What is Valfabion's water quality like?

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PROJECT POSSIBLE THANKS TO:

- GLOBE group: 20 students

PROJECT ASSOCIATES

- Local residents of Veli Vrh
- Institute of Public Health of the County of Istria, Pula – employees from the Water Department as outside collaborators

ZAVOD ZA JAVNO ZDRAVSTVO ISTARSKE ŽUPANIJE
ISTITUTO DI SANITÀ PUBBLICA DELLA REGIONE ISTRIANA

The GLOBE Program

1. Research questions and hypotheses

On the edge of the Pula Bay in the settlement of Veli Vrh, there is a stream hidden in the woods which much is unknown.

The first mystery lies in the stream's very name.

Some locals believe that the stream has no name while others call it Tivoli after part of the settlement of the same name. There is also a name Valfabion. This information was given to us by a Croat and Veli Vrh native, Aldo Rojnić.

We proceeded to refer to the stream as Valfabion.

Another question is related to the quality of the stream water as well as its use throughout the years.

The locals also informed us that the water from the stream was used for drinking and agriculture and that the firth was rich with fish during the first half of the 20th century.

We couldn't get more detailed information on its usage because the stream is located on the site of a former military zone which had restricted access.

Curious, we wanted to learn what Valfabion's water quality is like.

- We implemented the project in two phases: First phase: November 2015 - October 2016, second phase: November 2016 - April 2019.

- Our first research questions were:

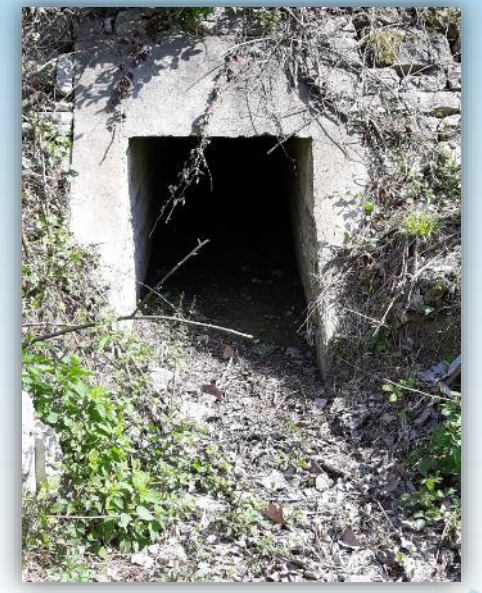
What is the Valfabion water quality like?

Can the water from the stream be used for drinking?

We assumed that the stream was polluted and that the water is unsafe to drink, considering the fact that there is a sewage outflow at the part of the stream which flows into the sea.

- Our second research question was:

Has the water quality of the Valfabion stream gotten better or worse over the last three years?



We believe that the water will be less polluted compared to three years ago because the number of sewage outfalls has been reduced.

2. METHODS

- GPS protokols and the Google Earth platform – coordinates, map
- With the help of literature – list and naming of the most common plant species
- GLOBE protocols for the atmosphere – air temperature, type and amount of cloudiness
- hydrological GLOBE protocols – water analysis (Table 1)
- physical – chemical and microbiological analysis of water samples by ZZJZIŽ – according to the Policy on compliance parameters, methods of analysis, monitoring and safety plans for human consumption and the means of keeping the register by legal entities performing the activity of public water supply. (NN 125/2017).

Table 1. Physical test methods – of chemical parameters of water

PARAMETER	METHOD
TEMPERATURE (°C)	Thermometer
COLOR	Visual
TURBIDITY	Visual
SCENT	Noticeable scent, after shaking
pH	Paper indicator
OXYGEN (mg/L)	According to the instructions from the kit
CHLORIDES (mg/L)	
AMMONIA (mg/L)	
NITRATES (mg/L)	
NITRITES (mg/L)	
SULFATES (mg/L)	
PHOSPHATES (mg/L)	
TOTAL HARDNESS (mg/L $CaCO_3$)	

Field and classroom work

- In the period from November 2015 to April 2019, we studied the stream at three stations, which we named after their appearance:
- 1. Stream - cave (part of the stream is tucked into a stone cave and the water is stagnant in that part)
- 2. Stream – flowing water: (in this part the stream flows quickly and we believe that there is one of the springs)
- 3. Stream - firth (the place where the stream flows into the sea).

