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Human impact on the water quality of River Emajõgi

Mattias Ilp

Romer Ojaveer

Mārtiņš Ozols

Heath Lindgren

Sāra Leimane

Maša Blažević

Jana Biškup

Sofia Vesselova

Franka Tomljanović

Petra Kubin

Supervisor: Agne Jõgis

Support: Roosi Ahas

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Abstract

Our report talks about our research topic, *Human impact on the water quality of Emajõgi.* We chose this topic because when we were taking measurements we spotted a construction of a nearby promenade and we wondered how this construction with all of its trash would affect the water quality of Emajõgi. We took different measurements right next to the construction and we took some measurements further down to the river. We thank the other hydrosphere team for providing us with data from upstream, before the construction site. We did not find a lot of papers on this topic so we could not compare our data to the other research papers but we did in fact compare our data to the other hydrosphere team to get a fuller picture of the extent of the impact the construction has on the water quality of Emajõgi.

Keywords: environmental problems, water quality, measurements

Introduction

River Emajõgi, flowing through South Estonia, stretches approximately 100 kilometers, and connects Lake Võrtsjärv to Lake Peipus. It serves as a vital artery for various ecological systems. Emajõgi is not only crucial for its biodiversity but also serves as a key resource for recreational activities and has historical significance for the communities residing along its banks. Its importance is underscored in academic and environmental studies, highlighting its ecological, economic, and social value to Estonia. In terms of length, the Emajõgi is the ninth river in Estonia, but in terms of water content it is the second largest after Narva River - with an average annual flow of about 70 m3/s. (wikipedia, s.a., Riige, 2007)

Tartu is the second biggest city in Estonia, and it is also the regional center of South Estonia. The city is divided into 17 distinctive districts. According to Statistics Estonia, 97435 people lived in Tartu in 2023. (Tartu infokeskus, 2023)

Scientists have found that urban development near water sources can impact meteorology and the general health of the water body. It can change the generation of rain and may enhance the generation of summer thunderstorms. Debris and other harmful chemicals can get into the water while building and this might destabilise the nitrates level, phosphorus level or other necessary chemical level. (McGrane, 2016)
It is important to study this topic because we cannot live without water and if we contaminate it then we will not survive in the future. It is important to study this topic globally because tens of thousands of people die every year and all of this is caused by lack of clean water (McGrane, 2016). It is important to study this topic socially because if the environmental problems get really bad it will start to affect the real estate prices and the quality of life will get worse (Cellmer, R., Senetra, A., & Szczepanska, A. (2012).

Research question and hypothesis

The research questions and hypotheses are important because it is important to look more into how constructions and other human activities affect the rivers that are flowing through the city. They interested us because Emajõgi is an important river and if it gets polluted the pollution gets carried forward to Lake Peipus and onward into the already pretty polluted Baltic sea.

Based on that the following research questions were formulated:

- How does the construction of the promenade in the centre of Tartu affect the water quality of Emajõgi?
- To what extent does the construction of the promenade affect Emajõgi?

Our hypotheses were that the construction has a negative impact on water quality and the impact of the construction of the promenade on Emajõgi is far-reaching.

