



CENTER FOR THE URBAN RIVER AT BECZAK

Research the Hudson River through Data Analysis

So, you need to come up with a research question about the Hudson River. There are a lot of questions, even more data, and seemingly endless ways to explore the many datapoints that organizations collect. This lab is a guide to help you think about how to ask questions, look into how plausible they are, revise them, or rewrite them altogether. This should not be used as an exact example to follow, but rather, to help you think about the types of questions, and the types of data, you can use to complete your research project. If you need more information about the Hudson River before you begin, you can find that here:

<https://www.centerfortheurbanriver.org/river/> (and/or watch this video here: <https://www.youtube.com/watch?v=jCKYg1NtBnl>).

Let's get started. First, try to think about what *you* find interesting about the Hudson River. Is it the fish that are caught, maybe the American eels you heard about? Is it that the water is really cloudy and kind of brown looking (turbid), but you learned that it is actually filled with little plants and animals, phytoplankton and zooplankton? For the purposes of this lab, I will start with salinity and how it changes in the river, which has always been interesting to me.

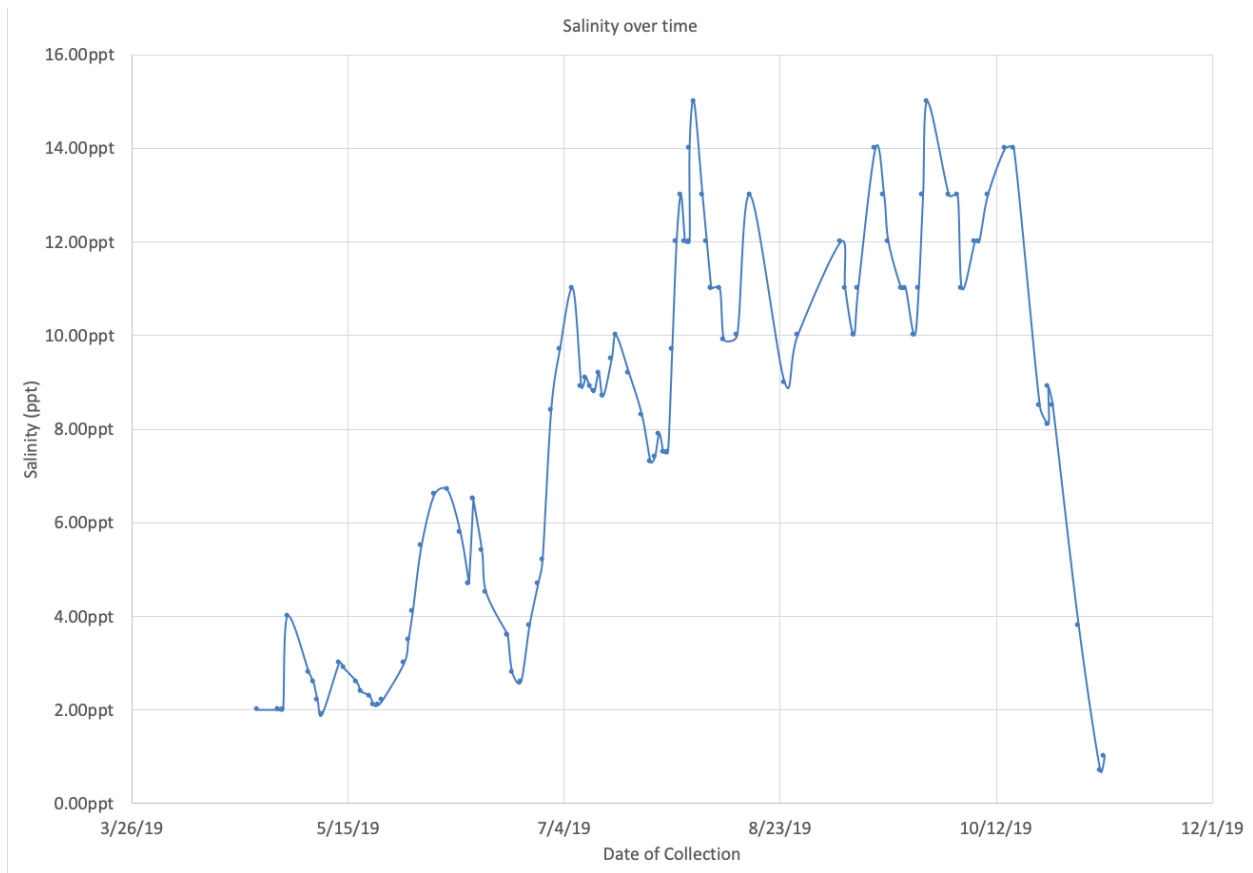
Let's focus on salinity and why I find it interesting. The Hudson River's salinity is constantly changing - not just from location to location, but even in one place, the salinity can change throughout the day depending on the weather or the tide. At which tide would you expect to see higher salinity? High or low tide? Why? What kind of weather might lower the salinity in the estuary? Why?

