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Aquatic plants and their influencing factors

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Abstract

River ecosystems play a crucial role in the environment, and it is therefore essential that the nutrient concentrations in rivers are adequate for aquatic plant growth. By studying the water transparency, nitrate and phosphorus concentrations, and investigating the presence of aquatic plant cells in the rivers Berkel and IJssel, the influence of water transparency and the aforementioned essential nutrients on the growth of aquatic plants was studied. The experiments were performed in the IJssel river, a river with strong current, as well as in the river Berkel, which is calmer.

The goal of the research was to investigate which of the factors have the most influence on plant growth. Water transparency was measured using a Secchi disk and water samples were collected from both rivers in order to research the level of nitrate and phosphorus using test kits, and the amount of aquatic plant cells using the Telkamer of Bürker Türk method. The weather and environment at the study sites were also accurately observed.

In the Berkel river, when the phosphorus and nitrogen levels dropped, so did the amount of plant cells. However, in the IJssel river, when the concentration of phosphorus dropped, the amount of plant cells rose. There was no visible connection with the nitrogen levels. Due to these contradicting results, no conclusion was drawn.

Although our research was inconclusive, it provides a significant starting point for future studies and gives insight into the influence of nutrient concentrations and water transparency on the presence of aquatic plants in the IJssel and Berkel. To confirm the results obtained, future research is needed over a longer period of time and using standardised and more accurate methods. Furthermore, research could be done to investigate the cause of contradicting results.

Key words: plant cells, nitrogen, phosphorus, water transparency

Introduction:

The world is getting more and more developed regarding technology. Machines and electronics are becoming increasingly advanced. The use of chemical fertilisers and pesticides has increased enormously to meet the high demand of food supply needed for the world population.[1] However, people also start recognising the effects of the production and usage of these technological items.

Pollution has recently been a primary concern for most countries [2,3]. This is not a big surprise though. Pollution has devastating effects on the environment and affects all organisms, humans including[4]. Air pollution leads to a stronger greenhouse effect, which causes the global temperature to rise. Ground pollution can poison land, making it more difficult to grow crops. Sea pollution lowers the quality of the water, making it more difficult for sea life to survive, and can alter underwater sea currents.

A form of pollution, which seems to get less attention than the rest, is river pollution. When it rains, fertilisers and pesticides from farmlands stream into the rivers. This heavily affects the plant life within these rivers. Both pesticides and fertilizer can change the nutrient balance in the water, which can help the aquatic plants to grow. However, this does much more harm than good[5].

When aquatic plant growth starts to increase rapidly, it can cause the plants to choke river life, like fish, and cause the plants (that dwell in the lower levels of the rivers) to die. Two major nutrients that are important to plant growth are nitrogen and phosphorus, nutrients that are prevalent in fertilizers. The amount of these nutrients therefore influences the population of plant life in rivers. The quantity of these nutrients differ from river to river due to having different sources, and going through different terrain. Prime examples of such contrasting rivers are the Berkel and the IJssel. The IJssel being a wide river with strong current, the Berkel being a calmer, meandering river.

In order to learn what the effects of fertilizers and pesticides to rivers are, the effect of the two major nutrients on plant growth must be known.

The research that was conducted was to see the effect of certain major nutrients on the growth of aquatic plants. This was done by collecting water samples from the aforementioned rivers, the Berkel and IJssel, and putting each sample through multiple tests to measure the amount of nitrogen and phosphorus, and the population of plants. The transparency of the water was also measured, as this contributes to indicating the concentration of various nutrients in the river. The results were then used to see what the correlation is between the amount of nutrients in the river and the growth of aquatic plants. This is essential to discover possible pollution or increased or unbalanced nutrient concentrations.

Research and knowledge on the factors influencing the growth of aquatic plants also give an idea of the water quality of the rivers and can contribute to keeping watch on the rivers' water quality. Rivers are an essential part of ecosystems, which means that they must be safeguarded to keep the environment balanced. Additionally, this research is of great importance as it serves as a starting point for measurements in the future to keep track of developments and to discover seasonal changes and long-term trends.

Finally, this research was conducted to increase understanding of the effects of differences in factors influencing the growth of aquatic plants in rivers.

Background information:

In order to conduct research, certain knowledge regarding aquatic plants, nitrogen, phosphorus, water transparency, and the rivers Berkel, and IJssel must be known.

AQUATIC PLANTS

Aquatic plants are known for living in a watery environment, either in freshwater or saltwater. They are also called ‘aquatic macrophytes’ (aquatic photosynthetic organisms), or hydrophytes. The plant must be fully immersed in the water, or at least floating on it, for it to be an aquatic plant. An example of this is a water lily, it floats partially on the surface of the water.

There are many different groups that these plants are categorised in (morphology= study of shape) but the four main types of them include: marginal, deep water, floating and oxygenating plants. Another group of classification is as followed: Amphicytes, Elodeids, Isoetids, Halophytes, Nymphaeids and Pleuston.

The depth and the speed of the water flowing has a lot of influence on the distribution of these plants across rivers, lakes, ponds etc. The concentration of nutrients, salinity and other factors also have influence on the amount/growth of aquatic plants in a certain area. [6 until 11]

NITROGEN

Nitrogen is converted into ammonia by rhizobium in the roots of plants which is converted into nitrates again by nitrifying bacteria. Plants use these nitrates to make essential proteins [12].

Nitrogen plays a central role in plant productivity because it is a major component of amino acids, proteins, nucleic acids, and chlorophyll[13].

Organic N commonly constitutes 1.5 to 5% of the dry weight of plants, although there is some variation with age, species, and plant organ. In leaves and stems approximately 60% of the N is present as enzyme or membrane protein and most of the remainder is in the form of free amino acid nitrogen[14]. In seeds over 90% of the N is in the form of storage proteins [15].

PHOSPHORUS

Phosphorus serves as one of the most essential elements for aquatic plants. This nutrient is present in all living plant cells and is involved in major processes. [16]

Phosphorus is part of nucleotides which make up the sugar-phosphate backbone of nucleic acid structures like DNA and mRNA. As phosphorus is incorporated in the genetic material of plants, it contributes to the regulation of protein synthesis and is therefore important in cell division and the development of tissues. Phosphorus is also a component of the chemical structure of the crucial ATP molecules which are involved in photosynthesis and associated with complex energy transmissions. In addition, phosphorus supports the development and growth of a plants’ roots which are required to take up nutrients and improve the storage and transportation of elements throughout the cell [17 & 18].

Plants require an abundance of phosphorus elements during the early periods of rapid growth. As phosphorus’ functions cannot be performed by any other nutrient, a too little amount of this nutrient is clearly visible.

A deficit in phosphorus causes a decrease in size of leaves, less rapid growth and underdevelopment. A plant will not develop proper roots and will not fully mature if it is not provided with enough phosphorus. A plant will also take on a dark green colour which is

caused by the buildup of carbohydrates that cannot be transformed because of the limited amount of available phosphorus. [19]
Plants mostly absorb phosphorus in the form of phosphate ions H_2PO^{4-} or HPO_4^{2-} via the roots and store the nutrient inside the plant or transport the element to the upper part of the plant. Phosphorus is often one of the nutrient elements that is shortest on supply in natural waters. The concentration of available phosphorus therefore influences the growth of plants in aquatic environments. [21 until 23]

WATER TRANSPARENCY

Water can become less transparent due to particles that are present in the water. If light intensity decreases, there is a possibility of less photosynthesis, which results in the amount of organisms living in the sea. Photosynthesis($6CO_2 + 6H_2$) ---(light)--> $C_6H_{12}O_6 + 6O_2$) is important for plant growth because it produces glucose which is needed to grow and reproduce.
Less light intensity will cause a decrease in growth of aquatic plants which can affect a complex food chain fundamentally. Therefore, water transparency is essential and often used as an indicator of water quality. [24 until 26]

RIVER IJSSEL

This river is branched from the well-known Lower Rhine. The river itself splits south of Westervoort, also known as the IJsselkop which is east of Arnhem. It flows into the IJsselmeer (Lake of IJssel), which borders North Holland, Flevoland and Friesland.

