GLOBE Estonia Learning Expedition

The Impact of a Spring and an Artificial Lake on the Ahja River

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1. Abstract

Overconsumption, water waste, climate change and pollution limit our access to quality drinking water. Due to this, our ability to grow crops and keep livestock is greatly inhibited, dehydration is an everyday occurrence, and more ecosystems are drying up daily. This is why it is crucial to study various water bodies, including rivers. The aim of our research was to assess the effect of an artificial lake and a spring on the Ahja river by taking samples of the river water and measuring various parameters. We found that the spring causes the river water to be more transparent, but does not have a significant effect on temperature. The concentration of dissolved oxygen and nitrates should be studied further in order to see what causes the concentration to be higher or lower.

Keywords: Ahja river; spring; artificial lake; water quality

Figure 1. Team River Ahja

2. Introduction

The Ahja, a river in Põlva County, South Estonia, is the largest tributary of River Emajõgi that starts from the Erastvere Lake. (3) It is 95 km long, and a section of it has been transformed into the Saesaare artificial lake, created for the Saesaare hydroelectric power station. (4) There is a spring called Emaläte, which flows into the river. The Ahja river is home for many different species of plants and animals and it is one of the most biodiverse rivers in Estonia. This is one of the reasons why it is so important to ensure its preservation by researching different factors that impact the river. (5) What we learn from researching one river can also help us preserve other rivers.

We could not find many other studies about the Ahja river or other rivers in Estonia, which measure the same parameters we did. There have been some studies about nitrate concentration in water bodies in Estonia, which have concluded that the level of nitrates has been increasing over the years. (8) However, they did not offer much information about The Ahja.

During our expedition we will be taking samples from the Ahja river, Emaläte spring and Saesaare artificial lake in order to learn what impact the spring and the lake have on the river and its water quality.

Research Questions:

1. Are there any spring induced changes in the river's water quality?
2. What can influence the water quality of the Ahja river?
3. What changes in river water quality can be noted when moving further from the artificial lake?

It is essential to study rivers and the factors that influence their water quality to better understand and protect these ecosystems. Our research questions focus on both manmade and natural influences to the Ahja river. Question 1 will help us understand the effect the spring has on the river and its water quality, and question 3 will help us understand the effect of the artificial lake. With our second research question we aim to find out whether there are any

other major factors besides the spring and artificial lake that could affect the water quality of The Ahja.

Hypotheses:

1. Downstream from the spring, water becomes clearer and lowers in temperature.
    - The clear and cool water from the spring causes the water downstream from it to be more transparent and colder.
2. The main influencers of water quality are the spring and artificial lake.
    - The surroundings of the river are fairly consistent and there are not any other major influencers near the river that we are aware of.
3. As you get further from the artificial lake, the oxygen concentration in the river decreases.
    - The concentration of dissolved oxygen is generally higher in flowing water with many obstacles. Rivers tend to become calmer the more downstream you go, so it is likely that the concentration of dissolved oxygen will decrease as you get further downstream from the artificial lake. (6)

3. Methods and Materials

Our expedition took place on 13 August 2024 from 14:30 to 18:30. During the expedition we collected hydrospheric data from multiple locations in the Ahja river, taking all the measurements twice to avoid errors. We collected data from five sites in the Ahja river: Suur Taevaskoda and Väike Taevaskoda, which were downstream from the spring, Emaläte spring, a bridge, which was upstream from the spring, but downstream from the lake and the Saesaare artificial lake. This allowed us to compare our results before and after the spring and see how the spring affects the river, as well as see how the water quality changes further from the artificial lake. We began downstream at Suur Taevaskoda and moved upstream towards the artificial lake. We measured the water's temperature, transparency, the amount of dissolved oxygen, conductivity, acidity, alkalinity and the amount of nitrates.

