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Review paper

Assessment of Water Quality in Vlora Bay by Measuring Physico-Chemical Parameters*

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Abstract: Seawater is an important component of coastal waters, with a wide variety of physical and chemical parameters that play a key role in understanding coastal dynamics and monitoring environmental health. This article provides a comprehensive overview of the most important physicochemical parameters in seawater, with a particular focus on their importance in coastal areas. Physical parameters studied include temperature, redox potential, electrical conductivity, dissolved solids, and water hardness which have a strong influence on environmental and hydrodynamic processes in coastal areas. Chemical parameters include various components such as dissolved oxygen, chloride ions, and pH, which are very important for the assessment of the environmental quality and health of coastal waters.
This article highlights the vital need to understand the physical and chemical parameters of seawater, especially in coastal areas. Accurate measurement and ongoing monitoring of these parameters offer insights into water quality and help implement sustainable management practices. Our consistent measurements confirm excellent water quality, underlining the importance of these efforts in conserving coastal ecosystems for future generations.

Keywords: Seawater, pH, Dissolved oxygen, Alkalinity, TDS, Chloride ions.

1. Introduction

The environment encompasses the natural world and the intricate interactions between air, water, land, and the organisms inhabiting them, including plants, animals, and humans. It serves as a fundamental cornerstone for sustaining life, providing essential resources vital for the existence of all living entities.

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Conserving and safeguarding the environment is paramount for the welfare of both current and forthcoming generations. Through conscientious actions and environmentally mindful decisions, we can contribute to fostering a healthier and more sustainable planet for ourselves and the diverse ecosystems reliant upon it. Seawater, characterized by its dynamic nature and spatial-temporal variability, is influenced by movements, and physical attributes such as temperature, pH, conductivity, and the presence of solid waste. These factors collectively create a spectrum of environmental conditions that profoundly impact the composition and dynamics of the biological communities inhabiting it [1].

Various physical and chemical parameters are employed to delineate the attributes of seawater. These parameters are pivotal in comprehending the dynamics of seawater and its interface with the atmosphere. Within this article, we have scrutinized key physicochemical parameters pertinent to seawater.

2. Methods and materials

2.1. Studied area

The city of Vlora, with approximately 100,000 inhabitants, is located in the Gulf of Vlora, which is considered the border between the Adriatic and Ionian seas (Figure 1). The island of Sazan is positioned at the entrance of the Gulf of Vlora, causing unfavourable water circulation conditions between the bay and the open sea.

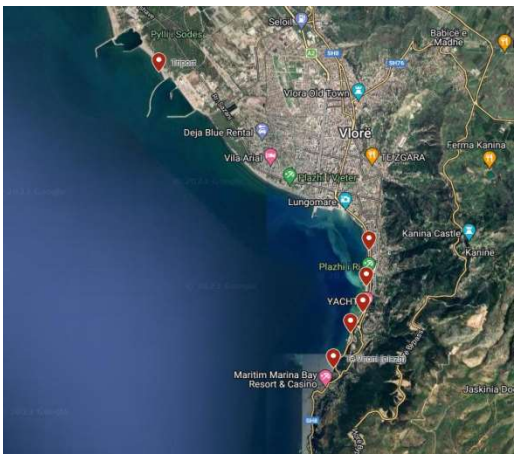

Fig. 1 – *Map of sampling points.*

The bay holds very suitable conditions to accommodate ships of various types. Two of the most important ports in the city of Vlora are the Commercial Port and the Fishing Port (Triport). Activity in the port can cause significant damage to water quality and, subsequently, to sea life and ecosystems, as well as to human health [1].

