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# Challenge-driven education for sustainable development: Integrating water quality and antimicrobial resistance monitoring in the Lower Danube Basin

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## Context & Aim

Danube River faces increasing environmental pressures from anthropogenic activities, including wastewater discharge and emerging pollutants, with implications for ecosystem and public health. Within the CIVIS program “Environmental Challenges Facing the Danube River”, students participated in interdisciplinary, challenge-driven research activities focused on water quality assessment and sustainability education.

This study aimed to evaluate the chemical and microbiological quality of the Danube River during 2023–2025 and to assess the educational value of integrating applied environmental research into higher education through a challenge-driven learning approach.

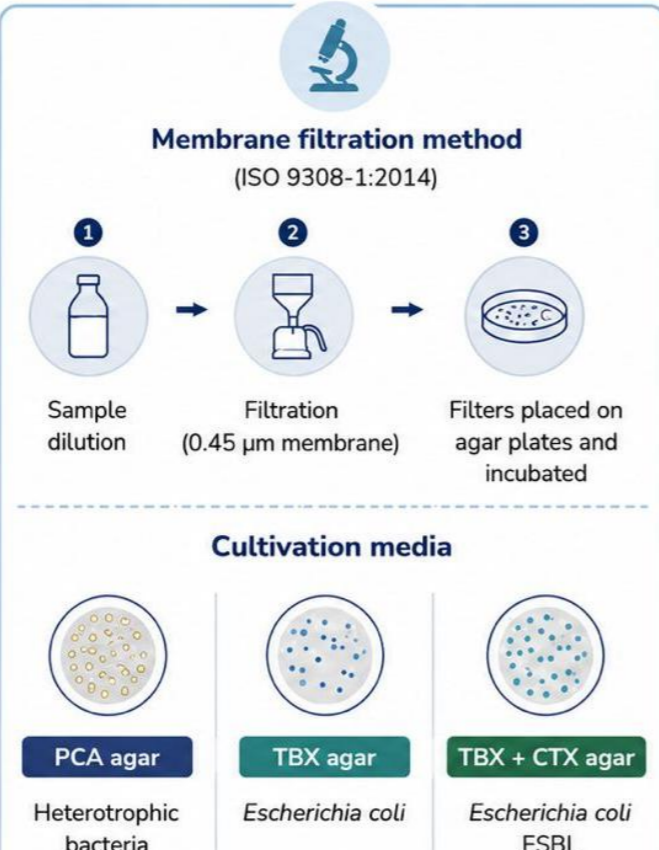
## Methodology

1 WATER SAMPLING → 2 CHEMICAL ANALYSIS → 3 MICROBIOLOGICAL ANALYSIS



- River samples collected in sterile glass/PEHD bottles filled to the brim (no air)
- In situ measurements:
  - Temperature
  - Dissolved Oxygen (DO)
  - pH
- Samples stored at 5°C until analysis

- pH
  - Conductivity (μS/cm)
  - BOD<sub>5</sub> (mg O<sub>2</sub>/L)
  - DCO / COD (mg O<sub>2</sub>/L)
  - Total Carbon (TC) (mg C/L)
  - Nutrients
  - Metals
- TC = TIC + TOC  
 MOC used to assess oxidation state of organic carbon



