requires towns and cities across the nation to clean up their sewage. This sewage treatment plant is one example of many that towns along the river built to treat their sewage before returning water to the river.
68. North River sewage treatment plant
Because of its population New York City has a huge amount of sewage that it needs to deal with. The city began plans to build a large sewage treatment facility in the mid-1980's. The problem was that nobody wanted the plant in their neighborhood. Eventually, a compromise was reached with

one neighborhood. The sewage treatment plant was built along the river with a public park on its roof. Local residents now have a new park that includes a gym and swimming facility and the city has a plant capable of handling the huge amount of waste generated daily.

69. fill in Hudson North Bay Marsh

The Clean Water Act also requires that anyone proposing to fill in part of a river obtain a permit to do so. Before granting a permit, the government must determine whether the fill will harm the river environment. If it will, officials can order changes in the project or prevent it from happening.

70. River activist checking discharge pipe

Many concerned citizens along the Hudson work hard to assure that the Clean Water Act is obeyed.

71. water chestnuts

Water chestnuts are an example of invasive species: plants or animals that are not native to the ecosystem. Because they are removed from their natural habitat they have few or no predators to keep their population in check. Patches of floating water chestnuts block the light that native submerged plants need to grow.

72. zebra mussels

Zebra mussels are another problematic invasive species. They've only been in the Hudson since the early 1990's, but they now number in the billions. These mussels block pipes, consume huge amounts of oxygen and plankton, and outcompete native freshwater mussels.

73. picnickers

Even though the Hudson has many environmental challenges left to face, it really is getting cleaner. More and more people along all parts of the river are coming down to picnic and take in the view,...

74. swimmers

...go for a swim,...

75. Clearwater

...and to sail on a beautiful, healthier river. By continuing our efforts, hopefully we can find a way to deal with the environmental problems the Hudson still faces and avoid creating more serious ones in the future.

76. Hudson River at Bear Mountain

77. credits

78. credits

