

Evaluating The Ecological Value of the Fushë Kuqe - Patok Lagoon Complex

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Abstract: Although wetlands occupy less than 9% of the Earth's surface, they contribute up to 40% of global annual ecosystem services. Wetlands, despite being among the most biodiverse ecosystems on Earth, face persistent pressures and threats, and remain inadequately researched. Our study will focus on a Managed Nature Reserve, part of which is the Patok - Fushe Kuqe Lagoon. From an ecological point of view, we have analysed the physical, chemical, nutritional and organic pollutant parameters relating to the lagoon waters. We measured the pH, DO, TSS, NH₄-N, NO₂-N, NO₃-N, PO₄-P, total phosphorus, COD and BOD₅. These parameters resulted within the standards, except for BOD and COD, which have shown values approximately 10 and 3 times higher than their respective concentration threshold limits, resulting in poor status of the lagoon's water quality. According to the results, high concentrations of phosphorus and nitrogen can lead to eutrophication, resulting in rapid growth of algae and phytoplankton, which decreases oxygen in surface waters and damages aquatic communities. This research aims to highlight the importance of sustainable management of the coastal lagoon, to preserve the ecosystem services, it provides and to promote actions that improve wetland resilience.

Keywords: coastal wetlands, ecological assessment, eutrophication, Patok - Fushe Kuqe Lagoon.

Introduction

Wetlands are considered the most important ecosystems worldwide and occupy a considerable area, which, according to some studies (Matthews et al. 1987; Finlayson et al., 1999), ranges from 5.3 million km² to 12 million km² of the Earth's surface. They are essential ecosystems because they provide ecological services such as biogeochemical cycles, climate, erosion and flood regulations, as well as groundwater control, coastal protection, climate change mitigation, biodiversity and habitat conservation and recreational opportunities (Millennium Ecosystem Assessment, 2005; Gardner et al., 2015; Newman et al., 2020; Ten Brink et al., 2011). Although wetlands occupy less than 9% of the Earth's surface, they contribute up to 40% of global annual ecosystem services (Zedler and Kercher 2005).

Wetlands in Albania occupy about 90,000 ha or 3.2% of the territory. While the total surface area of coastal lagoons is over 130 km², they are saltwater as a result of communication with the sea and extend along the coastline from north to south parallel to the sea. Our study will focus on the Managed Nature Reserve "Kune - Vain - Tale - Patok - Fushëkuqe - Ishëm", part of which is the Patok - Fushkuqe Lagoon.

Regardless of their importance, coastal wetland ecosystems are among the most threatened in the world (Millennium Ecosystem Assessment, 2005). They are seriously threatened by eutrophication, pollution, land-use changes, deforestation, overexploitation of groundwater resources, the introduction of invasive alien species, urbanization and increased economic development, caused by human activity in coastal areas of all continents (Millennium Ecosystem Assessment, 2005; European Commission 2007; Esteves et al., 2008; van Asselen et al. 2013; Davidson 2014; Wittmann et al., 2015). The greatest pressures on wetlands come from soluble substances such as nitrates and pesticides used in agricultural activities, heavy metals from industry, and phosphates from domestic wastewater (European Commission, 2007; Abazi & Balliu, 2012; Abazi et al., 2012; Abazi et al., 2013).

The Patok lagoon complex, from an ecological perspective, has problems related to discharges from rivers that carry potentially polluting substances and sediments (specifically from the Mat River) as well

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as discharges from drainage canals and agricultural areas of the villages surrounding the lagoon territory, which carry polluting elements of agricultural activity.

This scientific research is focused on the ecological assessment of the Patok - Fushe Kuqe lagoon complex, with the aim of understanding the current ecological state of the lagoon. The research goals are intended to be achieved through the knowledge and evaluation of the physico-chemical parameters of the lagoon waters. At the same time, it is aimed at the economic assessment, which is being carried out for the first time in a lagoon area, identifying the main goods and services of the lagoon ([Millennium Ecosystem Assessment, 2005](#)). The scientific objectives are:

- Assessing the ecological status of the lagoon complex through the analysis of several key environmental indicators such as physical-chemical parameters, the level of pollution from river discharges and the level of nutrients in the water.
- The evaluation of the relationships between the concentrations of nutrients and organic pollutants (nitrogen, phosphorus, COD, BOD) with the quality status of lagoon waters, in order to identify the risk of eutrophication.
- Identification and analysis of issues related to the management of the lagoon complex for its sustainable development.

This study aims to identify the ecological problems of this lagoon complex, with the aim of raising awareness for sustainable management of the lagoon.