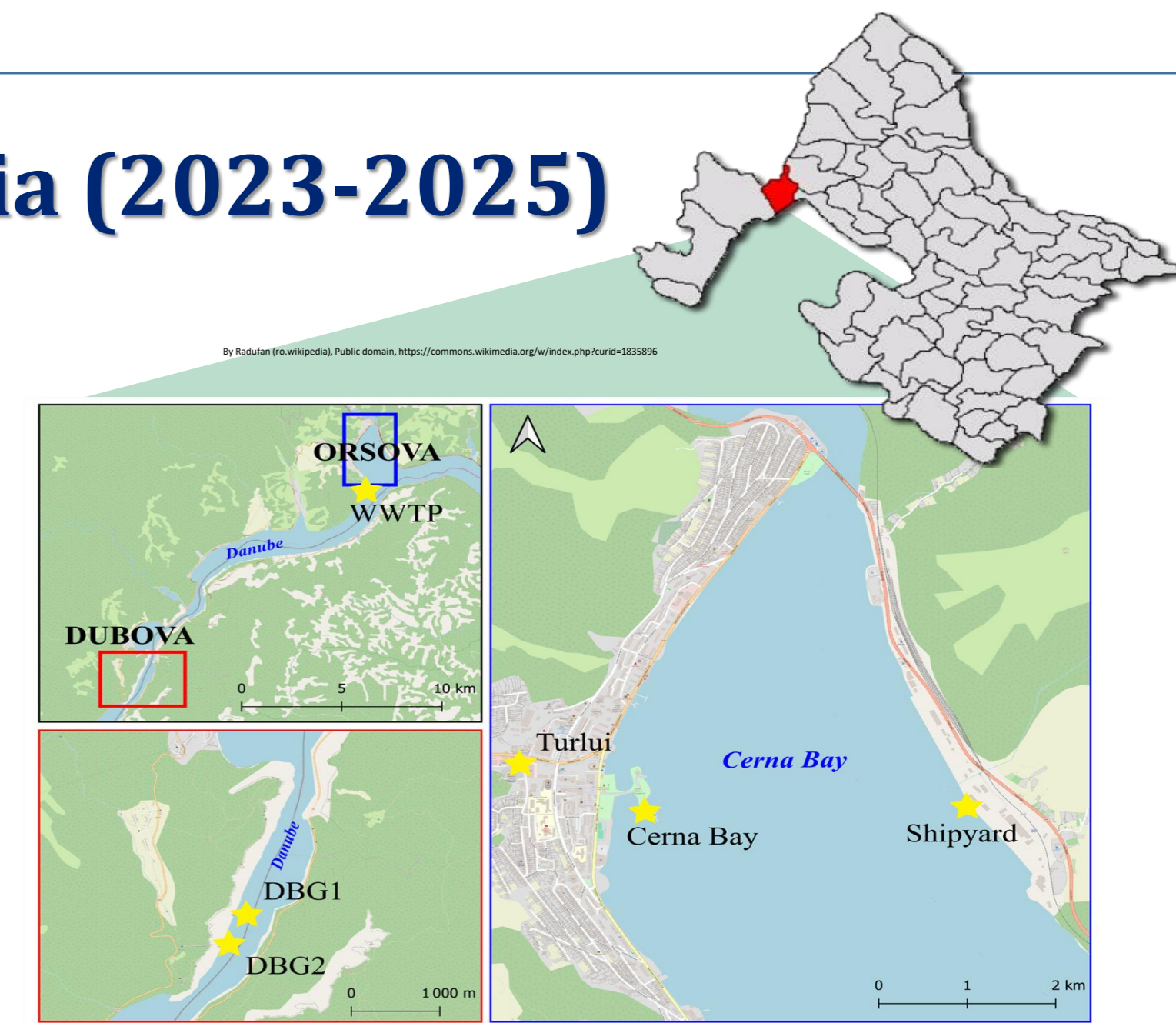
## Conclusion

The findings demonstrate that integrating applied research into a sustainable-development-oriented curriculum effectively links scientific inquiry with sustainability and One Health perspectives, offering a scalable model for embedding societal relevance into STEM education.

