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Investigation of algae toxins and hydrologic conditions of Lake Vombsjön

LOUCHERON Pierre

SYDVATTEN

Company supervisor : **Linda Parkefelt**

Ideon Science Park Scheelevägen 15, Alfa 5 223 70 LUND

Linda.Parkefelt@sydvatten.se

ENSIL tutor : **Geneviève FEUILLADE**

genevieve.feuillade@unilim.fr

Université de Limoges

Speciality Water & Environment

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Ribs = Risk-Based decision support for safe drinking water

DO :absorbance

mg/l : milligram per liter

ml : millliliter

ppm :parts-per-million

µg/l : microgram per liter

pH : hydrogen potential

Introduction

Sweden is a country with a large proportion of lakes and ponds. Indeed they represent 8,5% of its total area , whereas in France the surface water areas correspond to only 0.3% of the total area. With more than 38000 km² of surface water, a large part of the drinking water comes from this storage.

In south of Sweden, the largest producer of drinking water is Sydvatten AB. The company produces 8% of the drinking water consumed in the whole Swedish community. This corresponds to more than 900 000 inhabitants, and a flow of more than 2300 liters per second. Sydvatten's raw water come from two lakes: Vombsjön (in Scania's region) and Bolmen (in Småland's region).

In this study we will focus our attention on Vombsjön. This lake has a huge catchment area, which is unfortunately not in a really good condition because of both natural elements and human activities or behaviors. Indeed, the lake is suffering from many effects of agriculture activities, since agricultural lands dominate the catchment area. It leads to an increase of risk of contamination for the raw water.

The internship has been divided in two parts.

One of them is a project shared with students of Chalmers, one of Göteborg's universities. It is a research project called "Risk-Based decision support for safe drinking water" (RIBS) based on the faecal contamination. The origin of contamination can be both human (waste-water, septic tank in boats...) and animals (grazing animals, spreading of manure on agricultural land...). For an entire investigation, different water sites will be studied, like for example natural ground water and water coming from the inlet of the lake. Furthermore, this study will lead to a risk based management.

The second part of the project is more focussed on the investigation of algae toxins and the conditions of Vomb's lake. Agricultural activities and individual sewage systems of houses cause an increase of the phosphorus amount in the rivers and thus in the lake. One of the negative effects of a huge level of phosphorus is called eutrophication, because its process can lead to algal blooms of Cyanobacteria. And the threat is Cyanobacteria's production of harmful algal toxins. One of them is Mycrocystin, which is usually the most present toxin in eutrophicated lakes and also the most unwanted in fresh water reservoir. This kind of toxins can be very harmful for animals' and especially human's health. Moreover with the climate change and a global rise of temperature, the quantity of algae toxins is expected to increase in the future. All rivers and lakes can be affected by these risks and nowadays the water treatment plants are not really capable of extracting these toxins in the process of producing drinking water.

The aim of this project is to investigate the presence of algae toxins nowadays in the Vomb's lake in order to try to predict future levels of toxins. The goal would also be to find precautionary measures that could be used in order to keep and secure Vombsjön as a drinking-water reservoir for the future.

In order to carry out this study, samples at several depths in the lake have been collected and different parameters like pH, temperature and conductivity have been measured and followed. Then we have been able to determine the quantity of toxins in the lake thanks to a special kit for water samples analyses.

The following report will be divided in three parts. First a quick presentation of Sydvatten and a literature review about the impacts of eutrophication on lakes. Then a description of the material and methods that have been used during the project, and finally results and discussion.

Literature review

I) Sydvatten AB

1) Generalities

Sydvatten AB is a company founded in 1966 and is today one of Sweden's largest producers of drinking water. Indeed they produce safe drinking water to 75 percent of Scania's population. The company has 16 partner municipalities with a total of 900,000 inhabitants. Every year, Sydvatten produces more than 70 million cubic meters, corresponding approximately to 2 300 liters per second. In total, Sydvatten's pipe network for drinking water measures 280 kilometres.

They are 80 employees at four plants: Vomb plant in Lund municipality, Ringsjö plant in Eslöv, the head office in Hyllie, Malmö and the quarter of development and research in Lund .

Company growth on the future market is not based on corporate profit-maximisation, but rather on ultimate public welfare. Sydvatten is planning to offer other municipalities in the region the opportunity of being connected to the Company's distribution system, and to supply water to municipalities that are not joint-owners.

Sydvatten also works for the research and development in Swedish water in an organisation called Sweden Water Research in cooperation with VA SYD and NSVA. .

The drinking water produced by the company is taken from Lake Bolmen in Småland and Lake Vomb in Scania. Should a problem arise regarding water supplies, it will be possible to draw water from a reserve supply at Lake Ringsjön in Scania

2) Water pumping sites

- **Bolmen lake**

Bolmen lake covering 184 km² and it has a maximum depth of 37 m. Scania use this lake as a supply of fresh water. To transport the water to Scania, Sydvatten began the construction of a tunnel in 1975 and 12 years later it was taken into operation.

The tunnel is divided in two part. The first part is used to transport water from Bolmen in Småland to Äktaboden, a distance on 80 kilometers .This part of the tunnel is really interesting. Indeed the tunnel has a cross-sectional area of 9 square meters and thanks to 90 meter height difference, the water can flow by gravity all the way from Bolmen to Äktaboden. The water needs 8 days to through all this section.

The second part is a 25 km long pipe. It transports the raw water from Äktaboden to Ringsjö Water Purification Plant where the water is cleaned. To bring the water to the treatment plant, it needs to be pumped.

Every day the Ringsjö Water purification plant produces on average 1400 litres of drinking water per second with the water from the Bolmen lake.

- **Ringsjön**

Ringsjön is a lake situated in the middle of the Scania county. It's the second largest lake in the county of Scania. The lake covers 41 km² and it is divided in two part. The western part of the lake, called Västra Ringsjön has a depth of 6 metres at is deepest know point. And eastern parts of the lake, called Östra Ringsjön, has a depth of 17 metres. Both parts are separated by a headland.

The lake of Ringsjön is not often used to provide drinking water for the inhabitants of Scania. Indeed they use this supply only if the tunnel connected to the Bolmen lake cease to work. The last time it happened was in 2009, when the tunnel was almost completely blocked after a collapse.

- **Vombsjön**

The lake of Vombsjön is the second supply of water for Sydvatten. They have a tratments plant close to this lake and it's located at 20 km east of Lund. The lake has been the source of drinking water for Malmö since 1948

On the next part of the report we will focus on the lake Vombsjön and the water treatment plant..

Figure 1: Sydvatten drinking water network

II) Lake of Vombsjön

1) Generalities

Vombsjön lake (Figure 2) is a fresh water reservoir for Sydvatten. It's not a big lake, with only a surface of 12 km², but still the second most important water supply for Syadvatten. So they have built a water treatment plant close to the lake and they pump water and bring it to the plant. In 1936 the water level of the lake was only 1m which is until today the lowering level of water of the lake. Moreover, the turnover of the lake water is approximately 0.7-0.8 years.

Figure 2: Vombjön lake

The lake is between the municipalities of Lund, Eslöv and Sjöbo. It is situated in the South of Sweden, at 20km to the East of Lund.

All around the lake it's possible to find agricultural lands, pastures, forests and houses. This surroundings could have lot of impacts on the lake so it's necessary to protect and keep an eye on this one

The table below (Table 1) show the main information about Vombsjön lake; (from Wikipédia)

Table 1: Information about Vombjön lake

Location	Scania, Sweden
Coordinates	55°40′N 13°35′E
Surface area	11,97 km²
Water volume	78,274 km^3
Average depth	6,6 m
Maximum Depth	16 m
Watershed Surface	447 km²

2)Catchment area/ Inlet/Outlet

The lake Vombjsön has three inlets. Two are on the east of the lake, and one in the north of the lake. The largest inlet, Björkaån which is situated on the south east has a catchment area that is 340 km². The vertical drop from the highest sources of outflow is about 140 meters.

The other two are Torpsbäcken and Borstbäcken and they are smaller thant the fisrt.

The total catchment area of the lake is 435 km².

The only outlet is in North West and is called Kävlingeån

The following figure (Figures 3) show the position of the inlets and the outlet of the lake :

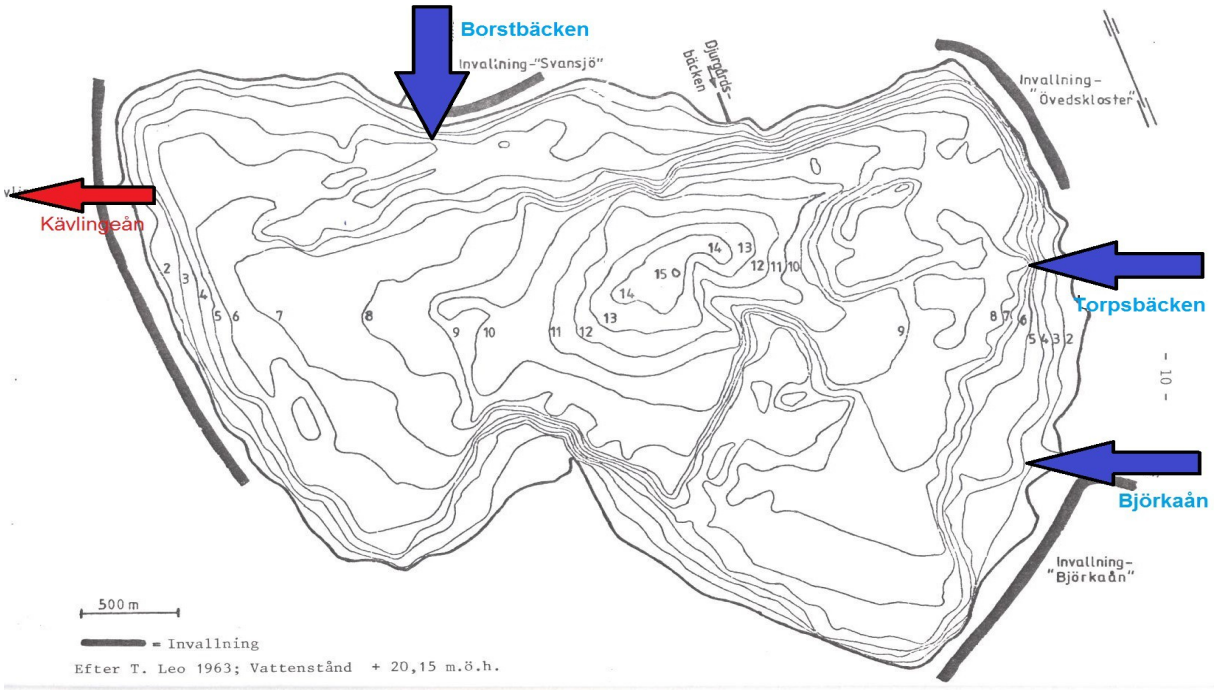


Figure 3: Vombjön Inlets and outlets

As we can see on the next figure (Figure 4) there is a large part of agricultural land on the lake catchment area. Indeed 72% are agricultural land; 13% forest; 10% open grounds; 3% water surface and 2% are villages. Agricultural areas are dangerous for the lake because they bring phosphorus to the lake.

If the amount of phosphorus is huge, a phenomenon of Eutrophication has more chance to appear. We will develop this phenomenon on the third part of the literature review, but it could create an algal bloom and an increase of toxins. At the end, the eutrophication affects the whole drinking water system and the quality of the drinking water.

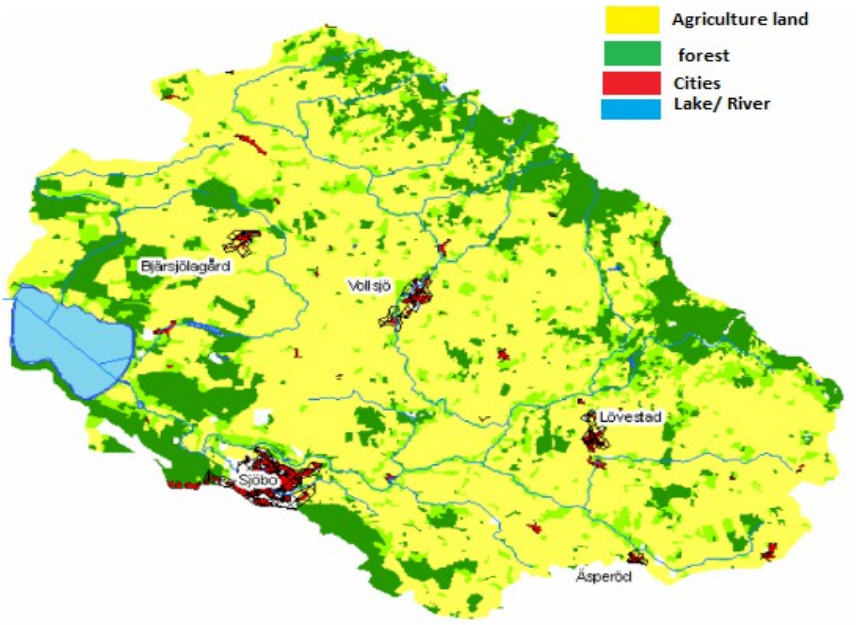


Figure 4: Vombjön catchment area

3) Vombsverket Station

The plant of Vombsjön (Vombverket) was built in 1940 and became operational in 1948. They produce approximately 900 litres of drinking water per second.

Sydvatten pump the water through two pipes in the Vombjön lake. After a first filtration the water goes into one of the 54 ponds of artificial infiltration. The water seeps slowly throught the soil of grand and sand. Three months after, the water is pumped to Vombverket for the final processing.

The following figure (Figure5) shows the drinking water process:

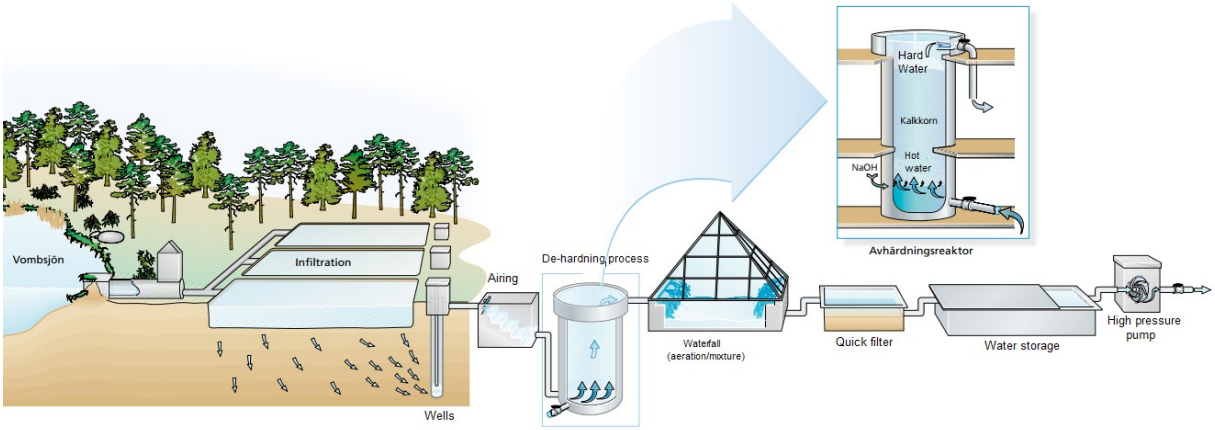


Figure 5: Vombverket drinking water process

III) Eutrophication

1) Definitions

Originally, eutrophication was defined as a natural phenomenon which leads gradually, the geological time scale, to the filling of shallow lakes and the formation of marshes and meadows and forests.