Now, where can we find Hudson River data? We can start by looking at the data CURB has posted in the past. Let's click on the Research tab and go down to the Seining link. We can download 2019's yearly seining data to investigate salinity, since they keep all their catch and water quality data together in one document:

<https://www.centerfortheurbanriver.org/research/seining.html>.

Let's figure out a question we can ask when thinking about salinity. What if we just started by looking to see how salinity changes throughout the sampling season? That way, we can see if there are any daily, monthly, or seasonal trends, and think about what may be causing them. Let's also make sure we understand what we're looking at – the unit for salinity is ppt, or parts per thousand. If we have a salinity reading of 2.0ppt, is that high or low? What about 16ppt? What is the salinity of the ocean? Should we expect to see higher or lower in our estuary?

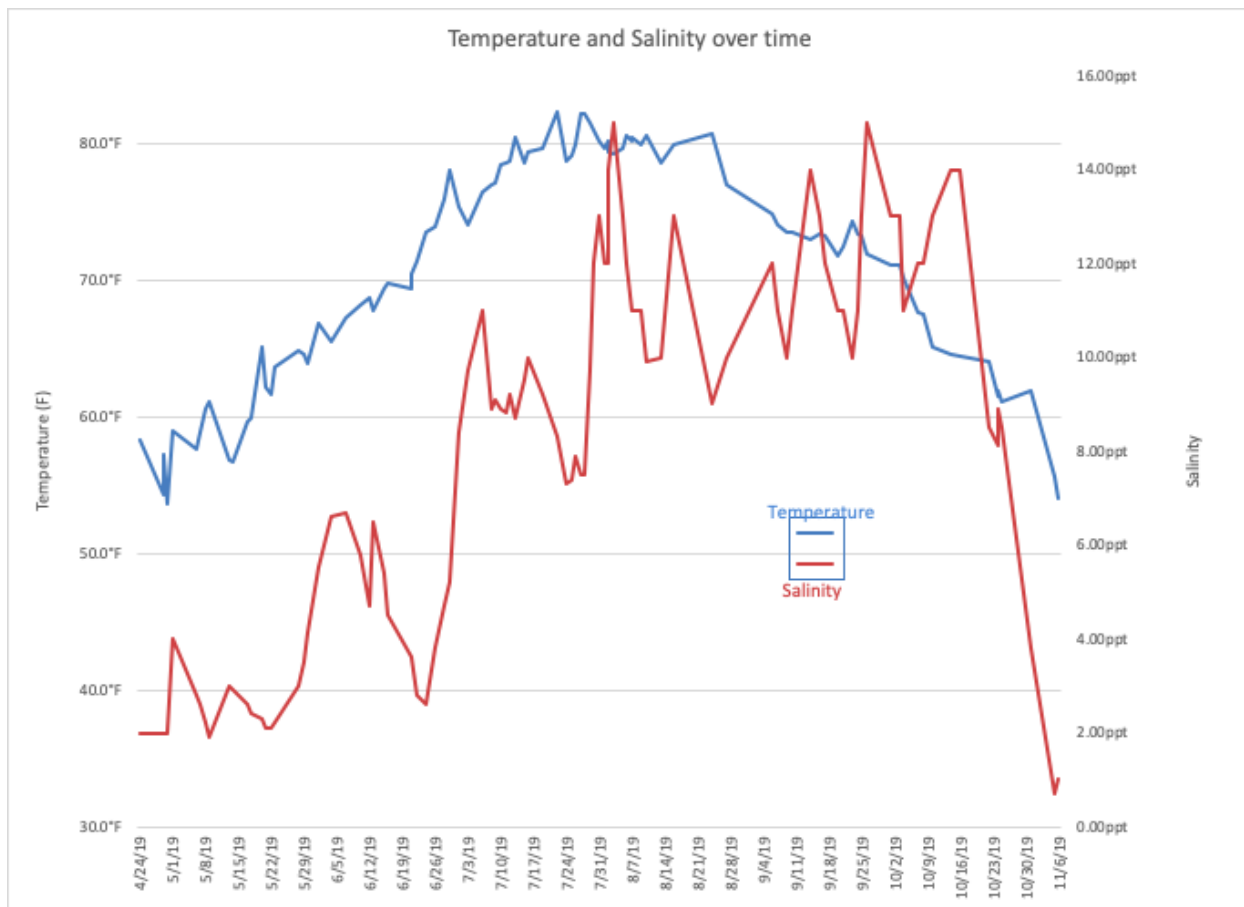
(I made scatterplot charts in Excel to come up with the next few images. If you don't know how to do this on your own, reach out to your teacher, or me! Eli Caref, ecaref@sarahlawrence.edu).