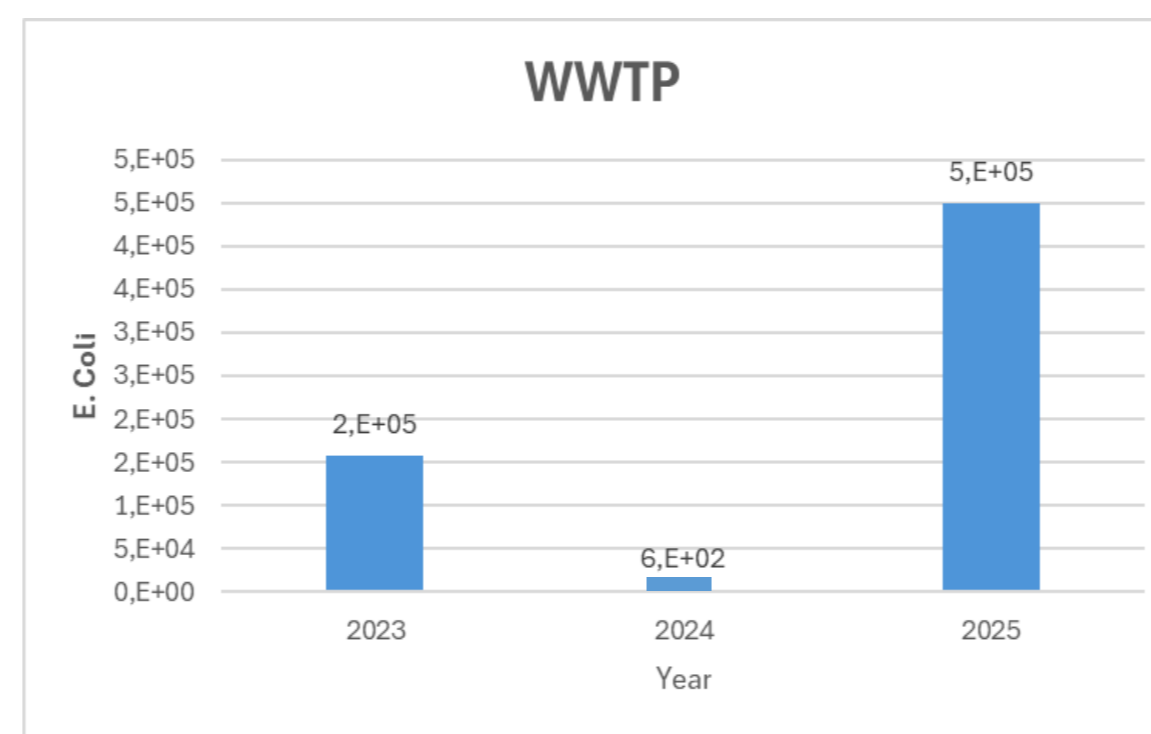
## Case study: Orșova, Romania (2023-2025)

Natural park under high anthropic pressure

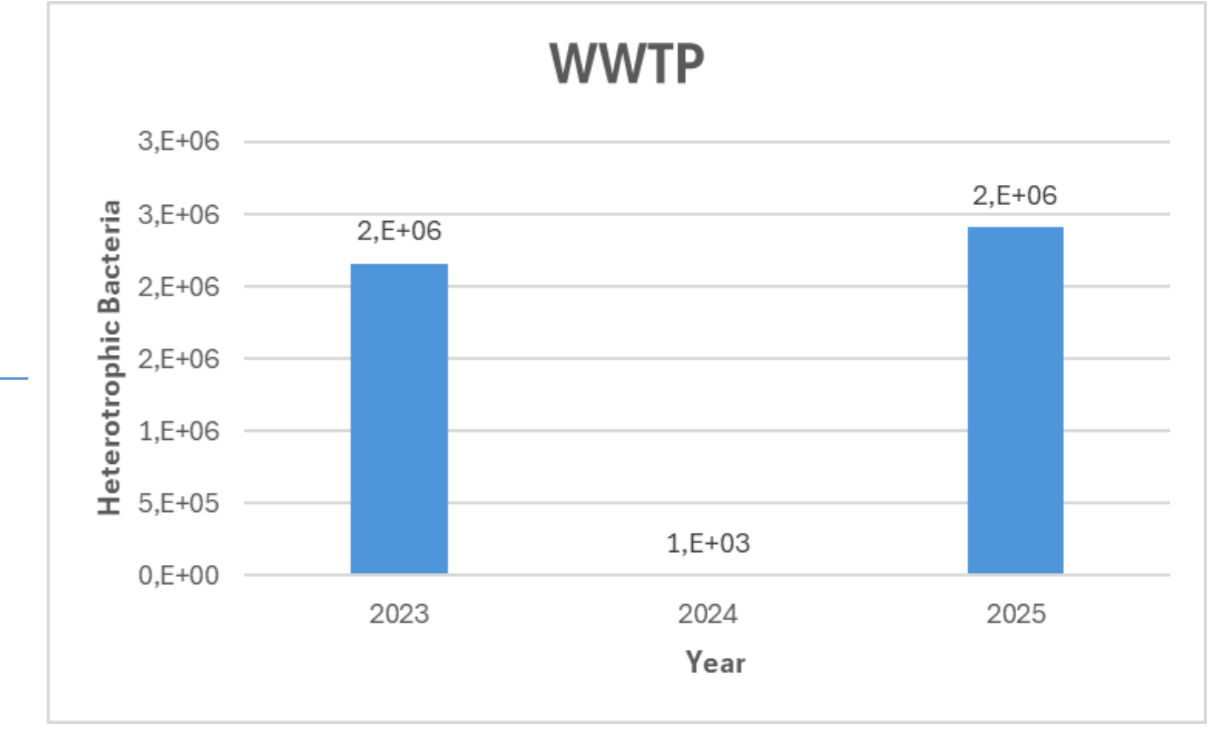
No.	Sampling points
1	Danube Gorges (DBG1)
2	Danube Gorges (DBG2)
3	Cerna Bay
4	Shipyards
5	Waste water treatment plant (WWTP)
6	Turlui Stream



