Changes in climate: Changes in ecology

Sandy put a big exclamation point on what could be the results of climate change. The experts, however, were clear in saying that such and event has no direct trail of clues that leads back to climate change. Really did get people thinking though.

This summer, I was lucky enough to paddle with one of the experts who kept the discussion rational prior to, during and in the weeks following the storm. Adam Sobel of the Lamont Dougherty Observatory brought o group of people out on the river and along the way we had a short conversation about the Bronx River and climate study. The river has been used in classrooms for years as a study of human affects on water, specifically pollution with the worst culprit being storm water runoff and bacteria from sewers. This year however proved to be a very difficult year for our canoe team due not to sewage but lack of water in the river. We already knew that August made trips more of a drag; literally, due to the lower water, but this year it seemed like every trip, from July through September and beyond, was a question of wading instead of paddling. The graph below shows the median river flow marked by yellow triangles and 2012 flow as the blue continuous line. I mentioned it to the climate folks and they said we should look into using river issues and I shall. But I realized that we have some interesting information that relates to climate that goes beyond paddling as well.

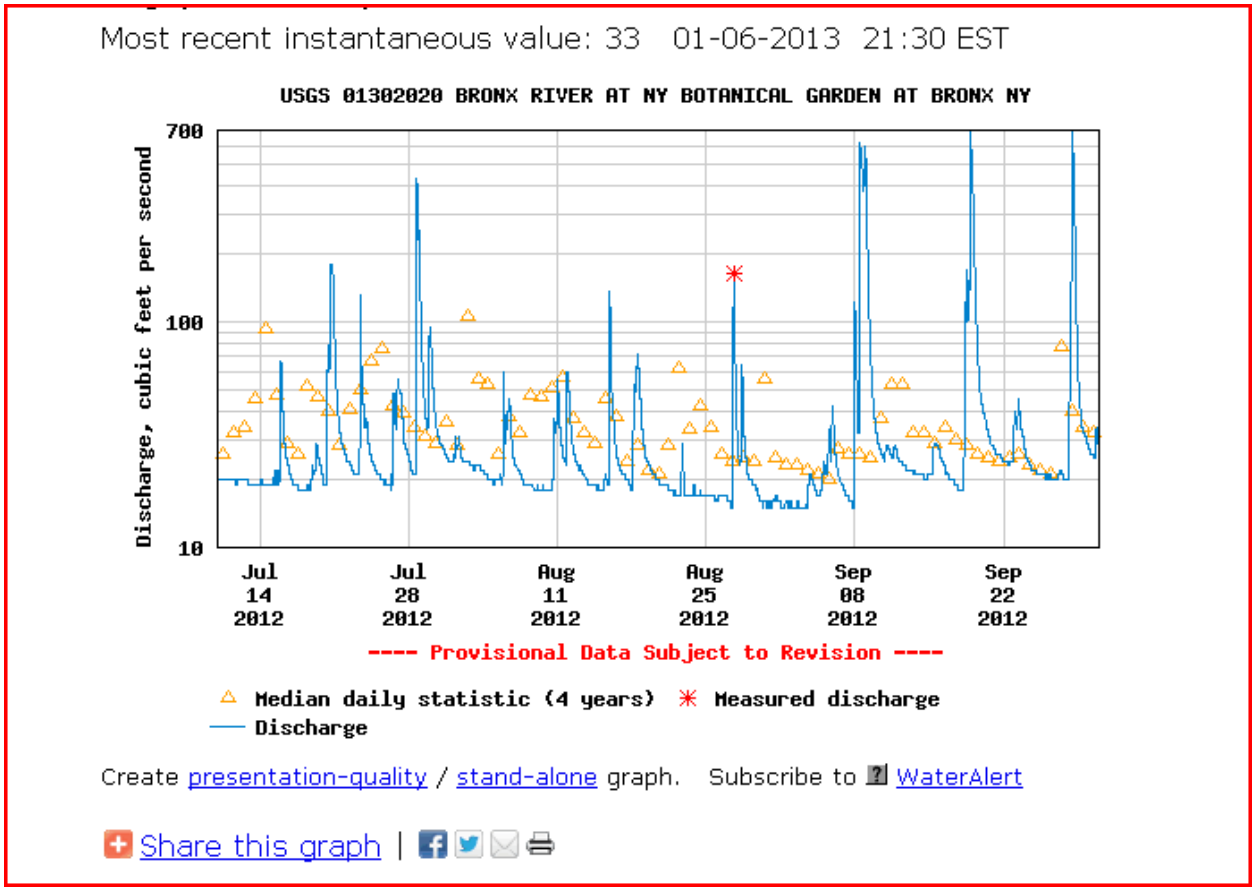

Figure 1 2012 saw more than 50 days of flow less than 20cfs. In 2011 there were 2, and the 4 year average was 8 days.