2.2. Determination of physico-chemical parameters

On May 30, 2023, water samples were gathered from six stations (Vilat, Vefa, Rrapi, Kampi i pionerëve, Mustafa, and Triport) using 1.5-liter PET bottles, positioned at depths of 10-30 cm and a distance of 3 m from the shoreline. These samples were promptly transported to the laboratory on the same day under refrigeration, maintaining a temperature below 4°C. Upon arrival, the physicochemical parameters of the water were analyzed. Water temperature, pH, and conductivity were measured using a Hanna portable pH meter, while dissolved oxygen levels, both in percent and mg/litre, were determined using the Multi 3510 IDS apparatus. Total suspended solids (TSS) were assessed by passing a litre of water through a pre-weighed filter (pore size 0.42 μm), dried at 105°C for 2 hours, and reweighed post-drying. Total alkalinity was determined by titrating the sample to a pH level of 4.2, expressed in mg CaCO3/litre. Chloride levels in the water were determined using the argentometric method, involving titration with AgNO3 solution.

3. Results

pH – The pH levels across all six stations consistently range between 8.2 and 8.3, indicating uniformity in this parameter among the stations. These values fall within the acceptable range for marine waters, reflecting a slightly alkaline pH characteristic (Figure 2a).

Temperature - Seawater temperature exhibits variability influenced by factors including location, depth, season, and currents. In our study, the average water temperature recorded is 22.7°C, which aligns with typical levels for the sampling period (May), see Figure 2b.

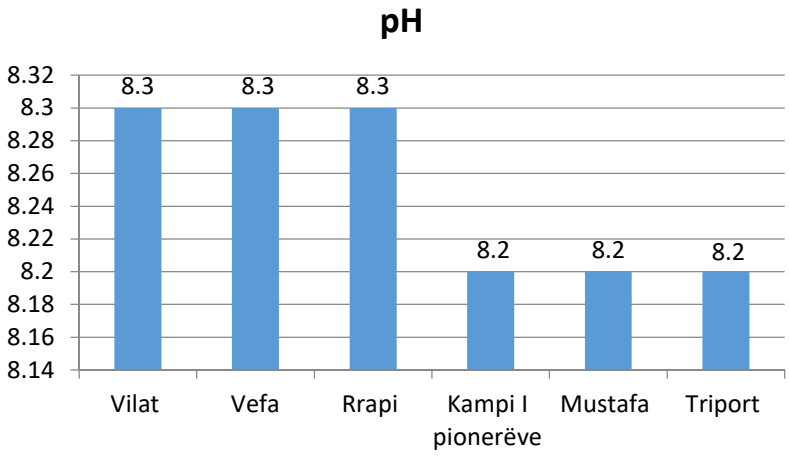

Fig. 2a – *pH.*

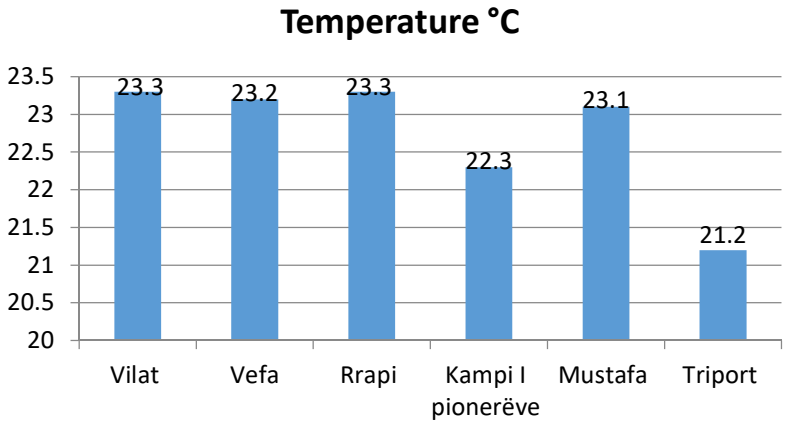

Fig. 2b – *Temperature.*

Dissolved Oxygen (DO) - Essential for various life forms, including fish, invertebrates, bacteria, and plants, dissolved oxygen supports vital respiratory processes akin to terrestrial organisms. The required oxygen levels vary across different species. In our study, the recorded DO level of 8.26 mg/litre falls within the permitted values (between 7 and 8 milligrams per litre (mg/L) [2] (Figures 2c-d).