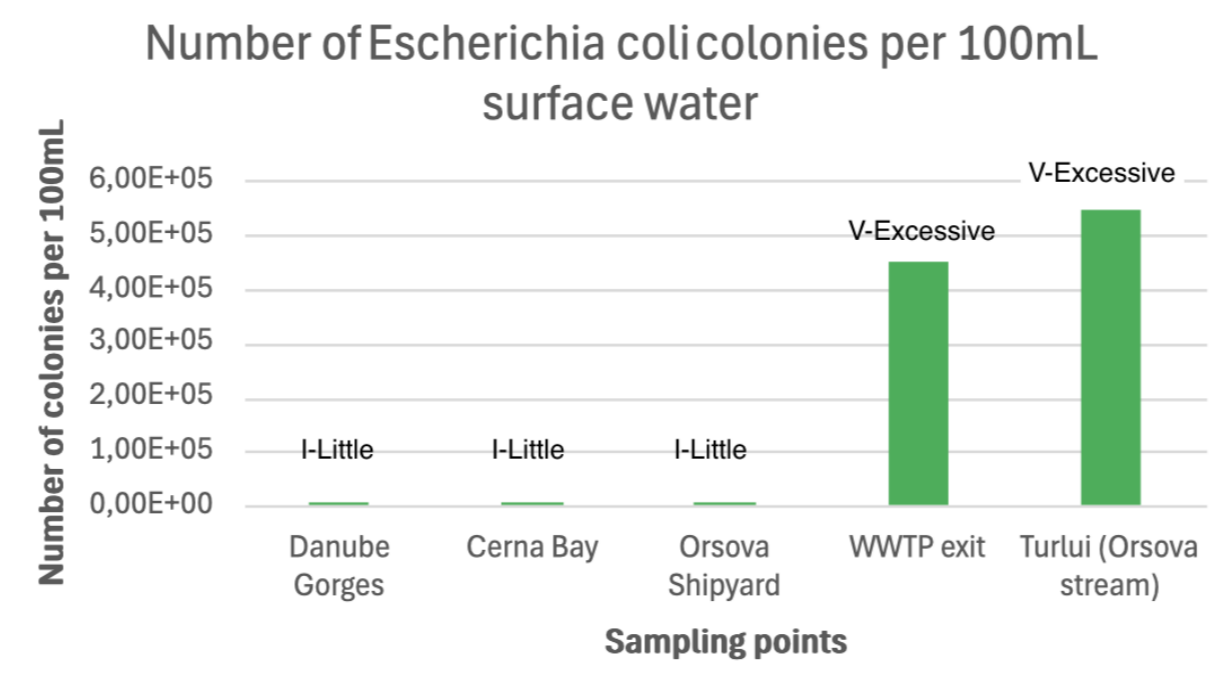
## Results



Higher TOC levels were associated with increased heterotrophic bacterial concentration.

