Abstract

Title:
The impact of human activity on the rivers water quality of our town, Vervins (Picardie, France).

Abstract:

We have studied the biodiversity of the rivers in our city during two years. We have noticed a degradation of the biodiversity. This might have been caused by a decrease of the oxygen level. We think that this reduction is caused by domestic pollution.
Could we improve the situation by combining technical progress and informing/educating the citizens?
First we observed the diatoms and macro invertebrates, as well as physicochemical parameters. Then, we have decided to re-oxygenate the water, thanks to a simple process based on a waterfall system modelled by us. So now, we should observe a better biodiversity around our system.
To continue this approach, we decided to educate the inhabitants so they could understand what we do and help reduce pollution.
With our waterfall system and the increase of awareness, we should see a significant increase in the number of water species and thus a better biodiversity.

Keywords
Biodiversity, diatoms, water quality, oxygen, eutrophication

Introduction

Vervins Location and characteristics

Vervins is a small rural town located in Northern France, near the Belgian border. Vervins has 2507 inhabitants with a density of 242 inhabitants/km². Its area is 10,35 km² and is altitude is between 120 and 208 meters. There are some industries and farms around the studied rivers, with an hospital and a water treatment plant.

Figure 1: Vervins location and aerial view

Watercourses studies

We led a research on different spots of a local river the "Chertemps". Its length is 4.5 km from the source. Our main spots were on the gardens and the outlet, which had different flow. In the garden the quality is better thanks to waterfalls. The outlet had a lower debit compared to the garden's site. We have also worked in uphill of the gardens and in downstream.

Figure 2: Vervins hydrography

Figure 3: Vervins' place on the Seine's watershed area

Content

Purpose of the investigation

The team that has initiated the study in 2016 worked on "Simone" and "Chertemps" rivers. Their goals were to estimate a medium town impact on the water quality in the crossing rivers. Then construct hypotheses about the causes of the changes between the uphill and the downhill slope of a river. And finally inform the local community about the consequences of human activities on the water quality.

Today, with a new group, we have continued and confirmed the study.
We have three missions:

- Estimate the impact of pollution on biodiversity
- Make a 3D model accessible to all and to oxygenate the water of our rivers
- Sensitize the population of our town

Method

We collected our samples on one site, including 5 work post. However, we used an approximate GNBI; the studied rivers are undersized regarding to these calculation standards.
To complete our results, we have observed diatoms, which are watery micro-organisms. It is possible to work out a biotic index with diatoms (DBI) but the equipment needed was too expensive so we couldn't afford using it.
These single-cell alga sampling are achievable on all watercourse types, excepting salt water.

Figure 4: Our 7 sampling sites around the town

Figure 5: first, second and third sampling sites aerial view

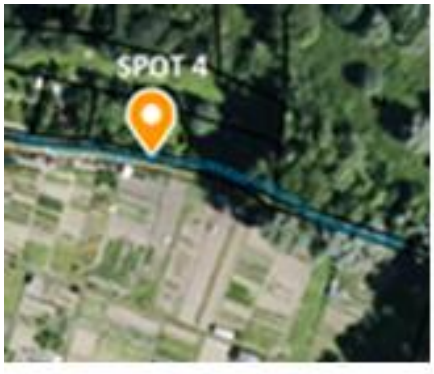

Figure 6: fourth sampling site aerial view

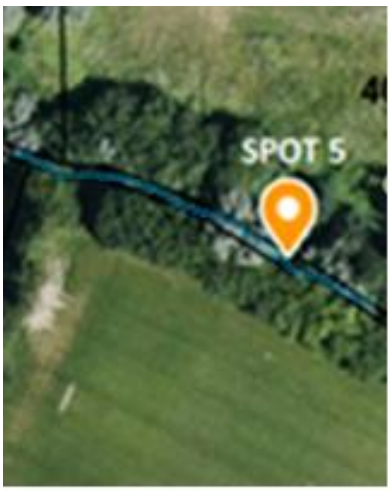

Figure 7: five sampling site aerial view

Figure 8: six sampling site aerial view

Figure 9: seventh sampling site aerial view

Sampling and physicochemical protocol

Purpose 1: Estimate the impact of pollution on biodiversity

The diatoms are an indicator of water quality. We have decided to study the physicochemical parameters of the rivers and then the diatoms.