We can see from this chart that salinity started at about 2.0ppt in the spring, and more or less rose (with a few exceptions) throughout the summer maxing out at about 15ppt, and fall, when it dropped precipitously. What do you think caused the salinity to change like this over time? Could it have to do with weather?

What about the weather might cause salinity to change? Does warmer weather mean higher salinity? We know that that evaporation in the summer can increase the salinity of the water. How many different days would we need to look at before we could really answer that question? What else might we need to look at? Let's look back at that Excel file with the total catch of 2019.

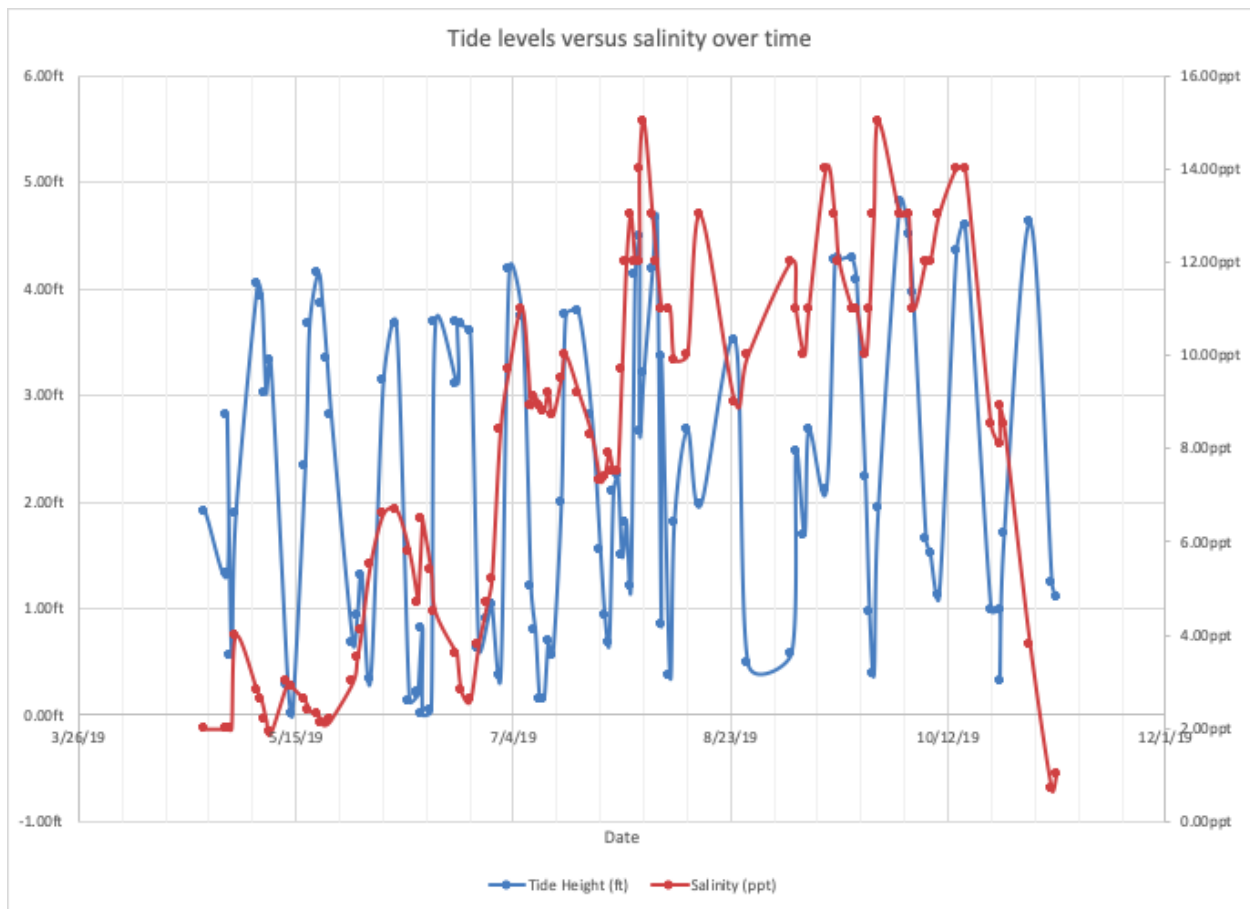
Hm, the first thing I noticed when I opened up the page is that the first four days of data have exactly the same salinity measurement (2.0ppt) but the temperature is a little bit different each day. On the fifth day, the temperature goes up a little bit to 59 F and the salinity rises to 4.0ppt too, but the salinity seems to go back down to around 2ppt for the next few weeks and the temperature steadily rises. One day in early May the temperature goes up to 65F but the salinity is still 2.6ppt! But I noticed that later in the season, we start to see both temperature and salinity rising sort of together: by July we start to see salinity rise above 7.0ppt while the temperature gets over 75 Fahrenheit. So maybe overall there's a trend between salinity and temperature rising together, but we might not be able to see a direct change in any two days of sampling. Maybe a good way to try this out would be to make a graph of the season to see if salinity and temperature do correlate with each other.