Research locations:

1. Suur Taevaskoda - Ahja river after the spring
2. Väike Taevaskoda - Ahja river after the spring

3. Emaläte spring - the spring
4. Bridge - Ahja river before the spring
5. Saesaare artificial lake - Ahja river before the spring

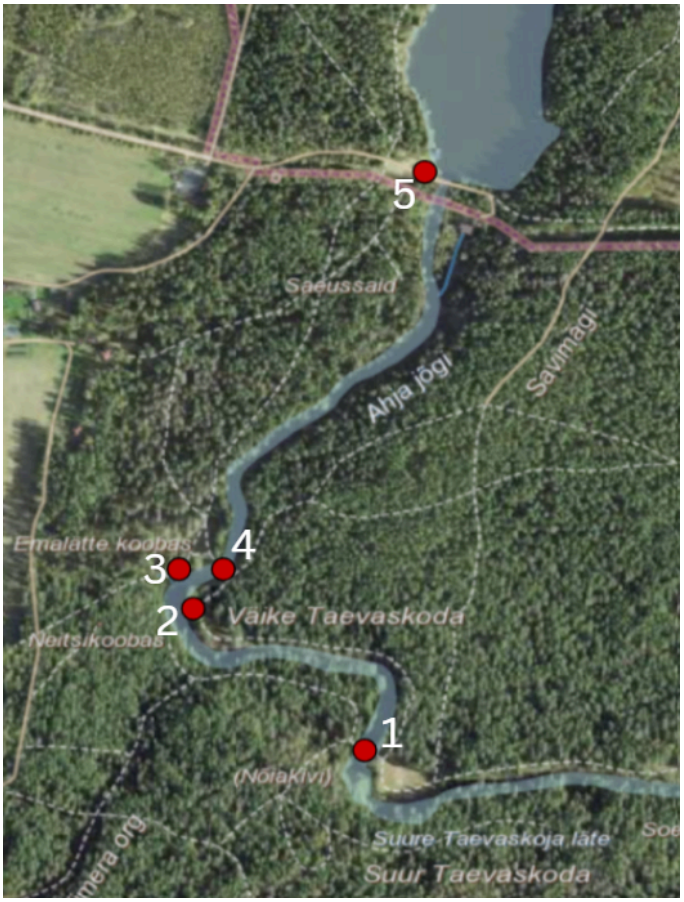

Figure 2. Map of our research locations in the Ahja River (1)

Figure 3. Map of our research location in Estonia (2)

Table 1. Used equipment

	Equipment	**Usage**
1	Bucket with rope	Gathering water from the river
2	Vernier sensors	Measuring water temperature, dissolved oxygen, pH and conductivity
3	Labquest 2	Viewing the data from the Vernier sensors
4	Secchi tube	Measuring water transparency
5	Paper and pen	Writing down data
6	Nitrate kit	Measuring the amount of nitrates in the water
7	Alkalinity kit	Measuring the alkalinity of the water

