AQUATHON REPORT :

Water qualities in Brest

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ABSTRACT

During the Aquathon project, which lasted 2 weeks, we tested the seawater quality in Brest to determine the wellbeing of Brest's ecosystems. We planned to compare the water quality from multiple locations in Brest and set them against global ocean data. We wanted to test the accuracy of accessible water test kits on seawater. We also aspire to participate in the development of citizen science projects around water testing. Unfortunately, we did not manage to find global seawater values, so we compared our data with each other. We were not able to get a seawater test kit to compare with the more common freshwater quality strip test. Not knowing the reliability of the test we used for seawater, we can not give any expertise to get involved in a citizen science project. Even though we are not sure of the validity of our results, we found that Brest's waters are too acidic and not enough alkaline, but it still seems to be in less catastrophic conditions than we expected.

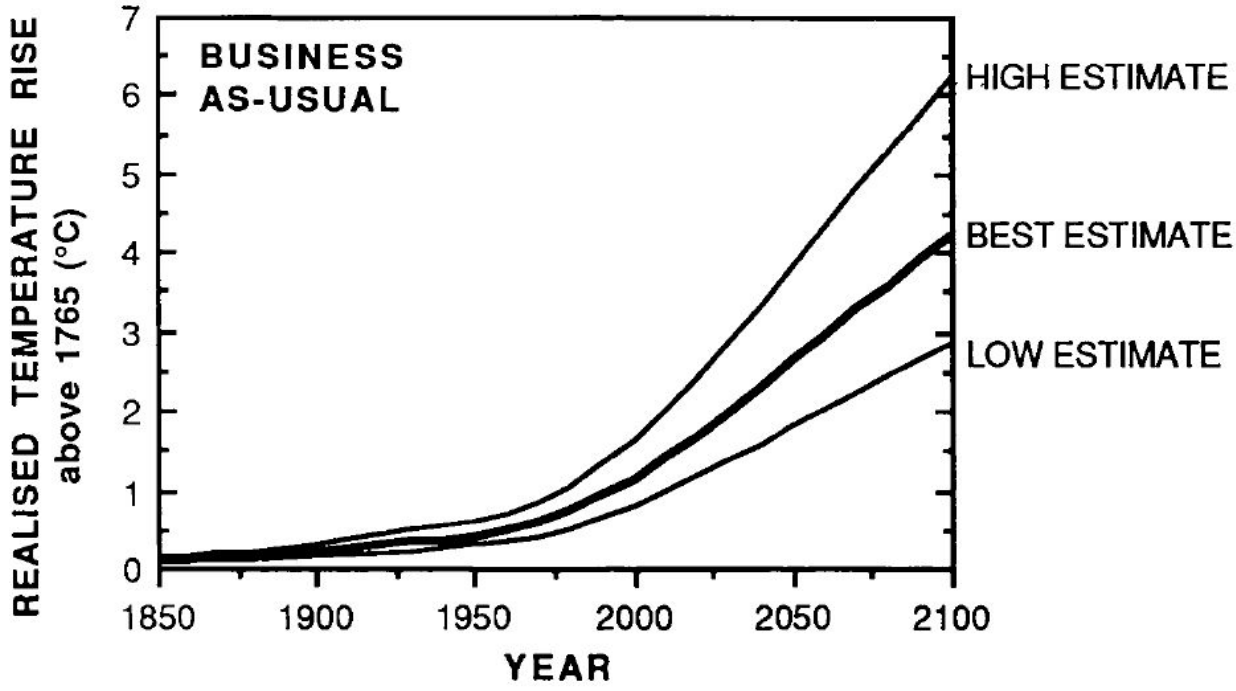

Figure 1 : Evolution of the global surface temperature till now and for the years to come

Figure 2 : Each year local authorities pick up an estimate of 70 000 tons of green algae on beaches. The amount of algae found on shores this year has been the highest of the last 8 years.

INTRODUCTION

Since the end of the 20th century, global warming has become a major issue that humanity needs to solve. Indeed, this phenomenon is characterized by the increase in temperature of the oceans and atmosphere. It is induced by the amount of heat trapped on the Earth's surface, mostly caused by greenhouse gas emissions (CO2, etc.). The exponential increase of global warming since 1950 is "very likely" due to the rise of greenhouse gases used in human activities. Latest Intergovernmental Panel on Climate Change projects that global surface temperature could increase by 1.1 to 6.4°C in the 21st century *(Figure 1)*. The most devastating effect of Global warming could be seen in water, one of our most important resources.

