

GLOBE Regional Learning Expedition 2022

The effect of Käsnu harbour on water characteristics

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Estonia

2022

ABSTRACT

We wanted to know what effect Käsnu harbour has on water characteristics. According to those questions we picked three places: Käsnu pier, Käsnu harbour and Käsnu stone beach. We measured all those places in one day. The whole expedition was about five hours long. The Käsnu pier and the stone beach have been untouched; only the Käsnu harbour had been dredged about two weeks ago and also new floating water bridges were added there.

Our hypothesis was: Harbour area water characteristics are affected by the harbour.

Our main goal is to investigate if the harbour has an effect on water characteristics.

The characteristics of water that we measured and GLOBE protocols used were air temperature, transparency with transparency tube, water temperature, dissolved oxygen level, conductivity, pH, alkalinity, nitrates. We proved that our hypothesis was right and that water in the harbour has slightly different characteristics.

If the project continues in the future, we would like to measure for a longer time and during other seasons. And also to study the difference in the harbour with hindsight from its dredging.

In the future, it would be nice to go back, take the same measurements and see if the results change. We would also like to know how the results change seasonally or even at nighttime. This way we would have a more exact picture of the effect Käsnu harbour has on water characteristics.

Key words: hydrology, water characteristics, Käsnu harbour

INTRODUCTION

The Baltic Sea (Figure 1) is the youngest sea on the planet, almost enclosed, experiencing near-arctic conditions and is one of the world's largest brackish waters. It is surrounded by 9 countries - Estonia, Latvia, Lithuania, Russia, Sweden, Finland, Denmark, Norway and Germany (European Commission).

The Baltic Sea supports unique ecosystems but is severely affected by general threats like biodiversity loss and climate change, and by specific local pressures such as eutrophication, overfishing, elevated levels of contaminants such as pharmaceuticals, and litter, in particular plastic waste (European Commission).

The Baltic Sea is a brackish water body, where rivers and precipitation bring most of the fresh water. The Baltic Sea gets its salinity from the Atlantic Ocean through the Danish Straits. The salinity of the Baltic Sea depends on the distance from the Danish straits (Jaspers *et al*, 2021).

Our research location is located on the coast of Northern Estonia at Käsnu peninsula and Käsnu bay which is part of the Gulf of Finland (and Baltic Sea respectively). The bay is open to winds and the shoreline dynamics has been found to affect the water characteristics (Grudzinska *et al*, 2013).

RESEARCH QUESTION AND HYPOTHESIS

Studying the water characteristics is very important. It tells us a lot about how human activity affects the water quality.

The purpose of our research was to analyse the water characteristics in Käsmu. We wanted to know if the water characteristics in Käsmu harbour are different from the surrounding areas. Because the harbour had been dredged about a week before our arrival, we had reason to believe that the water characteristics would be different from areas near the harbour.

Based on that we formulated our hypothesis:

- Harbour area water characteristics are affected by the harbour.

METHODS AND MATERIALS

We did fieldwork at the research locations and analysed the water samples on 3 August 2022 from 2:00 PM to 6:30 PM. We measured in Käsnu, Estonia (Figure 1 and 2) at three locations - Käsnu pier, Käsnu harbour and Käsnu stone beach. The locations were all 300 metres from each other.



Figure 1. Location of Käsnu in Estonia. Source: Google Maps.



Figure 2. Map of research and measuring locations. First is Käsnu pier, second is Käsnu harbour and the third is Käsnu stone beach. Source: Estonian Land Board

The first location was Käsnu pier (Figure 3). The air temperature at the pier was 22°C, the water temperature was 19°C and there was a strong wind. The shore was rocky and there was sand on the beach. The vegetation on the shore was mainly reed and other plants. The seabed was sand and mixed sediments.



Figure 3. The first research site: Käsnu pier

The second location was Käsnu harbour (Figure 4). The air temperature at the harbour was 23°C, the water temperature was 20°C and there was a breeze. There was no rain and the water transparency was more than 120 cm. The shore was sandy, the harbour was surrounded by boulder fences. The vegetation at the shore was mainly birch and pine. The seabed was a mix of sand and sediments.