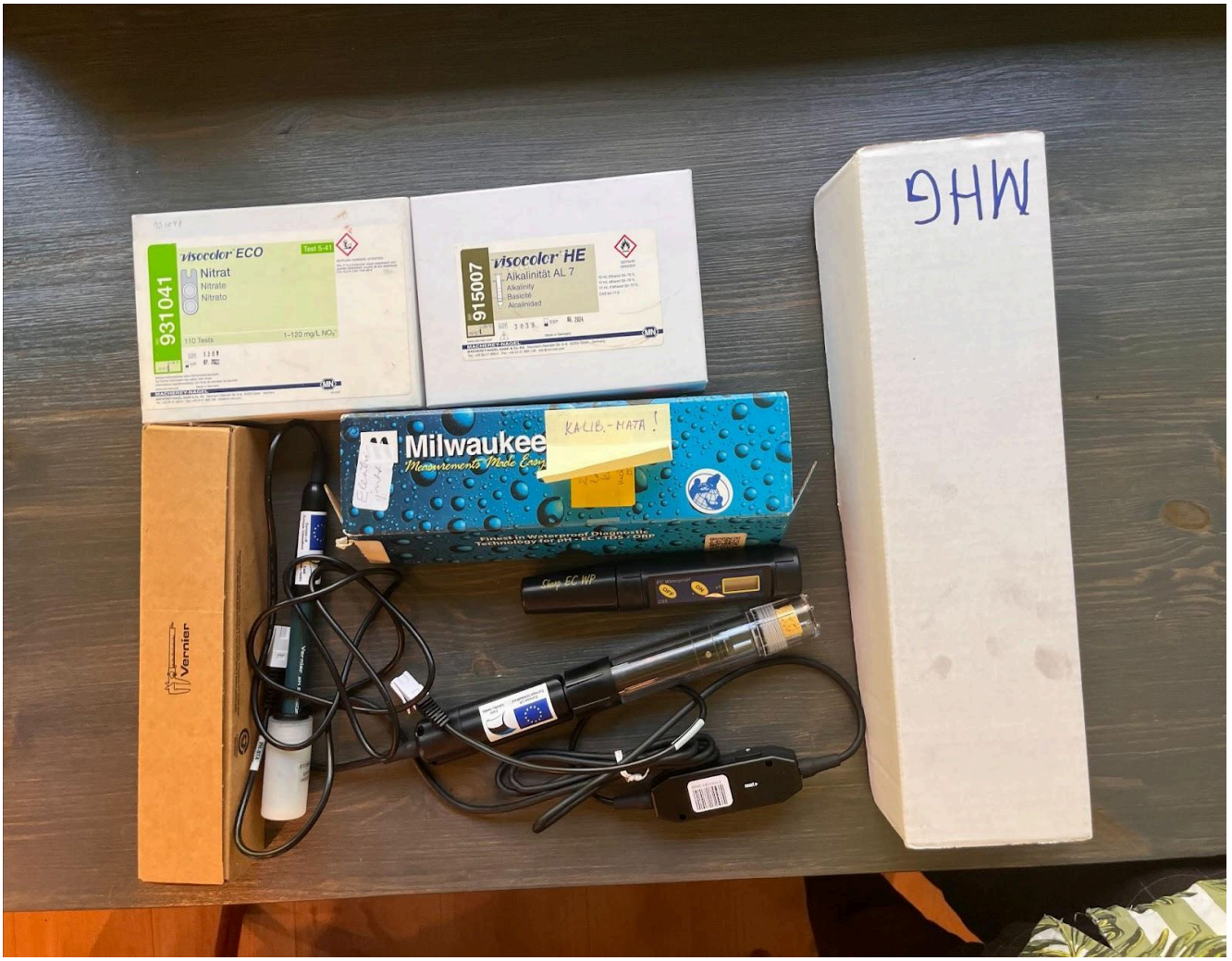

Figure 4. Used Equipment

4. Results

Table 2. First sample.

	Suur Taevaskoda	**Neitsi-koobas**	**Taevaskoja Emaläte**	**Ahja river before spring**	**Saesaare artificial lake**
pH	7.35	7.6	6.6	7.15	-
Temperature(℃)	17.7	17.8	7.6	17.9	-
Conductivity(µS/cm)	320	324	237	324	315
Dissolved Oxygen(mg/L)	7.02	6.9	8.38	7.1	7.4
Alkalinity(mg/L)	260	240	240	300	280
Nitrates(mg/L)	0.7	0.7	1.1	0.9	0.5
Transparency(cm)	87	95	>120	80	103

Table 3. Second sample.

	Suur Taevaskoda	**Neitsi-koobas**	**Taevaskoja Emaläte**	**Ahja river before spring**	**Saesaare artificial lake**
pH	7.6	7.5	6.42	7.19	7.5
Temperature(℃)	17.7	17.8	7.4	17.9	20
Conductivity(µS/cm)	320	322	240	324	323
Dissolved Oxygen(mg/L)	7	7	8.3	7	7.4
Alkalinity(mg/L)	280	260	240	300	280
Nitrates(mg/L)	0.7	0.7	1.1	0.9	0.7
Transparency(cm)	93	98	>120	85	105

Table 4. The average of two samples.

