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# P 2. ASSESSMENT OF ECOLOGICAL STATUS OF VJOSA RIVER IN ALBANIAN, BASED ON CHEMICAL INDICATORS AND BIOMONITORING

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**ABSTRACT:** Water ecosystems are the main assets of our country, especially Vjosa River as the last wild river in Europe. Vjosa is a national park and is considerate as the blue heart of Europe. Thus, continuous assessments are necessary for preserving of water quality and conserving biodiversity of water ecosystem. Nowadays, the studies of water ecosystems are focused in chemical monitoring and biomonitoring too. Traditional measures of water quality are based on physic-chemical parameters but using biomonitoring especially diatoms algae we can evaluate historical pollution of water ecosystems. Our study was focused in the assessment of water quality and ecological status of Vjosa River, based on chemical and biological parameters. During 2021-2022 in five sampling point were collected water samples and biological samples. Water samples were analysed for NH4+, NO2-, NO3- and PO43- as chemical parameters. Biological samples were analysed for microalgae as diatoms. The values of ammonium ranged from 0.035 to 0.09mg/l. NO2 from 0.008 to 0.083mg/l and NO3 varied from 0.125mg/l to 0.32mg/l. The values of phosphates ranged from 0.01 to 0.08mg/l. Vjosa River resulted to be in a high and good quality, compared with WFD. Based on diatoms, 96 species were found in 5 sampling points and their ecological values show a trophic status that range from oligotroph up to meso-eutrophic. Also, a PCA analysis in SPSS 20 program was used to see the correlation that existed between chemical and biological parameters.

***Keywords**: Vjosa River, National Park, Ecological Status, Biomonitoring, Diatoms Algae*

## 1. INTRODUCTION

Water ecosystems are the main assets of our country, especially Vjosa River as the last wild river in Europe. Vjosa is a national park and is considerate as the blue heart of Europe. The Vjosa river flows from northwestern Greece to southwestern Albania, spanning approximately 272 kilometres in total length. The Greek section of the river covers the first 80 kilometres while the Albanian section covers the remaining 192 kilometres. The average discharge of the Vjosa river is 195m3/s. Notable tributaries include Voidomatis and Sarantaporos in Greece, and Drino and Shushicë in Albania. Vjosa river is the place when people can raft in its meandering waters, hike and camp in its lush forests, or climb and swim in its impressive canyons with crystal water. Vjosa has a rich environment, from microscopic organisms to threatened species, which are essential to the ecosystem of the waterway. More than 150-winged insect species, roughly 60 mollusc species, a minimum of 31 fish species, 31 reptile species, 257 bird species, around 70 mammal species, and over 350 plant species live there (ActaZooBot, 2018). Water ecosystem is of particular importance, including here the uses of water for swimming, fishing, irrigation or drinking waters (Kupe & Alikaj, 2020). Therefore, it is essential to conduct continuous assessments to maintain healthy ecosystems. Chemical assessment and biomonitoring are closely related in the evaluation of water ecosystems. Chemical monitoring allows us to evaluate the current state of waters, but biomonitoring holds several advantages over chemical monitoring as it summarises the biota's response to a range of pollutants in water ecosystems over time (Alikaj et al., 2022). This study aims the evaluation of trophic status of Vjosa river, based on chemical parameters and diatoms algae. Furthermore, to compare the results that come from two types of monitoring in order to give the best correlation that exist between them and the importance of each monitoring form.

## 2. MATERIAL AND METHODS

### 2.1. The study area, Water and diatom algae sampling

The Vjosa river was the focus of our study (figure 1). Five sampling points along the Vjosa River were determined and three expeditions from November 2021 to October 2022 were realized. Samples for chemical analyses and diatoms algae were collected at the same sampling points. The parameters like pH, temperature, were measured on-site using portable apparatus. The samples for chemical parameters were transported to the laboratory in refrigerated containers at a temperature of 4°C and were subsequently analysed within 24 hours and ISO standard methods (5, 6, 7, 8) were used during analysis. The laboratory responsible was accredited and belonged to the Department of Environment and Natural Resources at the Agricultural University of Tirana.