But now we talk about eutrophication when a body of water acquires a high concentration of nutrients and stimulate the growth of aquatic plants and algae. These plants consume the oxygen in the water and it could have a huge effects for human, animals and other organisms dependent on the water.

It's possible to divide the eutrophication in several steps:

- First the lake, or the body of water, receive an enrichment of inorganic nutrients (for example nitrate or phosphate which is the primary limiting factors). This enrichment could be the result of human activity (agricultural land or sewage water..)
- Then if the amount of phosphorus is adequate, the growth of aquatic plants will be limited and algae will be favouring. It's particulary evident to see the growth of algae in slow moving rivers or shallow lakes.
- When the algae die it's the most important part of the eutrophication. They decompose and the nutrients contained in that organic matter are converted into inorganic form by microorganisms. During the transformation, an important level of oxygen is consumed in the water. This thing could create a state of hypoxia (lack or absence of oxygen). Moreover the lack of oxygen cause the death of others organisms and a severe reduction of the water quality.

One of the most important algae which is causing the eutrophication is the Cyanobacteria, which further discussed below.

2) Cyanobacteria

a) Definitions

The principal actors of eutrophication are the cyanobacteria. The oldest fossil of cyanobacteria known are more than 3.5 billion years old and nowadays 2 000 species have been identified. It's one of the largest groups of bacteria on earth.

Cyanobacteria are in the same time bacteria and algae. They have no nucleus and intracellular organites (like bacteria) and they have chlorophyll A and many pigments in order to have photosynthesis activity (like algae).

Cyanobacteria live in the water, they're quite small and usually unicellular. They can manufacture their own food and often grow in large colonies or filaments of cells. Spherical colonies can measure three or four centimeters in diameter. It's the reason why they're large enough to see them.

These microorganisms is able to grow in very different environments and adapt to very hard environmental conditions (salinity, extreme temperatures, alkalinity...). They are capable of colonizing freshwater as well (lakes, rivers, ponds, estuaries) as marine environment

When there is a big explosion of the number of cells we call this phenomenon “a bloom”. In this case, the proliferations are most commonly seen on the surface where they form aggregates Floating called blue-green algae

Cyanobacteria have no internal membrane systems like other bacteria and the external membrane has folded to increase the total surface area. In this membrane a chemical reactions of photosynthesis take place.

The photosynthesis consist to use the energy of the sunlight. Indeed they use pigments like chlorophyll to capture the energy from the sunlight. Cyanobacteria are the only bacteria that contain chlorophyll A. A part of this light is used to excite electrons of the water molecules. Cynobacteria typically employ several strategies which are collectively known as a "carbon concentrating mechanism" to aid in the acquisition of inorganic carbon (CO2 or bicarbonate). This carbon react with water and produce sugar (glucose) for energy and oxygen that is released.

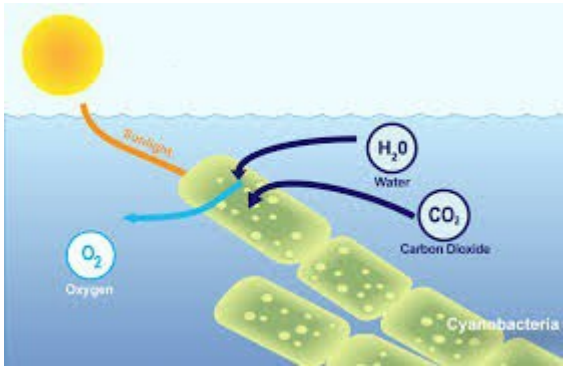


Figure 6: Cyanobacteria photosynthesis

b) Parameters influencing the growth of cyanobacteria

First cyanobacteria cannot maintain an abnormally high population for long and will rapidly die and disappear after one or two weeks. But they can grow rapidly if conditions remain favorable so an another bloom can quickly replace the previous one. This is the reason why it may appear that the bloom continuous to occurs for up to several months.

Different parameters influence the growth of cyanobacteria, but all of them have an impact on the photosynthesis.

First the sun light that have different effects on the growth of cyanobacteria and the photosynthesis. Indeed the photosynthesis production will decrease if the light is not enough. Moreover the turbidity or the presence of suspended particles in the water affects the amount of light that reaches into the water. So in turbid water, the photosynthesis is less likely to occur on the bottom of the water body because of the lack of light.

The temperature have also a huge impact on the photosynthesis rate. In fact the photosynthesis Is initiated and increased speed by heat. But every bacteria have an optimum temperature range. For the cyanobacteria the optimum temperature is between 15°C and 30°C. If the temperature is lower than this range the photosynthesis will not be initiated. As a contrary if there is too much heat, it will break down the enzymes during the process and slow down the photosynthesis.

To favorise the photosynthesis they still need nutrients to grow and reproduce. These nutrients are typically phosphorus and nitrogen. Cyanobacteria need a lot of phosphorus, and they often develop faster if the ratio N:P is low. An agricultral land close to the body of water can raise phosphorus and nitrogen concentrations to very high levels.

So human activities could have an indirect impact on the growth of cyanobacteria and could be responsible of a bloom.

As a conclusion all parameters like carbon, temperature, nutriments, light which affect the photosynthesis have an influence on the cyanobacteria growth.

c) Cyanotoxins

Toxins are created by algea when they grow and the toxins realeased to the water when they die. Toxin could be created by Cyanobacteria in order to increase their domination in the aquatic world and to regulate their metabolism.

In most cases, the cyanobacteria toxins exist intracellularly in the cytoplasm and are retained within the cell. There are different types of toxins, the Anatoxin-a and the microcystin are found approximately 95 % of the time intracellularly during the growth stage of the bloom. For those species, when the cell dies or breaks, the cell membrane ruptures and the toxins are released into the water (extracellular toxins).

However, in other species, a significant amount of the toxin may be naturally released to the water by the live cyanobacteria cell; the reported ratio is about 50% intracellular and 50% extracellular.

There are several parameters which impact the production of toxins:

- the luminous intensity (if the intensity is high the growth of cyanobacteria will be reduced and the toxin production decreased)
- nutrients and iron
- Temperature and pH
- The effect of Zooplankton (when zooplankton were around the cyanobacteria the toxin production increase)

The blooms can also cause an increase of the pH (high photosynthetic activity), the conditions give a net advantage to the cyanobacteria compared to the other-microscopic alagae, due to a reduction of the availability in CO2.

In our study we have analysed Mycrosistins, they come from the hépatotoxines types. This kind of toxin is the most present in case of eutrophication. Mycrosistins have a 7 amino acids peptide cyclic structure and are very robust. If the temperature decrease under 15°C, their grow slowly. Moreover if environmental conditions become harder for the cyanobacteria, they can take a state of “sleep” and continue their growth when the conditions will be better.

Mycrosystins are toxic for the environment, animals and humans.

3)Effects and consequences of cyanotoxins

One of the first effects of cyanobacteria is the decreasing of the oxygen levels. Indeed cyanobacteria consume oxygene at night (respiration) when there is no light for photosythesis. Moreover when they bloom it will be dangerous when they die. Bacteria will consume oxygen in order to decompose the dead algae and a significant part of toxin could be released in the water. This bloom and the lack of oxygen caused problems for the environment.
Fish and other aquatic creatures are the first touched by the lack of oxygene. and we can see quickly a large concentration of dead fish.

Moreover the algal bloom could have direct or indirect effects on the human health. First a direct exposure from swimming or drinking affected water can cause headaches or upset stomachs or worst, hepatic symptoms that can lead to the death.

An indirect exposure, like eating fish could also be dangerous. Indeed if we eat fish, which lives in an algal bloom environment, we will consume concentrated toxin.

The environment is also touched by the algal bloom, for example the water pH can increase with the high photosynthesis activity.

The following table (Table 2) show us, some of effects that could be beget by cyanotoxin on the human health :

Table 2: Examples of cyanotoxin effects on human healf (source water.epa.gouv)

Cyanotoxin	Number of known variants or analogues	Primary organ affected	Health Effects	Most common Cyanobacteria producing toxin
Microcystin-LR	80~90	Liver	Abdominal pain Vomiting and diarrhea Liver inflammation and hemorrhage Acute pneumonia Acute dermatitis Kidney damage Potential tumor growth promotion	Microcystis Anabaena Planktothrix Anabaenopsis Aphanizomenon
Cylindrospermopsin	3	Liver		Cylindrospermopsis Aphanizomenon Anabaena Lyngbya Rhaphidiopsis Umezakia
Anatoxin-a group	2-6	Nervous System	Tingling, burning, numbness, drowsiness, incoherent speech, salivation, respiratory paralysis leading to death	Anabaena Planktothrix Aphanizomenon Cylindrospermopsis Oscillatoria

Material and methods

I) Planning of the project

It's possible to divided the internship in three part. First the literature research to understand the investigation that will be lead during the second part of the internship.

Then the second part with the field work and all analysis. As we can see on the following figure (Figure7) every weeks looked the same. But we had 3 weeks which were different with the RIBS project.

Finally the internship is concluded by the report redaction and the oral preparation. Moreover on the August 28 an oral presentation have been realised to explain our project during the three month for the Ringsjöverket personal.

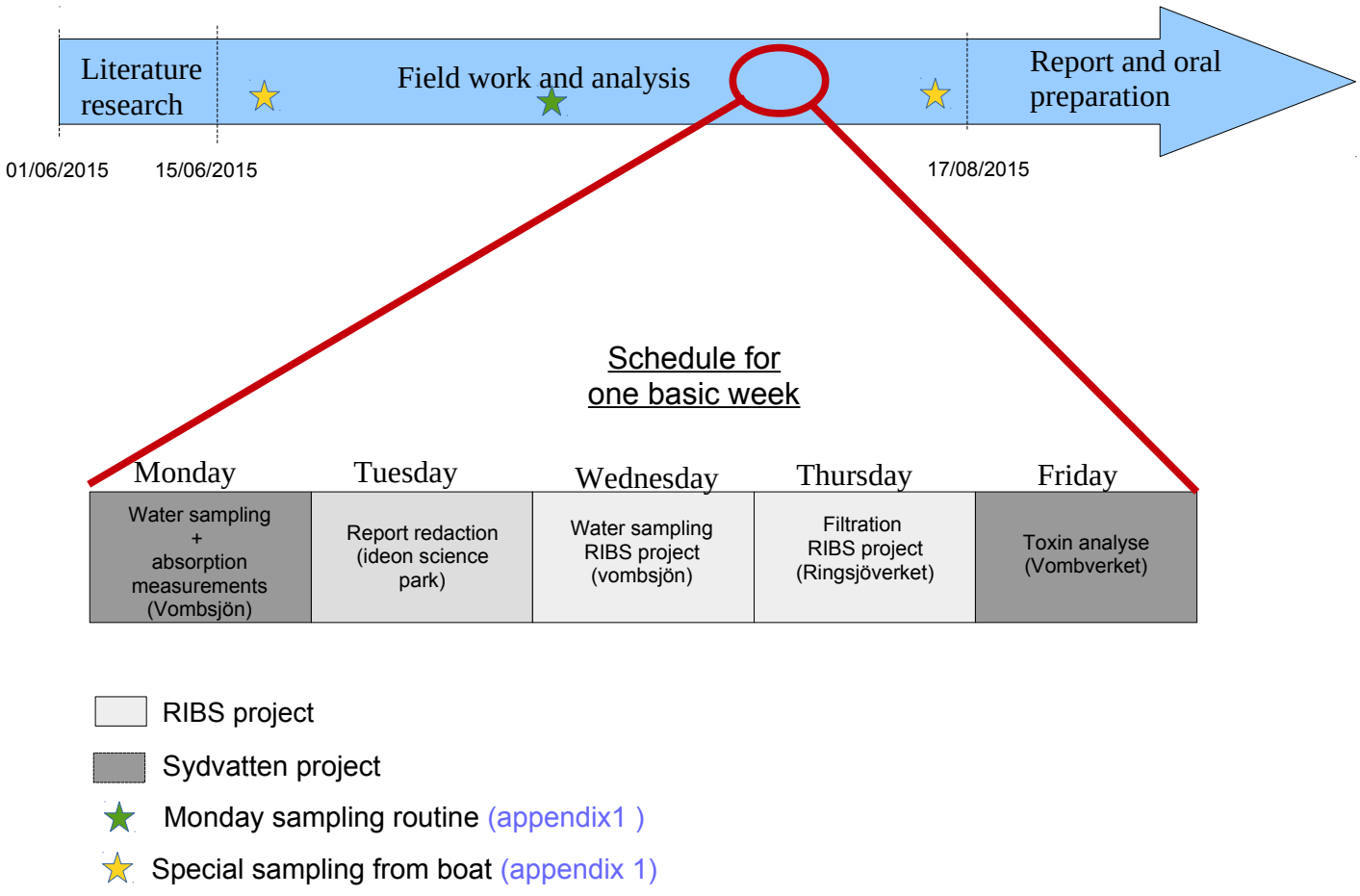


Figure 7: Planning of the internship

II) Ribs project

1) Sampling sites

Figure 8: Ribs sampling sites

A total of 10 water samples should be collected:

1. Water treatment plant:
    a. Sampling from boreholes – incoming raw water to the drinking water treatment plant.
    b. Sampling at the infiltration site.
2. Vressel:
    a. Household wastewater at the pumping station (well) in Vressel. Discharge from on-site sewers are pumped to Vombsjön.
    b. Sampling from Björkaån upstream the bridge in Vressel.
3. Sampling from Torpsbäcken , north of Vressel.
4. Sampling in Borstbäcken . On the border between Sjöbo and Eslöv municipalities.
5. Öveds monastery
    a. Upstream of grazing site, in ditch next to pasture
    b. Downstream of grazing site, taken from a bridge just outside the pasture border.
    c. We have had an other grazing site, upstream of the site 5a. Indeed during the internship cows have moved to an other grazing so we needed one more site.
6. Natural ground water source – it should be cleaned in advance to avoid organic matter that is not originating from the ground water itself. We have build a pipe and collected the water with a pump to be sure that it's only the ground water.