3. DATA DISPLAY AND ANALYSIS

Picture of the first Valfabion station where measurements were taken

1. Stream – cave:
Latitude 44.8861
Longitude 13.8478
Elevation 2.5m

2. Stream – flowing water:
Latitude 44.8859
Longitude 13.8484
Elevation 2m

3. Stream – firth:
Latitude 44.8839
Longitude 13.8479
Elevation 0m

- Due to the inaccessibility of the terrain, we were not able to fully implement the GLOBE MUC protocols to determine the natural environment. Therefore, with the help of the literature, we listed and named the most common plant species observed in the area.
- The sea rush is located only at the third station where the stream flows into the sea. From all the spring plants we have seen anemone, dandelion, daisy and many others. According to the plant species we observed in the area, we concluded that a mixture of coastal evergreen and deciduous forests predominates.

The most common plant species in the stream area:

Aleppo pine (*Pinus halepensis L..*)

Sharp-leaved asparagus (*Asparagus officinalis L..*)

Prickly boar (*Ruscus aculeatus L..*)

Laurel (*Laurus nobilis L..*)

Blackberry (*Rubus fruticosus L.*)

Holm oak (*Quercus ilex L.*)

Holly (*Phillyrea latifolia L.*)

Pistachio tree (*Pistacia lentiscus L.*)

Golden fern (*Asplenium ceterach L.*)

Downy oak (*Quercus pubescens L.*)

Thorn (*Paliurus spina-christi L.*)

Common juniper (*Juniperus communis L.*)

Ivy (*Hedera helix L.*)

Smilax (*Smilax aspera L.*)

Dandelion (*Taraxacum officinale L.*)

Anemone *(Anemone hortensis L.)*

Daisy (*Bellis perennis L.*)

Sea rush (*Juncus maritimus L.*)

Results of the physico – chemical and microbiological analysis

- First phase: November 2015 – October 2016

Table 2. Results of the physico – chemical analysis of the water sample from the three stations in the period November 2015 – October 2016

PARAMETAR	RESULTS			REZULTS OF THE ZZJZIŽ ANALYSIS		
	19.11.2015. – 27.10.2016.			10.3.2016.		
	Station 1: Stream - cave	Station 2: Stream – flowing water	Station 3: Stream - firth	Station 1: Stream - cave	Station 2: Stream - flowing water	Station 3: Stream - firth
TEMPERATURE (˚C)	12 – 15	12 – 15	12 – 15	17.9	17.6	17.7
COLOR	none	none	none	3 Pt/Co	<2 Pt/Co	<2 Pt/Co
TURBIDITY	transparent	transparent	transparent	3.70 NTU	3.70 NTU	3.51 NTU
SCENT	none	none	Unpleasant with faeces	-	-	-
pH	6.5 – 7.5	6.5 – 7.5	6.5 – 7.5	6.99	6.96	6.94
OXYGEN (mg/L)	3	3	3	8.96	9.06	8.42
CHLORIDES (mg/L)	-	-	-	36.1	267	3978
AMMONIA (mg/L)	0	0	0	<0.015	<0.015	0.264
NITRATES (mg/L)	10	10	10	12.0	11.8	10.6
NITRITES (mg/L)	0	0	0	<0.010	<0.010	<0.010
SULFATES (mg/L)	<200	<200	<200	-	-	-
PHOSPHATES (mg/L)	0	0	0	-	-	-
TOTAL HARDNESS (mg/L $CaCO_3$)	>375	>446.25	>446.25	351	446	2528
ELECTRICAL CONDUCTIVITY 20˚C (µS/cm)	-	-	-	593	1351	10560

Table 3. Results of the microbiological analysis of water samples from the three stations – November 2016 (ZZJZIŽ)

PARAMETER	UNIT OF MEASUREMENT	RESULTS		
		10.3.2016.		
		Station 1: Stream-cave	Station 2: Stream-flowing water	Station 3: Stream-firth
NUMBER OF BACTERIA, 37°C/48h	no/1 mL	34	12	378
Pseudomonas aeruginosa	no/100 mL	1	1	34
NUMBER OF BACTERIA, 22°C/72h	no/1 mL	230	415	1900
Clostridium perfringens	no/100 mL	11	7	440
Enterococci	no/100 mL	48	53	1540
Fecal coliform bacteria	no/100 mL	38	50	1100
Total coliform bacteria	no/100 mL	82	115	3300
Escherichia coli	no/100 mL	38	43	1650

- In the first phase of the research, we had only five measurements and one from ZZJZIŽ (March 2016). We noticed that our water temperature values at all three stations change in the range from 12 °C in March 2016 to 15°C in October 2016. The pH value varies from 6.5 to 7.5 through the specified periods of the year, while the values of other parameters are always the same for all three stations. The scent was unpleasant at the third station, we assume due to the proximity of the sewer outlet. Comparing the results with the results of ZZJZIŽ, we noticed the only large deviation in the amount of dissolved oxygen and we suspect the malfunction of our reagent. Also our pH measurements are not accurate because we determined the pH value using indicator papers. At station 3, the electrical conductivity values are very high compared to the values at stations 1 and 2.
- Microbiological results show that at the station 3 the values of all parameters are significantly higher compared to stations 1 and 2, which indicates the highest water pollution at station 3.