In laboratory (before sampling)
- Hardware preparation (different sensors measuring conductivity, oxygen, turbidity, pH, temperature, current speed, depth, light, GPS location).
-Surber samplers, brushes, sampling tubes,90% ethanol.

On site
- Spot a sampling site and differentiate 5 distinct posts.
- Measure the physicochemical parameters with the sensors.
- Place the Surber samplers in order to take macroinvertebrates sampling.
- Take some rocks in the net demarcation.
- Rub these rocks with brushes to pick up the diatoms.
- Lift the net.
- Drain it in a basin or in a jar.
- Put the content in a sampling tube with 90% ethanol.
- Label (date, hours, GPS coordinates…)
- Repeat for each post.

In laboratory (after sampling)
Macro-invertebrate preparation
- Pour the sampling tube content in the sieve
- Wash out several times with clear water.
- Pick up the different species with a flat clip, put them in a petri box.
- Identify each species with a magnifying glass, count and classify them, calculate the GNBI with the reference table (see annex n°3)
- Repeat for each sampling tube.

Diatoms preparation
→ Pick up 2 mL from the sample to put in a test tube.
→ Add 8 mL of hydrogen peroxyde to destroy the organic matter. Let it settle in for 12 hours at room temperature.
→ Complete 2 or 3 decantation cycles with distill water to purify the sample. You can either use decantation, which lasts about 10 hours, or a 1500 turns/minute centrifuge during 3 minutes. We choose the method with centrifugation Take the sample back and put a drop of solution on a slide.
→ With a heating, let the solution vanish until the liquid has disappeared.
→ Put one or three resin drops on the slide (with an index of refraction superior to 1.7). Let the resin boil slowly on the heating and then place the slide on a plan surface. Apply a chip immediately and carry out a soft pressure on it until you hear the valve crisp on the glass.
The preparation is ready when the resin is solid and the slide cold.

Physicochemical parameters

Post	Light (lux)	Depth (cm)	Flow speed (m/s)	Temperature (0 °C)	Ph	oxygen	GPS (lat/long)
1	179.44	2	0.29	11.5	7.1	9.20	49°49’56”N/3°54’ 49”E
2	108.95	5	0.26	11.4	7.6	9.82	49°49’56”N/3°54’ 47”E
3	102.54	6.5	0.22	11.3	7.4	10.2	49°49’56”N/3°54’ 47”E
4	551.15	28	0.1	11.1	7.2	9.63	49°49’56”N/3°54’ 52”E
5	115.36	11	0.1	11.3	7.9	19.46	49°49’56”N/3°54’ 56”E
Garden 1	179.44	6	0.29	11.8	8	10.48	49°49’54”N/3°54’ 47”E
Garden 2	307	15	0.06	11.4	8.2	10.3	49°49’52”N/3°54’ 50”E

Physicochemical parameters of different site

The physicochemical features that we found are globally normal. The riverbed is composed of gravel.
Though, we can notice some parameters:

- Temperatures and ph are medium
- The dissolved oxygen concentration is between 9.20mg/L-1 and 19.48 mg/L-1. We can say there is less oxygen in the Chertemps river than in the Private Garden. The difference is probably produced by the slop difference which is more important in the garden sites.
- The brightness is between 102.54 lux and 551.15 lux. The light is more present in the site 4 of Chertemps river.
- The depth of the Chertemps is between 2 and 28cm.