**Figure 1.** Vjosa river and the sampling points.

Diatom algae material was obtained by gently scraping the upper surface of selected rocks from the river using a toothbrush. The resulting suspensions were collected and preserved in 4% formaldehyde (Kupe & Alikaj, 2020). Diatom frustules from organic and inorganic sources were purified by boiling the material. Initially, the material was treated with HClcc and then, after washing, boiled again with $H_2SO_4$cc. During the final procedure, some crystals of $KNO_3$ were added as per the protocol described by Krammer and Lange-Bertalot (4). Biological analysis (for diatoms), at Botany laboratory of Agronomic Sciences Department. Chemical analysis was compared with the WFD (11) standard, and trophic classes were determined for each station by calculating the Trophic Diatom Index (TIDIA) for diatoms algae. To identify correlations between chemical and biological parameters, PCA analysis was performed using the SPSS 20 program.

## 3. RESULTS AND DISCUSSION

Results of chemical analysis are shown in table 1. The situation of nutrients in water are in a good amount. The levels of ammonium in the Vjosa river were found to be of high quality according to the WFD. The $NH_4^+$ values fall within a range of 0.035 mg/l to 0.09 mg/l, whereas the $NO_2$ values range from 0.008 mg/l to 0.083 mg/l. The quality of Vjosa river's waters has been classified as high to moderate based on nitrite values. However, at Çarshove point, the situation is moderate due to the discharge of waters from Sarandoporos river.

The nitrates values varied from 0.12 mg/l to 0.32 mg/l, while the phosphates values ranged from 0.01mg/l to 0.08 mg/l. Based on these values, the quality of water for nitrates can be determined as first class of water quality according to WFD and phosphates are of first class mostly.

**Table 1.** Chemical parameters at Vjosa river

| **Parameters** Unit | **Tem, $H_2O$** $^{O}C$ | **pH** | **$NH_4^+$** mg/l | **$NO_2^-$** mg/l | **$NO_3^-$** mg/l | **$PO_4^{3-}$** mg/l |
|---|---|---|---|---|---|---|
| Tri urat | 13,9 | 8,215 | 0,09 | 0,083 | 0,125 | 0,08 |
| Sajmola | 14 | 7,9 | 0,04 | 0,028 | 0,3 | 0,06 |
| Memaliaj | 15,83 | 8,33 | 0,04 | 0,008 | 0,25 | 0,03 |
| Poçem-Aragosta | 15,66 | 8,14 | 0,045 | 0,012 | 0,24 | 0,01 |
| Mifol | 16 | 8,085 | 0,035 | 0,036 | 0,32 | 0,02 |
| Max | 16 | 8,33 | 0,09 | 0,083 | 0,32 | 0,08 |
| Min | 13,9 | 7,9 | 0,035 | 0,008 | 0,125 | 0,01 |

Ninety-six species of diatom algae were identified in the five sampling points (refer to Table 2). The number of species varies from 10 at Mifol and Memaliaj stations to 33 species at Poçem station. The trophic diatom index ranges from 1.2 at Sajmola to 1.9 at Mifol station. Consequently, the waters of Vjosa River exhibit trophic classes ranging from Oligotroph to Meso-eutroph at Mifol. Based on diatoms, Vjosa River's quality can be classified as moderate, primarily due to the presence of inorganic matter. The saprobic index values range from 1.1 at Memaliaj to 1.5 at Mifol and Tre-urat. These saprobic indexes correspond to oligosaprob to ß-mesosaprob, indicating that the water quality is excellent. Therefore, we can conclude that there is no organic matter present in the Vjosa river.

Four parameters of chemical analysis, the total number of diatom species, saprobic index (which determines organic matter) and the diatom species with the largest numbers were included in the PCA analysis (table 3).