All these sites have been chosen to study different effects on the water that human and animals could create. Moreover several sites are interesting because we take samples on the three inlets of the lake, so the study of these samples could help to understand the origin of the phosphorus for example.

2)Material and methods for RIBS project

a)For samples:

To collect samples we use a special sampler with an extensible arm. This special arm is necessary to collect water in the river from a bridge for example. Moreover temperature and the hour of each samples are taken for the future analyse of Chalmers Students.
appendix 2

The samples are collected in 1L glass bottles which have been sterilised before. The time between reopening the sterilised bottles, taking the water sample and reattaching the cap should be as short as possible due to risk of contamination .Plastic gloves should also be used to limited the contamination risk.

The bottle should be properly marked and stored in a cool bag/box during transportation. When they are back at the lab water, the samples should be stored in a refrigerator (ca 4-8 °C) until filtered. The water sampling it needs to be: “Fast, cool and dark”.

b) Filtration

After collection of samples, they are filtrate.

There are two types of filters: 0.45 µm and 0.22 µm pore sizes.
500 ml of each water sample should be filtered through a filter with each pore size.
One of the most important things it's to work in a sterilised environment. So there are several rules which need to be respected.

- Plastic gloves should be used at all times.
- The filter cup needs to be washed with hot water and sterilised after (sprayed with ethanol and air dried for a while)
- To put filters it's necessary to use tweezers which have been disinfected (soaked in methanol and then burned). We are using two filters, the first is a supportive filter put on the bottom part of the filtration cup and the other is the filter with the right pore size. Then the top part of the filtration cup is put on top of the bottom part of the filtration cup with the filter in between
- Add 500ml water from the sampling bottle with a sterile pipette

(filtration material in appendix 2)

Filtering device is attached to the water tap to create a suction. Then we start to add 500 ml of the samples, in case all water cannot pass through the filter due to clogging or similar, the remaining volume should be measured

After this, we remove the top part of the filtration cup and we placed the filter in a sterile Eppendorf-tube, properly marked and stored in a freeze. (Figure 9)

Figure 9: Marking of Eppendorf-tube

3)Sydvatten project

1)Sampling sites

The location of the different sampling sites was established the last year by Magalie and Florian. They studied the depth of the lake to determine where the most representative samples can be taken. 3 sites were selected. We just had to enter these coordinates in our GPS to be able to find the place of each samples when we went out on the lake. The following figure (Figure10) represents the map of the lake with the 3 different locations and the GPS coordinates:

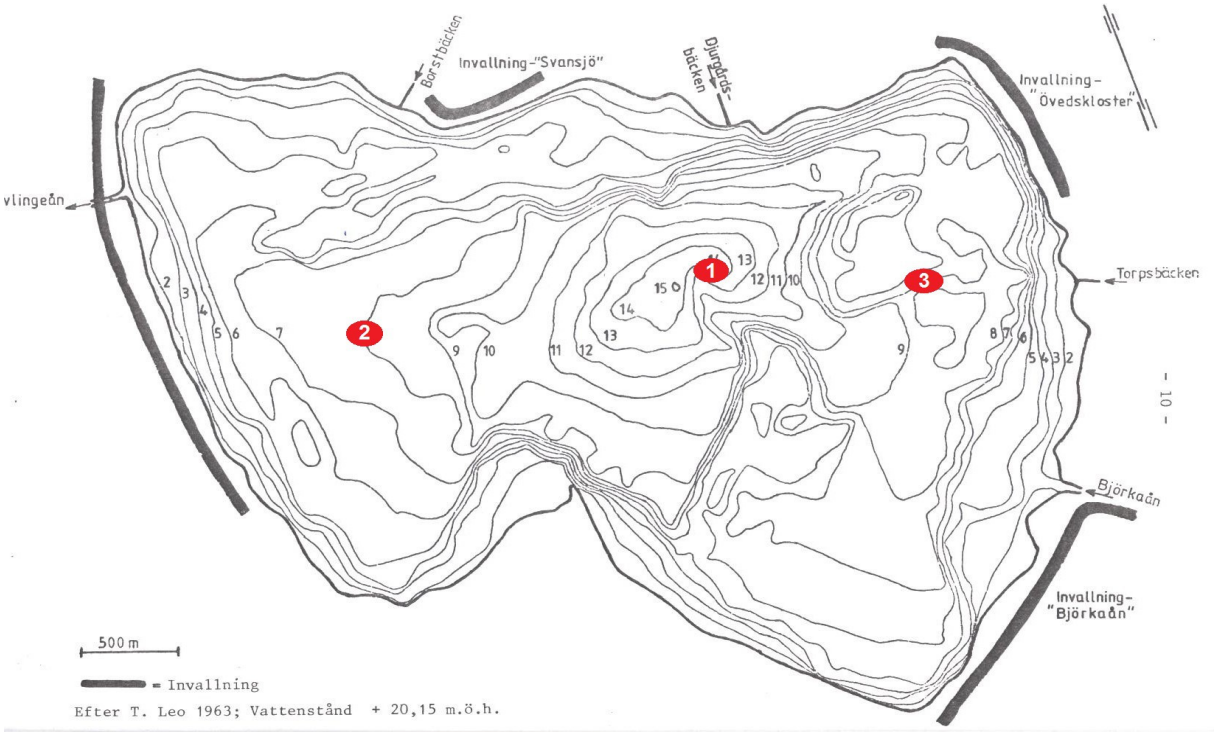


Figure 10: Map of the lake and sampling sites

Water is sampled from three locations in the lake:
1: 55°41.154 N 13°34.446 E (14m)
2: 55°41.131 N 13°36.672 E (6m)
3: 55°41.340 N 13°34.128 E (7m)
Water samples are sampled with a “Ruttner” water sampler.

2) Material for samples

We used a specific sampler (Ruttnerhämtare) which allows us to take a single sample of the deep water. So this time we used a generic sampler which can be bought in a specialized store (appendix 2).

Thanks to a weight that we let slide down the sampler’s rope, we can close the sampler at the desired depth.

At each location (1, 2, and 3) two samples are taken:
- 1 surface sample 0,5 m of depth.
- 1 bottom sample 1 m above bottom.

For the bottom sample we need to be carful and be sure of that we do not stir up bottom sediments while sampling.

Each sample needs to be slipt in two parts:
- for absorptions measurement, 6 samples are collected in one plastic container each (250 ml)
-for toxin analysis each of the 6 samples are put into a glass container (100 ml, fill it up).

Both of them are put in the cool box directly after sampling and keep it cool during transport to lab in order to not modify parameters and toxin concentrations which are sensitive to the temperature and the light.

3)Toxin analyses and hydrologic conditions of the lake

a)Water column profile

In order to better understand the conditions of the life of cyanobacteria and to anticipate the amount of toxin that they could released, we analyse some important parameters. Indeed every week when we went to the lake to collect samples we measured 5 parameters. This parameters were: temperature, conductivity, redox potential, dissolved oxygen and pH.

These parameters awere measured at each meters along the depth on every sites.

Moreover we know for example that the temperature could have an affect on the growth of cyanobacteria so it's important to know these parameters at each depth. Indeed cyanobacteria could grow only on the bottom of the lake if life conditions are better than at the surface.

To do that we used a multi-parameter analyzing tool which allowed us to do all of these analyses in the same time (appendix 2).

b) Absorptions measurements

For every sample collected into plastic containers we used a spectrophotometer for the measurements.
We can divided the work in two parts. And for each part we will analysed the same parameters which are:

- Chlorophyll A (465 nm and 665 nm)
- Humus
- UV

These parameters have been choose because they could give information about the presence of cyanobacteria. Indeed for example Chlorophyll A is the primary molecule responsible for photosynthesis. That means that chlorophyll A is found in every single photosynthesizing organism, from land plants to algae and cyanobacteria. Moreover for the Chlorophyll A there are two wavelengths, it represent the maximum of absorption for the Chlorophyll A (figure11)

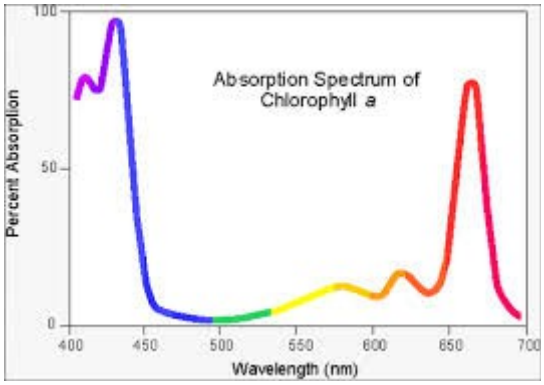


Figure 11: Spectre Chlorophyl A

There are two parts in the work because we analysed with and without filtration.

So first we measure samples without the filtration.The 6 samples are run through the spectrophotometer. The spectrophotometer has a "flow-through" cuvette. The sample is automatically sucked into the cuvette of the spectrophotometer.

Then we filtered the samples with 1µm pore size. A suction was not necessary, since the gravity was enough to pass the water through the filter.

Finally after filtering, the 6 samples are run through the spectrophotometer for absorption measurements.

c) Toxin analyses

The 6 samples collected into glass containers needed some manipulation before analysis.

- **Preparation for toxin analysis**

Each of the 6 samples were divided into two parts; part A and B. Part A was put in the freezer.
Then the part B was filtrated. For the filtration we used a syringe filtration with a pore size of 0.45µm *(syringe picture appendix 2)*
After the filtration each part are put in the freezer.
Before analysis, samples are thawed three times during nights, and frozen during the days. The third (and last) thawing is done the night before toxin analysis. When frozen, the samples (A and B) can be left in the freezer indefinitely until the day before analysis.

- **Toxin analysis**

For the toxin analysis we use Beacon test kit; Microcystin tube kit, item #: 20-0098 (appendix 2). This kit work with a system of Microcystins and a Microcystin-enzyme conjugate. If there are Mycrocysins-enzyme in the sample, the substrate become blue. Moreover if it's a lighter blue the concentration on toxin will be higher than a darker blue. The entire protocol can be found in appendix 3.
Then a spectrophotometer is used at 450 nm to perform analyses.

Results and discussion

I) Parameters evolution of water column's

First we will see the evolution of parameters obtained thanks to the multi-parameter analysing tool. All the data (pH, conductivity, redox potential, temperature, dissolved oxygen content) can be found in appendix 4

The weather was not really good and there iwas only minor changes in the weather during the entire summer. So parameters at each site are approximately the same for different dates. But during one week weather conditions have been better so we can compare parameters between this week and the others.

The following graph shows the evolution of temperature and oxygen according to the depth for the first sampling site at Vomb's lake on the 15th June 2015.

As we can see the temperature stay constant on all depths of the lake. Furthermore the oxygen level start to decrease only on the bottom of the lake and we can conclude, that its evolution is constant. Indeed when the sond is close to the bottom of the lake there are more sediments in the water and when the sond touch the ground, sediments prevent the oxygen to be present so its value is decreasing.

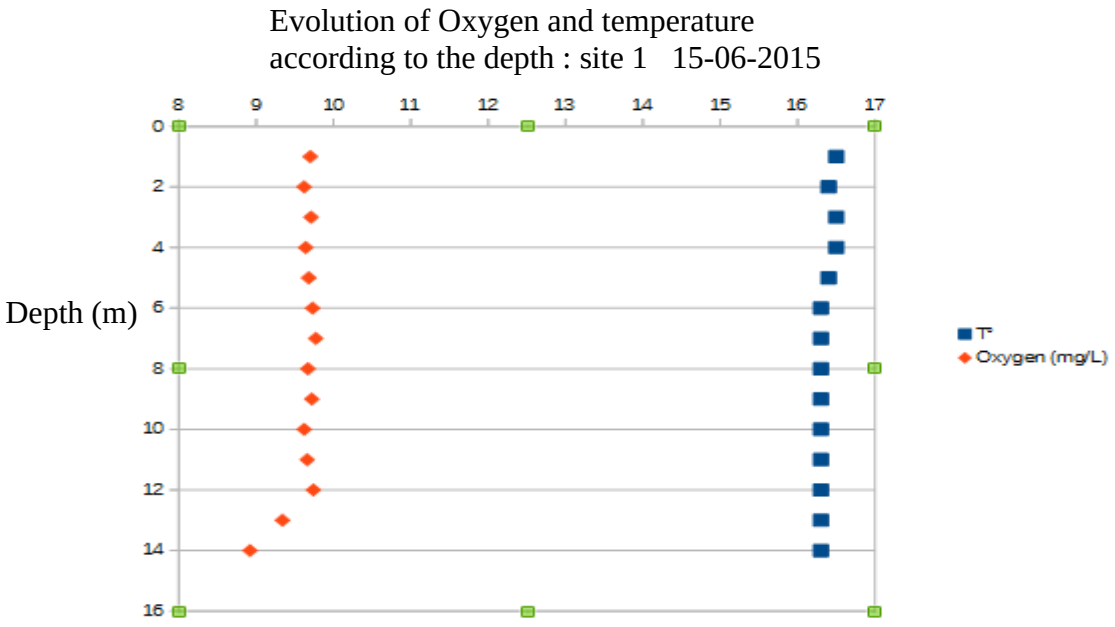


Figure 12: Temperature and oxygen's evolution (site 1 - 15 June)

The next graph treat data from the 10th of August, it was the best weather of the summer. The evolution of the temperature and oxygen are a little bit different. Indeed both of them are decreasing along the depth. This day was the warmest day for samples so the temperature on the lake is higher than the other days. Moreover the temperature is lower in bottom layers than on the surface of the lake, the sun and the hot air haven't had the time to warm up the entire lake.