Water quality depends on the water parameters such as acidity (pH), turbidity, salinity, nitrite (NO2) and nitrate (NO3) level, alkalinity (KH), the general hardness of the water (GH). These properties impact the stability of marine ecosystems as well as the environment. To limit these effects, scientists defined threshold values.

Indeed, the pollution of Brittany's seawater has been a recurring theme in today's media *(Figure 2*). That is why we wanted to study the water quality in Brest to test that information. It is interesting to study Brest's water coast because it hosts an important diversity of natural ecosystems. The coast is linked to the Atlantic Ocean, where many rivers converge into. Those rivers, polluted by nitrates and pesticides used in human agriculture and livestock breeding, meet in Brest roadstead. (1) This ecological nightmare causes the proliferation of the green algae *Ulva Armoricana*, which is a highly invasive, nitrophilic (dependent on nitrates to grow and proliferate) species. (2)

Our experiments will allow us to test the water quality as well as study the quantity of plankton in Brest waters. The seawater quality is usually given by the wellbeing of the ecosystem (we can deduce the water quality by the number of fish, or scallop in the case of Brest roadstead, of a species).

Another reason we conducted this project was to have an idea of how the general public could run their own water quality test at home using basic aquarium water testing kits, which are easily accessible. This would allow the development of citizen science projects on water quality testing by the general public all around the globe.

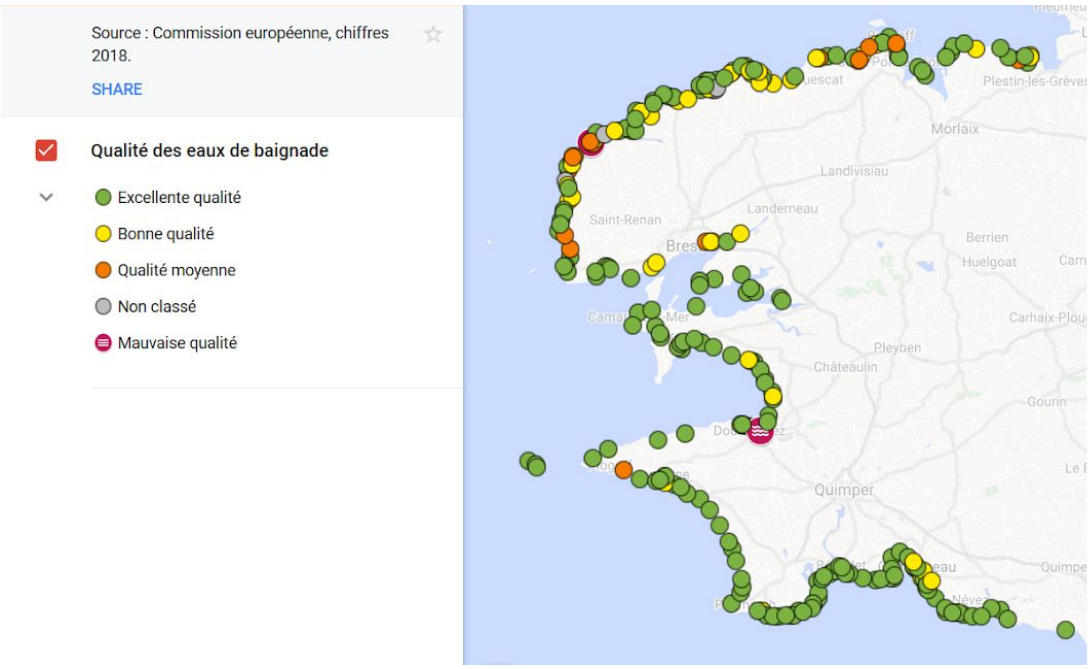

Figure 3 : Brest's water qualities for swimming

Figure 4 : the Pro JBL Scan protocol

HYPOTHESIS

We wonder if Brest and the neighboring cities around have an influence on seawater quality *(Figure 3)*. We can also question if global warming has an effect on Brittany's littoral wellbeing. To properly answer these questions, we compared the water quality from multiple locations in Brest, and set them against previous data. This allowed us to determine the evolution of the water quality and find out which areas are the most polluted.