The IJssel passes through a lot of industrial territory and farming regions, which can possibly cause unbalanced concentrations of nutrients and other particles in the IJssel. It discharges around 300 m3/s.

Even with its big surface, in the winter when the temperature is cold enough the water can freeze, of course. This has influence on the water level, because the ice (and snow) melt once the temperature goes up again. [27]

RIVER BERKEL

The river Berkel flows through Germany and the Netherlands. It's main source is Westphalia, in Germany. It joins the IJssel in Zutphen after approximately 115 kilometers. The basin is 850 square kilometers.
The Berkel used to be a shipping and transportation route for resources and foods from Munster to Borculo and Zutphen. The boats however were not that big, they were flat bottomed and are called “Berkelzompen”. About 60 years ago, the river Berkel was channelized because there was a danger for a flood, so they changed it to avoid flooding and to improve drainage. The towns that the river flows near to are Billerbeck, Coesfeld, Gescher, Stadtlohn, Vreden, Eibergen, Borculo, Lochem, Almen, Warnsveld and Zutphen.
The Berkel is also near Almen, which is where the measurements for this research have taken place. It is located in the middle of a agricultural environment, and nature reserves. The landscape of Almen is a bocage. This means that the environment consist primarily out of hedgerows and hedges. [28 until 31]

Research questions

1. What is the connection between the factors influencing the growth of aquatic plants available and the presence of aquatic plants in the Berkel and IJssel?

1.1 What is the difference in the level of nitrogen between the river Berkel and the river IJssel?

1.1.1 What is the level of nitrogen in the river Berkel?

1.1.2. What is the level of nitrogen in the river IJssel?

1.2 What is the difference in the level of phosphorus between the river Berkel and the river IJssel?

1.2.1 What is the level of phosphorus in the river Berkel?

1.2.2. What is the level of phosphorus in the river IJssel?

1.3 What is the difference in the level of transparency between the river Berkel and the river IJssel?

1.3.1 What is the level of transparency in the river Berkel?

1.3.2. What is the level of transparency in the river IJssel?

1.4 What is the difference in the amount of aquatic plants between the river Berkel and the river IJssel?

1.4.1 What amount of aquatic plants is present in the river Berkel?

1.4.2 What amount of aquatic plants is present in the river IJssel?

Hypothesis

Sub questions
If there would be a difference in the level of nitrogen between the river IJssel and Berkel then the river Berkel would have a higher nitrogen level as nitrogen is present in fertilizer and there is more agriculture around the Berkel. [32 until 34]

If there would be a difference in the level of phosphorus between the river IJssel and Berkel then the river Berkel would have a higher level of phosphorus as it is present in fertilizer and there is more agriculture around the Berkel. [35 until 42]

If there is a difference in the level of transparency between the river Berkel and the river IJssel then the river IJssel would be more transparent as it has an higher current and there will be less pollution from agriculture. [41&42]

If there is a difference in the amount of aquatic plants between the river IJssel and the river Berkel than the river Berkel will have an higher amount of aquatic plants as there is more phosphorus and nitrogen present. [43]

Main question
If there is limited phosphorus in the IJssel, then the plants in the Ijssel will have less leaf expansion and surface area, as well as less leaves in general. Phosphorus plays an important role in cell division. It is a component of the complex nucleic acid structure in plants, which regulates the *protein synthesis**, and is therefore important to the development of new tissue and cell division.

*Protein synthesis is made up of two steps, transcription and translation. Transcription is the process of rewriting parts of DNA in the form of mRNA. Translation is the translating the mRNA code into proteins through tRNA. This is directly correlated to plant growth.

If there is limited nitrogen in the IJssel, then there will be less plants, and they will be smaller. Nitrogen is converted to ammonia by rhizobium, which is converted to nitrates again by nitrifying bacteria. Plants use these nitrates to make proteins, and proteins are the food source for plants. When there is more nitrogen, then more proteins will be made, which will cause more larger plants to grow. Therefore, when there is limited nitrogen in the Berkel, then there will be less plants, and they will be smaller.

If the water in the IJssel is more transparent, then there will be more plants in the water, and they will be bigger in the IJssel. Sunlight is essential for the process of photosynthesis, and without it, the growth of plants will be hindered, and it will be harder for younger plants to grow. Sunlight will be able to shine on the bottom of the river bed with transparent water, meaning all the plants will have access to sufficient sunlight.
When the water is transparent, then there will be more plants in the water, and they will be larger.

Materials

1. Transparency
- Secchi disk

2. Nitrogen test
- nitrate test kit
- test tube rack
- 4 test tubes
- test tube stopper
- 2 bottles with sample water from the IJssel
- 2 bottles with sample water from the Berkel
- stopwatch

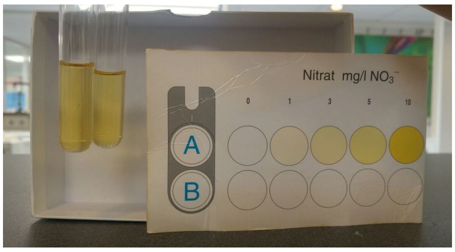
3. Phosphorus test
- phosphorus test kit
test tube rack
- 4 test tubes
- test tube stopper
- 2 bottles with sample water from the IJssel
- 2 bottles with sample water from the Berkel
- stopwatch

4. Aquatic plant count
- microscope with camera
- Coverslip
- pasteur pipet
- a bottle with sample water from the Berkel
- a bottle with sample water from the IJssel
- demi-water
- lens cloth
- kitchen roll
- computer
- usb stick
- paper
- DinoCapture Imaging Software
- Telkamer of Bürker Türk

Methods:

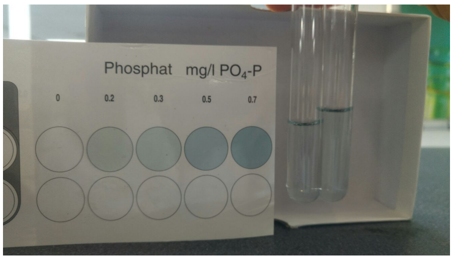
Collecting water sample
Four plastic bottles (0.5 Litres) were cleaned several times with normal water, then the bottles were closed and per sample location two bottles were brought. At the sample location a suitable place near the river was chosen and the bottle was put underwater just about 20 cm near the coast. Once the bottle was fully underwater the cap was taken off and the bottle was filled. Only when the bottle was fully filled and there were no air bubbles visible anymore the bottle was closed underwater. Only then the bottle was taken out of the water and brought to the lab on school. This was repeated so there were two bottles of samples per location.

Nitrogen [43]
A sample of 5 mL was taken out of one of the IJssel water bottles by using the plastic syringe. That sample was put into a test tube. This process was repeated for the other IJssel water bottle and the two Berkel water bottles. 5 drops of the first solution, which was labeled NO_3^{-1}, were put into all the test tubes, with the water from the rivers in it. Each solution was mixed for 30 seconds by hand (the top of the test tube was kept on the same place while the bottom turned around). One level measuring spoonful of NO_3^{-2} was added into each individual test tube. The mixture was immediately shaken for 1 minute on the same way as described before. The mixture was left alone for 5 minutes, and placed next to the paper with the indicator colours as shown in the picture on the side. The number above the colour indicated the amount of nitrate mg/l. The colour of the mixture and the colours on the paper were matched, then the results were recorded.



An example of the nitrate test.