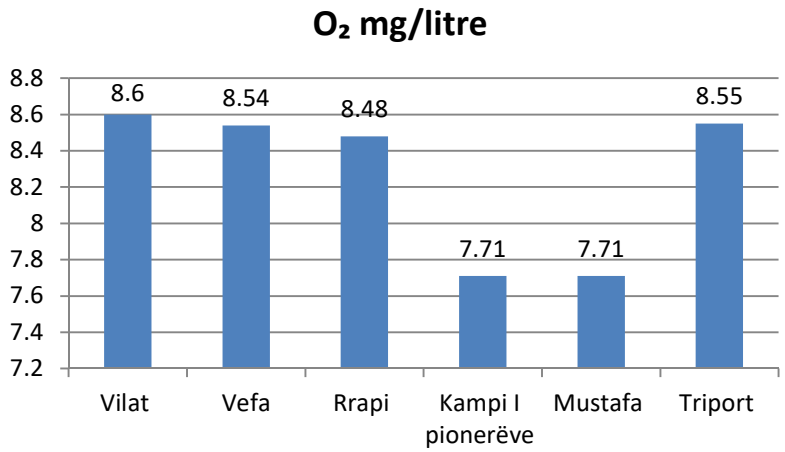

Fig. 2c – *Dissolved oxygen.*

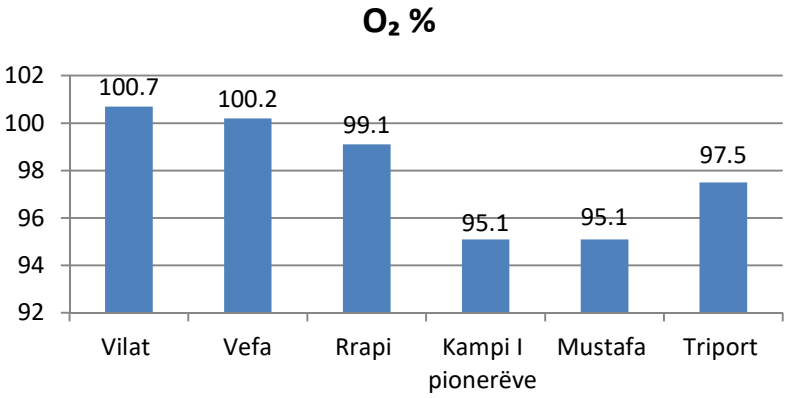

Fig. 2d – *Dissolved oxygen.*

Total Dissolved Solids (TDS) - TDS represents the collective dissolved content of both inorganic and organic substances in a liquid, encompassing molecular, ionisable, or micro granular forms. Typically quantified in parts per million (ppm) [3], TDS values for saline waters commonly range from 10,000 to 35,000 ppm. Across our samples, TDS levels fluctuate from 22,600 ppm in the Mustafa area to 28,000 ppm in the Triport sample. These recorded values fall within the permissible range for TDS in saline waters (Figure 3).