Materials and Method

Study Area

Patok Lagoon is part of Rodoni Bay and is about 4.5 km long and 1.3 km wide and is located between the two rivers Mat to its north and Ishem to its south. The Patok Lagoon is connected to the Adriatic Sea through a channel in the southern part which is directly connected to the sea (Fig. 1). The Patok lagoon complex was designated in 1962 ([Decision, 2010](#)) it has the status “Managed Nature Reserve”, in category IV according to the IUCN, amended in 2022 ([Decision, 2022](#)).

The Patok - Fushe Kuqe wetland complex had an area of about 4,200 ha but has undergone major changes under the action of natural factors (sedimentary deposits and erosion) and human activities which have reduced the surface area of the lagoon. Nowadays, the Patok wetland complex consists of an inner and outer lagoon with an area of about 480 ha, a forest area of about 200 ha and agricultural land of about 600 ha. The area encloses only fresh sediments brought by the Mat River from mountain catchments and is characterized by river alluvium and ophiolitic sand and pebbles.

From a climatic point of view, the Patok - Fushe Kuqe wetland complex is characterized by a mild winter and cool summer, an average annual temperature of about 15.5 °C and an average annual rainfall of about 1,463 mm and with about 2479 hours of sunshine per year, which indicates that it is a typical Mediterranean plain area with high climatic potential that favors the development of the lagoon's biodiversity.

The environmental impacts of the lagoon water are related to the sediment flows of the Mat River, along with which come polluting elements, which reduce the normal functioning of the lagoon, affecting its productivity. In the eastern part, the lagoon is bordered by agricultural land, the activity of which affects the water quality in the lagoon through inflows.

Sampling and Processing

To determine the ecological status of the lagoon, based on several key physico-chemical indicators in this wetland complex, water sampling was conducted at 6 sampling stations. Sampling stations have been strategically selected, at the estuaries and channels connecting the lagoon to the surrounding villages, to monitor the impact of all potential sources of pollution. Specifically, in the estuaries and channels connecting the lagoon with the villages around it to see the impact of potential pollution sources.

“Ruttner” samplers were used for the sampling process. For each station, 1.5 liters of water were collected in plastic bottles, which were then placed in a refrigerated box (4 °C). Further, the samples taken were sent and analyzed at the Laboratory of the Department of Environment and Natural Resources at the Agricultural University of Tirana. The sampling stations in the Patok Lagoon are shown on the Fig. 2 and Table 1 . Water sampling sites and geographic coordinates

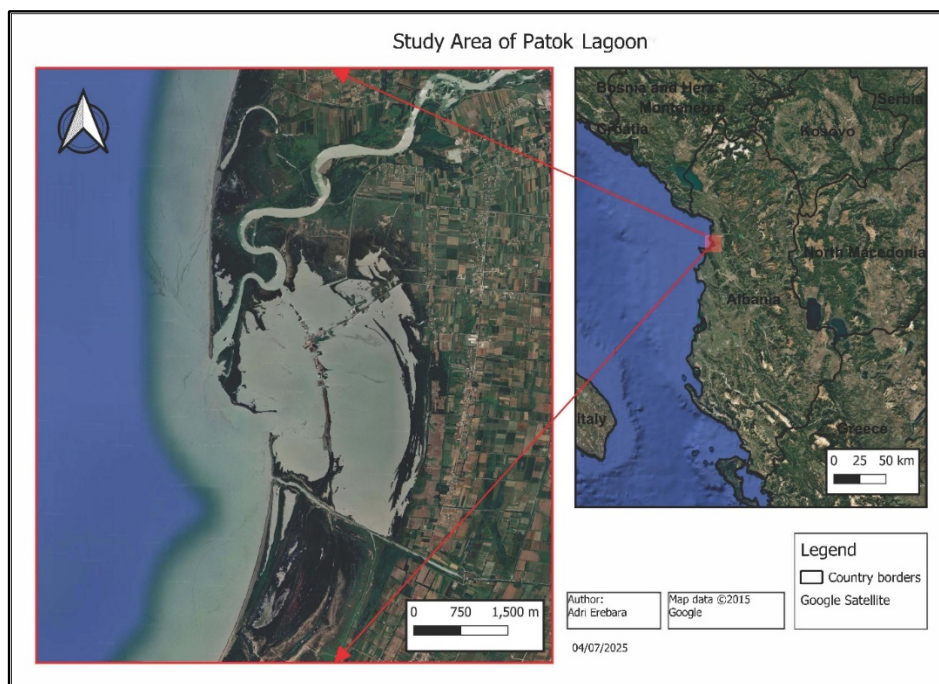


Figure 1. Study area of Patok Lagoon (map data: Google Earth, QGIS, 3.34.7-Prizren)