Phosphorus [43]
A sample of 5 mL was taken out of one of the IJssel water bottles by using the plastic syringe. That sample was put into a test tube. This process was repeated for the other IJssel water bottle and the two Berkel water bottles. 6 drops of the first solution, which was labeled PO_4^{-1}, were put into all the test tubes, with the water from the rivers in it. Each solution was mixed for 30 seconds by hand (the top of the test tube was kept on the same place while the bottom turned around). Afterwards, 6 drops of PO_4^{-2} were dropped into each individual test tube. The mixtures were mixed for 1 minute by hand (the top of the test tube was kept on the same place while the bottom turned around), and left alone for 10 minutes. They were placed next to the indicator paper as shown on the picture on the right. The number above the colour indicated the amount of phosphate mg/l. The colour of the mixture and the colours on the paper were matched, then recorded.



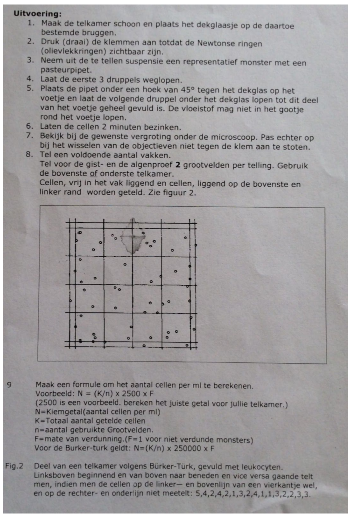
An example of the phosphate test.

Water transparency [26]

The petri dish was thrown into the water while holding the stick, this was done a few meters from the coast in the IJssel and from a bridge in the Berkel. The rod was put underwater, until the disk was not visible anymore for the naked eye. The rope was pulled back up, and while this was done the knots were counted. Each knot was 10cm apart from each other, so the knots counted were multiplied by 10cm. The results were then recorded. The results were compared from the Berkel and the IJssel, and the one which had more visible cm, had a higher water transparency.

Counting plants

The counting platform was cleaned by flushing demi-water over it and it was then tapped on with kitchen roll to get the most water of and then the last bits of water were taken off using a lens cloth. The coverslip was softly placed on the counting slip, while one side was on the counting slip the other was softly dropped down. The bridges were put on the counting slip and then they were turned and pushed, until the newton rings were visible. After the bottles sample water were shaken, a sample was taken out of the Berkel water bottles using a Pasteur pipette. The first 3 drops were spilled, on purpose. The pipette was placed on a 45 degree angle onto the counting platform. The pipette continued to drop water, until the counting platform was full. The platform was left alone for 2 minutes, so that the cells could settle in. The computer was turned on and the program (dinocapture) with which the microscope was connected was turned on. The lens was turned so the picture on the screen was horizontal. The microscope was used to find the square in which the cells were counted this was the square where all the little square were closed. 3 big fields were counted. The cells were counted and recorded. The number of cells present were calculated using a formula. The results were then recorded.



Uitvoering:

1. Maak de telkamer schoon en plaats het dekglaasje op de daartoe bestemde bruggen.
2. Druk (draai) de klemmen aan totdat de Newtonse ringen (olievlekkringen) zichtbaar zijn.
3. Neem uit de te tellen suspensie een representatief monster met een pasteurpipet.
4. Laat de eerste 3 druppels weglopen.
5. Plaats de pipet onder een hoek van 45° tegen het dekglas op het voetje en laat de volgende druppel onder het dekglas lopen tot dit deel van het voetje geheel gevuld is. De vloeistof mag niet in het gootje rond het voetje lopen.
6. Laten de cellen 2 minuten bezinken.
7. Bekijk bij de gewenste vergroting onder de microscoop. Pas echter op bij het wisselen van de objectieven niet tegen de klem aan te stoten.
8. Tel een voldoende aantal vakken.
   Tel voor de gist- en de algenproef **2** grootvelden per telling. Gebruik de bovenste of onderste telkamer.
   Cellen, vrij in het vak liggend en cellen, liggend op de bovenste en linker rand worden geteld. Zie figuur 2.

9 Maak een formule om het aantal cellen per ml te berekenen.
Voorbeeld: $N = (K/n) \times 2500 \times F$
(2500 is een voorbeeld. bereken het juiste getal voor jullie telkamer.)
N=Kiemgetal(aantal cellen per ml)
K=Totaal aantal getelde cellen
n=aantal gebruikte Grootvelden.
F=mate van verdunning.(F=1 voor niet verdunde monsters)
Voor de Burker-turk geldt: $N=(K/n) \times 250000 \times F$

Fig.2 Deel van een telkamer volgens Bürker-Türk, gevuld met leukocyten. Linksboven beginnend en van boven naar beneden en vice versa gaande telt men, indien men de cellen op de linker— en bovenlijn van een vierkantje wel, en op de rechter- en onderlijn niet meetelt: 5,4,2,4,2,1,3,2,4,1,1,3,2,2,3,3.

Results:

Observations

Date	Berkel	IJssel
06-03	It was an hour after sunrise, there was a bit of wind, and it was approximately 4 degrees outside. The weather was cloudy. For multiple days before the measurements there was frost. The berkel was wide and the water level was quite high. The river had flooded a bit, and you could hear a few birds chirp. The transparency was 65 cm down	It was an hour after the sun had risen, there was a light breeze. There was no sunlight, seeing as it was very cloudy. It was 3 degrees celsius outside of the water, but the water was ice cold. The flow of the river was slower than usual. The transparency was 110 cm down.
20-03	There was a bit of wind, just as last time. The flow was as usual. The sun was ⅛ of the round, it was strong, but it was not warm. It was 2 degrees, and the day before the measurements there was frost. It was a clear day, with a clear sky. The farmland was not ingested yet, and there were a few sheep across the land. There were a few birds on the water, and you could hear the birds. There was no garbage, but you could smell the fertilizer. The measurements were taken 8 meters from the riverbank. This time the transparency was 80 cm deep.	The night had frost, which meant that it was cold. It was about 2 degrees celsius. The weather was clear, there were no clouds and the sun was visible, however not very strong. There was a light breeze, but not a lot of wind for the ijssel. The water was higher than normal, the other place was flooded, so the measurements were taken a meter backwards towards the coast . 2 boats had just passed by, which can explain the higher waves, but the current was also stronger than usual. 60 cm down
27-03	There was a tiny bit of wind, you could hardly feel it. There was a regular flow in the berkel; however, there was slag on the water. The farmland had not changed. Yet again you could hear a few birds. It was 3 degrees. The measurements were taken half past 8, and it was cloudy, a bit misty, no sun, and pretty cold. The day before there was a lot of mist. There was no cattle this time. The water was about 20 cm lower that usual, so the measurements were a few metres to the left. It was 105 cm deep.	It was cloudy, the apparent air temperature was high. The wind was still, that explained the weak flow of the river. There was a regular amount of birds chirping. There was no flood this time. It was 2 degrees, and it was misty. The estimate of the knots was 6, seeing as the disk was not present.

28-03	There was no data for this day that was written down.	The water transparency was measured at 12 o'clock at noon, with 10 degrees. It had 7 knots, which means 70 cm downwards. The weather was the same as the day before; however, the water was slightly higher than the day before. There was a slight stronger wind than the 27th of march.
3-04	There was just a bit of wind. The weather was cloudy but the sun started to shine too at about a sixth of its round. There was only just a bit of wind. There was a low flow, but yet again there was slag in the water. The farmlands were still not in use. You could hear the birds, but they were not visible. It was 11 degrees outside. Yesterday was a nice day, it was sunny, and it was a bit colder, which explained the frost during the night. It was 100 cm down with the disk.	The weather was pleasant. There were a few clouds in the sky, a light breeze, but not so much sun. The water level was a bit higher than normal, but the rest was as the usual. The temperature seemed high, as it was only 5 degrees. The transparency was 80 cm downwards.