	Suur Taevaskoda	**Neitsi-koobas**	**Taevaskoja Emaläte**	**Ahja river before spring**	**Saesaare artificial lake**
pH	7.47	7.55	6.51	7.17	7.5
Temperature(℃)	17.7	17.8	7.5	17.9	20
Conductivity(µS/cm)	320	323	238.5	324	319
Dissolved Oxygen(mg/L)	7.01	6.95	8.34	7.05	7.4
Alkalinity(mg/L)	270	250	240	300	280
Nitrates(mg/L)	0.7	0.7	1.1	0.9	0.6
Transparency(cm)	90	96.5	>120	82.5	104

The amount of dissolved oxygen in the river was highest in the Emaläte spring (8.32 mg/L) and lowest downstream from the spring by Neitsikoobas (6.95 mg/L). It was 7.4 mg/L in the artificial lake, 7.05 mg/L in the river downstream from the lake before the spring and 7.01 mg/L the furthest downstream in Suur Taevaskoda.

The concentration of nitrates was highest in the water from the Emaläte spring (1.1 mg/L) and lowest in the artificial lake (0.6 mg/L). The concentration upstream from the spring was 0.9 mg/L and 0.7 mg/L downstream from spring.

5. Discussion

Our hypotheses were:

1. Downstream from the spring, water becomes clearer and lowers in temperature.
2. The main influencers of water quality are the spring and artificial lake.
3. As you get further from the artificial lake, the oxygen concentration in the river decreases.

Hypothesis 1 was partially supported. The water downstream from the spring was, in fact, more transparent than upstream from the spring, being the most transparent directly after the spring, if not counting the water from the spring itself or the water in the artificial lake. As for temperature, the water did become cooler, however, the change was negligible. The temperature before the spring was higher by only 0.1℃, which could have been caused by getting more sunlight, as the samples upstream were taken later in the day.

Hypothesis 2 was unsupported. Although both the spring and artificial lake had an effect on the various parameters measured in the experiment, it appears that there are more factors that affect The Ahja's water quality. Some possible factors are the velocity of the river, the composition of the river bed and surrounding vegetation, which could be studied more in the future.

Hypothesis 3 was unsupported. The concentration of oxygen after the lake was lower in some locations and higher in others. The amount of dissolved oxygen in the water is generally caused by the speed of the river and the amount of obstacles in the water, so it makes sense that there would be more oxygen in the Emaläte spring, where the water is flowing out from underground quite fast. What is intriguing, however, is that the concentration of oxygen in the river was the lowest downstream from the spring by Neitsikoobas, but rises again further downstream in Suur Taevaskoda. It is possible that the riverbed by Neitsikoobas has few obstacles and the river is calmer there.

What was interesting about our data, was the concentration of nitrates in the water being highest in the Emaläte spring, since groundwater should, in theory, be cleaner than river water. This has most likely something to do with the amount of nitrates in the soil, which the spring water flows through, and how close to the surface the groundwater flows before emerging. This is something that could be more looked into because, although the level of nitrates in Emaläte (1.1 mg/L) is not high compared to other water bodies in Estonia, the rising concentration of nitrates in groundwater is a growing problem around the world. (7,8) It would be useful to know what causes the higher level of nitrates, in order to prevent it from rising to dangerous levels. In general, nitrate levels below 1 mg/L are considered completely safe for ecosystems. (7)

Possible errors could have been caused by human error, especially with the tests for alkalinity, nitrates and transparency, as they required visual assessment. Errors could also have come from malfunctioning of the equipment or the fact that the measurements were taken at different times of day as we moved upstream along the river.

6. Conclusion

We were able to confirm the spring's effect in clearing up the water. However, it did not seem to have an effect on the temperature. Our data concerning conductivity was inconclusive and did not show any real changes throughout the river.

Our expedition was important, because the data we collected from the Ahja river can help us assess the water quality of the river. By determining the causes for different results we can figure out ways to preserve the Ahja river as well as other rivers in Estonia. As the next step, figuring out how the spring runs underground before emerging would help us determine the source of higher levels of nitrates in the spring’s water. Studying the river’s velocity and the river bed could help us determine what causes the different levels of dissolved oxygen in various locations in the river.

If we had to repeat our research, we would gather a larger team, so we could try to take all the measurements at the same time, in order to avoid any inaccuracies caused by changes in weather. In addition, we would take multiple samples over a longer course of time, which would allow us to see the impact of rain and other weather conditions on the river.

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