Table 1. Water sampling sites and geographic coordinates

Sample no.	Sample ID	Lagoon	UTM_WGS84_Zone 34T	
			East	North
1	Mat 1	Patok	382156	4610928
2	Mat 2	Patok	382154	4610805
3	Bar 1	Patok	382822	4610640
4	Bar 2	Patok	383126	4610789
5	Village 1	Patok	384125	4611050
6	Village 2	Patok	384154	4611420

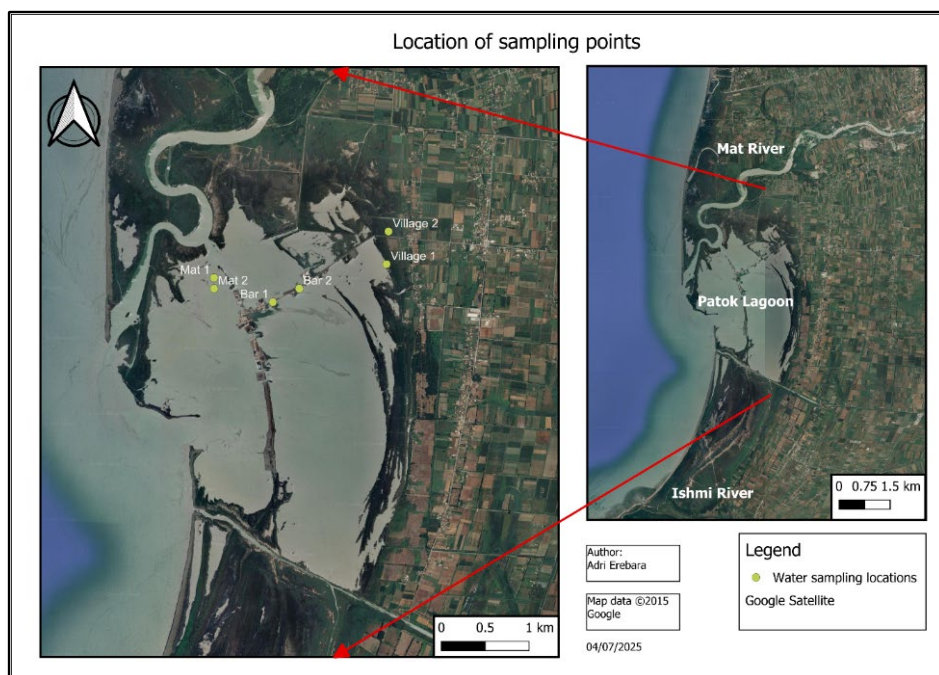


Figure 2. Geographical position of the Patok Lagoon and sampling sites (map data: Google Earth, QGIS, 3.34.7-Prizren)

Methods used for water physical-chemical analysis

The physico-chemical pollution indicators that were analyzed and the standard procedure followed are:

- **pH and Dissolved Oxygen (DO)** – measurements were carried out in the field using the multiparametric probe WTW 340i
- **Total Suspended Solids (TSS)** – the quantity of solid particles is measured by the difference in weight of a filter, which has collected the suspended particles in the water column, by drying at 105 °C.
- **Ammonium (NH₄-N)** – the method ISO 7150:1984 was applied, where the water sample was measured in a strong alkaline solution, which reacted with a chlorinating agent to form monochloramine. The spectrometric measurement was made at a wavelength of about 655 nm of the blue compound formed by the reaction of ammonium with salicylate and hypochlorite ions in the presence of sodium nitroso pentacyano-ferrate (III) (sodium nitroprusside).
- **Nitrites (NO₂-N)** – are determined by their reaction with the reagent amino-4 benzene sulfonamide in the presence of orthophosphoric acid and measurement of absorbance at 540 nm (S SH EN 26777: 1993).
- **Nitrates (NO₃-N)** – the measurement was performed in a 10 mm optical cuvette, with spectrometric measurements of absorbance at 324 nm according to the ISO 7890-1:1986 method.
- **Phosphorus Forms (PO₄-P)** – to measure phosphates, as PO₄³⁻, organic phosphorus and hydrolyzed polyphosphates were oxidized with potassium peroxodisulphate to orthophosphates. The absorbance was measured and the concentration of orthophosphates present was determined at 880 nm, using the ISO 6878:2004 method (ISO, 2004).
- While for **total phosphorus**, measurements were carried out in a spectrophotometer with a wavelength of 880 nm, using the U.S. Environmental Protection Agency, 1978 method.
- **Chemical Oxygen Demand (COD)** – the oxidation of organic materials in the presence of H₂SO₄ and KMnO₄ at the boiling point was used to calculate COD. Unconsumed KMnO₄ reacts with oxalic acid at the end of the oxidation phase, and KMnO₄ also defines the residues of this reaction (ISO 15705:2002).
- **Biological Oxygen Demand (BOD₅)** – was measured using the OXI-top system over a 5-day incubation period (APHA, AWWA, & WEF, 2017).