The images above show where along the river IJssel the measurements were done.

The images above show where along the river Berkel the measurements were done.

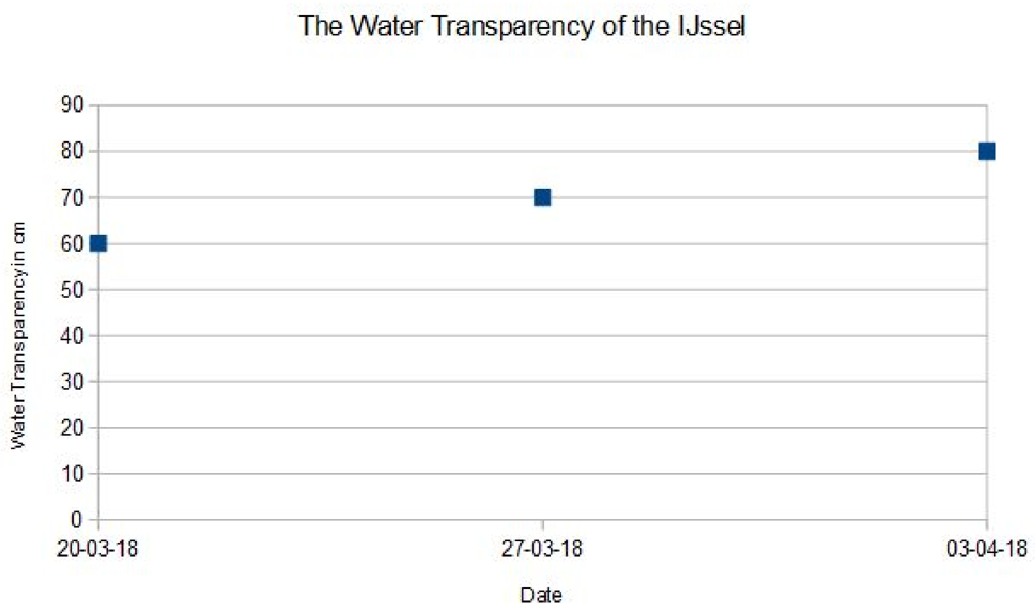
The image above shows the distance between the two measuring locations.

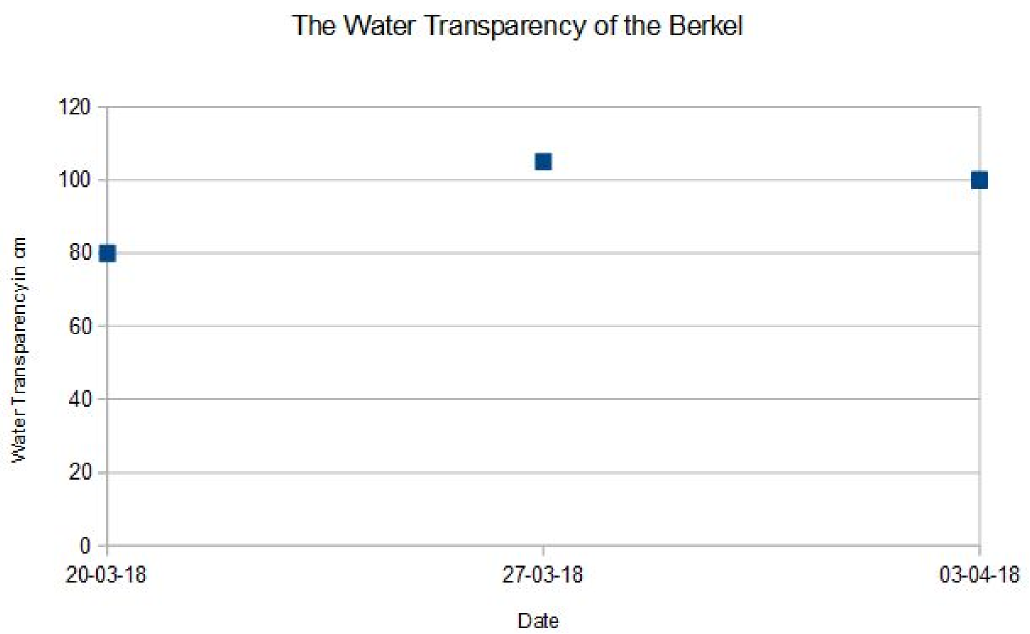
Results:

<u>Water transparency (secchi disk):</u>

	IJSSEL in cm	**BERKEL in cm**
WEEK 1: 20-03	60	80
WEEK 2: 27-03	70	105
WEEK 3: 03-04	80	100

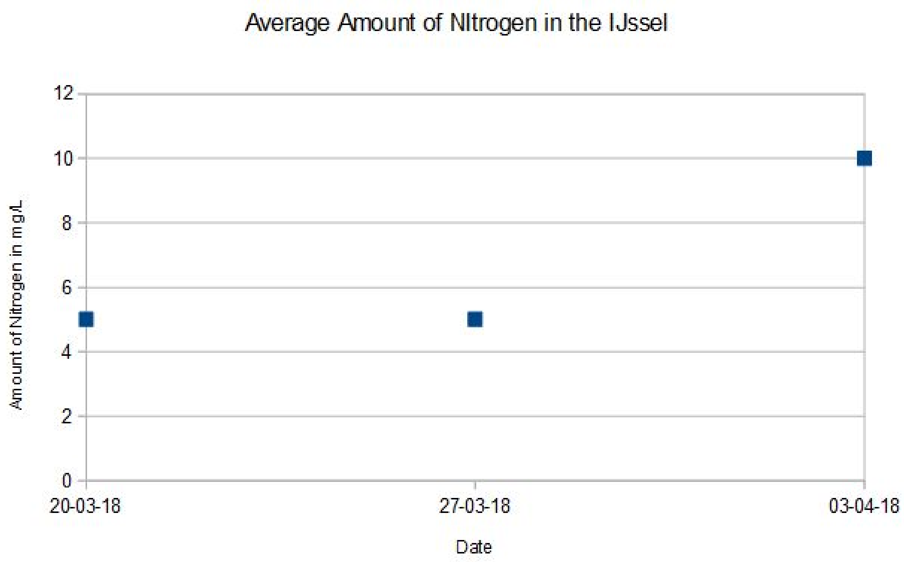
In this table the transparency measured with the secchi disk for each week in each of the rivers is shown. Below, two graphs are shown.



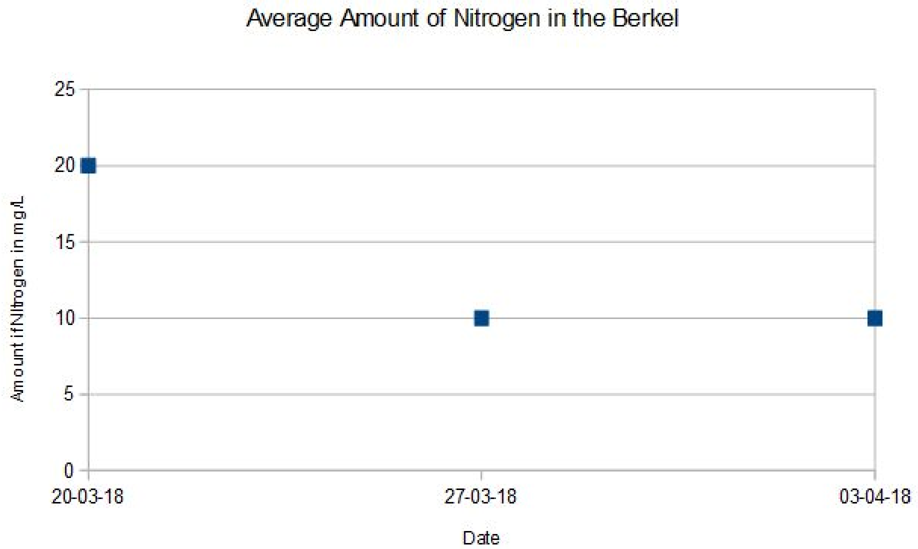


PHOSPHOR: *mg/l*	Week 1	Week 2	Week 3
IJssel	0,3	0,5	0,2
Berkel	0,5	0,5	0,3
NITRATE: ***mg/l***	Week 1	Week 2	Week 3
IJssel	5	5	10
Berkel	20	10	10