Evolution of Oxygen and temperature according to the depth : site 1 10-08-2015

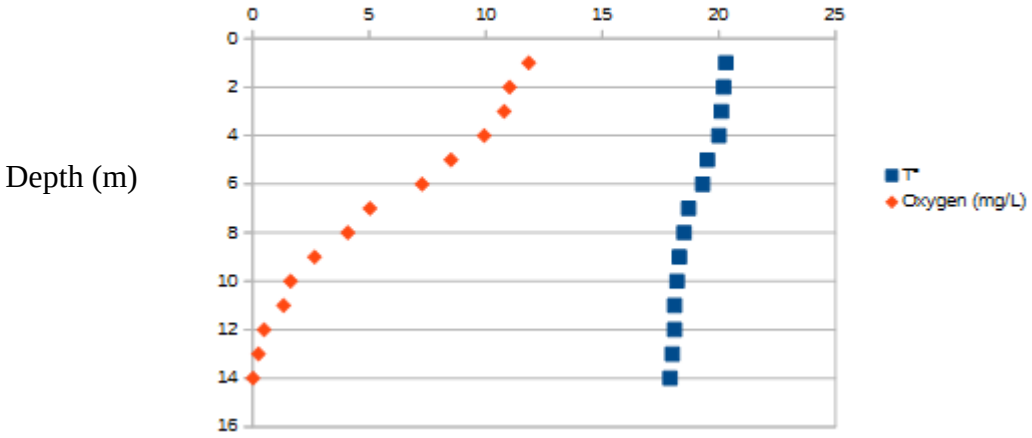


Figure 13: Temperature and oxygen's evolution (site 1 - 10 August)

As we saw previously, when the external temperature is higher the progression of the parameters is more variable. Between the two graphs we can see that the second have a significant decrease for the oxygen parameter. Moreover at seven meters the temperature is decreasing and the oxygen is higher so we can suppose that a thermocline is present in the lake.

Usually we found a thermocline when there are a pronounced decrease of the water temperature at a certain depth. The thermocline prevents the oxygen from surface water to enter the bottom water.

If a thermocline is present in the lake the growth of cyanobacteria could be affected. Indeed cyanobacteria needs oxygen to develop them and a minimum of temperature, so with the thermocline these two parameters are reducing in the bottom of the lake. During cyanobacteria growth it would be more on the surface of the lake.

II) Toxins and absorptions measurement

1) Toxin concentrations

The toxin analyse is important for Sydvatten, indeed they need to know the quantity of toxin for the quality of the drinking water. During the process the toxins are not treated so if there is too much toxin in Vombsjön the repercussion for human health could be dangerous.

Every week we have performed this toxin analyse in order to have an idea of the amount. We will focussed only on one date, for the other dates concentration found are in the appendix 5

In this report we will study samples from July 20.

After analysing the samples with the spectrophotometer a standard curve wias used to get the concentration.

Table 3: DO for calibrators solution

Concentration (ppb)	DO (nm)	% DO
0	2.255	100
0.3	1.553	76.1647866601
0.8	1.108	54.340362923
1	1.014	49.7302599313

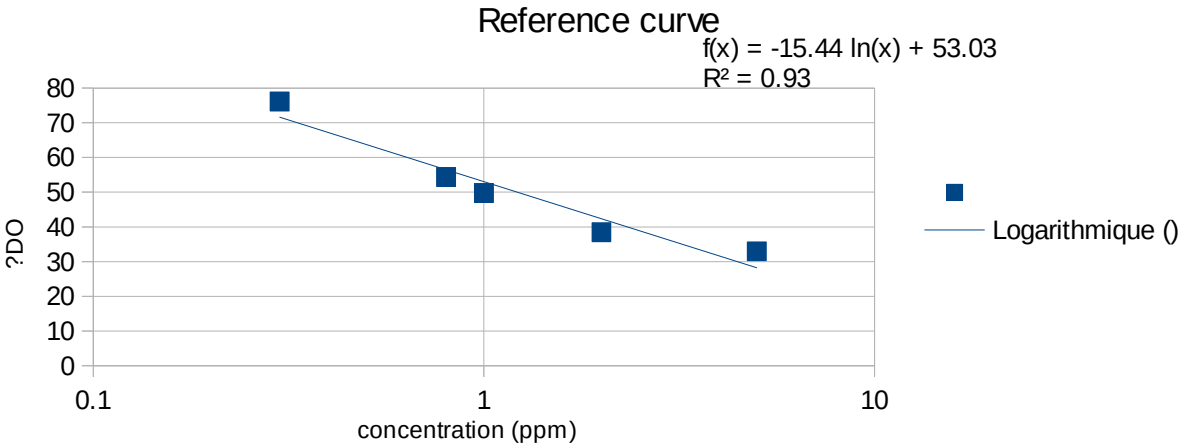


Figure 14: Reference curve for toxin analyse

The standard curve was drawn with lod-sale on the X axis. Then a logarithm model have been chosen to draw the curve. We used the equation from the curve to find the toxin concentration on each sample.

Table 4: Toxin concentration for sample of the July 20

	Tubes	DO (nm)	% DO	ln X	Concentration (ppm)
Before filtration	1A	1.646	72.993348115	-1.292825376	0.2744941372
	1A'	1.395	61.862527716	-0.571889304	0.564457998
	2A	1.691	74.988913525	-1.422076863	0.2412125308
	2A'	1.536	68.115299335	-0.976877297	0.3764849158
	3A	1.645	72.949002217	-1.289953121	0.2752836878
	3A'	1.726	76.541019956	-1.522605798	0.2181427099
After Filtration	1B	2.33	103.32594235	-3.257447981	0.0384864911
	1B'	2.297	101.86252772	-3.162663557	0.0423128881
	2B	2.428	107.67184035	-3.538928997	0.0290444171
	2B'	2.427	107.62749446	-3.536056742	0.02912796
	3B	2.524	111.92904656	-3.814665503	0.0220450872
	3B'	2.584	114.58980044	-3.987000819	0.0185552814

We re-inject the DO of each samples in the equation and we find the concentration in ppm. As we can see in the table, toxin concentration are low, but they are the highest that we have got during the summer. Indeed the weather was not good so cyanobacteria haven't got ideal conditions to growth. So it's difficult to compare all the results because we just have low concentration and no significant results.

Moreover, there is no regulation or limit for the quantity of cyanotoxin in the drinking water in Sweden so it is not possible to conclude on the dangerousness at these concentrations.

2) Mycrosystin kit limit's

To use the mycrosystin kit we had to be very careful. Indeed there are lot of things which could have an influence on the results.

For example, if there is bubble in the solutions during the test, the results will be affected even if it is very small bubble. There are also specific times to respect between the addition of solution or during the incubation, because reactions between the several solution need to be the same for each tube.

The next graph show a problem during manipulations. In fact on the 7th of July the toxin concentration for the filtrated samples are higher than the toxin concentration for the sample without filtration. These results are not possible, when the samples are filtrated with filter pore size of 0.45 µm, cells are blocked during the filtration. After the filtration, all samples are thawed in order to kill the cells and released toxin in water. Moreover the most of toxins come from the cells, or a large part cells have been blocked by the filtration on the sample B. So is not possible to obtain a higher toxin concentration for the "sample B" than the "sample A".

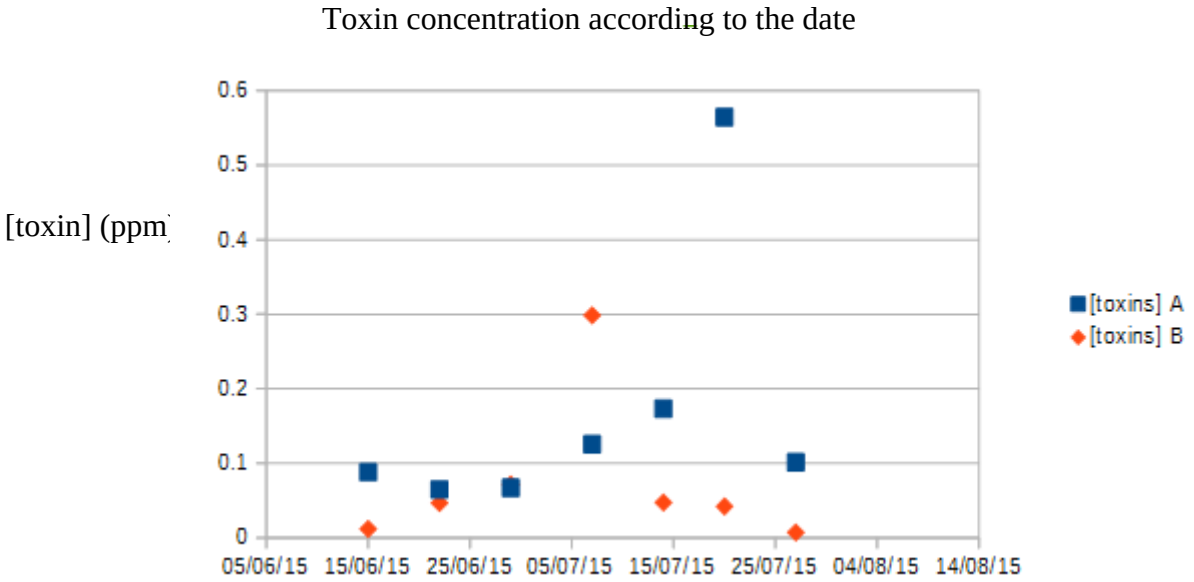


Figure 15: Mycrosystin kit limit's

This error could come from a bubble in the solutions or an incorrect reaction time.

This sensibility of the kit can create problem for the analyse of toxin. Indeed we have already low concentration, so if a small error arrived during manipulation the effect on the results will be very important.

3) Temperature's impact on toxin concentration

On the next graph we will focused on the 14th and 20th of July. On the 14th the bottom of the lake had a temperature of 17.7° C and on the 20th the temperature was 18.5°C

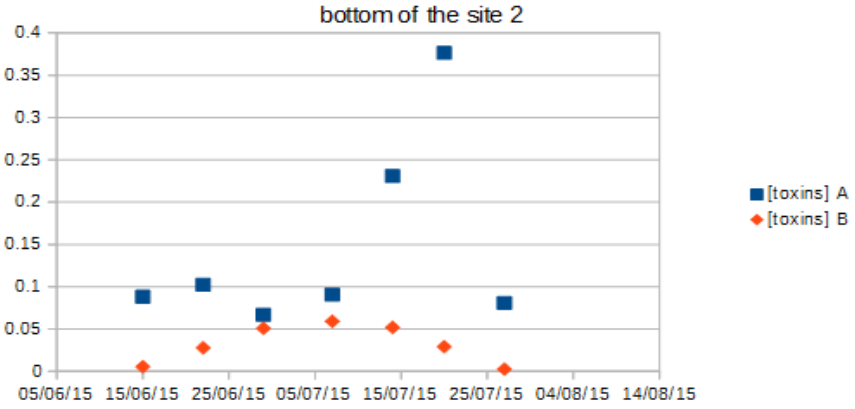


Figure 16: Toxin concentration for the bottom of the lake (site 2)

On the 14th the surface of the lake had a temperature of 18.4 °C and on the 20th the temperature was 18.6°C

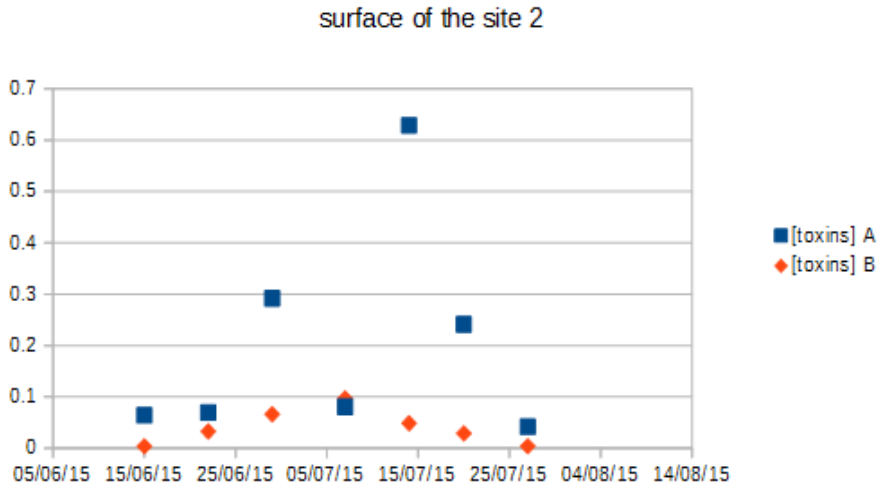


Figure 17: Toxin concentration for the surface of the lake (site 2)

First we can see that on the bottom of the lake, the toxin concentration was hiigher the 14th of July. On a contrary at the surface of the lake the concentration was higher the 20th of July.

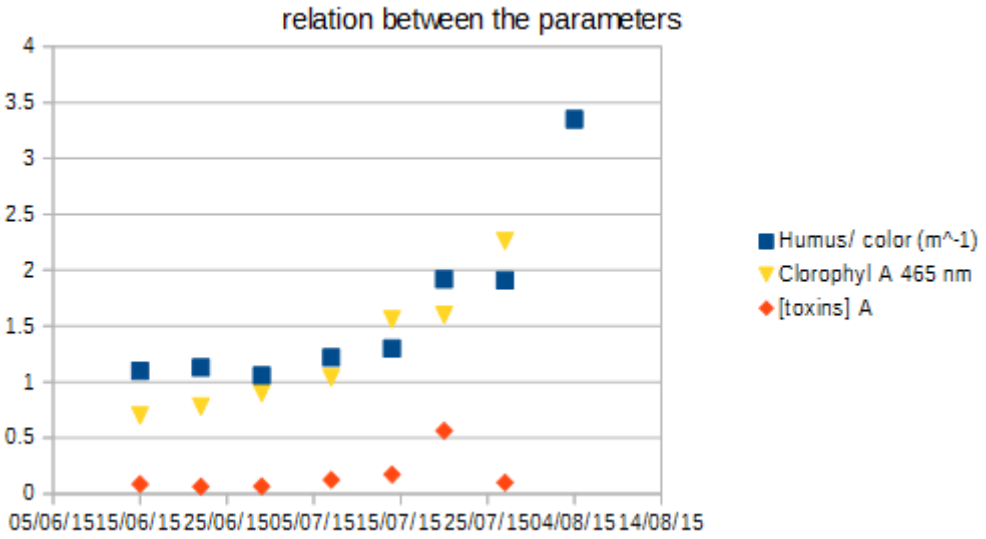
The temperature could have had an affect on the concentration, indeed the temperature on the 14th decrease more with the depth than on the 20th. And we can see a higher difference between concentration on the 14th than on the 20th. On the surface the concentration is twice that on the bottom. So we can think that on this date the temperature has got an impact on the toxin concentrtion

.

Moreover on the July 20th , temperatures are approximately the same on the surface and the bottom of the lake, and we can see a lower difference between both concentrations. Other parameters like the oxygen could help to explain the differences between these two dates.

4) Relation between absorptions measurement and toxins

All the data (pH, conductivity, redox potential, temperature, dissolved oxygen content, humus, chlorophyll and toxin concentration) for each site at the surface and 1m up to the bottom can be found in appendix 6



Figures 18: Relation between absorptions measurement and toxins

As we can see in the graph these three parameters have almost the same evolution. Indeed there are relations between them.

For example the chlorophyll A is a pigment present on the Cyanobacteria, it capture the sunlight to promote the photosynthesis. So the evolution between the toxin concentration and the chlorophyll A are the same normally, but sometimes we found different variations. These differences could be a problem during the analyse of toxin.