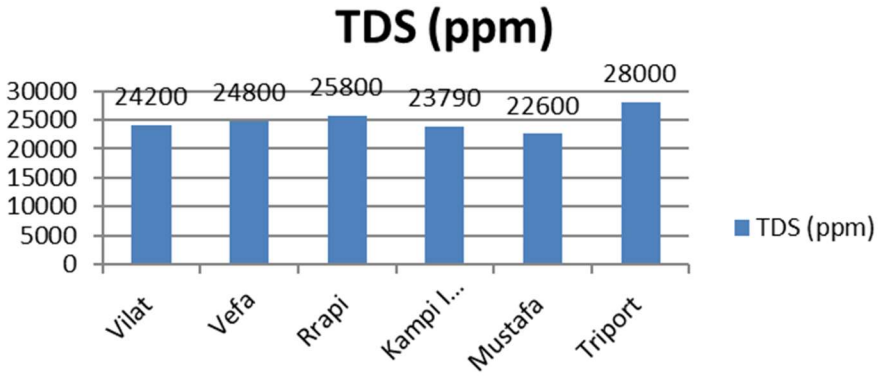

Fig. 3 – *TDS in sampling areas.*

Conductivity – Conductivity measurement provides valuable insights into water quality, serving as a direct indicator of pollutant levels and an indirect gauge of salinity. Maintaining optimal salinity levels is crucial for sustaining aquatic life, as excessive salinity can be detrimental to fish and other organisms. Given that saltwater contains salt ions, its conductivity range is notably higher, typically around 55,000 µS/cm [4]. Our conductivity data aligns with expectations for a saltwater environment. The highest conductivity reading, observed at the Triport location with a value of 53,000 µS/cm, remains within acceptable limits. This elevated reading correlates with other parameters such as chloride ions and Total Dissolved Solids (TDS), indicating consistency across multiple metrics (Figure 4).

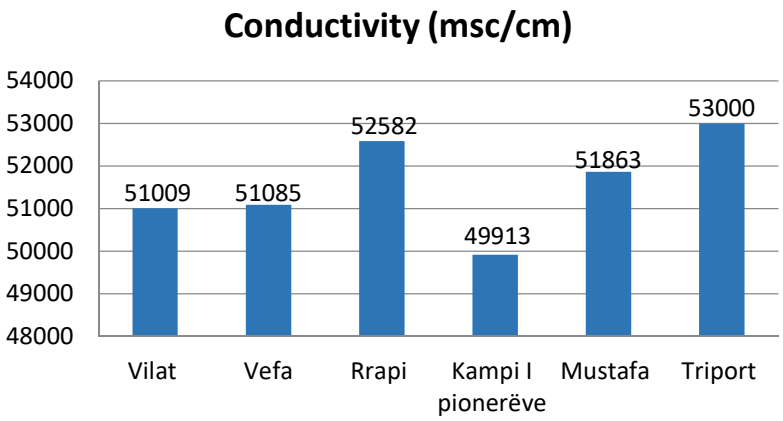

Fig. 4 – *Conductivity in sampling areas.*

Chloride ions, naturally present in both freshwater and saltwater environments, are primarily sourced from dissolved salts like sodium chloride or magnesium chloride. In modest quantities, chloride plays a crucial role in maintaining normal cellular function in both plants and animals. Seawater typically contains a chloride ion concentration of approximately 19,400 mg/L [5]. In our sampled locations, chloride concentrations range from 17,800 mg/L to 19,060 mg/L, with variations attributed to the discharge of freshwater from several canals at select sampling sites (Figure 5).

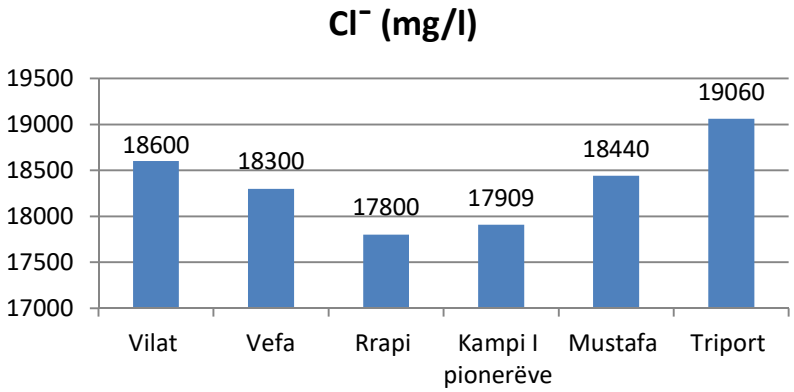

Fig. 5 – *Chloride ions in sampling areas.*

Alkalinity - Alkalinity refers to the buffering capacity of a water body, representing its capacity to neutralize both acids and bases, thereby sustaining a relatively stable pH level [6]. In seawater, total alkalinity typically falls within the range of 100 to 130 mg/L as CaCO3, with an average value of approximately 116 mg/L [7] (Figure 6).