MATERIALS

1. Falcon 50mL conical tubes
2. Spectrophotometer & Spectrophotometric cuvette
3. Water multitest Pondlab 200 OR PRO JBL Scan
4. TDS Meter

PROCEDURE

1. Collect seawater with a falcon tube

---------- Spectrophotometric analysis----------

2. Choose the desired wavelength
3. Put 1mL of Tap Water in a spectrophotometric cuvette, and put it into the spectrophotometer
4. Press the “BLANK” button, wait 5 seconds, and remove the blank
5. Put 1mL of seawater in a spectrophotometric cuvette
6. Press the “SAMPLE” button and wait 5 seconds
7. Write down the absorbance
8. Remove the sample
9. Repeat for each sample…

---------- PRO JBL SCAN analysis---------- *(Figure 4)*

2. Soak the water analysis strips, shake it to dry off and put it onto the PROSCAN color Card
3. With the application JBL PROSCAN APP, scan the Color card with the analysis strips on.

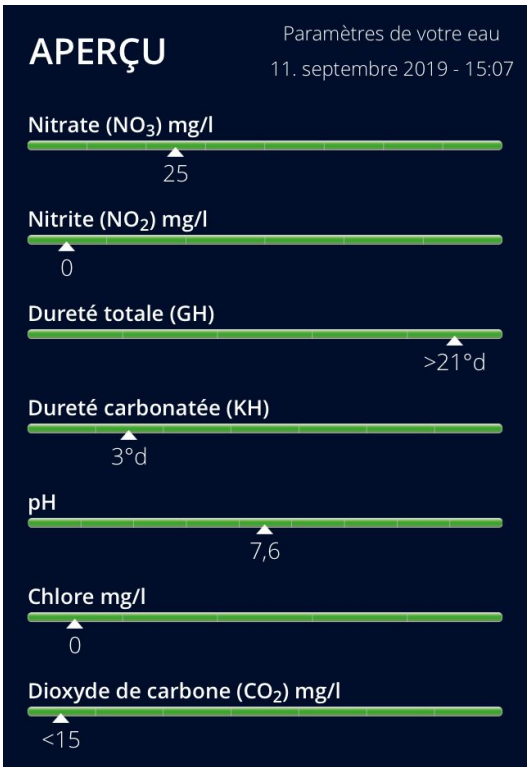

Figure 5 : PRO JBL SCAN on a sample of seawater

Figure 6 : PRO JBL SCAN strips

THE PONDLAB 200 MULTITEST KIT, a failure!

We first used the Ntlabs Pondlab 200 Multitest kit to test water quality. This kit allows us to measure the pH, the concentration of nitrite/nitrate/ ammonium, the KH, and the GH. Unfortunately, this test is meant to be used in ponds as its name suggests. The results obtained were very incoherent compared to what we were expecting and compared to its counterpart: the PRO JBL Scan kit.

THE PRO JBL SCAN KIT, a success?

We were able to collect samples and use the PRO JBL Scan kit. By using the PRO JBL Scan app we managed to determine with ease the concentration of nitrite and nitrate, the pH, the GH, the KH, and the concentration in CO2 in the water. This kit is meant to be used in freshwater but being less sensible and more permissive it allowed us to have more coherent results than the ones obtained with Pondlab 200 Multitest kit. *(Figure 5 and 6)*

DATA

	pH acidity	Nitrite (mg/L)	Nitrate (mg/L)	Alkalinity (°d)	Hardness (°d)	Temperature (°C)	CO2 (mg/L)
Beach (1) Green Algae	7,6	0	0	6	>21	15	<15
Beach (1) Brown Algae	7.6	0	0	6	>21	15	<15
Beach (2)	7,6	0	0	6	>21	16	<15
Beach (3)	7,6	0	0	3	>21	16	<15
Beach Average	**7.6**	**0**	**0**	**5.25**	**>21**	**15.5**	**15**
Harbor (1)	7,2	0	25	6	>21	16	<15
Harbor (2)	7,1	0	25	6	>21	16	<15
Harbor Average	**7.15**	**0**	**25**	**6**	**>21**	**16**	**<15**
River	**7**	**0**	**40**	**>4,5**	**>14**	**16**	**<15**
Tap Water	**7.4**	**0**	**40**	**6**	**>7**	**16**	**<15**

Figure 7 : Results of the PRO JBL SCAN on different samples

RESULTS

We tested the Water multitest Pondlab 200 and the PRO JBL Scan analysis strips on seawater samples in Brest to determine the pH, salinity, nitrite and nitrate concentration, KH (alkalinity), GH (general hardness of the water), as well as the CO2 concentration *(Figure 7)*. We also measured the absorbance of samples to establish a relationship between turbidity and plankton concentration. Both of these test kits are specific to freshwater aquariums, so we must keep a critical eye on our data. However, the PRO JBL Scan analysis strips seem to give more accurate results compared to what we were expecting. So we decided to consider this test reliable.