Results

Sampling site 1:

Post	Species	Quantity	Quality
Chertemps, Exutoire	Navicalas slesvicensis	1	Bad
	Hantzschia Abunetara	1	mediocre
	Navicula oligotraphenta	1	Bad
	Cymbella Hustedtli	1	Mediocre
	Navicula veneta	1	Bad
	Navicula microdigitapadiat	1	Mediocre

Sampling site 1 : Diatoms observed

Result sampling site 2 :

Post	Species	Quantity	Quality
Chertemps site 2	Navicula tripunctata	1	Bad
	T.flucculosa		
	Naviculacées, navicula	2	Mediocre
	Naviculacées, Navicula veneta	1	Bad
	Cocconeis placentula	1	Passable

Sampling site 2 : Diatoms observed

Result sampling site 3

Post	Species	Quantity	Quality
Chertemps site 3	Aulacosika ambiga	1	Bad
	Cocconeis placentula	1	Passable
	Luticula goeppertiana		
	Eunotia minor	1	Bad
	Gomphonema bavaricum	1	Mediocre
		1	Passable

Sampling site 3 : Diatoms observed

Result sampling site 4

Post	Species	Quantity	Quality
Chertemps site 4	Placulacés	1	
	Naviculacées frustulia saxonia	1	Bad
	Naviculacées, navicula integra	1	Mediocre
	Araphidées flocculosa	1	Passable
	Navicalacées navicula slesvicensis	1	Bad
	Naviculacées sellaphora	1	Bad
	Navicula pseudolanceolata	2	Bad

Sampling site 4 : Diatoms observed

Results sampling site 5

Post	Species	Quantity	Quality
Chertemps site 5	T.flocculosa	1	Passable
	Cocconeis placentula	1	Passable

Sampling site 5 : Diatoms observed

Result garden's sampling site 1

Post	Species	Quantity	Quality
Chertemps private garden 1	Araphidées T.flocculosa	1	Passable

Garden's sampling site 1 : Diatoms observed

Result garden's sampling site 2

Post	Species	Quantity	Quality
Chertemps private garden 2	Nitzschia brunoi	1	Mediocre
	Araphidées T.flocculosa	1	Passable
	Cocconeis placentula	1	Passable

Garden's sampling site 2 : Diatoms observed

Observations sampling site 1

The diatoms study allows us to observe a poor quality. We found three diatoms that show a bad quality and three diatoms that show a mediocre quality.

Observations sampling site 2

The diatoms study allows us to observe a poor quality. We found two diatoms that show a bad quality, a diatom which proves that the water is mediocre quality and a diatom that show a passable quality.

Observations sampling site 3

The diatoms study allows us to observe a medium quality. We found two diatoms which show a bad quality, a diatom which shows a mediocre quality of the water and two diatoms which show a passable quality.

Observations sampling site 4

The diatoms study allows us to observe a medium quality. We found a lot of species of diatoms. In this site, there are a majority of diatoms which show a bad quality.

Observations sampling site 5

The diatoms study allows us to observe a medium quality. We found less species of diatoms. There are two diatoms which show that the water is passable.

Observations garden's sampling site 1

The diatoms study allows us to observe a good quality. We found less species of diatoms. But the diatom shows that the quality of the water is passable.

Observations garden's sampling site 2

The diatoms study allows us to observe a passable quality. We found two diatoms which show a passable quality of water.

Data interpretation

According to Tuffery and Verneaux's biotic index method, some species population tumbles when there is pollution.
In fact, the diatoms observation imparts the same degradation. Water heat is a sign of organic pollution.
Between the sampling sites are pollution sources.
About the entirety of samplings have pollution in common, except Vervins downtown, the water pollution can be due to phosphate and nitrate; this type of pollution doesn't act on turbidity.
The Chertemps uphill results are average though the sampling took place near the source.
We can see a loss of quality from the Chertemps uphill to Vervins downtown.
However, there are no farms or industries between these points. The pollution intervening here would be domestic.