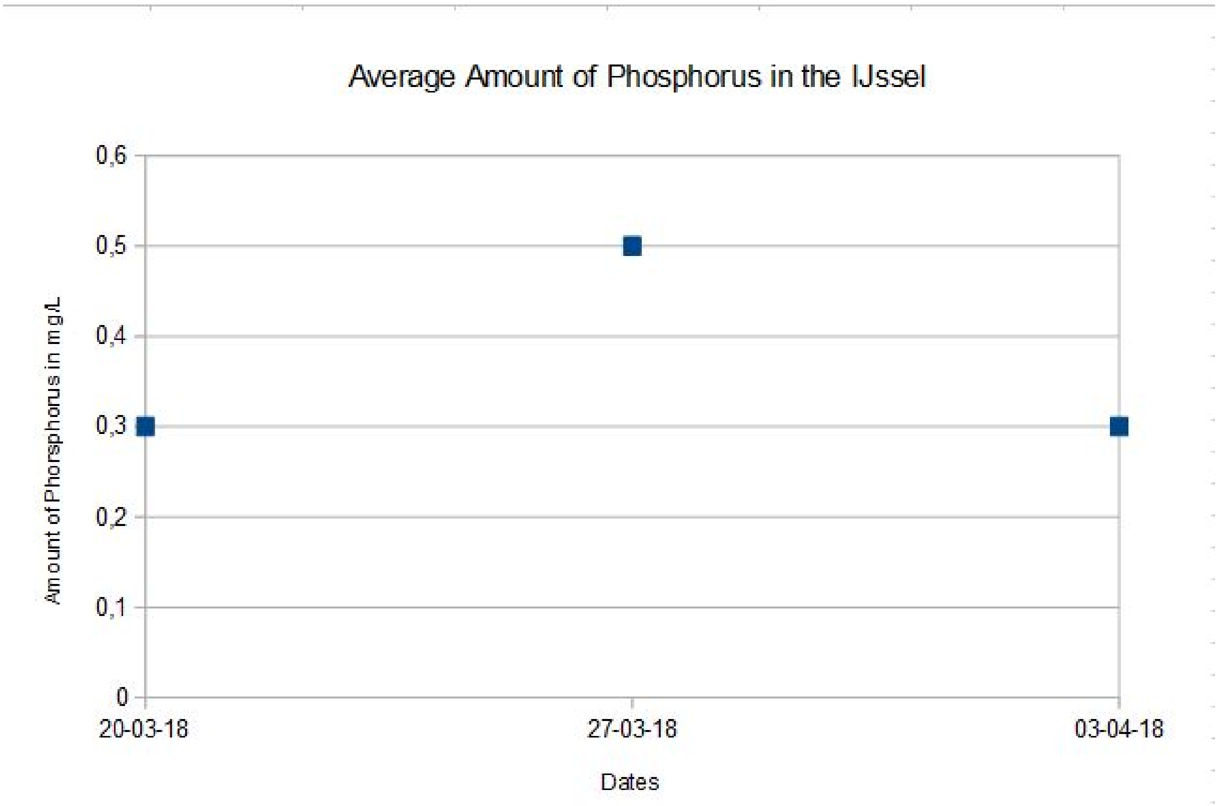
In this table the amount of phosphorus and nitrogen measured is shown for each week in each of the two rivers.



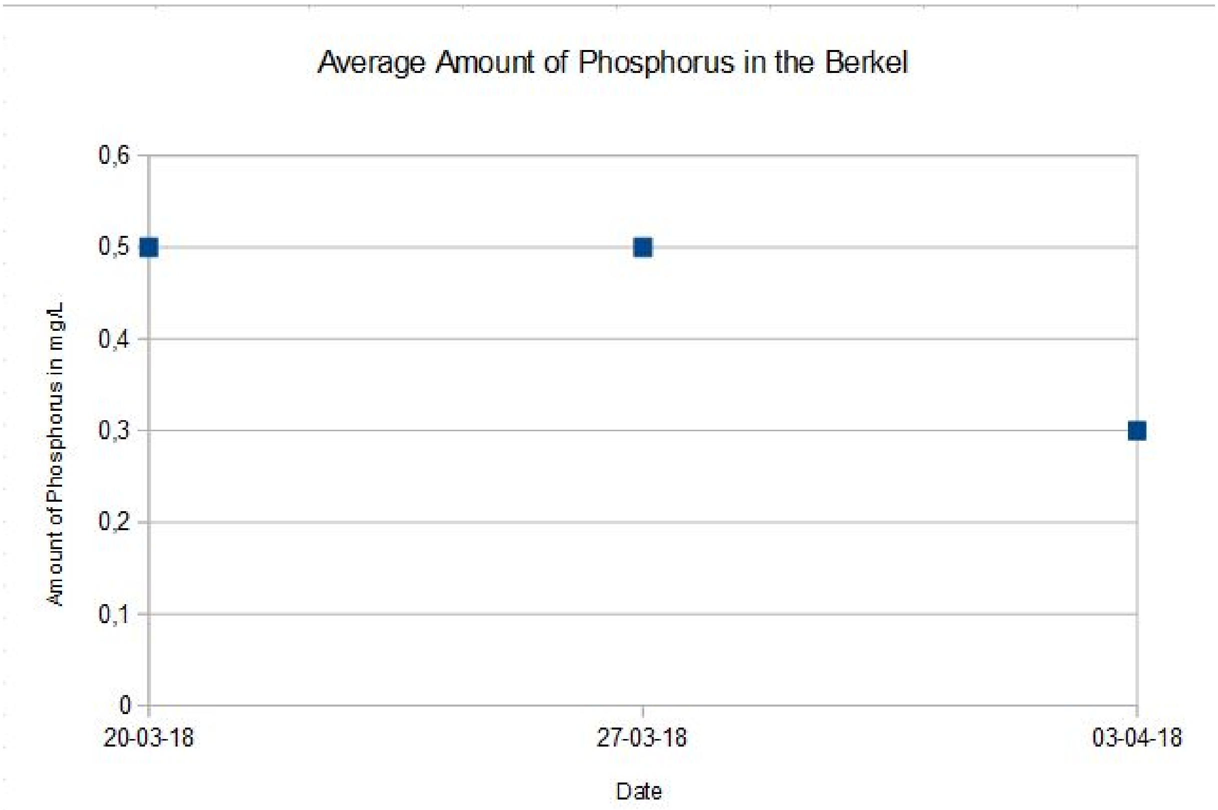
In this graph, the amount of nitrate in the IJssel is shown.



In this graph, the amount of nitrate in the Berkel is shown.



In this graph, the amount of phosphorus in the IJssel is shown for each of the weeks.



In this graph, the amount of phosphorus in the Berkel is shown for each of the weeks.