- ZZJZIŽ means Institute of Public Health of the County of Istria, Pula

- Second phase: November 2016 – April 2019

Table 4. Results of the physico – chemical analysis of the water sample from the three stations in the period November 2016 – April 2019

PARAMETER	RESULTS			RESULTS OF THE ZZJZIŽ ANALYSIS		
	24.11.2016. – 4.4.2019.			4.4.2019.		
	Station 1: Stream - cave	Station 2: Stream - flowing water	Station 3: Stream - firth	Station 1: Stream - cave	Station 2: Stream - flowing water	Station 3: Stream - firth
TEMPERATE (˚C)	7 – 22	7 – 22	7 – 22	20.2	19.7	18.7
COLOR	none	none	none	<2 Pt/Co	<2 Pt/Co	<2 Pt/Co
TURBIDITY	transparent	transparent	transparent	1.67 NTU	7.17 NTU	3.32 NTU
SCENT	none	none	Unpleasant with faeces/ none	-	-	-
pH	6.5 – 7.5	6.5 – 7.5	6.5 – 7.5	6.93	6.99	6.93
OXYGEN (mg/L)	3 – 5	3 – 5	3 – 5	8.14	7.69	8.36
CHLORIDES (mg/L)	-	-	-	1637	836	2256
AMMONIA (mg/L)	0	0	0	<0.015	<0.015	<0.015
NITRATES (mg/L)	10	10	10	12	12.1	11.8
NITRITES (mg/L)	0	0	0	<0.010	<0.010	<0.010
SULFATES (mg/L)	<200	<200	<200	-	-	-
PHOSPHATES (mg/L)	0	0	0	-	-	-
TOTAL HARDNESS (mg/L $CaCO_3$)	>375	>446.25	>446.25	512	523	965
ELECTRICAL CONDUCTIVITY 20˚C	-	-	-	2230	2260	5960

Table 5. Results of the microbiological analysis of water samples from three the stations – March 2016 (ZZJZIŽ)

PARAMETAR	UNIT OF MEASUREMENT	RESULTS		
		4.4.2019.		
		Station 1: Stream-cave	Station 2: Stream-flowing water	Station 3: Stream-firth
NUMBER OF BACTERIA, 37˚C/48h	no/1 mL	29	76	58
Pseudomonas aeruginosa	no/100 mL	29	159	39
NUMBER OF BACTERIA, 22˚C/72h	no/1 mL	89	1140	230
Clostridium perfringens	no/100 mL	6	36	3
Enterococci	no/100 mL	2	142	22
Fecal coliform bacteria	no/100 mL	8	50	65
Total coliform bacteria	no/100 mL	128	3298	1101
Escherichia coli	no/100 mL	6	48	61

- In the second phase of the research, we had a larger number of measurements, on average once a month with a summer break, and one of the ZZJZIŽ. We noticed that only the values of temperature and pH values change at different times of the year and minimal of oxygen, while the values of other parameters are always the same for all three stations. The water temperature range at all three stations ranged from 7 °C, (December 2016 and January 2017), to 22°C (June 2018). We also observed that at the third station, in the last year, the smell is no longer unpleasant like the faeces smell. Comparing the results with the results of ZZJZIŽ, we again observed a deviation in the amount of dissolved oxygen. Comparing the values from Table 2 and Table 4, at the 1st and 2nd stations a significantly higher value of chloride was observed compared to the measurement three years ago, while at the 3rd station this value was slightly reduced. Also at the 1st and 2nd stations the value of electrical conductivity was significantly increased, while at the 3rd station this value was reduced by half.