Beginning in 2001, salt marsh restoration began in the area around Concrete Plant Park. Parks Natural Resource Group used innovative implementation procedures to try to restore the only unarmored (meaning it was natural-like, with no big boulders or concrete bulkheads) section of shore line in the Bronx River estuary. Farther to the south, the following years would have a contractor creating a beach like salt marsh area which included the planting of salt marsh grasses, namely Spartina Alternflora. Looking at the newly planted and maintained area when the park opened in September of 2009 was like being in a wild, natural marsh area, surrounded by highways and big buildings that is.

Spartina is an amazing plant in that it thrives in salty environments. It is able to draw in the salty water as all plants draw in water, but it uniquely then secretes the salt out through its leaves. A close look at the leaves shows them covered in salt crystals.

By the middle of 2010 though, the spartina was not holding up. It was sparse in several areas and not as tall as the previous year. By late summer there were other plants starting to grow and seemingly taking over. I placed an annoyed call out to the experts to tell them about what was happening and to hopefully get the contractor to fix this obviously botched job. When Mike Feller of Natural Resource Group got my message and the photos that followed he had another perspective. Turns out the plant that was coming in, a thick stemmed tall plant with elongated, multi lobed leaves, was water hemp, a native shore line plant. "I always though it looked like a cross between a pot plant and a christmas tree," he said, or something of that nature. He also said we should be glad it came in instead of an invasive and that in the fall the berries would be great for the song birds.

It turns out that water hemp and spartina live in the same neighborhood, but generally they don't mix. Instead, they tend to have a mutual land use covenant where the spartina will grow only up to the tidal zone that has a given amount of salt water intrusion and the water hemp marks the fresh water line. Assuming that is true, it would seem to say that the spartina had been misplanted in that area since the salt content was not sufficient either for its survival or for it to hold its ground against the water hemp. It points to the importance of monitoring an area of restoration well before any planting is being done. A given amount of tidal change does not guarantee that the salinity of the water will change as well. The Bronx River flows as freshwater down as far as 180th street before the tide and the ocean's salty water begins to wedge its self up, forced to the bottom of the channel by the lighter fresh water flowing down stream. It is possible to test the very surface of the water in the estuary at Concrete Plant park and find less than 5 parts per million (ppm) which is very low considering the ocean maintains 30-35 ppm and changes the height of the river there by six to seven feet every six hours with the tide.

In 2011, the water hemp was like a forest at Concrete Plant Park and, instead of consternation, brought hope as the purple berries appeared in the fall and, as Mike had said, were fully taken advantage of by the smaller birds. It also made for a great story about man's attempt at engineering nature and nature having other plans with a good result all around. But nature, and perhaps unplanned for engineering by human beings, means the story is not fully told.

This past year, 2012, I waited for the water hemp. Instead, some sparse grass plants started to come in. I assumed that the upland grasses had now migrated down to the higher sections and were displacing the water hemp, a few of which did begin to come up but did not last very long. A closer observation and consultation with others found that it was actually spartina beginning to grow in again. But what and how? If the water hemp for the past two seasons had seemed to dominate the area, why was this salt grass starting to come back all on its own? It is more obvious than I had thought. A few facts are worth going over and it will become clear.

The density of water changes with the amount of dissolved solids, in this case, sea salt (sodium chloride plus sulfates, calcium, potassium, magnesium and more), that it contains. In the ocean (marine environment) that amount is, as mentioned, 30-35 ppt. Fresh water has almost no salt, less than 0.5 ppt, and some may be dissolved from other minerals in river beds, but let's not talk about what happens in the winter: that is another story. In estuaries, these two densities come together, and create varying amounts but they remain fairly consistent through the vertical water column with the densest (heaviest, 30-35ppt) water on the bottom and the lightest (fresh water) on the top. Like a building, these levels have floors that scientists have named. A shared vocabulary makes sharing information easier. They are, starting with the lightest:

Fresh Water, tidal and non tidal (<0.5ppt)
Oligohaline (<5.0 ppt)
Mesohaline (<18.0 ppt)
Polyhaline (<30.0 ppt)
Euhaline , marine, better known as the ocean

In the oceans, away from the mouths of rivers you will generally find an entire euhaline area. But as you move towards the fresh water, the water stratifies. It does not do so in a vertical fashion but as a wedge shape (called the salt wedge, but it could be the fresh water squeeze) which depends upon the force of the tide compared to the force of the flow of the river downstream. Greater flow flattens out the wedge, with the dense water being squeezed to the bottom.