Purpose 2: Make a 3D model to all and to oxygenate the water of our rivers

During our study, we have noticed that the oxygen level was very low in the outlet and was better in the gardens so we took inspiration of waterfalls in the gardens. We decided to make a 3D model that can re-oxygenate the water of the outlet.

We made a miniature test to check the if our 3D model work. This 3D model is basic: This is an articulated grid that is simple, economic and affordable. We used a free software called Blender and a 3D printer to realize this project.
We have tested the 3D model and obtained an increase of 1 mg/l of oxygen level in the water.

Purpose 3: Sensitize the population of our town

We want to educate people of our region about the quality of our rivers. To do that, we did a survey on approximatively fifty people. We asked questions to them.

Our results led us to this conclusion:

- 72% of people interviewed live in the countryside and 27% in town.
- In addition, we have found that 95% are sensitive to the water quality. However, 60% of these people think that they affect the rivers.
- Finally, 25% don't know where are redirected their wastewater.

So, we can say that peoples of our city and around are not fully aware of the poor quality of biodiversity in our rivers. Indeed, it's because of this non-awareness on the human impact on the pollution of our watercourse that we came to these results.

Conclusion

Industries, farms and even people breed pollution, for instance organic pollution (sewage, garbage...).

We found increasingly bad results from Vervins uphill to the downhill slope. We can infer that our way of living, even in a small town, has harmful effects on water biodiversity.

The rivers studies are of a poor quality. Indeed, we can see it from the diatoms present in them. A lack of oxygen observed in the Chertemps is really unusual near the source. This fact should open a way to further investigations, such as the creation of a model to re-oxygenate water so that we can understand the causes of its results. In addition, a survey was conducted with residents around our city to gain knowledge on the level of awareness of the population.

Thus, thanks to our former comrades, we were able to continue their study and confirm their results. However, we did a little part of all the work science could do on this subject, and our project can be carried on more deeply, from year to year, by the others pupils of our school. Our mission will be to train more the future students so the researches can continue, and our results will become more and more accurate.

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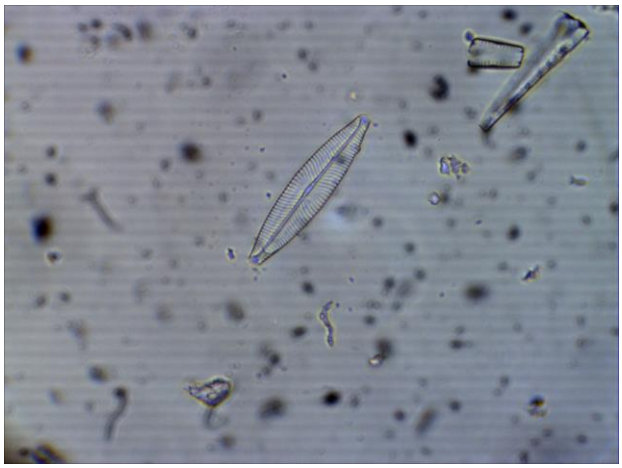
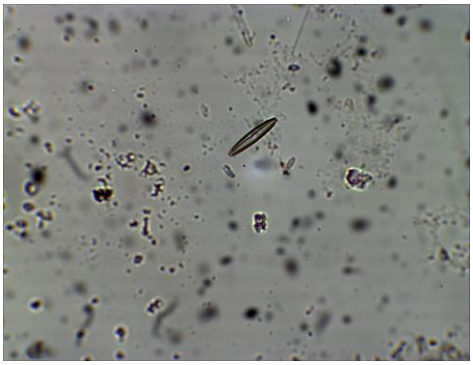
Annexes

Some Diatoms (MOx500)