Moreover the humus variation is almost the same since cyanobacteria colored the water so if the amount of toxin increase the humus increase.

If we focussed on July 27th the evolution of the three parameters are not the same, indeed toxin concentration has decreased whereas the chlorophyll A has increased compare to the last week. The humus remained stable.

This difference of evolution can be explained by the presence of other aquatic plants, all plants which are using photosynthesis have the chlorophyll A.

To conclude it is hard to explain results beacause of the lower quantity of toxin during the summer and the other parameters are not exclusive for cyanotoxin.

CONCLUSION

Vombsjön is a lake located in Scania, region of southern Sweden, and used for drinking water production. It is the second largest water resource used by Sydvatten, drinking water supply.

However an eutrophication phenomenon has been observed in the lake for many years, due to several parameters but mainly an increase in the amount of nutrients in the water like phosphorus and Nitrogen. Human activities play an important role in this increase of nutrients, mostly through agricultural activities in the lands surrounding the lake.

And Eutrophication represents a big threat because it generally leads to proliferations of cyanobacteria, which are able to take the monopoly in the water, and thus cause a loss of diversity, but also to produce and release toxins.

As a consequence, cyanobacteria are an obvious threat for the ecosystem , their toxins are harmful for human health, and represent a real issue for the drinking water production.

The aim of the project was to investigate the presence of algae toxins nowadays in the Vomb's lake in order to try to predict future levels of toxins. Another important goal was to find precautionary measures that could be used in order to keep and secure Vombsjön as a drinking-water reservoir for the future.

Many water samples have been taken weekly during the whole summer in order to measure different parameters and follow their evolution with time. Some parameters were expected to have a positive effect on the apparition of cyanobacteria's blooms, however since the weather was extremely bad (one of the coldest summer recorded in Sweden the last fifty years), the conditions were not good for the production of toxins. Moreover, and even if sometimes some parameters showed similar trends, it was hard to find many correlations between them.

Another study has been carried at the same time, with a university from Göteborg, in order to determine how the lake is affected by faecal contamination. The aim of this teamwork was to predict the affects of faecal contamination sources on the microbial content present in the water.

Thus, this report is mainly focused on the lake's bad condition and its relation to human activities. The threat is real because it concerns the drinking water: precautionary measures need to be found in order to secure Vomb's lake if Sydvatten wants to ensure a high quality also in the future.

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LIST OF APPENDIXES

APPENDIX 1 : Special and monday sampling

Monday Sampling routine

On the monday 6th of July double samples of each site are taken.

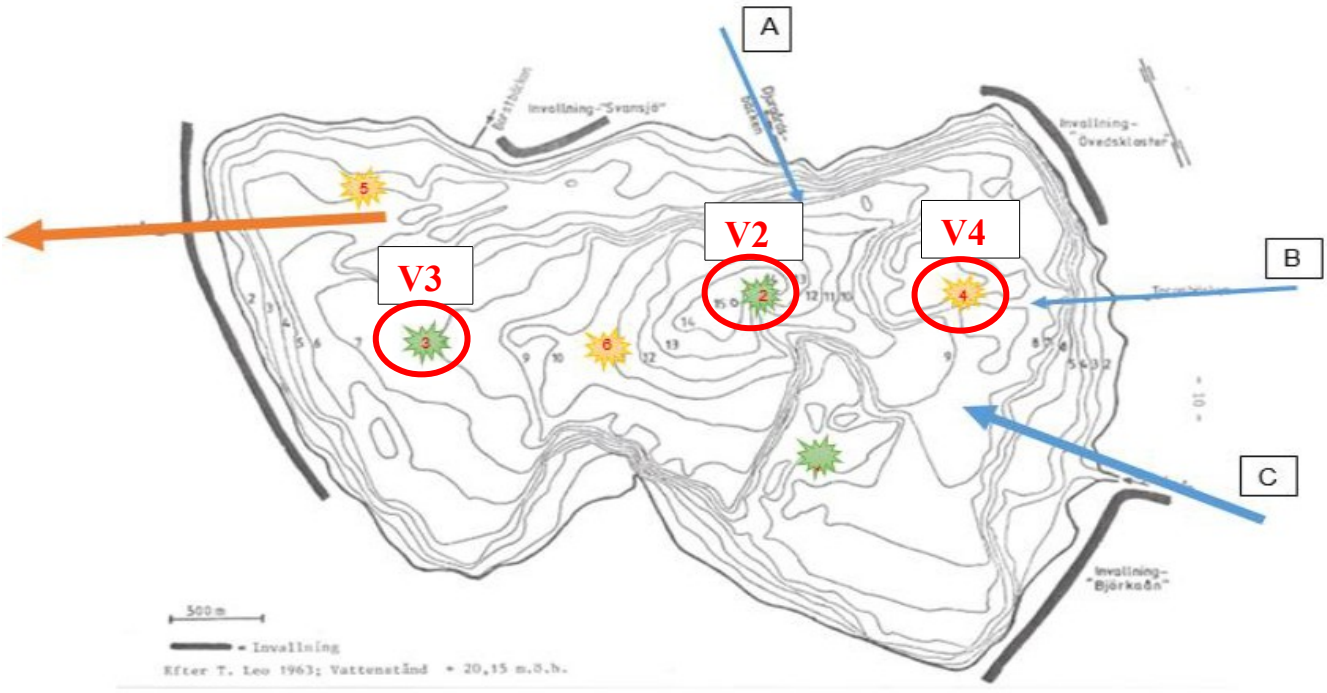
- One sample from each site have been send for cultivation analysis for faecal indicators.
- The other samples have been filtered like a basic sampling routines

. The main reason for this is to compare the two different methods.

Special sampling from boat

The variations in the microbial ecosystem in the lake have been studied at two occasions . Samples are taken with the boat at the same sites that samples for the Sydvatten project.

Point V2 (sampling from -1, -3, -6, -8, -10 and -13 m)
Point V3 (sampling from -1 m and -6 m)
Point V4 (sampling from -1 m and -6 m)



Water samples have been filtered in the same way as a basic sampling routine.

APPENDIX 2 : Material used

Multiparameter

Filtration material

Water sampler (RIBS project)

Water sampler (Sydvatten project)

syringe + filter

Mycrosystin kit

USE PRINCIPLES

The Beacon Microcystin Tube Kit uses a polyclonal antibody that binds both Microcystins and a Microcystin-enzyme conjugate. Microcystins in the sample compete with the Microcystin-enzyme conjugate for a limited number of antibody binding sites. In the assay procedure you will:

- Add Microcystin-enzyme conjugate and a sample containing Microcystins to a test tube, followed by antibody solution. The conjugate competes with any Microcystins in the sample for the same antibody binding sites. The test tube is coated with anti-rabbit IgG to capture the rabbit anti-microcystin added.
- Wash away any unbound molecules, after you incubate this mixture for 20 minutes.
- Add clear substrate solution to each tube. In the presence of bound Microcystin-enzyme conjugate, the substrate is converted to a blue compound. One enzyme molecule can convert many substrate molecules.

Since the same number of antibody binding sites are available in every tube, and each tube receives the same number of Microcystin-enzyme conjugate molecules, a sample containing a low concentration of Microcystins allows the antibody to bind many Microcystin-enzyme conjugate molecules. The result is a dark blue solution. Conversely, a high concentration of Microcystins allows fewer Microcystin-enzyme conjugate molecules to be bound by the antibodies, resulting in a lighter blue solution.

NOTE: Color is inversely proportional to Microcystin concentration.

Darker color = Lower concentration

Lighter color = Higher concentration

MATERIALS PROVIDED IN THE BEACON MICROCYSTIN TUBE KIT

40 antibody coated tubes

1 vial of Negative Control (0.0 ppb Microcystin-LR)

1 vial each of 0.3 ppb, 0.8, 2.0 and 5.0 ppb Microcystin-LR Calibrator

1 vial 1.0 ppb Microcystin control

1 vial of Microcystin-HRP Enzyme Conjugate

1 vial of Microcystin Antibody Solution

1 vial of Substrate

1 vial of Stop Solution

1 vial of 100X Wash Solution

You also need these items:

- Photometer capable of reading optical density of 12 mm tubes at 450nm.
- Tape or Parafilm®
- Pipette capable of delivering 500ul.
- Watch or timer
- Laboratory grade water or deionized water.

PERFORMANCE CHARACTERISTICS

SPECIFICITY

The Beacon Microcystin Tube Kit does not differentiate between Microcystin-LR (used as kit calibrators) and other microcystin variants, but detects their presence at varying degrees. The following table shows the relative values for the percent cross-reactivity (%CR) versus Microcystin-LR.

Variant	%CR
Microcystin-LR	100
Microcystin-RR	73
Microcystin-YR	58
Microcystin-LA	2
Microcystin-LF	3
Microcystin-LW	4
Nodularin	126

PRECAUTIONS

- Store all kit components at 4°C to 8°C (39°F to 46°F) when not in use.
- Do not freeze kit components or expose them to temperatures greater than 37°C (99°F).
- Allow all reagents and samples to reach ambient temperature before you begin the test.
- Do not use kit components after the expiration date.
- Do not mix reagents or test tubes from kits with different lot numbers.
- Transfer of samples and reagents by pipette requires constant monitoring of technique. Pipetting errors are the major source of error in immunoassay methodology.
- The assay is not specific for microcystin and will react with related structures. See table in Performance Characteristics for specific information.
- Samples found to have or expected to have concentrations of microcystin greater than 5.0 ppb should be diluted prior to analysis.

SAMPLE PREPARATION

If required, samples containing live algae can be lysed before analysis to release the toxins in the cells. A simple freeze/ thaw cycle will accomplish this. Be sure the sample temperature is ambient before running in the assay.

ASSAY PROCEDURE

1. Bring all kit reagents and samples to be run to room temperature.
2. Prepare 1X wash solution by diluting the 100X wash concentrate with DI water. 1 mL concentrate per 99 mL DI water.
3. Remove the required number of anti-Rabbit IgG coated tubes from the re-sealable foil bag. Place tubes in rack and label with samples or calibrator level. Be sure to re-seal the bag with the desiccant to limit exposure of the tubes to moisture.
4. Add **500 µL of Enzyme Conjugate** to each tube.
5. Pipet **500 µL of calibrators, control or samples** into the appropriate tubes. Be sure to use a clean pipet tip for each solution to avoid cross contamination.
6. Add **500 µL of Antibody solution** to each tube.
7. Swirl the tubes rapidly to mix the contents.
8. Incubate for **20 minutes**.
9. After incubation, remove the covering and vigorously shake the contents of the tubes into a sink. Flood the tubes completely with wash solution, then shake to empty. Repeat this wash step four times for a total of five washes. Invert the rack on absorbent paper and tap out as much water as possible.
10. Add **500 µL of Substrate** to each tube.
11. Cover the tubes and incubate for **20 minutes.**
12. Add **500 µL of Stop Solution** to each tube in the same order of addition as the Substrate.

    WARNING: Stop Solution is 1N hydrochloric acid. Handle carefully.
13. Read the tubes with a spectrometer or tube reader at 450nm within 20 minutes of stopping reaction. If the reader has dual wavelength capability, read at 450nm minus 605 or 650nm.

APPENDIX 4: Water column profile

Site n°1

Date	Depth (m)	Air pressure	T°	Oxygen (mg/L)	Conductivity(mS/cm)	pH	Alkalinity(mV)
2015-06-15	1	0.9996	16.5	9.7	354.1	8.49	102.6
	2		16.4	9.62	354	8.49	103.6
	3		16.5	9.71	354.2	8.48	104.6
	4		16.5	9.64	354.1	8.48	105.6
	5		16.4	9.68	353.5	8.49	106.1
	6		16.3	9.73	353.1	8.49	107.2
	7		16.3	9.77	353.1	8.49	107.7
	8		16.3	9.67	353	8.49	108.4
	9		16.3	9.72	352.8	8.49	109.4
	10		16.3	9.62	352.8	8.49	110.1
	11		16.3	9.66	352.8	8.49	110.2
	12		16.3	9.74	352.8	8.49	110.9
	13		16.3	9.34	351.4	8.19	107.7
	14		16.3	8.92	317.5	7.71	78
2015-06-22	1	0.9906	16	9.7	349.1	8.56	111.8
	2		16	9.59	349.1	8.57	111.8
	3		16	9.58	349.2	8.57	112
	4		16	9.58	349.3	8.57	112.2
	5		16	9.36	349.2	8.57	112.5
	6		16	9.41	349.3	8.57	113
	7		16	9.48	349.3	8.58	113.3
	8		16	9.45	349.3	8.58	113.8
	9		16	9.41	349.3	8.58	114.2
	10		15.9	9.43	349.3	8.56	114.8
	11		15.9	9.23	349.4	8.56	114.9
	12		16	9.33	349.4	8.57	115.1
	13		15.9	8.97	349.5	8.54	115.9
	14		15.5	0.11	333.9	7.74	-109.3
2015-06-29	1	1.003	16.5	10.56	352.6	8.69	119.8
	2		16.5	10.35	351.8	8.7	120.5
	3		16.5	10.1	351.5	8.7	121.3
	4		16.5	10.15	351.5	8.7	122.1
	5		16.5	10.07	351.4	8.7	122.6
	6		16.5	10.01	350.5	8.7	123.1
	7		16.5	9.95	371.5	8.7	123.9
	8		16.4	9.92	353.4	8.7	124.5
	9		16.4	9.83	352.2	8.68	125.2
	10		16.2	9.19	351.7	8.64	126.7
	11		16.1	8.6	351.1	8.58	128.3
	12		16	7.97	352.6	8.47	130.5
	13		15.9	7.47	351.9	8.42	131.8
	14		15.8	2.97	347	7.96	136.1