Amount of plants per Grootveld (0,2 mm * 0,2 mm)

IJSSEL	**Week 1**	**Week 2**	**Week 3**
Field 1	3	4	2
Field 2	5	0	2
Field 3	3	2	3
BERKEL	**Week 1**	**Week 2**	**Week 3**
Field 1	4	3	0
Field 2	11	1	2
Field 3	8	3	0

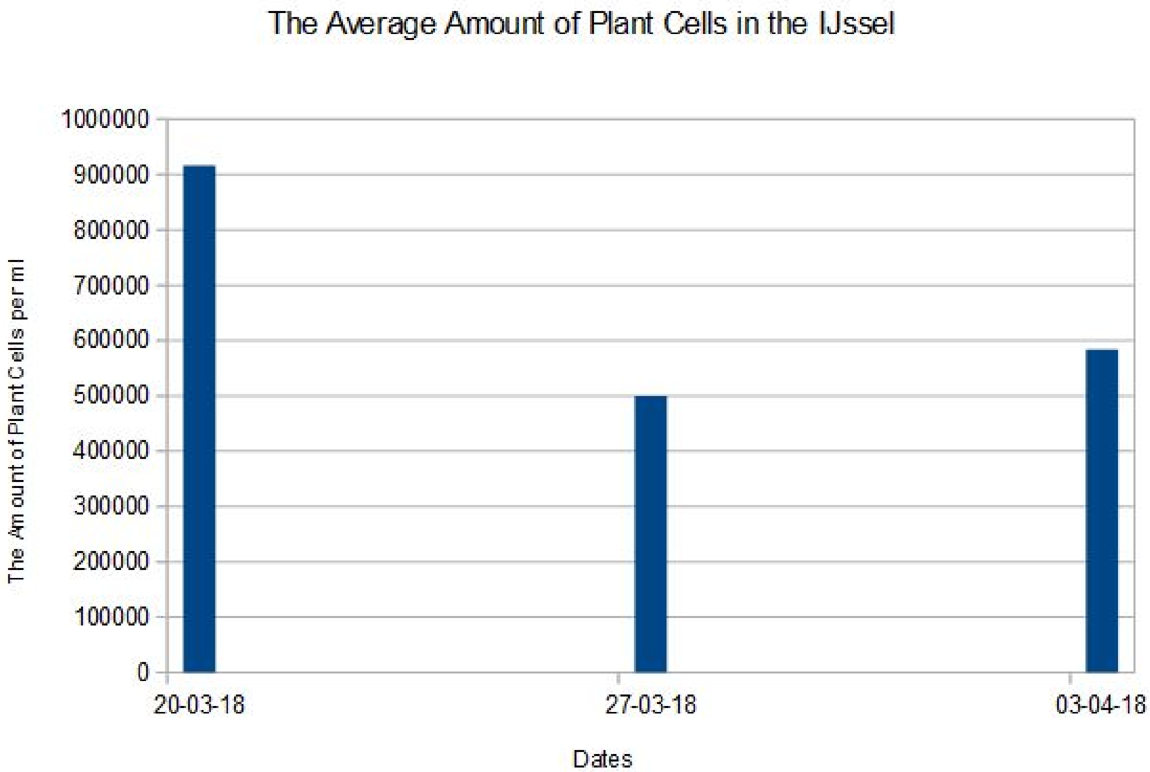
*Example of calculation: N= (K/n) * 250000 * F*
IJssel: Field 1, Week 2

- *N= (4/1) * 250000 * 1 = 1000000*

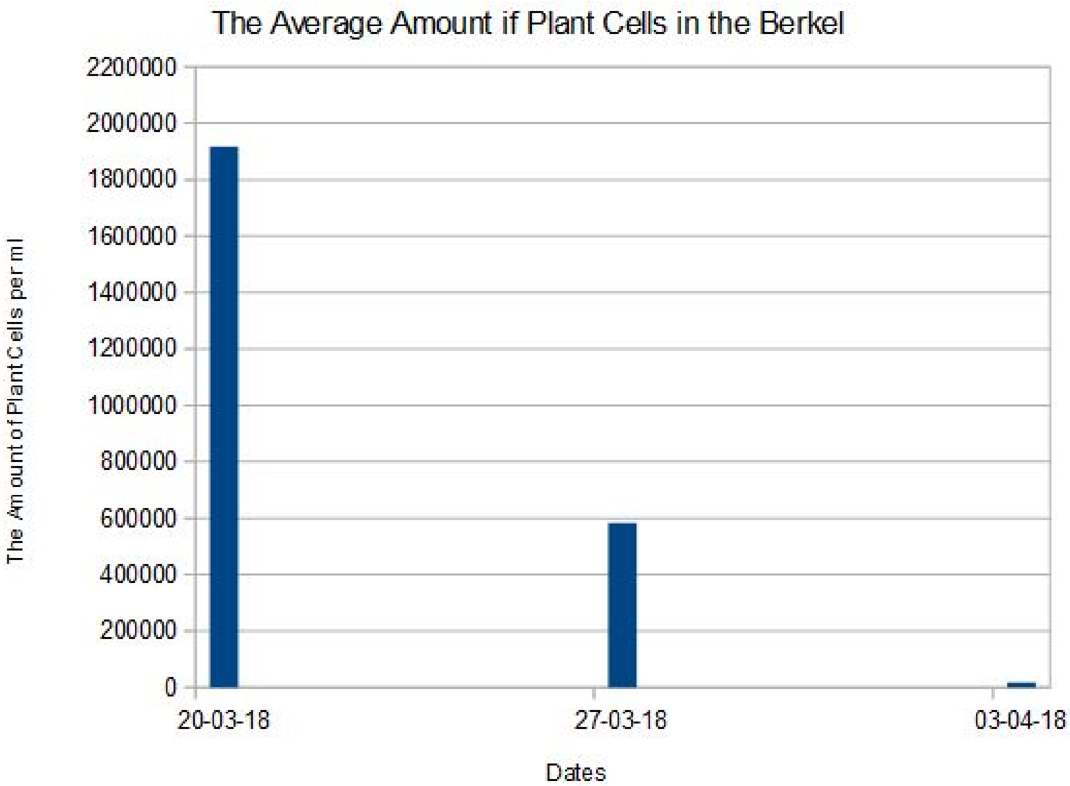
K= Total amount of cells counted
n= amount of Grootvelden used
F= level of dilution (1 for no dilution)
N= amount of cells per ml

Amount of aquatic plant cells in each river per ml

IJSSEL	**Week 1**	**Week 2**	**Week 3**
Field 1	750000	100000 0	500000
Field 2	1250000	0	500000
Field 3	750000	500000	750000
BERKEL	**Week 1**	**Week 2**	**Week 3**
Field 1	1000000	750000	0
Field 2	2750000	250000	500000
Field 3	2000000	750000	0

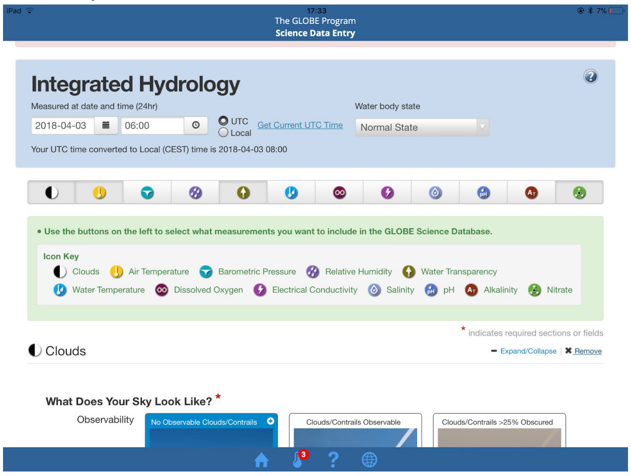


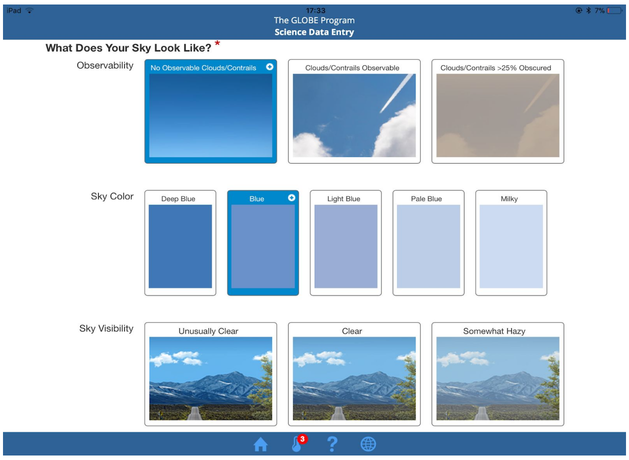
This graph shows the amount of aquatic plants in the IJssel per week per field measured.