Figure 4. The second research site: Käsmu harbour

The third location was a beach covered in stones (Figure 5). Since it doesn't have an official name, we named the location as Stone beach. The air temperature in the stone beach was 21°C, the water temperature was 21°C and there was a small breeze. The shore was a mix of pebbles and sand. There were boulders on the shore and in the sea. The seabed was a mix of sand and sediments.



Figure 5. The third research site: Käsmu stone beach

For our research we used GLOBE hydrology protocols: temperature, transparency (with the transparency tube), dissolved oxygen, conductivity, pH, alkalinity, and nitrates. The equipment we used for alkalinity, nitrates and dissolved oxygen can be seen in Figure 6. Measuring process can be seen on Figure 7.



Figure 6. Kits for measuring alkalinity, nitrates and dissolved oxygen



Figure 7. Measuring process

DISCUSSIONS

Our research showed that the water characteristics in Käsnu harbour are different from the surrounding area. We analysed the most important factors and differences found from the experiments. Results are shown in Table 1.

Water characteristics	1. location: Käsnu pier	2. location: Käsnu harbour	3. location: Käsnu stone beach
air temperature (°C)	22	23	21
transparency (cm)	>120	>120	>120
water temperature (°C)	19	20	21
dissolved oxygen (mg/l)	7.3	6.8	9.6
conductivity (µS/cm)	10672	10849	11032
pH	8.65	8.44	8.99
alkalinity (mg/l)	79	82	79.3
NO ₃ ⁻ (mg/l)	0.5	1	0.5

Table 1. The conditions at measuring locations.

The dissolved oxygen levels were the highest in Käsnu stone beach (9.6 mg/L) and the lowest in Käsnu harbour (6.8 mg/L). The low dissolved oxygen levels could be because of the excessive algae growth caused by phosphorus (MPCA, 2009).

All investigated locations were quite transparent. The transparency was more than 120 cm in all three locations.

The warmest water temperature was in Käsnu stone beach (21°C), the coldest location was Käsnu pier (19°C). The water temperature in Käsnu harbour was 20°C.

The nitrate levels in Käsnu harbour were higher (1 mg/L) than in Käsnu pier and in Käsnu stone beach (0.5 mg/L). Our working hypothesis is that there were no plants in Käsnu harbour that could consume the nitrates.

Alkalinity levels were the highest in Käsmu harbour (82 mg/L). We think the high alkalinity could be because the harbour was recently dredged and the pier was rebuilt, the seabed and the sediments got mixed. Since the bedrock is limestone, which is alkaline, the alkalinity levels rose.

CONCLUSIONS

We discovered that the water characteristics in Käsnu harbour are different from the surrounding area.

The alkalinity and nitrate levels were higher than at the pier and at the stone beach. We think the alkalinity levels were higher because of the calcium carbonate also known as limestone, which is the bedrock. Since the harbour was recently dredged, the seabed and the sediments got mixed. We think that the nitrate levels were higher because we didn't see any plants that could consume the nitrates.

We also discovered that the dissolved oxygen levels were lower than the surrounding area. It could be because of the higher air and water temperature. The pH levels were lower than at the pier and at the stone beach. When carbon dioxide is taken up by ocean water, it reacts with water to form carbonic acid. This is leading to a gradual fall in the oceans' pH.

If we could do the research all over again, we would plan our activities more ahead. We think our research would be even more useful, if we had measurements from before the dredging and building activities in Käsnu harbour. Then we could make more conclusions and analyse the effect of the dredging more thoroughly. We would have also measured the air humidity and salinity in all three locations.

In the future, it would be nice to go back, take the same measurements and see if the results change. We would also like to know how the results change seasonally or even by nighttime. This way we would have a more exact picture of the effect Käsnu harbour has on water characteristics.

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