Date	Depth (m)	Air pressure	T°	Oxygen (mg/L)	Conductivity(mS/cm)	pH	Alkalinity(mV)
2015-07-07	1	0.9961	19.7	9.74	377.3	8.56	81.5
	2		19.6	9.91	381.5	8.58	87.4
	3		19.6	9.79	382.3	8.6	93
	4		19.5	9.72	384.5	8.62	101.3
	5		19.3	9.5	335.5	8.62	108.6
	6		19.2	9.47	372.7	8.63	116.6
	7		19.2	9.33	381.2	8.64	113.7
	8		19.1	9.33	371.2	8.64	118.5
	9		18.9	9.16	371.3	8.62	120.9
	10		18.7	8.76	370.5	8.58	122.9
	11		18.6	8.54	370.1	8.55	123.6
	12		18.5	8.58	370	8.55	124.2
	13		18.5	8.04	369.8	8.49	125.1
	14		18.4	7.98	370.3	8.48	125.6
2015-07-14	1	0.9954	18.5	9.39	365.6	8.66	128
	2		18.5	9.46	365.4	8.67	129.8
	3		18.5	9.29	365.5	8.67	131.1
	4		18.3	9.16	365.1	8.63	133
	5		18.3	9.06	365.1	8.61	134.3
	6		18.3	8.83	365.2	8.6	135.1
	7		18.2	8.87	365.1	8.59	136.4
	8		18.2	8.35	365.1	8.55	137.9
	9		18.1	8.45	364.7	8.56	138.2
	10		18.1	8.12	365.1	8.52	139.5
	11		17.9	6.97	365.4	8.39	142.9
	12		17.8	6.23	365.4	8.3	144
	13		17.6	5.3	365.2	8.19	146.4
	14		17.4	0.05	355.6	7.8	-77.6
2015-07-20	1	0.9925	18.6	10.31	361.7	8.81	122.8
	2		18.6	10.29	361.7	8.81	122.9
	3		18.6	10.26	361.8	8.82	123.2
	4		18.6	10.23	361.8	8.81	123.8
	5		18.6	10.19	361.8	8.81	124.3
	6		18.6	10.05	361.7	8.8	125.1
	7		18.6	10.07	361.7	8.8	125.6
	8		18.5	10.05	361.3	8.8	126.2
	9		18.5	9.99	361.2	8.8	126.9
	10		18.5	9.9	361.2	8.7	127.6
	11		18.5	9.97	361	8.8	127.9
	12		18.5	9.93	361	8.8	128.4
	13		18.5	9.91	360.7	8.8	129.1
	14		18.5	0.06	359.1	7.9	-110.7

Date	Depth (m)	Air pressure	T°	Oxygen (mg/L)	Conductivity(mS/cm)	pH	Alkalinity(mV)
2015-07-27	1	0.9882	18.2	9.21	349	8.76	126.1
	2		18.2	8.92	349.1	8.75	127.2
	3		18.2	8.85	349.2	8.75	128
	4		18.2	8.81	349.2	8.75	128.6
	5		18.2	8.87	349.2	8.75	129.7
	6		18.2	8.53	349.2	8.75	130.6
	7		18.2	8.64	349.1	8.75	131.8
	8		18.2	8.57	349	8.74	133.1
	9		18.2	8.55	349.1	8.74	134.7
	10		18.1	8.57	349.4	8.72	135.9
	11		18.1	8.34	349.7	8.71	137.6
	12		18	7.86	350.3	8.68	138.9
	13		18	8.86	350.2	8.04	136.6
	14		18.1	1.26	350.2	7.91	138.8
2015-08-04	1	1.0009	18.5	10.87	337.7	8.76	139.4
	2		18.4	10.85	337.3	8.76	141.5
	3		18.4	10.8	337.3	8.76	142.7
	4		18.4	10.8	337.3	8.76	144.2
	5		18.4	10.71	337.4	8.75	145.5
	6		18.3	10.37	337.9	8.74	146.3
	7		18.1	9.94	338.8	8.71	148
	8		18.1	9.96	338.5	8.73	148.4
	9		17.8	8.25	341.9	8.6	151.6
	10		17.8	7.27	344.2	8.5	154
	11		17.7	7.29	344.1	8.51	153.8
	12		17.5	4.68	347.7	8.26	158.5
	13		17.4	2.09	350.3	8.03	163
	14		17.4	0.03	342.8	7.86	-101.2
2015-08-10	1	1.0044	20.3	11.84	33.7	8.86	138.1
	2		20.2	11.02	334.7	8.82	139.5
	3		20.1	10.79	335.6	8.79	140.8
	4		20	9.93	337.9	8.74	142.7
	5		19.5	8.51	339.4	8.6	146.2
	6		19.3	7.27	342.2	8.46	148.8
	7		18.7	5.03	348.6	8.2	153.7
	8		18.5	4.08	349.3	8.07	154.9
	9		18.3	2.66	350.7	7.95	156.7
	10		18.2	1.63	351.5	7.86	157.5
	11		18.1	1.33	351.7	7.81	157.2
	12		18.1	0.49	352.8	7.75	157.6
	13		18	0.25	353.9	7.74	156.8
	14		17.9	0.02	355.8	7.88	42.9

Site n°2

Date	Depth	Air pressure	T°	Oxygen (mg/L)	Conductivity(mS/cm)	pH	Alkalinity(mV)
2015-06-15	1	0.9999	16.4	9.66	353.5	8.5	136.6
	2		16.4	9.69	353.5	8.5	135.6
	3		16.4	9.63	353.3	8.5	135.1
	4		16.4	9.73	353.3	8.5	135
	5		16.3	9.62	353.3	8.5	134.4
	6		16.3	9.62	353.2	8.5	134.2
	7		16.1	9.26	351.8	8.45	134.7
	8		15.7	0.09	345.9	7.82	-49.5
2015-06-22	1	0.9913	15.9	9.44	348.8	8.55	84.3
	2		15.9	9.35	348.8	8.54	89.3
	3		15.9	9.44	348.8	8.55	92.8
	4		15.9	9.52	348.8	8.55	95.1
	5		15.9	9.39	348.8	8.56	96.7
	6		15.9	9.3	348.8	8.56	97.9
	7		15.9	9.33	348.8	8.56	99.6
	8		15.5	0.09	335.6	7.85	-82.1
2015-06-29	1	1.003	16.5	10.51	310.6	8.72	121.9
	2		16.5	10.41	351.3	8.74	122.6
	3		16.5	10.22	350.7	8.73	123.3
	4		16.5	10.34	351.1	8.72	124
	5		16.1	8.59	350.4	8.59	126.8
	6		15.9	8.09	349.9	8.53	128.3
	7		15.9	7.66	350.1	8.47	129.7
	8		15.8	0.56	351.4	8.02	134.4
2015-07-07	1	0.9957	18.4	8.68	372.7	8.37	102.5
	2		18.4	8.57	374.9	8.39	105.5
	3		18.3	8.39	374.3	8.41	109.3
	4		18.2	8.36	370.5	8.43	114.7
	5		18.2	8.4	370.3	8.48	127.5
	6		18.2	8.09	372.7	8.48	127.1
	7		18.1	7.84	367	8.45	128.4
	8		17.6	0.05	355.3	7.86	-73.9
2015-07-14	1	0.9955	18.3	9.28	364.3	8.6	129.5
	2		18.2	9.18	364	85.9	130.8
	3		18.1	8.75	363.8	8.56	132.5
	4		18.1	8.35	363.9	8.54	133.8
	5		18	8.4	364.2	8.51	135.1
	6		18	7.7	364.4	8.45	136.6
	7		17.7	5.54	364.8	8.22	140.5
	8		17.4	0.04	357.1	7.73	-142.4

Date	Depth	Air pressure	T°	Oxygen (mg/L)	Conductivity(mS/cm)	pH	Alkalinity(mV)
2015-07-20	1	0.993	18.6	9.99	362.4	8.77	135.8
	2		18.6	9.94	362.4	8.78	135.3
	3		18.6	9.64	362.4	8.78	135.3
	4		18.6	9.6	362.6	8.77	135.3
	5		18.6	9.74	362.5	8.77	135.5
	6		18.6	9.62	362.4	8.76	135.6
	7		18.6	9.35	362.6	8.75	136.1
	8		18.5	0.06	344.5	7.85	-1.4
2015-07-27	1	0.9883	18.1	9.12	348.3	8.77	117.8
	2		18.1	9.05	348.3	8.78	118.8
	3		18	9.04	348.2	8.77	120.2
	4		18	8.8	347.9	8.76	121.4
	5		17.8	8.66	346.5	8.75	123.2
	6		17.7	8.38	347	8.71	124.9
	7		17.7	8.12	347.2	8.7	125.5
	8		17.7	0.39	345.5	7.94	91.2
2015-08-04	1	1.0008	19	11.79	334.5	8.77	164.5
	2		19	11.97	333.7	8.79	163
	3		19	11.93	333.9	8.78	162.7
	4		18.9	11.7	333.6	8.78	162.5
	5		18.9	11.47	333.8	8.76	162.5
	6		18.8	11.09	334.7	8.72	163.1
	7		18.8	9.67	334.7	8.18	64.9
	8		18.8	0.12	325.4	7.76	-5.2
2015-08-10	1	1.0043	19.8	10.79	338.8	8.78	143.1
	2		19.6	9.98	339.1	8.7	143.9
	3		19.6	9.74	340	8.66	144
	4		19.6	9.26	340.9	8.62	144.4
	5		19.3	7.58	345.4	8.41	148
	6		18.7	4.49	348.3	8.05	153.1
	7		18.7	3.38	348.5	7.93	55
	8		18.6	2.44	345.4	7.79	27.9

Site n°3

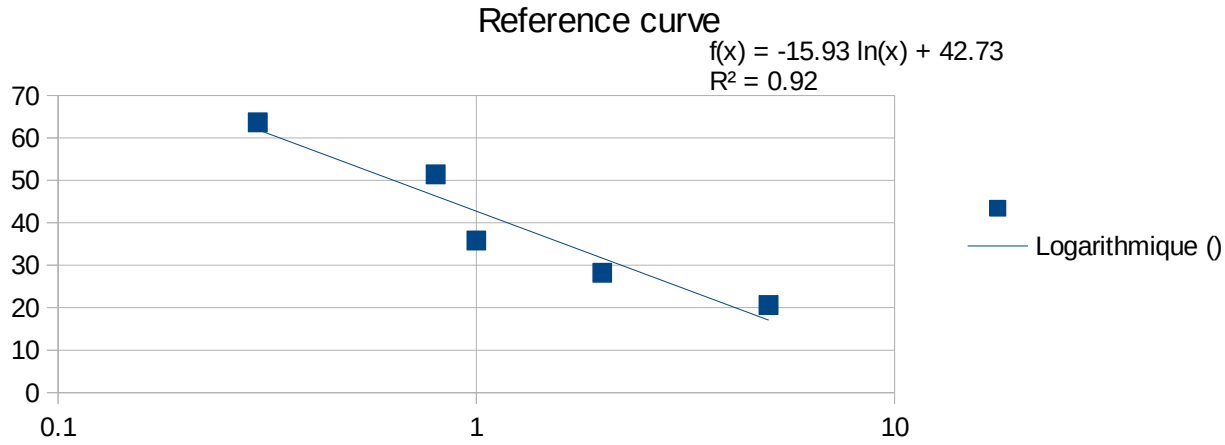
Date	Depth	Air pressure	T°	Oxygen (mg/L)	Conductivity(mS/cm)	pH	Alkalinity(mV)
2015-06-15	1	0.999	16.9	9.79	356.7	8.59	227.8
	2		16.9	9.99	356.7	8.59	213.2
	3		16.9	10.05	356.6	8.59	204.5
	4		16.9	10.04	356.8	8.59	199.9
	5		16.9	10.15	357	8.59	190.9
	6		16.9	10.08	357.1	8.6	187.2
	7		16.9	10.06	357	8.59	185.1
	8		16.9	10	357	8.59	182.1
	9		16.5	0.83	355.3	7.85	-99.2
2015-06-22	1	0.9903	16	9.45	349.4	8.57	97.2
	2		16	9.26	349.5	8.58	98.3
	3		16	9.46	349.5	8.58	99.1
	4		16	9.22	349.5	8.58	99.8
	5		16	9.12	349.5	8.58	100.5
	6		16	9.13	349.6	8.57	101.5
	7		16	9.24	349.6	8.57	102.2
	8		16	9.06	349.7	8.55	103.3
	9		15.9	8.77	350.2	8.52	104.4
	10		15.7	0.07	344.4	7.87	-114
2015-06-29	1	1.003	16.5	10.5	347.7	8.69	180.6
	2		16.5	10.21	346.8	8.7	180.3
	3		16.5	10.16	346.8	8.7	179.5
	4		16.5	10.32	347.1	8.7	179.5
	5		16.5	10.22	347.3	8.71	178.4
	6		16.4	9.95	339.4	8.69	177.6
	7		16.3	9.46	352.7	8.65	177.7
	8		16.2	9.09	349.8	8.61	177.6
	9		16	6.93	353.6	8.38	177.6
	10		15.9	0.52	346.3	7.75	-52.4
2015-07-07	1	0.9964	20.6	9.45	388.9	8.58	130.8
	2		20.6	9.31	359.4	8.59	129.2
	3		20.5	9.35	383.2	8.6	131.1
	4		20.4	9.49	382.1	8.61	132.5
	5		19.9	8.92	380.1	8.57	137.4
	6		19.8	8.24	375.6	8.51	140.7
	7		19.7	8.14	379.5	8.5	145.5
	8		19.2	8.06	374.7	8.47	148.3
	9		17.9	0.08	359.7	7.82	-91.9
2015-07-14	1	1.003	16.5	10.5	347.7	8.69	180.6
	2		16.5	10.21	346.8	8.7	180.3
	3		16.5	10.16	346.8	8.7	179.5
	4		16.5	10.32	347.1	8.7	179.5
	5		16.5	10.22	347.3	8.71	178.4
	6		16.4	9.95	339.4	8.69	177.6
	7		16.3	9.46	352.7	8.65	177.7
	8		16.2	9.09	349.8	8.61	177.6
	9		16	6.93	353.6	8.38	177.6
	10		15.9	0.52	346.3	7.75	-52.4

Date	Depth	Air pressure	T°	Oxygen (mg/L)	Conductivity(mS/cm)	pH	Alkalinity(mV)
2015-07-20	1	0.9924	18.7	9.95	362.2	8.77	176.8
	2		18.7	9.91	362	8.77	175.1
	3		18.7	9.78	362	8.77	173.5
	4		18.7	9.92	362	8.77	172.9
	5		18.7	9.86	362.1	8.77	172.3
	6		18.6	9.9	362.1	8.78	171.2
	7		18.6	9.8	362.3	8.77	170.9
	8		18.6	9.82	362.2	8.77	170.7
	9		18.5	0.07	347.8	7.74	-2.6
2015-07-27	1	0.9881	18.1	9.05	348.3	8.77	88.2
	2		18	8.72	347.9	8.74	97.8
	3		17.9	8.85	347.9	8.74	105.6
	4		17.9	8.68	348	8.73	114.7
	5		17.9	8.63	348	8.74	118.6
	6		17.9	8.53	348.2	8.74	122
	7		17.9	8.51	348.3	8.74	124.1
	8		17.9	8.36	348.2	8.73	126.3
	9		17.9	0.33	346.4	8.05	133.6
2015-08-04	1	1.001	18.1	9.53	341.4	8.68	139.8
	2		18.1	9.47	341.5	8.67	142.3
	3		18.1	9.32	341.5	8.66	144.7
	4		18	9.33	341.6	8.65	146.4
	5		17.8	8.4	343.2	8.6	149.3
	6		17.8	7.93	344.2	8.57	151.1
	7		17.7	7.65	345.1	8.54	152.2
	8		17.6	7.12	346.6	8.5	153.7
	9		17.5	1.51	339.3	7.91	-60.9
2015-08-10	1	1.0043	20.7	12.85	326.2	8.85	140.9
	2		20.5	12.48	326.2	8.81	145
	3		20.5	12.22	326.4	8.78	147.4
	4		20.1	9.72	337.5	8.63	152.8
	5		20	10.13	335.7	8.65	153.6
	6		19.7	8.66	338.6	8.56	156.4
	7		19	5.89	345.7	8.27	162.7
	8		18.2	1.92	351.6	8	169.6