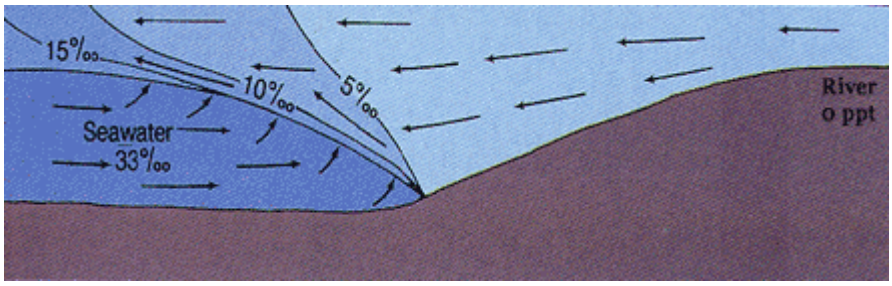

Ilustración 2 http://www.msci.sc.edu/seas/estuaries.html

2011 was one of the wettest years ever in NYC in terms of rainfall. The Bronx River had only one or two days over the course of the year where the flow was less than 20 cubic feet per second (cfs), a point we

use for enough water to have at least a decent paddle downstream, and only a handful of days below 30 cfs. The sustained flow in the river was much greater than the mean flow over the past 4 years.

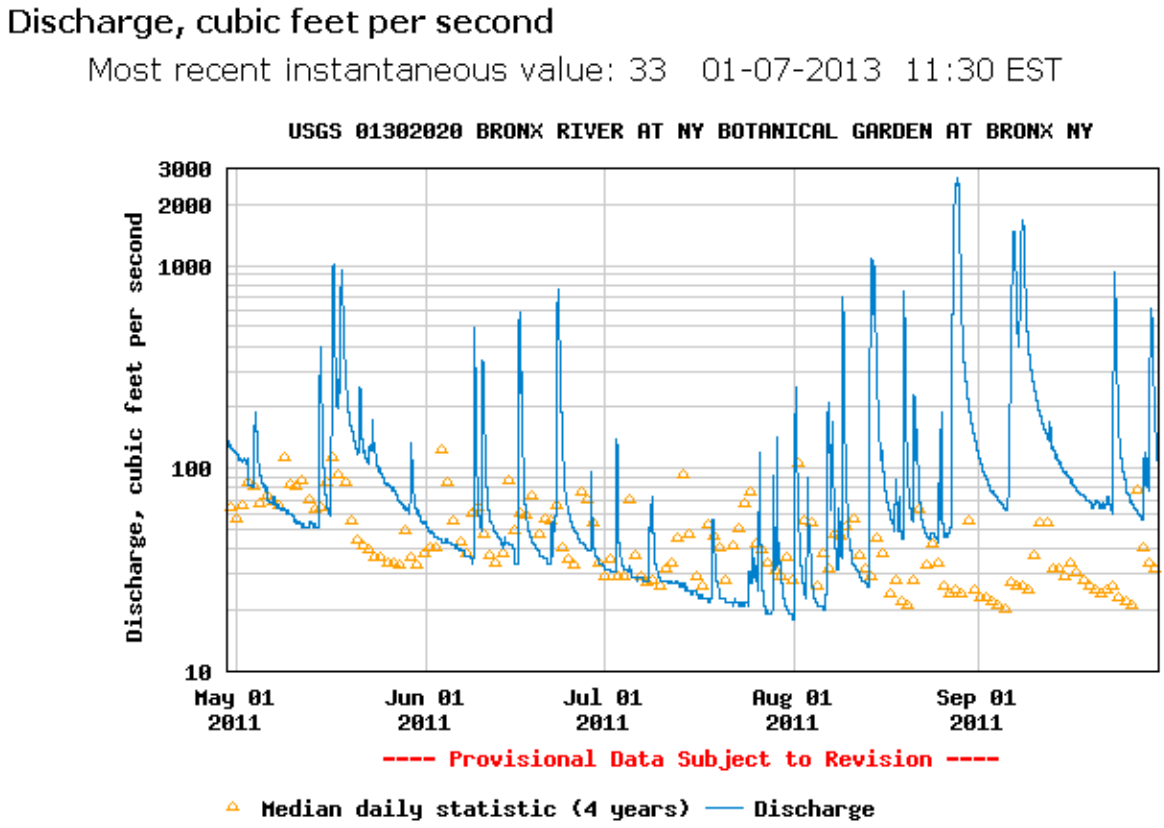

Ilustración 3 Bronx River flow in 2011 was much higher than average

This sustained flow of fresh water would mean that the salt wedge was pushed farther out than the median as well, exposing the salt marsh at Concrete Plant Park to more fresh water than would be expected on an average year. There is and added issue in that area in that excessive rain causes what might have been a freshwater stream that entered the river from the west to push up out of a storm drain and run down the bank. This added to the river flow could create an almost fresh water environment right in the estuary.

With 2012 being one of the driest years in a long time, the amount of fresh water has decreased, as can be noted in figures one and three. With less force coming down the river, the salt wedge was able to push its way farther north, increasing the salinity of the salt marsh areas and allowing for the still extant roots of spartina to get a second chance at life. The song birds have missed out on their fall feast, but quite possibly the organisms that rely on salt marsh grasses for habitat may have had a grand time.

This tracking of plants over several years does not raise the finger of blame toward climate change, though some may argue that using this with the long known data may do just that. But more importantly on an immediate basis it shows us that, in a dynamic ecology, we are able to witness, monitor and track changes in our environment in real time. The dynamism may be a result of climate change and we should be concerned, but it is still amazing.