**Table 2.** Data of diatoms algae in each station

| **Table of species** | **Poçem** | **Mifol** | **Memaliaj** | **Sajmola\ Kelcyre** | **Tre urat** |
|---|---|---|---|---|---|
| | p% | p% | P% | p% | p% |
| **Number of species, N:** | 33,0 | 10,0 | 10,0 | 31,0 | 18,0 |
| **Trophic Diatom Index, $TI_{DIA}$:** | 1,7 | 1,9 | 1,8 | 1,2 | 1,5 |
| **Trophic classes** | Mesotroph | Meso-eutroph | Mesotroph | Oligotroph | Oligo-mesotroph |
| **Quality** | Moderate | Poor | Moderate | Very good | Good |
| **Saprobic Index, SI** | 1,4 | 1,5 | 1,1 | 1,3 | 1,5 |
| **Saprobic classes** | Oligosaprob | Oligosaprob to ß-mesosaprob | Oligosaprob | Oligosaprob | Oligosaprob to ß-mesosaprob |
| **Quality** | Very- very Good | Very good | Very- very Good | Very- very Good | Very good |

Based on the correlation of these parameters, it can be concluded that the parameters were separated into three components: diatom algae species such as *Cymbella affinis, Diatoma mesodon, Diatoma hyemalis,* and *Gomphonema olivaceum var. olivaceolacum*, which had higher correlation coefficients, were associated with higher levels of phosphates. This indicates that an increase in phosphate concentrations leads to a greater number of diatom species. Similarly, a correlation between the number of species and phosphates reveals the same outcome. In addition, we can conclude that the aforementioned species are highly susceptible to changes in inorganic substances.

**Table 3.** Components and the correlation of parameters in PCA analysis

**Structure Matrix**

| | Component | | |
|---|---|---|---|
| | **Diatoms algae** | **Inorganic matters** | **Organic matters** |
| N-NH4 | | ,972 | ,505 |
| N-NO3 | | -,973 | |
| N-NO2 | | ,817 | ,769 |
| P-PO4 | ,816 | ,483 | |
| SI | | | ,960 |
| Nr. Of species | ,969 | | |
| *Achnanthes exilis* | | ,975 | ,528 |
| *Cocconeis pediculus* | | ,424 | ,912 |
| *Cocconeis placentula var lineata* | | ,669 | ,779 |
| *Cymbella affinis* | ,968 | | |
| *Diatoma mesodon* | ,941 | | |
| *Diatoma hyemalis* | ,944 | | |
| *Gomphonema olivaceum var olivaceolacum* | ,990 | | |

*Extraction Method:* Principal Component Analysis.
*Rotation Method:* Oblimin with Kaiser Normalization.

The second component pertains to inorganic substances and is mostly associated with species such as *Achnanthes exilis, Cocconeis pediculus* and *Cocconeis placentula var lineata*. Two types of correlation are observed: a positive correlation between these species and ammonium and nitrites, and a negative correlation between species and nitrates. These species grow and are stimulated by changes in the amount of ammonium and nitrites. However, a negative correlation indicates that diatoms increase their numbers during periods of high nitrate levels. The increase in the number of diatoms results in a reduction of nitrates, as they use them for growth. Nitrate ($NO_3^-$) is the main nutrient required for diatoms to grow and develop well. The high concentration of nitrate in the water will stimulate the growth of the diatom, because nitrate in certain concentrations provides a good condition for the diatoms to grow (E D Masithah et.al, 2019). The third component comprises organic matter. The strong correlation observed between *Achnanthes exilis, Cocconeis pediculus, and Cocconeis placentula var. lineata* implies that these species are susceptible not only to inorganic matter, but to organic matter as well.

## 4. CONCLUSION

The chemical parameters and diatom species of Vjosa River demonstrate that the ecosystem is in good condition. There is a discernible correlation between species and chemical components. The abundance of diatoms is affected differently by nutrient variations, such as phosphates, nitrites, and nitrates. A correlation between species and nitrates demonstrated that diatoms thrive in an abundance of nitrates. The increase in diatom count leads to a reduction in nitrates within the water ecosystem.

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