- For the first test (Beach 1 Green Algae and Brown Algae), we took two samples at the beginning of the beach, one close to the green algae, and one close to the brown algae, in order to test if the different types of algae influence the parameters. There are no significant differences between these two samples, so we could conclude that the type of algae does not change the water properties.

- For the second test (Beach 1, 2, 3, Harbor 1, 2), we took 5 different samples from different locations and compared it to tap water, to test which areas are the most polluted.
  Beach samples: we can see that there is no difference in quality between the different samples. Also, there is no presence of nitrate whereas tap water and river water have 40mg/L nitrate.
  Harbor samples: we can see that the nitrate concentration is higher than the beach samples (0mg/L) but still lower than the tap water sample (40mg/L). We can deduce that seawater in harbors is more polluted than normal seawater.
  River samples: the concentration of nitrate is the same as tap water (40mg/L) and the pH is lower (7).

CONCLUSION

Our results obtained with the PRO JBL Scan analysis strips seem coherent. Data collected from the same areas are similar. Compared to seawater global parameters, Brest waters are too acidic and not enough alkaline. The Harbor is more polluted than the beach which makes sense. Even though, Brest seawater quality is less catastrophic than what we expected.

However, can we really trust these results? Indeed, this water test kit is not adapted for seawater and is not precise enough. Furthermore, we did not gather enough data to be sure of the validity of our results.

WHAT TO IMPROVE

- Using real laboratory seawater tests should be more efficient, and more precise.
- The collection of samples should affect a larger area, in order to have results all around the Britanny's coast.
- Have a better organization before starting the project to know precisely which parameters to measure.

TO GO FURTHER

- Use our absorbance values to determine the amount of plankton in our samples (ecosystems balance)
- Test the presence of :
    - DSP (lipophilic toxins)
    - PSP (paralyzing toxins)
    - ASP (amnesic toxins)

DIFFICULTIES ENCOUNTERED

- Group dynamics :
    - We had a hard time properly sharing our tasks, which ended up causing problems because many members of the group ended up doing the same things.
    - We had different goals in mind, and because we didn't discuss what we all wanted to do, we headed in different directions, pushing the project in opposite ways.
    - All these problems were just a result of our difficulty in communicating with each other.
- Finding data: We did not find data on the evolution of Brittany's seawater qualities.
- Lack of Time

ANNEXES

---------- Colorimetric analysis with Ntlabs Pondlab 200 MultiTest----------

1. Put 5mL of seawater in a test tube

2a. pH Acidity: Add 5 drops of the Ammonia 1 reagent, 5 drops of the Ammonia 2 reagent, 5 drops of the Ammonia 3 reagent. Mix. Wait 10 minutes. Then, compare the color of the sample to the color scale provided.
2b. Ammonia: Add 5 drops of the 4-10 reagent. Mix. Then, compare the color of the sample to the color scale provided.
3c. Nitrite: Add 5 drops of the Nitrite reagent. Mix. Wait 2 minutes. Then, compare the color of the sample to the color scale provided.
2d. Nitrate: Add 6 drops of the Nitrate-1 and 6 drops of the Nitrate-2. Mix well. Wait 10 minutes. Then, compare the color of the sample to the color scale provided.
2e. KH Alkalinity: Take the KH reagent and add one drop by one and mix. The number of drops needed to bring blue color is equal to the KH value in °dH.
2f. GH Hardness: Take the GH A reagent and add two drops. Take the GH B reagent and add one drop by one and mix. The number of drops needed to bring blue color is equal to the GH value in °dH.

REFERENCES

1. https://www.futura-sciences.com/planete/dossiers/developpement-durable-geopolitique-guerre-eau-622/page/10/ Brittany's water pollution influenced by human agriculture
2. http://www.ethnographiques.org/2013/Levain nitrophilic nature of green algae
3. https://www.ouest-france.fr/bretagne/brest-29200/carte-finistere-decouvrez-si-l-eau-de-baignade-est-de-bonne-qualite-pres-de-chez-vous-6482778/amp seawater quality for swimming areas