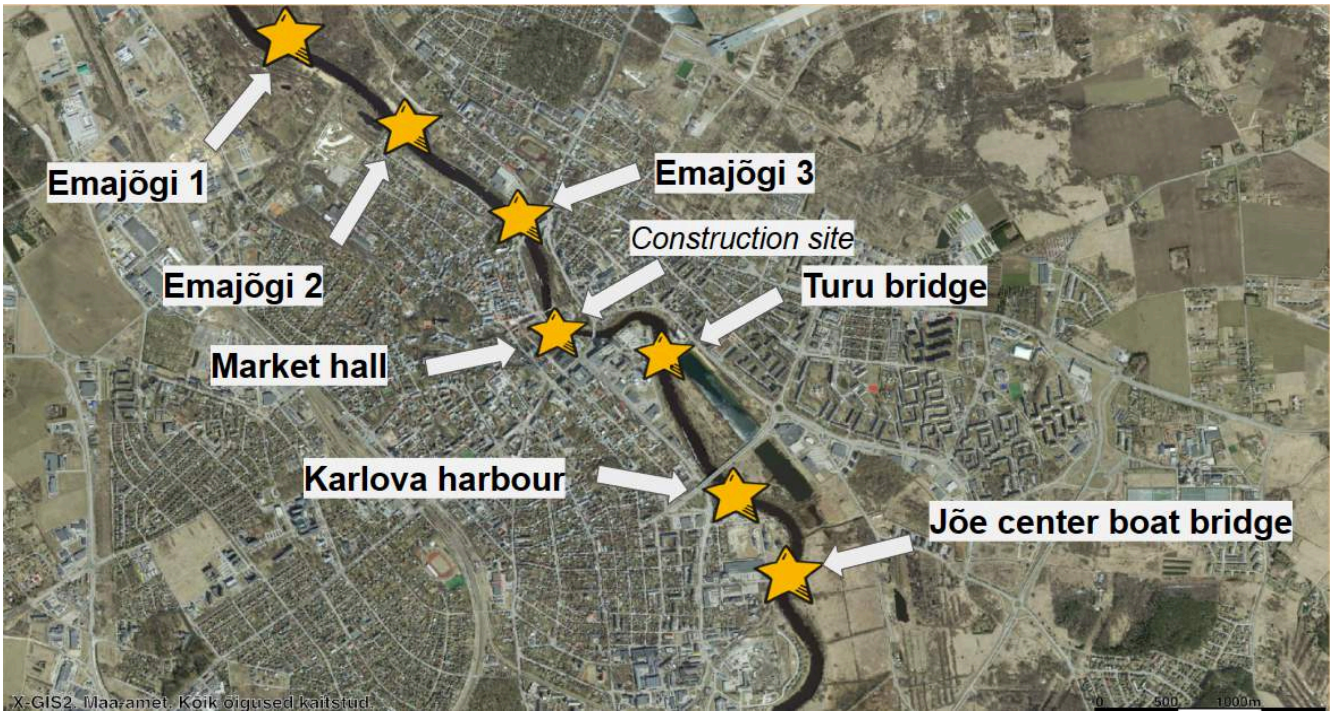
To find out how the construction of the promenade (Figure 1) affects the river we first took measurements of the water (dissolved oxygen, nitrates, transparency, pH, alkalinity, conductivity) at different points in the river and wrote them all down, then we created an excel table of the different measurements and last but not least we compared them to the measurements taken before the construction site to the measurements taken after the construction site.

The construction site
Figure 1

Our group taking measurements at the Jõe centre boat bridge
Figure 2

Methods and materials

We studied the river by taking measurements from Emajõgi at different places along the river to see how much does the construction actually affect the river. Research locations are seen on Figure 3.



Map of our study sites

Figure 3

Estonian Land Board [09.08.2023]

Our team cooperated with another GLOBE Learning Expedition team that investigated locations Emajõgi 1, 2 and 3. We started from the Market hall location. Figures 4 and 5 illustrate sampling locations whereas on Figure 4 the construction site is seen in the background.

Market hall site

Figure 4

Market hall site

Figure 5

Sampling location was a dock. The shore was a high concrete wall. It had good access to the river. Not very heavy boat traffic.

Our next sampling location was under the Turu bridge (Figures 6 and 7).

Turu bridge site
Figure 6

Turu bridge site
Figure 7

It was a natural shore. The water was not very accessible, one of us had to go in the water to get some clean water for sampling. Shore was covered by plants. Because of the location and quite loose sediments the water transparency was affected.

Our third location was at Karlova harbour (Figures 8 and 9).

Karlova harbour site
Figure 8

Karlova harbour site
Figure 9

There was good access to the water. A lot of boats were in (concrete) dock, but no heavy boat traffic could be seen on the river.

Our last sampling location was at Jõe centre boat bridge (Figures 10 and 11).

Jõe centre boat bridge site
Figure 10

Jõe centre boat bridge site
Figure 11

Sampling location was surrounded by vegetation. It had very easy access to water. We took the water sample from a boat bridge made of concrete.