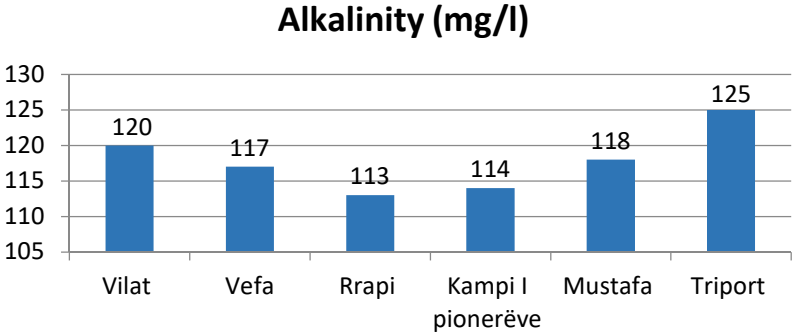

Fig. 6 – *Alkalinity in sampling areas.*

4. Discussion and conclusions

Based on the comprehensive analysis of the data collected from the six strategically positioned sampling points within Vlora Bay, a robust conclusion can be drawn regarding the overall satisfactory water quality, evidenced by the adherence to measured parameters within acceptable thresholds. Nonetheless, to ensure the continual preservation and enhancement of the bay's ecosystem, it is imperative to underscore the necessity of ongoing and systematic monitoring endeavours. Regular assessments not only guarantee the acquisition of more precise and comprehensive data but also enable the identification of potential fluctuations attributable to multifaceted factors, including seasonal variations, anthropogenic activities, and natural phenomena.

Moreover, it is strongly recommended to augment the existing monitoring protocols with extensive physico-chemical analyses targeting both organic and inorganic nutrients. This strategic approach would provide invaluable insights into the intricate dynamics of nutrient loading within the bay, thus facilitating a more nuanced understanding of its ecological health and resilience. By meticulously evaluating nutrient concentrations, particularly those implicated in eutrophication processes, authorities can devise targeted mitigation strategies aimed at preserving the delicate balance of the marine ecosystem. Additionally, integrating advanced analytical techniques such as spectroscopy and chromatography can further enhance the precision and scope of nutrient assessments, thereby empowering stakeholders with actionable intelligence to inform policy formulation and resource management initiatives.

In essence, while the current findings paint a favourable picture of Vlora Bay's water quality status, proactive measures must be adopted to fortify its environmental integrity and sustainability. Through sustained vigilance, informed decision-making, and collaborative engagement among stakeholders, the collective endeavour to safeguard this invaluable natural resource can be effectively realized, ensuring its enduring vitality for generations to come.

References

[1] S. Kane, F. Qarri, P. Lazo, “Environmental Situation of Vlora Bay, Albania Based on Physico-Chemical Parameters of Seawater”, Austin J Hydrol, 2(1): 1016, 2015.

[2] https://www.vims.edu/research/topics/dead_zones/impacts/

[3] https://theberkey.com/blogs/water-filter/what-is-theacceptable-total-dissolved-solids-tds-level-in-drinking-water

[4] https://atlas-scientific.com/blog/water-conductivity-range/
[5] https://www.ldeo.columbia.edu/edu/k12/snapshotday/activities/2011/Classroom%20HS%20activity/chloride%20conversion/Chloride%20and%20Salinity.pdf
[6] https://www.knowyourh2o.com/outdoor-4/the-role-of-alkalinity-in-citizen-monitoring
[7] https://www.globalseafood.org/advocate/typical-chemical-characteristics-of-full-strength-seawater/

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