Ok, with a little imagination, this chart seems to show that temperature and salinity generally increase and decrease together within a year, even though the salinity looks like it stays a little higher later into the year while the temperature is dropping by September. So maybe there is a correlation between temperature and salinity, but that's not the only thing that would affect the change in salinity.

What else can affect the salinity of the Hudson? How about tides? The tides in the Hudson River change every 6.5 hours or so, bringing in saltier water from the ocean at high tide and fresher water from upstate at low tide. There is about a 4 foot difference between high and low tide in Yonkers, which can sometimes be even more at new or full moons or in very windy conditions. If you look back at the CURB research spreadsheet, you can see that there is a "Tide Level at Seining" column, but instead of saying high or low, there are numbers in feet. How do you know if it's low or high, then? Any ideas?

The lower the number is to zero, the closer to low tide, and the closer the number to four, the closer to high tide (if it's ever above four then that means it was a super high tide). There's also a column showing the times for dead low tide, so you can match them up if that helps. If you look at any two or three days of data collection, it again doesn't seem like there is much of a correlation between tide and salinity - for instance, on 4/30 at very low tide, the salinity is 2.0ppt, the next day at mid-tide (1.89 ft) salinity goes up to 4ppt, then on May 6 at very high tide (4.05ft) salinity is back down to 2.8ppt. So what can you do with that information? Again, maybe making a graph of the whole season will help show trends.



So again, you can kind of see that as tide level goes up on many of the days, salinity increases as well. But there are a few times when that is just not the case, like in the end of June, when we see high tide every day but salinity is close to zero. What else could be happening at this time? Did it maybe rain at the end of June? If we go back to the spreadsheet, we can see that rainfall data from the previous day is collected as well. And sure enough, at the end of June we can see that it rained several inches in just one week! So maybe this is what brought salinity way down even though CURB sampled at high tide and the temperature was steadily rising.

These questions and charts give us a good introduction into looking at CURB's data to see how some parameters may impact others. What other parameters are you interested in exploring? What kinds of questions can you ask about them, and how can you use CURB's datasets to determine their correlations? Do you want to look at the catch numbers of a specific animal, and compare that to a certain parameter? Maybe you're interested in dissolved oxygen and temperature, or turbidity and temperature? What might these two parameters have to do with one another? How can you find out their real correlations in the Hudson?

Other resources and websites that can help you with some of these questions:

- Hudson River monitoring/data collection and analysis
 - HRECOS: <http://www.hrecos.org/>
- Lesson plans:
 - http://www.hrecos.org/index.php?option=com_content&view=category&layout=blog&id=36&Itemid=59
- A Day in the Life of the Hudson River (Snapshot Day):
 - Background: <https://www.ideo.columbia.edu/edu/k12/snapshotday/Background.html>
 - Data: <https://www.ideo.columbia.edu/edu/k12/snapshotday/Data.html>
 - Lesson plans: <https://www.ideo.columbia.edu/edu/k12/snapshotday/LessonPlans.html#middle>