We used the following GLOBE Hydrology protocols:

1. Water temperature
2. Conductivity
3. pH
4. Transparency
5. Dissolved Oxygen
6. Alkalinity
7. Nitrates

We used the following equipment: transparency tube, Vernier pH-meter, a bucket, dissolved oxygen kit, alkalinity kit, Vernier conductivity probe, nitrates kit, thermometer (probe)

We analysed the data by comparing it to the data collected by the other hydrology team before the construction of the promenade to the data collected after the construction of the promenade. We then made conclusions, answered the research questions and hypotheses and put together the presentation about the human impact on the Emajõgi.

Results and Discussion

Table of the research results

		Emajõgi 1	Emajõgi 2	Emajõgi 3	Market hall	Turu bridge	Karlova harbour	Jõe keskus boat bridge
Temperature	°C	23.0	22.2	22.3	22	22	22	22
Conductivity	µS/cm	373.0	360.0	325.0	258	381	387	379
pH		8.34	8.62	8.50	8.23	7.98	7.8	7.8
Transparency	m	0.26	0.31	0.27	0.32	0.17	0.29	0.21
Dissolved oxygen	mg/L	7.20	6.00	7.50	6.2	6.2	6.5	6.6
Alkalinity	mg/L	221.43	234.85	215.33	195.2	225.7	201.3	195.2
Nitrates	mg/L	0.20	0.20	0.20	<0.2	<0.2	0.2	0.2

During the construction works on the banks of Emajõgi, the river bed is also dug to some extent. This means that bottom sediments are pushed up from the bottom and water transparency decreases. The level of alkalinity also indicates the effect of construction.
If we look at the table above we can see that alkalinity is lower at the sampling location next to the construction site. Transparency of water is not affected. As mentioned above, Turu bridge low transparency may be a result of sampling method. When in other locations we could sample the water on boat docks, then at Turu bridge we had to go in the water and that affected the sediments which were mixed to surrounding water.
Based on the results, we found that the construction of the promenade does affect the water quality of Emajõgi. So the hypothesis was completely supported because our research shows that the construction has a negative impact on the river.
As for the second hypothesis, that the impact of the construction is far-reaching, we analysed the data from the construction site before Market hall. We can see that the water parameters normalise at the Turu bridge measurement site. Our second hypothesis is partially supported.

Conclusions

We found out that the construction of the promenade does affect the water quality of Emajõgi. Our results mean that building near water usually affects the water quality of the river, lake etc. Locally it means that the people are not aware that building near water affects the water quality and it should be more spoken about. The next time we would let multiple people do the same measurement because it will hopefully reduce the amount of mistakes and misreads of the measurements. We would do another measurement after the promenade is finished to see if the water quality changes in any way.
Our team had 2 students from Estonia, 2 students from Latvia, 1 student from the United States of America and 4 students from Croatia.

References

Cellmer, R., Senetra, A., & Szczepanska, A. (2012). *The Effect of Environmental Factors on Real Estate Value* [Review of *The Effect of Environmental Factors on Real Estate Value*]. Fig.net. https://www.fig.net/resources/proceedings/fig_proceedings/fig2012/papers/ts06h/TS06H_cellmer_senetra_et_al_5748.pdf

McGrane, S. J. (2016). Impacts of urbanisation on hydrological and water quality dynamics, and urban water management: a review. *Hydrological Sciences Journal*, *61*(13), 2295–2311. https://doi.org/10.1080/02626667.2015.1128084

Riige, S. (2007) Emajõel paiknevate vanajõgede suudmete avamise ja Kärevere paadikanali rekonstrueerimise keskkonnamõju hindamine. https://kliimaministeerium.ee/media/586/download

Tartu infokeskus (2023). Tartu arvudes 2022/23 https://tartu.ee/sites/default/files/uploads/Statistika/Tartu%20arvudes/Tartu-arvudes_2022-2023_est.pdf

Wikipedia, (s.a). Emajõgi https://en.wikipedia.org/wiki/Emaj%C3%B5gi