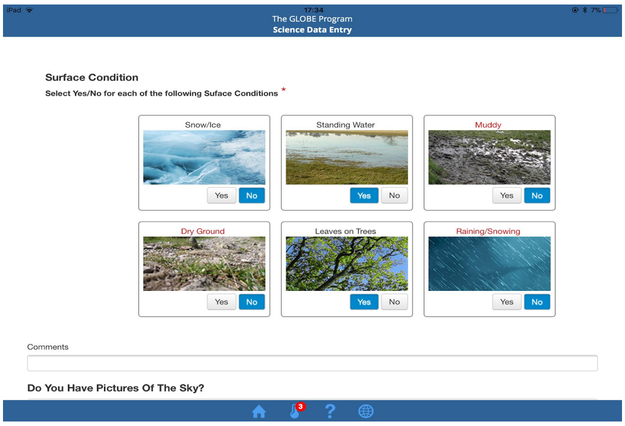


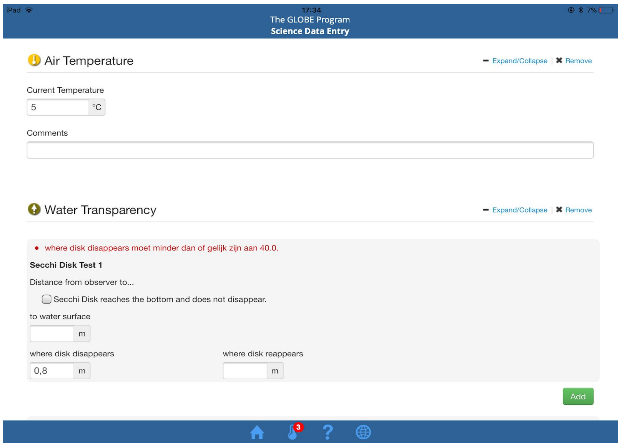
This graph shows the amount of aquatic plants in the Berkel per week per field measured.

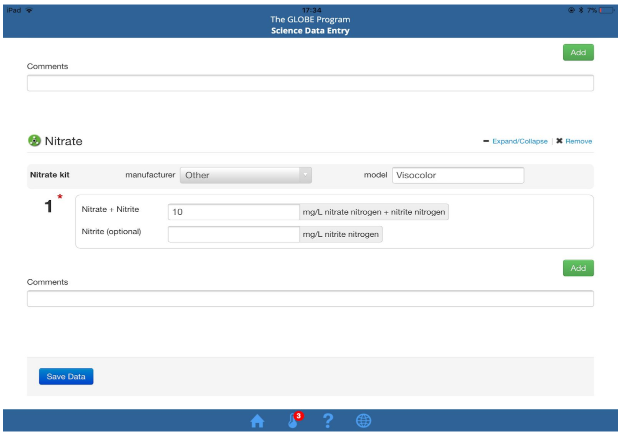
These pictures illustrate how the results were filled in with globe.

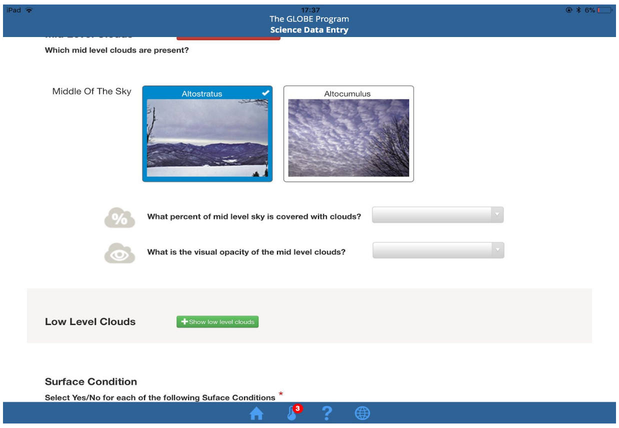


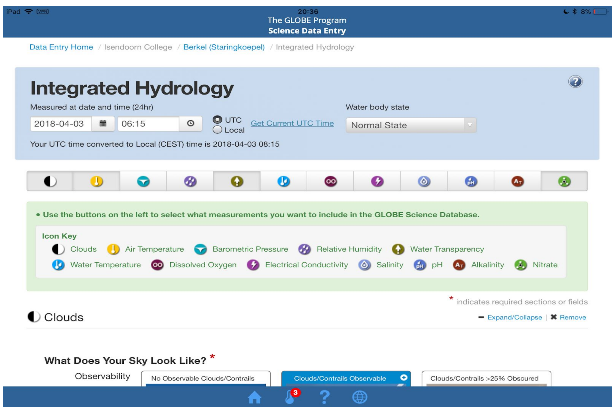





The GLOBE Program
Science Data Entry
Air Temperature
Expand/Collapse
Remove
Current Temperature
5
°C
Comments
Water Transparency
Expand/Collapse
Remove
where disk disappears moet minder dan of gelijk zijn aan 40.0.
Secchi Disk Test 1
Distance from observer to...
Secchi Disk reaches the bottom and does not disappear.
to water surface
m
where disk disappears
0,8
m
where disk reappears
m
Add


The GLOBE Program
Science Data Entry
Add
Comments
Nitrate
Expand/Collapse
Remove
Nitrate kit
manufacturer
Other
model
Visocolor
1
Nitrate + Nitrite
10
mg/L nitrate nitrogen + nitrite nitrogen
Nitrite (optional)
mg/L nitrite nitrogen
Add
Comments
Save Data


The GLOBE Program
Science Data Entry
Which mid level clouds are present?
Middle Of The Sky
Altostratus
Altocumulus
What percent of mid level sky is covered with clouds?
What is the visual opacity of the mid level clouds?
Low Level Clouds
Show low level clouds
Surface Condition
Select Yes/No for each of the following Suface Conditions


The GLOBE Program
Science Data Entry
Data Entry Home / Isendoorn College / Berkel (Staringkoepel) / Integrated Hydrology
Integrated Hydrology
Measured at date and time (24hr)
2018-04-03
06:15
UTC
Local
Get Current UTC Time
Water body state
Normal State
Your UTC time converted to Local (CEST) time is 2018-04-03 08:15
Use the buttons on the left to select what measurements you want to include in the GLOBE Science Database.
Icon Key
Clouds
Air Temperature
Barometric Pressure
Relative Humidity
Water Transparency
Water Temperature
Dissolved Oxygen
Electrical Conductivity
Salinity
pH
Alkalinity
Nitrate
indicates required sections or fields
Clouds
Expand/Collapse
Remove
What Does Your Sky Look Like?
Observability
No Observable Clouds/Contrails
Clouds/Contrails Observable
Clouds/Contrails >25% Obscured

Conclusion

The level of nitrate in the Berkel was in week 1 20 mg/l, week 2 10 mg/l and in week 3 10 mg/l. The level of nitrate in the IJssel was in week 1 5 mg/l, week 2 5 mg/l and week 3 10 mg/l. The difference in the level of nitrate between the Berkel and IJssel was in week 1 15 mg/l, week 2 5 mg/l and week 3 0 mg/l.

