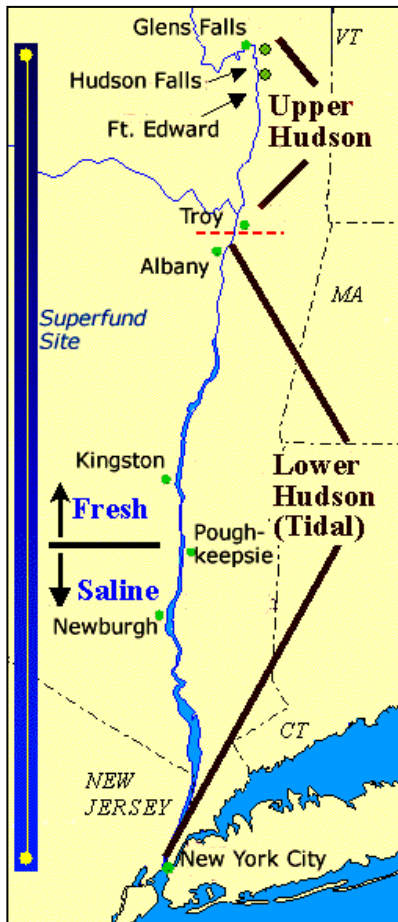




Level 3: PCBs in Hudson River Fish

❖ Background Information:



Map of the contaminated part of the Hudson River. Map courtesy of NOAA.

Polychlorinated biphenyls (PCBs) are man-made chemicals that were manufactured from the 1940s until the 1970s as a fire preventive and insulator in electrical equipment (like transformers and capacitors). They are a family of 209 different chemicals with different physical and biological properties. “PCBs are oily liquids that are chemically very stable and not very soluble in water. Instead, when released into the environment, they accumulate in sediments and especially in animal and plant fats” (Strayer, 2012). Unfortunately, PCBs can cause cancer, neurological and developmental problems in humans, and have been shown to cause reproductive problems in fish and animals along the Hudson River (Strayer, 2012). The Environmental Protection Agency (EPA) banned PCB production in 1977, but they estimate that 1.3 million pounds of PCBs had been discharged into the Hudson River prior to the ban (EPA, 2011).

PCBs in the Hudson

The Hudson River starts as a small stream in the Adirondack Mountains and flows south 315 miles to the ocean at New York City (see Figure 1, at left). PCBs were widely used around the world and entered the Hudson from a number of sources, but the largest sources are two (now closed) manufacturing plants owned by General Electric in Fort Edward and Hudson Falls. These two plants are about 200 miles north of New York City and 50 miles north of Troy, where there is a large dam on the Hudson. Because of the movement of water and erosion, PCBs have moved downriver to New York City, far south of the plants.

In 1980, Congress passed a law called the Superfund Act in order to fund the cleanup of abandoned or uncontrolled hazardous waste sites. A “National Priorities List” of abandoned hazardous waste sites that require cleanup was established, and the EPA either cleans up the site or tries to get the responsible party to pay for the cleanup. Due to PCB contamination, nearly 200 miles of the Hudson River are classified by the EPA as a Superfund site, making it one of the largest Superfund sites in the country. As part of the Superfund cleanup effort, the Hudson was dredged from 2009-2015 to try and remove the PCBs from the sediment. See the additional resources section to find out more about the dredging.



PCBs and Living Things

PCBs do not break down easily, last for a very long time, and bind to soil and sediment. Plankton (microscopic algae and animals) take up PCBs from the environment, but the molecules are not easily broken down by their bodies, so the PCBs just stay in their cells. When fish eat contaminated plankton the same thing happens – the PCBs accumulate in their bodies, and especially in their fat cells. A younger, smaller fish tends to have a lower concentration of PCBs, while an older, larger fish tends to have a higher concentration. However, where the fish spends time and eats is also important. Striped bass are migratory fish, which only spend some of their life in the contaminated Hudson River. Young striped bass that spend a lot of time in contaminated parts of the Hudson may have higher levels of PCBs than older ones in less contaminated waters like the ocean or near New York City. The amount of fatty tissue in a fish varies over time depending on whether there is a lot of food for the fish, so PCB levels might change in a single fish from year to year. As you can see, there are a lot of factors that influence the PCB levels in Hudson River fish!