APPENDIX 5 : Analyses of toxin

Toxin analyse : 2015-06-15

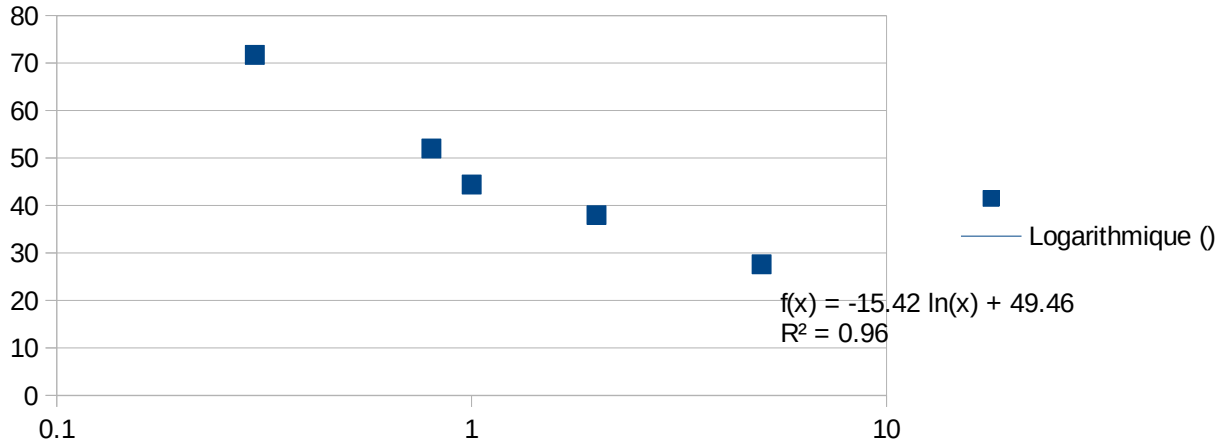
Concentration (ppb)	DO (nm)	% DO
0	2.039	
0.3	1.298	63.658656204
0.8	1.048	51.3977439922
1	0.731	35.8509073075
2	0.575	28.2000980873
5	0.42	20.5983325159



	Tubes	DO (nm)	% DO	ln X	Concentration (ppm)
Before filtration	1A	1.916	93.967631192	-3.215365892	0.040140644
	1A'	1.66	81.412457087	-2.42745953	0.0882607718
	2A	1.763	86.463952918	-2.74446873	0.0642824432
	2A'	1.66	81.412457087	-2.42745953	0.0882607718
	3A	1.891	92.741539971	-3.138421911	0.0433511559
	3A'	1.979	97.057381069	-3.409264723	0.0330655037
After Filtration	1B	2.265	111.08386464	-4.289503862	0.0137117265
	1B'	2.307	113.14369789	-4.41876975	0.0120490465
	2B	2.671	130.99558607	-5.539074108	0.0039301641
	2B'	2.563	125.698872	-5.206676112	0.0054798579
	3B	2.496	122.41294752	-5.000466244	0.0067348062
	3B'	2.515	123.34477685	-5.058943669	0.0063522661

Toxin analyse : 2015-06-15

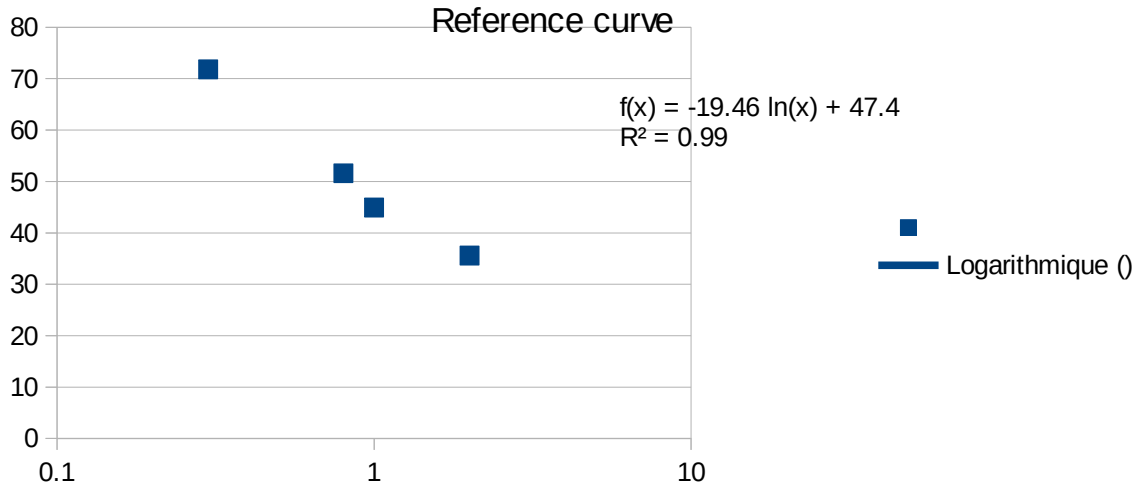
Concentration (ppb)	DO (nm)	% DO
0	2.556	100
0.3	1.833	71.7136150235
0.8	1.33	52.034428795
1	1.136	44.4444444444
2	0.971	37.9890453834
5	0.706	27.6212832551



	Tubes	DO	%DO	ln X	X (ppm)
Before filtration	1A	2.263	88.536776213	-2.534286477	0.0793182945
	1A'	2.341	91.588419405	-2.732199623	0.0650759895
	2A	2.315	90.571205008	-2.666228574	0.0695138981
	2A'	2.163	84.624413146	-2.280551673	0.1022277948
	3A	2.316	90.610328638	-2.668765922	0.0693377407
	3A'	2.208	86.384976526	-2.394732335	0.091197086
After Filtration	1B	2.589	101.29107981	-3.361461935	0.0346845153
	1B'	2.47	96.635367762	-3.059517519	0.0469103231
	2B	2.611	102.15179969	-3.417283592	0.0328014161
	2B'	2.676	104.69483568	-3.582211214	0.0278141272
	3B	2.633	103.01251956	-3.473105249	0.0310205544
	3B'	2.79	109.15492958	-3.87146889	0.0208277533

Toxin analyse : 2015-06-29

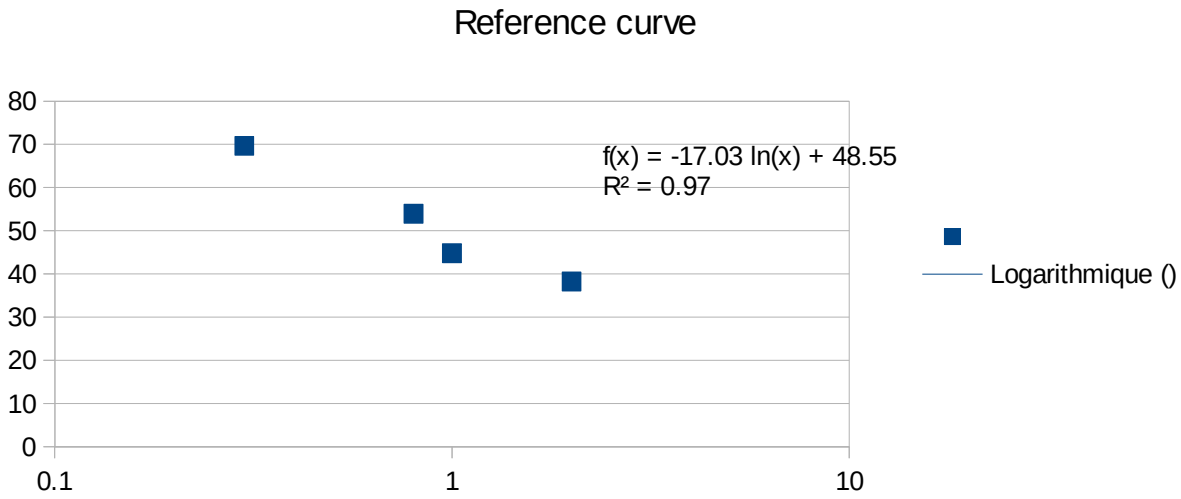
Concentration (ppb)	DO (nm)	% DO
0	2.721	100
0.3	1.954	71.8118338846
0.8	1.404	51.598676957
1	1.222	44.9099595737
2	0.968	35.5751561926



	Tubes	DO	% DO	lnX	X
Before filtration	1A	1.899	69.790518192	-1.150556884	0.3164604885
	1A'	2.72	99.963248806	-2.701260037	0.0671208846
	2A	1.942	71.370819552	-1.231775198	0.2917741609
	2A'	2.722	100.03675119	-2.705037633	0.0668678074
	3A	1.863	68.467475193	-1.082560156	0.33872722
	3A'	2.48	91.142962146	-2.247948518	0.1056156711
After Filtration	1B	2.934	107.82800441	-3.105462808	0.0448037782
	1B'	2.684	98.640205807	-2.633263309	0.0718436313
	2B	2.727	100.22050717	-2.714481623	0.066239281
	2B'	2.867	105.36567438	-2.978913342	0.0508480583
	3B	0.627	23.042998897	1.2519941642	3.4973102191
	3B'	2.838	104.29988975	-2.9241382	0.0537109601

Toxin analyse : 2015-07-07

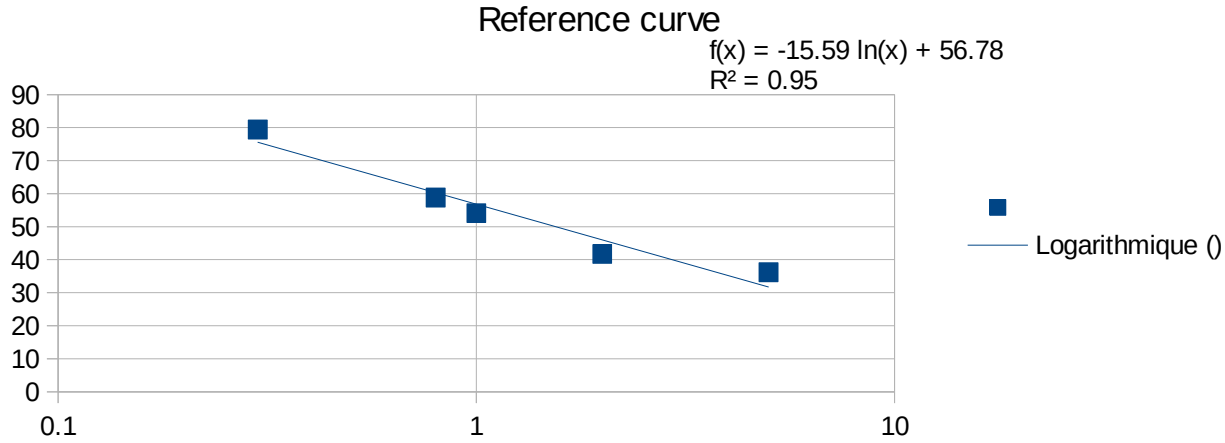
Concentration (ppb)	DO (nm)	%DO
0	2.494	100
0.3	1.737	69.6471531676
0.8	1.345	53.9294306335
1	1.118	44.8275862069
2	0.955	38.2919005613
5	0.693	27.7866880513



	Tubes	DO	%DO	lnX	X
Before filtration	1A	2.237	82.212421904	-1.976941516	0.1384921663
	1A'	2.282	83.866225652	-2.074065549	0.1256738087
	2A	2.487	91.400220507	-2.516519476	0.0807401363
	2A'	2.433	89.415656009	-2.399970637	0.0907206171
	3A	2.001	73.539140022	-1.467579922	0.2304825966
	3A'	2.16	79.382579934	-1.810751505	0.1635311962
After Filtration	1B	2.49	91.51047409	-2.522994411	0.0802190379
	1B'	1.881	69.128996692	-1.208582502	0.2986202733
	2B	2.401	88.239617788	-2.330904658	0.0972077675
	2B'	2.631	96.692392503	-2.827316381	0.0591714344
	3B	2.381	87.504593899	-2.287738421	0.1014957431
	3B'	2.725	100.14700478	-3.030197694	0.0483060874

Toxin analyse : 2015-07-14

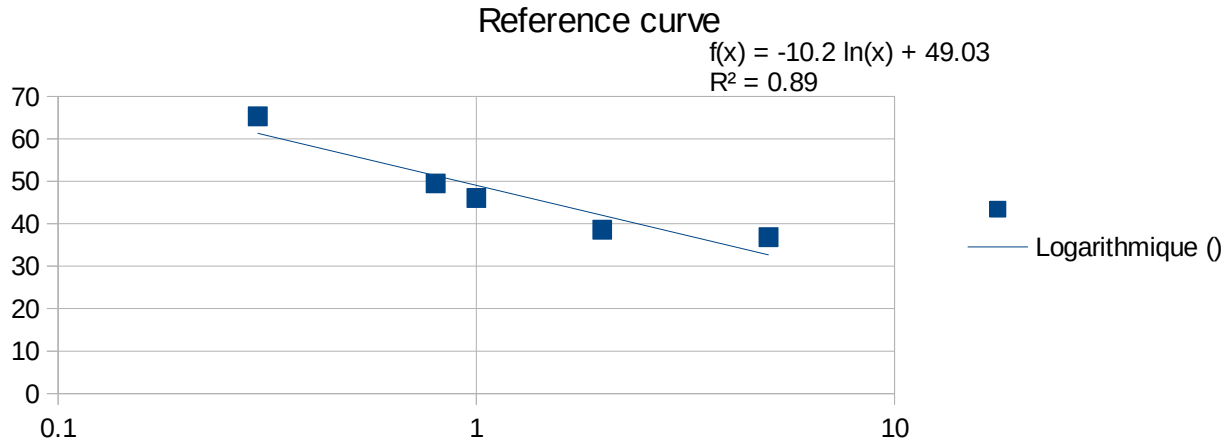
Concentration (ppb)	DO (nm)	% DO
0	2.509	100
0.3	1.619	79.4016674841
0.8	1.199	58.8033349681
1	1.103	54.0951446788
2	0.851	41.7361451692
5	0.738	36.1942128494