The level of phosphor in the Berkel was in week 1 0,5 mg/l, week 2 0,5 mg/l and in week 3 0,3 mg/l. The level of phosphor in the IJssel was in week 1 0,3 mg/l, week 2 0,5 mg/l and week 3 0,2 mg/l. The difference in the level of phosphor between the Berkel and IJssel was in week 1 0,2 mg/l, week 2 0 mg/l and week 3 0,1 mg/l.

The water transparency in the Berkel was in week 1 80 cm, week 2 105 cm and in week 3 100 cm. The water transparency in the IJssel was in week 1 70 cm, week 2 60 cm and week 3 70 cm. The difference in the level of transparency between the Berkel and IJssel was in week 1 10 cm, week 2 45 cm and in week 3 30 cm.

The amount of aquatic plants in the Berkel was in week 1 19,166 cells per ml, in week 2 5,833 cells per ml and in week 3 1,666 cells per ml.The amount of aquatic plants in the IJssel was in week 1 9,166 cells per ml, week 2 5 cells per ml, and in week 3 5,8 cells per ml. These results were multiplies to the power of 10^5. The difference in the amount of aquatic plants between the Berkel and IJssel was in week 1 10 cells per ml, in week 2 0,833 cells per ml and in week 3 4,167 cells per ml.

When looking at the results from the Berkel, it is visible that the amount of phosphorus and nitrogen and the amount of plants are connected. When the phosphorus and nitrogen begin to drop, the amount of plant cells begins to drop as well. There is no other visible connection with the other factors and the amount of plant cells.

When looking at the results from the IJssel, it is visible that when the level of phosphorus begins to rise, the amount of plant cells begin to drop. There is no other visible connection with the other factors and the amount of plant cells.

A trend which shows a connection between the amount of plant cells and the amount of nitrate, phosphor, and the transparency of the water cannot be found when the IJssel is compared to the Berkel. In fact, the rivers show contradicting results: when the amount of phosphorus rises, in the Berkel; the amount of plants begins to rise, while in the IJssel, the amount of plants begins to drop.

Therefore, there is no connection between the amount of plant cells and the amount of nitrate, phosphorus, and the transparency of the water when the IJssel is compared to the Berkel. When looking at the Berkel on its own however, you can conclude that the level of phosphorus and nitrogen drops, which causes a higher transparency, and less plants. This means that phosphorus and nitrogen are important to plant growth. When looking at the IJssel, no such conclusion can be drawn.

This can only be concluded from the time that that these amounts have been measured (20-03-2018 until 03-04-2018), which is around the start of spring.

Discussion

IJssel:

Phosphorus average: 0.3+0.5+0.2=1.0
1.0:3=0.333

Deviation 0.0333+0.17+0.133=0.34
average deviation 0.34:3=0.1122

The average deviation is one third of the average amount of phosphorus, so it is quite reliable.

Nitrate average: 5+5+10=20
20:3=6.667

Deviation: 1.667+1.667+3.33=6.667
Average deviation: 6.667:3=2.222

The average deviation is one third of the average amount of nitrate, so it is quite reliable.

Average amount of plants: 316,666+500,000+583,333=1,399,999
1,399,999/3=466,666
Average deviation: 150,000+33,334+116,667=300,001
30,0001/3=100,000

The average deviation is roughly one fifth of the average amount of plants, so it is quite reliable.

Berkel:

Phosphorus average: 0.5+0.5+0.3=1.3
1.3:3=0.443

Deviation: 0.077+0.077+1.33=2.87
Average deviation: 2.87:3=0.96

The average deviation is higher than the average results which means that the result is unreliable.

Nitrate average: 20+10+10=40
40:3=13.33

Deviation: 6.667+3.33+3.33=13.3267
Average deviation: 13.3267:3=4.44

The average deviation is about one third of the average result which means that it is quite reliable.

Average amount of plants: 1,916,666+583,333+166,666=2,666,665
2,666,665/3=888,888

Average deviation: 1,027,778+305,555+722,222=2,055,555
2,055,555/3= 685,185

The average deviation is around ⅘ of the average. This makes the results quite unreliable.

The research was done in the most concrete and accurate way possible, but there were certain things that could have been improved, which is shown from the results and the reliability found.

The first time that the experiment was done, there wasn't a protocol to count the plants yet. Eventually, it turned out that these results couldn't be used. As a result of that, there was less time in between the following measurements to catch up. This meant that there was not a lot of difference in the climate or surrounding areas.

When water samples were collected from the Berkel and IJssel, the water level had sometimes changed so we had to change places of where to get our sample. The difference in water level also caused that it was difficult to get the sample bottle filled, and therefore, sometimes there still was some air within the bottle.

Next time, the bottle should always be closed underwater to make sure that no air can get in. The water level should be taken into consideration, to make sure no problems come up when collecting the water.

In the IJssel, it was difficult to investigate the transparency with the secchi disk, as the current was strong, so the disk floated away. In addition to that, the water wasn't that deep at the sides. At times, it was difficult to count the amount of knots the secchi disk had in the water as you were standing above it. The results would have been more accurate if more people were counting what they saw from a different perspective. For example, from the side of the bank.

Next time, multiple people should be there to measure the transparency. This would make the method significantly easier, and the measurements would likely be more precise. In addition to that, spots where the current weakens should be found beforehand, so that no problems with the current occur.

when the secchi disk was forgotten, the day before the measurement would take place, and so the measurement had to postponed for a day. There was also time between getting the sample and putting them in the fridge, in which the bottles stayed for a few hours before the experiments could be carried out. The time in between each step could have influenced the results.

In following studies, the secchi should always be present at the measurement place so that it is impossible to forget. In order to combat the time issue, the experiments should ideally take place at the rivers themselves. However, that is not always possible. In such a case, a cooler should be brought in order to keep the samples cool, and in doing minimizing the chance that the condition of the water will change.

The same bottles were used for the tests with phosphorus and nitrogen, as with the plant counting. So, in between each measurement, the bottles were opened. That could have influenced the measurements, and it was often difficult to see the difference in colour. This was the same with the nitrogen test. The exact time spent waiting during the phosphorus and nitrogen measurements also could have influenced our results.

To solve this, multiple bottles should be used. Each experiment should have its own set of water bottles. This way, the contents are not in any way affected by the other experiments.

Lastly, the counting of the plants with the microscope had to be done quickly, and it was difficult to distinguish a plant algae from another black particle, and it is possible that both were counted.

In order to prevent this, the appearances of black dots should be minimized. This can be done by always using new counting platform per experiment, to reduce the amount of dust that can get on the platform, and cleaning even better. Dirt from the water samples should also not get on the counting platforms.

To improve our results, the tests should have been done more often with more samples, and with more people to make sure the measurements are precise and to assist the person doing the task.

As for another improvement to the research, the water temperature should be measured, as it can affect the amount of phosphorus and nitrogen. More time would also be needed, as it the end results would be more accurate if the measurements were done more often, over a longer period of time. In addition to that, this research only investigated a limited amount of factors that affect plant growth, so it is still possible that the amount of nitrogen and phosphorus actually have relatively little effect on the amount of plant life.

Lastly, when the research is looked at critically, there should have been more boundaries. The research should have been specific and measurable, and should have had less variables.

The next time the research is performed, the goal of the research must be more specific.

Due to all the uncertainties and the research done, the results of the research are not trustworthy. Future research could be done in checking more factors which affect the amount of plants in water and while doing that exclude the others. This can't be done in river water but that research would find out which factors are important. Then the research which is described to check the water quality could be applied, which was one of the reasons this research was conducted.

Furthermore, an investigation to find the cause of the contradicting results could be done.

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