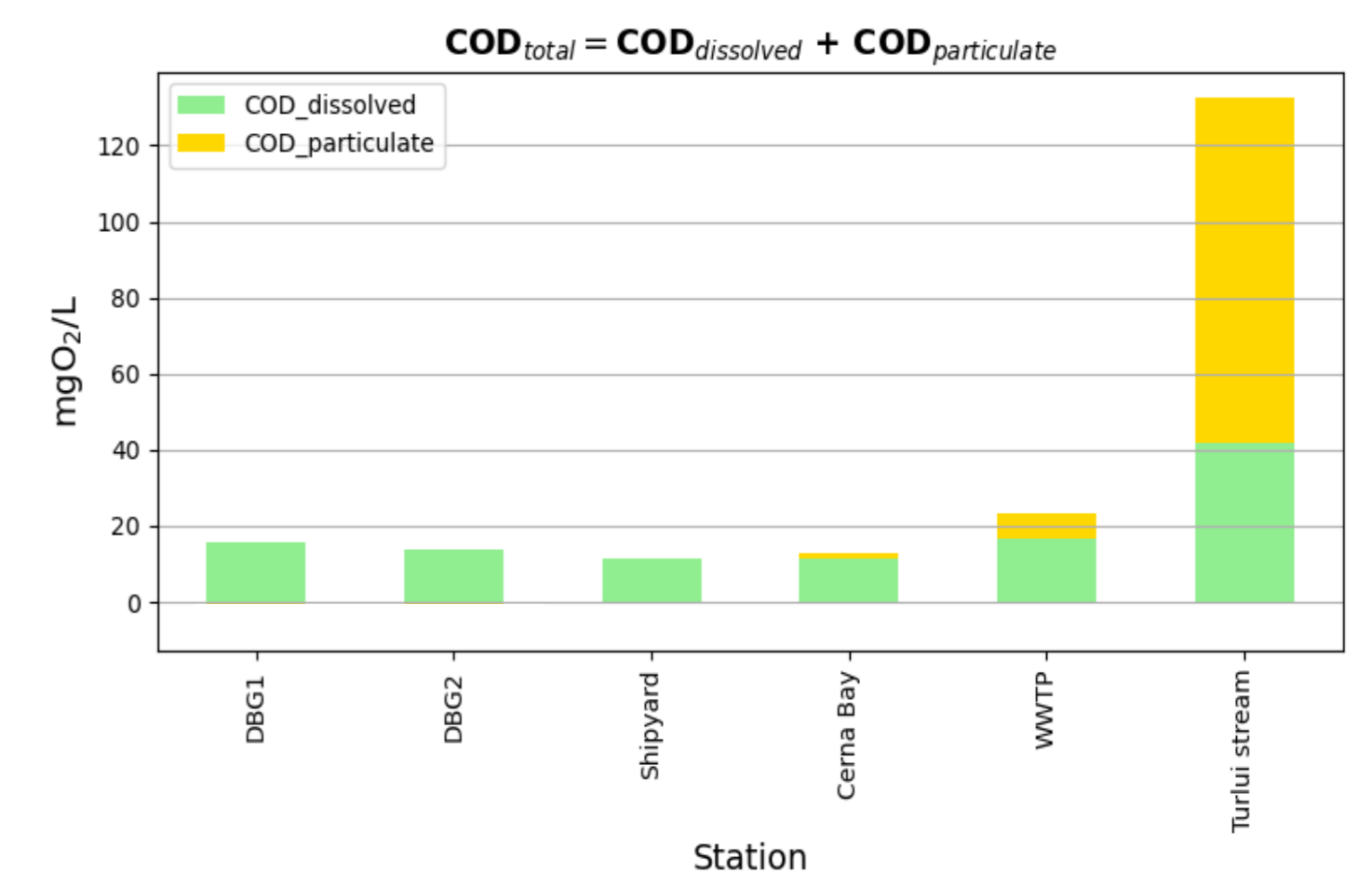
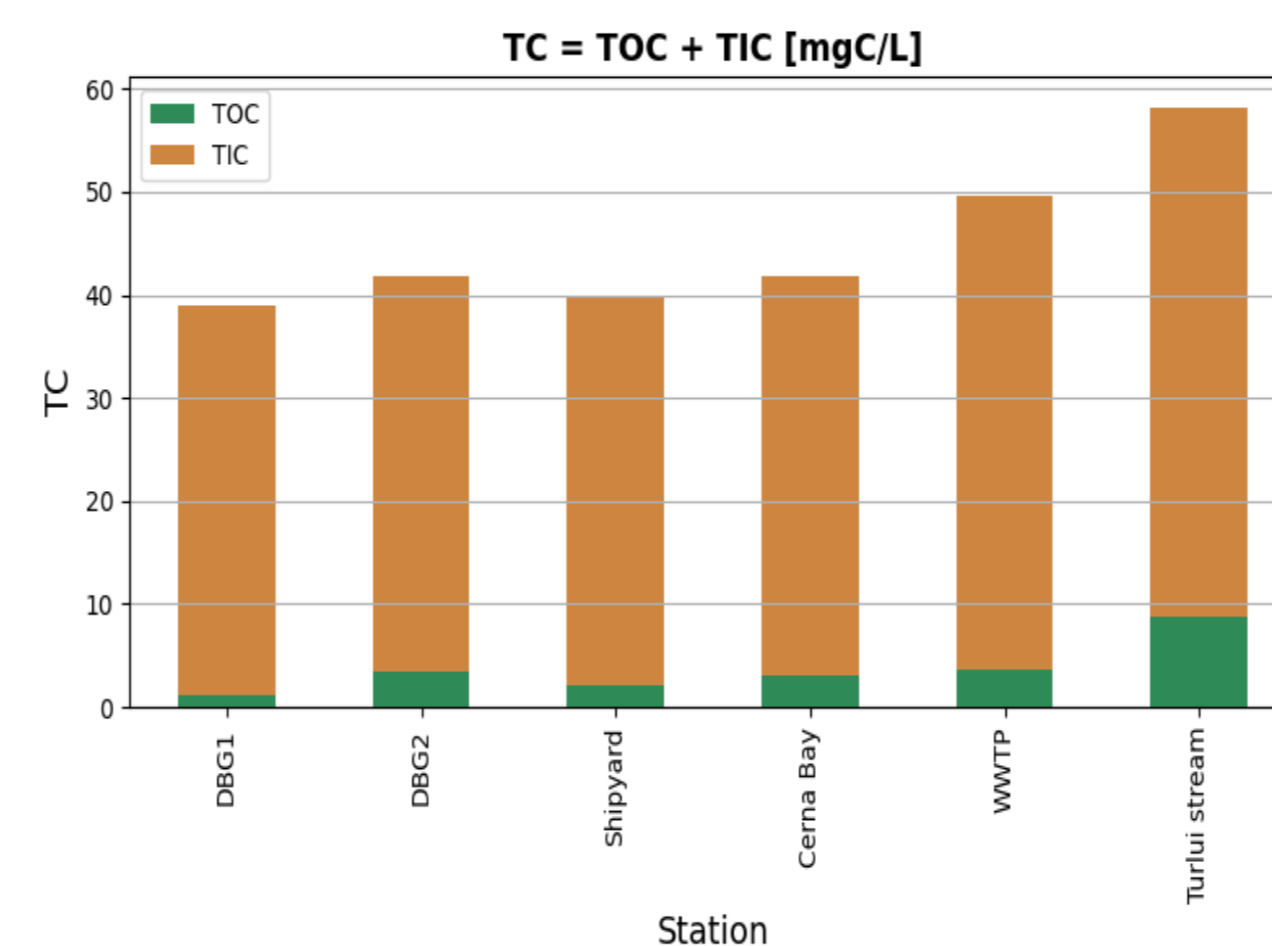


In 2025, there is approximately 2.88 times more *E. coli* load compared to 2023.



Classification of faecal pollution	Classes					
	I	II	III	IV	V	
Parameter	Faecal Pollution	Little	Moderate	Critical	Strong	Excessive
E. coli	In 100 mL water	≤100	>100-1000	1000-10000	10000-100000	>100000

EU water framework harmonized system integrating guidelines for bathing water quality (European Parliament & Council, 2006, European Council, 1976)



\*Learn more about the project: [luminita.marutescu@bio.unibuc.ro](mailto:luminita.marutescu@bio.unibuc.ro)