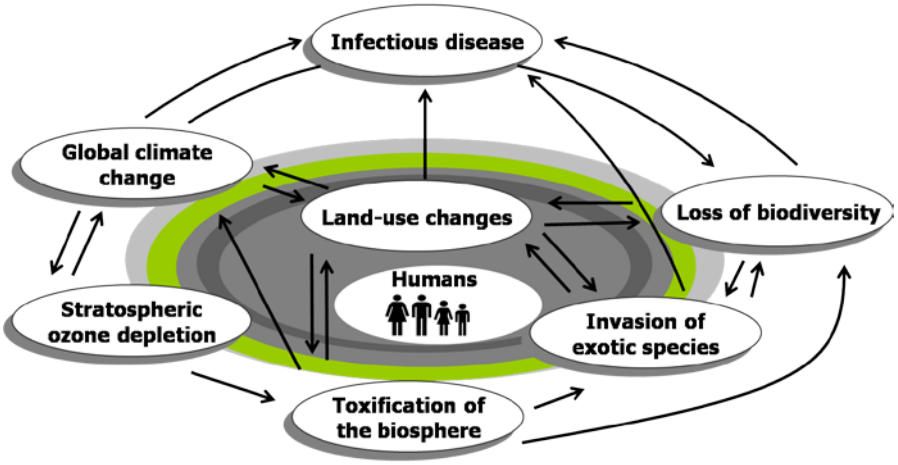
Change and the Hudson River

Paddling a kayak through the Hudson's marshes, watching a bald eagle preening its feathers or pulling in a net filled with immature white perch and tessellated darters, you would be tempted to say 'Ahh, this is the way nature is meant to be'. Quiet, and yet full of life. And then you hear the rumble of a train, and you notice the sea of purple loosestrife, or you watch a fisherman catch a largemouth bass. Humans have dramatically altered the Hudson's ecosystem, but it is difficult to describe what its natural state should be, since for all ecosystems, change is normal. However, we also know that we are putting tremendous pressure on the natural world, and it cannot withstand multiple stressors forever. In order to understand more about the Hudson River, and whether it is changing normally or experiencing unusual disruptions, scientists monitor how the river changes over months, years and decades. This critical information tells us how much we are changing the ecosystems we depend on, and provides information to policy-makers and planners who are concerned about human impacts.

Scientists often refer to change in two ways—as a *bend* or a *break*. A bend refers to a change that alters the ecosystem for a short period of time, but from which the ecosystem can ultimately recover (given enough time). A break, on the other hand, creates a permanent change in the ecosystem. Both human influences and natural processes can cause bends and breaks in ecosystems. Determining whether a change is a bend or a break can help scientists decide what research is needed and help land managers and governments decide which problem-solving strategies to put into place. For instance, heavy rains often cause a stream to flood, which can alter its pathway or cause erosion along its banks. Does this mean that we should restore the stream to its pre-storm 'path'? Land managers would generally allow this type of a bend in a stream ecosystem to persist, because it is a natural change that commonly occurs in healthy ecosystems.

However, some changes "break" an ecosystem in such a way that it cannot recover. These breaks have unintended consequences for humans. Many scientists and policy makers point to the deadly Indian Ocean tsunami or Hurricane Katrina as examples of incredible devastation caused by breaks in ecosystems. People in both of these areas had substantially increased land area for development and agriculture by cutting down mangrove forests and filling in wetlands. However, mangrove forests and other wetlands provide many ecosystem services, including shoreline stabilization and flood control, and they can greatly reduce the impact of coastal storms. These coastal areas act as buffers against the wrath of the ocean, but both regions have seen huge wetland losses. Had these wetlands been left intact, the damage caused by the tsunami and Hurricane Katrina would have been significantly reduced.

Scientists are concerned that we are slowly building towards other breaks in the global ecosystem, as interactions among climate change, species extinction, human development, pollution, invasive species, and habitat loss intensify.



Changes caused by human activities are interrelated, as shown in the conceptual diagram at left, created by Dr. Gene Likens. Each change is linked to other changes, making it difficult to attribute a species' extinction or an extreme flood to just one factor. Yet many lines of scientific research clearly show that humans are altering the earth on an unprecedented scale, at an unprecedented rate.

Human impacts on the Hudson River ecosystem may have begun with the Native Americans who burned areas for farming, building villages, and hunting, yet the most dramatic changes occurred after the arrival of Europeans. Despite slow population growth during the first two hundred years of colonization, tanneries, timber companies, and the paper industry contributed to the swift decimation of irreplaceable ancient forests; while rampant hunting caused local extinctions for many animals, including the panther, wolf, and the oyster, whose fishery collapsed in the late 1700s. Railroads were built along the Hudson and the river channel was dredged to allow easier passage for ships. Estimates suggest that over 50% of the shoreline has been modified, and substantial wetland acreage has been lost. Hundreds of dams were built along the Hudson's tributaries, which, along with the dam at Troy, have devastated native fish populations, impairing migration routes and destroying shallow-water spawning habitat. Shipping, railroads, and the opening of the Erie Canal allowed swift supply transport, which made life and commerce easier along the river, but also enabled the arrival of numerous invasive species. The Hudson River is now home to more than 113 non-native species, many of which cause significant economic damage. Finally, the region became a center for industry, which produced and dumped toxic chemicals, which still persist in the waterways.

Which of these changes were bends for the Hudson and which were breaks? How long do we have to wait until we decide? What can humans do to mitigate some of these negative impacts? We know that improvements are possible—after all, the Hudson's water quality has dramatically improved since the creation of the Clean Water Act—but we need to understand which changes are important and permanent. Answering these questions will help us make good decisions as we attempt to restore some of the natural functions and health of the Hudson River.

References:

Likens, G. 2004. Biogeochemistry: Some opportunities and challenges for the future. *Water, Air, & Soil Pollution*, vol. 4(2-3), p5-24.

Swaney, D.P., Limburg, K.E., & K. Stainbrook. 2006. Some historical changes in the patterns of population and land use in the Hudson River watershed. *American Fisheries Society Symposium*, vol. 51, p75-112.