❖ Dataset Timeframe:

- Data was collected from 2001-2011 on PCB levels in fish in the Hudson River by the NY Department of Environmental Conservation.

❖ Data Collection Methods:



DEC Fisheries Unit collecting striped bass from the Hudson River. *Photo courtesy of DEC Hudson River Fisheries Unit.*

- Each year New York State Department of Environmental Conservation (NYSDEC) scientists collect approximately 2,000 fish from more than 50 different locations in New York water bodies for NYSDOH fish advisories. Fish are collected annually from the Hudson and are analyzed for PCB concentrations. To collect data about Hudson River fish for the fish advisory, NYSDEC scientists follow a sampling plan that specifies the number, location and type of fish to collect in the Hudson each year. DEC staff try to collect the same species in the same locations in the river over time to see trends and to collect fish that people are most likely to catch and eat from the river. The scientists track the size and weight of the fish, its age, sex, and where and when it was caught.

- Once the scientists catch a fish they want to test for PCBs, they send it to a lab which prepares the fish. They blend the skin (which contains a lot of fat, or lipid) and belly fat of the fish with the meat for the analysis. The New York State Department of Health (NYSDOH) develops the advisories by reviewing the data on PCBs in Hudson River fish and updating the fish advisory as needed.



❖ Dataset Variables:

- **Location:** place on the Hudson River where the fish was collected.
- **River Mile:** miles from the New York City Battery to the sampling location.
- **Species Name:** common name of the species that was collected.
- **Year:** year that the fish was collected.
- **Season:** time of year (spring, summer, fall) that the fish was collected.
- **Sex:** sex of the fish. Sometimes the sex could not be determined, in which case U (unknown) is written in this box.
- **Length (mm):** length of the fish in millimeters.
- **Weight (g):** weight of the fish in grams.
- **Moisture (%):** percent of the fish body weight from moisture.
- **Lipid (%):** percent of the fish body weight from lipids or fats.
- **Total PCB (ppm):** PCB content of fish in parts per million.
- **Notes:** notes taken during collection and analysis.

❖ Information About Sites:

- Sampled sites are distributed across the length of the Hudson river between the Federal Dam at Troy and the New York City Battery.

Source of Datasets:

- Data are collected by NYSDEC scientists every year on the Hudson River. This data was provided by the New York State Department of Health (NYDOH).
- If you have specific questions about this research that you would like to ask the scientists, please email caryeducation@caryinstitute.org and we will be happy to contact the scientists on your behalf.

❖ Inquiry Idea Starters

Here are some sample questions you could ask using these data. These are just suggestions, and we hope you'll come up with many interesting questions of your own!

- How does PCB contamination change as you get farther away from New York City in any given year?
- Do male striped bass have higher PCB levels than female striped bass?
- How does PCB contamination change over time at any given site?

❖ Additional Resources

- Search the large collection of Hudson River lessons (including a unit on PCBs) that are available on the Cary Institute “For Educators” page: <http://www.caryinstitute.org/educators/teaching-materials/changing-hudson-project>
- The EPA information page about PCBs in the Hudson River: <https://www3.epa.gov/udson/>
- General Electric page about dredging the Hudson River: <http://www.hudsondredging.com/>
- New York Times article on PCBs in the Hudson: https://www.nytimes.com/2016/09/09/nyregion/general-electric-pcbs-hudson-river.html?_r=0



❖ References

Baker, et al. 2006. PCBs in the Upper and Tidal Freshwater Hudson River Estuary: The Science behind the Dredging Controversy. In Levinton & Waldman, editors, *The Hudson River Estuary*, Cambridge University Press.

EPA 2011, 2015. EPA's dredging website:

https://www3.epa.gov/hudson/pdf/cleaninghudson-brochure_4-2011.pdf

http://www.epa.gov/hudson/pdf/Phase2%20Dredging%20Year%205_2015_Final.pdf

New York-New Jersey Harbor & Estuary Program. 2012. *The State of the Estuary 2012: Environmental Health and Trends of the New York-New Jersey Harbor Estuary*.

Strayer, 2012. *The Hudson primer: the ecology of an iconic river*. University of California Press.