	Tubes	DO (nm)	% DO	ln X	Concentration (ppm)
Before filtration	1A	2.11	84.0972499	-1.752634881	0.1733166724
	1A'	2.11	84.0972499	-1.752634881	0.1733166724
	2A	1.606	64.009565564	-0.464045928	0.6287346774
	2A'	1.998	79.633320048	-1.46628178	0.23078199
	3A	1.732	69.031486648	-0.786193166	0.4555757997
	3A'	2.221	88.521323236	-2.036431258	0.1304935788
After Filtration	1B	2.538	101.15583898	-2.846912802	0.0580231737
	1B'	2.616	104.26464727	-3.046337283	0.0475327048
	2B	2.606	103.8660821	-3.020770042	0.0487636538
	2B'	2.581	102.86966919	-2.956851939	0.0519823033
	3B	2.456	97.887604623	-2.637261425	0.0715569656
	3B'	2.57	102.43124751	-2.928727974	0.0534650038

Toxin analyse : 2015-07-27

Concentration (ppb)	DO (nm)	% DO
0	2.326	100
0.3	1.519	65.3052450559
0.8	1.151	49.4840928633
1	1.071	46.0447119518
2	0.898	38.6070507309
5	0.856	36.8013757524



	Tubes	DO (nm)	% DO	ln X	Concentration (ppm)
Before filtration	1A	1.668	71.711092003	-2.223670524	0.1082111872
	1A'	1.683	72.355975924	-2.286906837	0.1015801805
	2A	1.893	81.384350817	-3.17221522	0.0419106537
	2A'	1.737	74.67755804	-2.514557564	0.0808986968
	3A	1.917	82.41616509	-3.273393321	0.0378776776
	3A'	1.882	80.911435942	-3.125841924	0.0438999576
After Filtration	1B	2.439	104.85812554	-5.474017017	0.0041943495
	1B'	2.308	99.226139295	-4.921753216	0.0072863451
	2B	2.447	105.20206363	-5.50774305	0.0040552496
	2B'	2.546	109.45829751	-5.925102717	0.0026715333
	3B	2.588	111.26397248	-6.102164394	0.0022380185
	3B'	2.595	111.56491831	-6.131674673	0.0021729389

APPENDIX 6 : Data for each site at the surface and the bottom

Site n°1 (surface)

Date		15/06/15	22/06/15	29/06/15	07/07/15	14/07/15	20/07/15	27/07/15	04/08/15
T°		16.5	16	16.5	19.7	18.5	18.6	18.2	18.5
Oxygen (mg/L)		9.7	9.7	10.56	9.74	9.39	10.31	9.21	10.87
Conductivity(mS/cm)		354.1	349.1	352.6	377.3	365.6	361.7	349	337.7
pH		8.49	8.56	8.69	8.56	8.66	8.81	8.76	8.76
Alkalinity(mV)		102.6	111.8	119.8	81.5	128	122.8	126.1	139.4
[toxins] A		0.04014	0.07931	0.31646	0.13849	0.17331	0.27449	0.10821	
UV (m^-1)		19.8	19.5	19.4	19.4	19.2	19.6	19.4	18.9
Humus/ color (m^-1)		1.13	1.26	1.16	1.27	1.37	1.88	1.9	1.85
Clorophyl A	465 nm	13.7	0.7	0.96	0.92	1.04	1.44	1.52	1.52
	665 nm	14.7	0.4	0.7	0.42	0.5	0.96	0.82	0.94
[toxins] B		0.01371	0.03468	0.0448	0.08021	0.05802	0.03848	0.00419	
UV (m^-1)		19.1	18.9	19	18.4	18.3	18.1	17.6	17.3
Humus/ color (m^-1)		0.721	0.731	0.822	0.708	0.684	0.721	0.717	0.66
Clorophyl A	465 nm	0.5	0.46	0.56	0.46	0.46	0.46	0.46	0.42
	665 nm	0.1	0.06	0.14	0.08	0.06	0.1	0.1	0.06

Site n°1 (bottom)

Date		15/06/15	22/06/15	29/06/15	07/07/15	14/07/15	20/07/15	27/07/15	04/08/15
T°		16.3	15.9	15.9	18.5	17.6	18.5	18	17.4
Oxygen (mg/L)		9.34	8.97	7.47	8.04	5.3	9.91	7.86	2.09
Conductivity(mS/cm)		351.4	349.5	351.9	369.8	365.2	360.6	350.3	350.3
pH		8.19	8.54	8.42	8.49	8.19	8.79	8.04	8.03
Alkalinity(mV)		107.7	115.9	131.8	125.1	146.4	128.4	136.6	163
[toxins] A		0.08826	0.06507	0.06712	0.12567	0.17331	0.56445	0.10158	
UV (m^-1)		19.7	19.4	19.3	19.4	19	19.7	19.4	20.8
Humus/ color (m^-1)		1.1	1.13	1.06	1.22	1.3	1.92	1.91	3.35
Clorophyl A	465 nm	17.5	0.7	0.78	0.9	1.04	1.56	1.6	2.26
	665 nm	18.8	0.34	0.24	0.34	0.42	0.96	0.88	1.6
[toxins] B		0.01204	0.04691	0.07184	0.29862	0.04753	0.04231	0.00728	
UV (m^-1)		19.1	18.9	18.8	18.5	18.3	18	17.6	17.5
Humus/ color (m^-1)		0.749	0.724	0.762	0.692	0.715	0.715	0.714	0.745
Clorophyl A	465 nm	0.4	0.46	0.48	0.44	0.46	0.46	0.46	0.5
	665 nm	0	0.08	0.08	0.06	0.08	0.1	0.08	0.1

Site n°2 (surface)

Date		15/06/15	22/06/15	29/06/15	07/07/15	14/07/15	20/07/15	27/07/15	04/08/15
T°		16.4	15.9	16.5	18.4	18.4	18.6	18.1	19
Oxygen (mg/L)		9.66	9.44	10.51	8.68	8.68	9.99	9.12	11.79
Conductivity(mS/cm)		353.5	348.8	310.6	372.7	372.7	362.4	348.3	334.5
pH		8.5	8.55	8.72	8.37	8.37	8.77	8.77	8.77
Alkalinity(mV)		136.6	84.3	121.9	102.5	102.5	135.8	117.8	164.5
[toxins] A		0.06428	0.06951	0.29177	0.08074	0.62873	0.24121	0.04191	
UV (m^-1)		19.7	19.6	19.4	19.4	19	19.9	19.1	18.9
Humus/ color (m^-1)		1.08	1.2	1.17	1.25	1.26	2.01	1.68	1.91
Clorophyl A	465 nm	15.7	1.6	0.92	0.98	0.92	1.56	1.42	1.48
	665 nm	18.2	0.3	0.4	0.4	0.42	0.82	0.8	1
[toxins] B		0.00393	0.0328	0.06623	0.0972	0.04876	0.02904	0.00405	
UV (m^-1)		19.2	19.2	18.8	18.6	18.2	17.9	17.6	17.3
Humus/ color (m^-1)		0.752	0.843	0.729	0.7	0.687	0.669	0.699	0.737
Clorophyl A	465 nm	0.4	0.54	0.46	0.44	0.42	0.42	0.44	0.5
	665 nm	0	0.16	0.06	0.08	0.06	0.06	0.08	0.12

Site n°2 (bottom)

Date		15/06/15	22/06/15	29/06/15	07/07/15	14/07/15	20/07/15	27/07/15	04/08/15
T°		16.1	15.9	15.9	18.1	17.7	18.6	17.7	18.8
Oxygen (mg/L)		9.26	9.33	7.66	7.84	5.54	9.35	8.12	9.67
Conductivity(mS/cm)		351.8	348.8	350.1	367	364.8	362.6	347.2	334.7
pH		8.45	8.56	8.47	8.45	8.22	8.75	8.7	8.18
Alkalinity(mV)		134.7	99.6	129.7	128.4	140.5	136.1	125.5	64.9
[toxins] A		0.08826	0.10222	0.06686	0.09072	0.23078	0.37648	0.08089	
UV (m^-1)		19.6	19.5	19.1	19.4	19	19.7	19.4	18.9
Humus/ color (m^-1)		1.04	1.3	0.966	1.27	1.3	1.9	1.9	1.93
Clorophyl A	465 nm	12.7	0.4	0.72	0.9	0.94	1.72	1.48	1.44
	665 nm	17.4	0.3	0.24	0.42	0.42	0.84	0.78	0.98
[toxins] B		0.00547	0.02781	0.05084	0.05917	0.05198	0.02912	0.00267	
UV (m^-1)		19.2	19	18.8	18.6	18.2	18	17.8	17.2
Humus/ color (m^-1)		0.749	0.792	0.751	0.716	0.733	0.732	0.761	0.712
Clorophyl A	465 nm	0.4	0.5	0.48	0.46	0.46	0.46	0.5	0.46
	665 nm	0	0.1	0.08	0.08	0.1	0.1	0.12	0.1

Site n°3 (surface)

Date		15/06/15	22/06/15	29/06/15	07/07/15	14/07/15	20/07/15	27/07/15	04/08/15
T°		16.9	16	16.5	20.6	16.5	18.7	18.1	18.1
Oxygen (mg/L)		9.79	9.45	10.5	9.45	10.5	9.96	9.05	9.53
Conductivity(mS/cm)		356.7	349.4	347.7	388.9	347.7	362.2	348.3	341.4
pH		8.59	8.57	8.69	8.58	8.69	8.77	8.77	8.68
Alkalinity(mV)		227.8	97.2	180.6	130.8	180.6	176.8	88.2	139.8
[toxins] A		0.04335	0.06933	0.33872	0.23048	0.45557	0.27528	0.03787	
UV (m^-1)		19.8	19.5	20.5	19.5	19.4	19.6	19.4	19.1
Humus/ color (m^-1)		1.13	1.18	2.04	1.31	1.48	1.85	1.89	1.96
Clorophyl A	465 nm	12.4	0.8	1.94	1.04	1.16	1.58	1.4	1.58
	665 nm	20.5	0.2	1.66	0.52	0.72	0.78	0.84	0.88
[toxins] B		0.00673	0.03102	0.34973	0.10149	0.07155	0.02204	0.00223	
UV (m^-1)		19.3	19	18.9	18.4	18.3	18	17.8	17.6
Humus/ color (m^-1)		0.763	0.77	0.733	0.704	0.689	0.699	0.693	0.783
Clorophyl A	465 nm	0.6	0.46	pas assez eau	0.44	0.46	0.44	0.44	0.54
	665 nm	0.2	0.08	0.08	0.08	0.08	0.08	0.08	0.16

Site n°3 (bottom)

Date		15/06/15	22/06/15	29/06/15	07/07/15	14/07/15	20/07/15	27/07/15	04/08/15
T°		16.9	15.9	16	19.2	16	18.6	17.9	17.6
Oxygen (mg/L)		10	8.77	6.93	8.06	6.93	9.82	8.36	7.12
Conductivity(mS/cm)		357	350.2	353.6	374.7	353.6	362.2	348.2	346.6
pH		8.59	8.52	8.38	8.47	8.38	8.77	8.73	8.5
Alkalinity(mV)		182.1	104.4	177.6	148.3	177.6	170.7	126.3	153.7
[toxins] A		0.03306	0.09119	0.10561	0.16353	0.13049	0.21814	0.04389	
UV (m^-1)		19.9	19.4	19.5	19.2	19	19.6	19.2	19
Humus/ color (m^-1)		1.23	1.13	1.1	1.13	1.26	1.84	1.72	1.91
Clorophyl A	465 nm	10.2	0.8	0.78	0.88	1	1.48	1.48	1.54
	665 nm	18.4	0.4	0.28	0.36	0.46	0.82	0.84	0.86
[toxins] B		0.00635	0.02082	0.05371	0.0483	0.05346	0.01855	0.00217	
UV (m^-1)		19.4	19.1	19	18.6	18.3	17.9	17.9	17.4
Humus/ color (m^-1)		0.893	0.853	0.77	0.816	0.753	0.689	0.778	0.687
Clorophyl A	465 nm	0.6	0.56	0.5	0.56	0.5	0.44	0.54	0.44
	665 nm	0.2	0.18	0.1	0.16	0.12	0.08	0.18	0.08

ABSTRACT

The Vomb's lake situated in Scania in the South of Sweden is a tank of water used by Sydvatten for the drinking water. This one is subject to an eutrophication phenomenon which is really dangerous for the environment but also for the drinking water consumer's health. This phenomenon is lead by a phosphorus excess which generally come from sewage water and especially from the agriculture. Indeed on the catchment area of the lake, 72% of it surface are agricultural lands. The eutrophiaction can leads to a huge growth of algal which is called bloom. It is a real issue because these algal released their toxin in the water after their death.

The aim of the project is to determine the toxin concentration and caraterize as much as possible the living conditions of Cyanobacteria.

In order to realise this project a huge number of parameters and samples have been done during the summer. However the weather was really bad and the Cyanobacteria grow was not further, during the entire stage only low toxin concentration have been found. But it is possible to see an evolution of the Cyanotoxin's growth when the temperature and the sun are more present. In spite of these bad conditions, the lake is suitable to the eutrophication phenomenon, Sydvatten has to be vigilant about the evolution of toxins.

RESUME

Le lac de Vombsjön, situé en Scanie dans le sud de la Suède est un réservoir d'eau potable utilisé par Sydvatten. Ce dernier est sujet à un phénomène d'eutrophisation qui peut être réellement nocif aussi bien pour l'environnement que pour la santé des consommateur de cette eau. Ce phénomène est lié à un excès de phosphore qui provient en général des eaux usées mais surtout de l'agriculture. L'agriculture est grandement présente puisque les terres agricoles correspondent à 72% de la surface du bassin hydrographique du lac. L'eutrophisation peut amener à un développement massif d'algue appelé bloom, ceci est un réel problème car ces algues relâchent des toxines dans l'eau principalement lors de leurs mort.

Ce projet a pour but de déterminer la concentration en toxine présente dans le lac mais aussi d'essayer de caractériser au mieux l'es conditions de vie des Cyanotoxines.

Pour cela un grand nombre de paramètres et de prélèvements ont été effectués durant l'été. Cependant les conditions météorologiques n'étaient pas favorable pour le développement des Cyanobactéries, de faibles concentrations en toxines ont été obtenues durant la totalité du stage. Il est tout de même possible de voir que la température et la présence du soleil ont un impact important sur la croissance des Cyanotoxines. Malgré les mauvaises conditions il a été possible d'observer que le lac était propice au phénomène d'eutrophisation, il faut donc que Sydvatten reste vigilant quand à l'évolution de ce dernier.