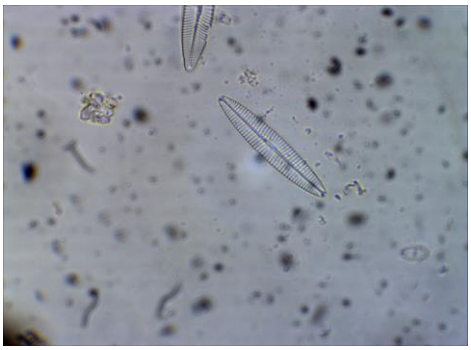


Navicula Erifuga

Navicula Tripunctata

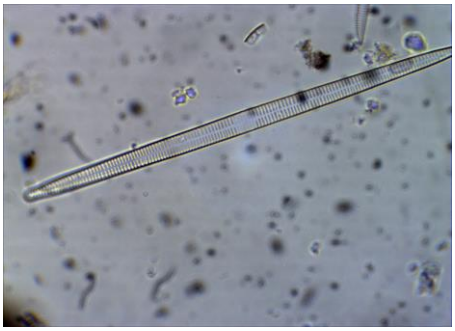


Navicula minuscula

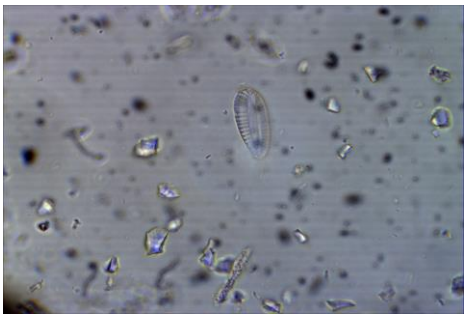


Navicula veneta

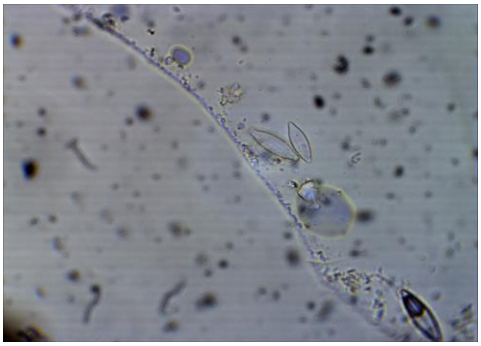
Navicula molestiformus



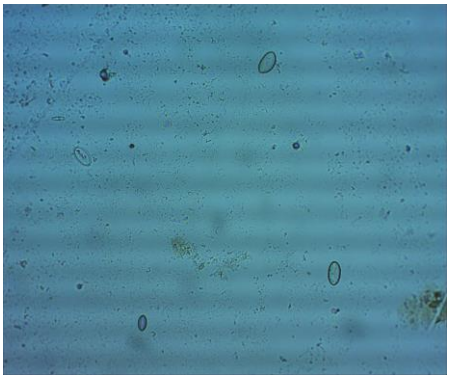
Fragilaria ulna



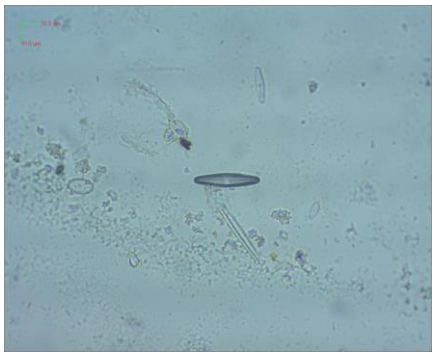
Surinella brebissonil



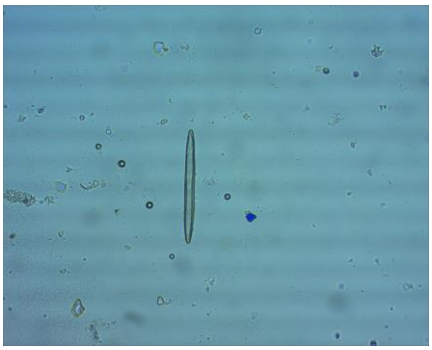
Craticula accomoda



Cocconeis placentula



Navicula lanceolate



Bacillaria paradoxa

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