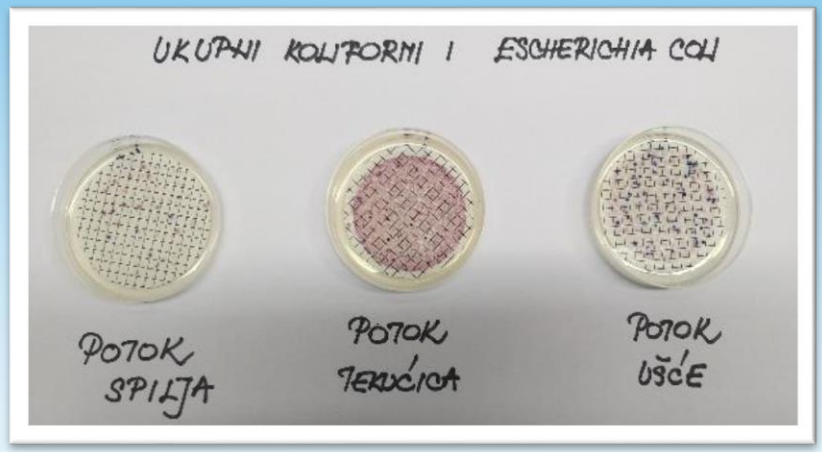
- Comparing the values of the parameters from Table 3 and Table 5, a significant decrease in the values of all parameters was observed at station 3. A decrease was also observed at station 1, except for the value of the number of total coliform bacteria which increased by 2/3 and the number of colonies of Pseudomonas aeruginosa species which increased from 1 to 29 / 100mL. Deterioration of the results is observed at station 2. in all parameters.

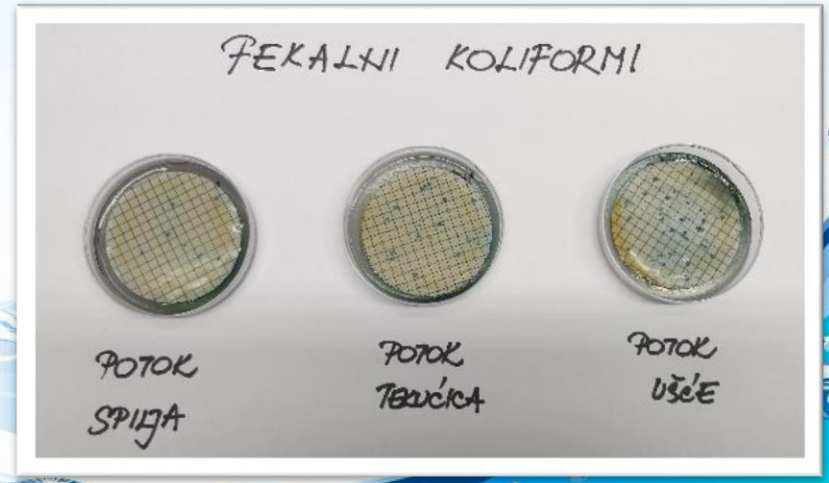
4. DISCUSSION AND CONCLUSION

- According to the Ordinance on Limit Values of Ecological Status for Basic Physico-Chemical Indicators, we assume that our stream is of the type HR-R_17, lowland and mountainous small streams of Istria.
- Based on the obtained values and the Maximum Permitted Concentrations (MAC) prescribed by the Regulation, we made conclusions about the probable quality of water from our stream.

- According to microbiological parameters, the ecological state of water from all three stations is poor.
- It is more difficult to determine its quality based on chemical parameters considering it has high nitrate values while also being rich with oxygen.
- For the full picture of its ecological condition, we lack additional measurements of other parameters, especially of biological element qualities.

- Bacteria of Pseudomonas aeruginosa, Escherichia coli, Clostridium perfringens and enterococci were found at every station. However, these are not allowed to be in drinking water, according to the Policy (NN 125/2017), which means their permitted value must be 0.
- Based on the results, we concluded that the water from the stream cannot be used for drinking, and its usage for watering vegetables for instance is also questionable. This confirmed our hypothesis.





- **We believe that the sewage outfalls into the stream caused its pollution, which is indicated by the increased number of colonies of fecal bacteria, especially at station 3, as well as a high amount of nitrate.**

- In the second phase of our research, a decrease in the number of bacteria at stations 1 and 3 indicates an improvement in water quality. The results of microbiological parameters increased at station 2, which **partially confirms our second hypothesis.**

- **Nevertheless, we can conclude that the sewage discharge that flowed directly into the water at the 3rd station was reduced.**

- In the end, we can conclude that the water from our stream cannot be used for drinking as it was once used by the locals. In addition, the part that flows into the sea no longer seems to be inhabited by fish as it once was.
- We believe that human negligence towards the environment has led to this. However we still hope that in the near future the sewage discharge into the stream will be completely closed out and that the water quality will improve so that it can once again be inhabited by many fish species.

- We made a small contribution by removing some of the observed waste which we are very proud of !!

5. LITERARY SOURCES

- NN 73/2013, Uredba o standardu kakvoće vode
- Kovačić, Sanja; Nikolić, Toni; Ruščić, Mirko; Milović, Milenko; Stamenković, Vanja; Mihelj, Darko; Jasprica, Nenad; Bogdanović, Sandro; Topić, Jasenka Flora jadranske obale i otoka - 250 najčešćih vrsta. Školska knjiga, Zagreb 2011.
- GLOBE database
- GLOBE handbook and protocols