The control of the degree of pollution of lagoon waters is carried out through the measurement and evaluation of the most important parameters such as: organic matter content, usually expressed as Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD₅), nutrients, mainly the various forms of nitrogen and phosphorus content, as well as temperature, pH, salinity, dissolved oxygen, and suspended solids. Important indicators in determining water quality and its use are organic load indicators (U.S. Environmental Protection Agency, 1999). Sources of organic matter include wastewater discharges, industrial effluents, and agricultural land drainage waters. This organic pollution leads to increased metabolic processes that require oxygen. The content of nutrients, such as phosphorus and nitrogen, causes the phenomenon of eutrophication, i.e. the excessive production of algae, phytoplankton, etc., causing a decrease in oxygen in surface waters and damage to biotic communities that are of great importance to humans.

Flora and fauna of the lagoon

Flora

In the Fushe Kuqe - Patok lagoon complex 166 plant species are recorded (Dhora and Beqiraj, 2001). The main types belong to: 29 *Graminaceae* family, 7 *Cyperaceae*, 7 *Chenopodiaceae*, 8 *Rosaceae*, 10 *Leguminosae*, 11 *Compositae*, as well as *Equisetum*, *Pteridium* etc.

In its western part the most common are the underwater meadows of *Fucus virsoides* and *Posidonia oceanica*. *Fucus virsoides*. Fanerogamous meadows cover about 40% of the lagoon bottom layer and are mainly composed of *Zostera noltii*, but in the most shallow and quiet water of the lagoon there is also *Ruppia spiralis* and *Ruppia cirrhosa*. In the meadows of *Posidonia oceanica* a population of *Penaeus keratulus* is identified. In the peripheral area the lagoon is covered by hygro and hydrophilic vegetation which are dominated by 3 main plant associations of *Phragmites*, *Thypha* and in some places *Scirpus* species. While halophile vegetation is located in the north and southern part of the lagoon and

consists of some plant associations where the most important are *Arthrocnemum* and *Juncus*. Some of the most important associations are *Arthrocnemum*, as well as *Salicornia europaea*, *Limonium vulgare*, *Inula crithmoides*, *Halimione portulacoides*, *Artemisia coerlescens* etc.

The dune vegetation is mainly found in the western part that borders the sea. In the vicinity of water this vegetation is missing, then comes and is gradually added where the types are composed of *Cakile maritime*, *Xanthium strumarium*, *Salsola kali*, *Eryngium maritimum*, *Medicago marina*, *Ephedrum Distachia*, *Cyperus capitus*, *Echinophora spinosa* etj.

The shrub vegetation consists of a high number of shrubs that are dominated by *Tamarix*, *Vitex* and *Rubus* species. The *Tamarix* species endures salt, grows rapidly and creates environments suitable for housing and reproducing water birds.

Whereas the forest surface that comprises the Fushe Kuqe forest is located in the eastern part of the lagoon. From human activity about half of the forest area is damaged. The wooden floor of this forest is dominated by *Alnus glutinosa*, *Fraxinus angustifolia*, *Ulmus campestre*, *Quercus robur*, *Populus alba*, *Pinus pinea* and *Pinus halepensis*. Instead, the bush floor of the forest is quite dense, consists of *Rubus ulmifolius*, *Crataegus monogyna*, *Oyrocantha coccinea*, *Rosa sempervirens*, *Juniperus oxicedrus*, etc.

Fauna

The diversity of aquatic habitats of the Patok wetland complex, such as freshwaters, canals, marshes, estuaries and the shore around the lagoon, has allowed the development of a variety of groups and species of fauna such as mollusks (mussels and snails), crabs, insects, fish, amphibians, reptiles and especially birds and mammals. The three most interesting groups of animals are: **1) marine mollusks**, which are numerous. There are species of interest such as several species of *cephalopod* mollusks which are important for sea fishing. **2) crabs** are another important group. Particularly important are saltwater crabs, which are numerous and play an important role in nature. Many species of crustaceans are found in the area, such as *Gennadas elegans*, *Lucifer typus*, *Solenocera membranacea*, *Penaeus trisulcatus*, *Sicyonia carinata*, *Athanas nitescens*, *Crangon crangon*, *Paguristes eremita*; **3) insects** are the largest group that play an important role in the biogenic circulation of substances. This insect fauna of the area belongs mostly to the orders of dragonflies (*Odanata*), locust (*Orthoptera*), bedbugs (*Hemiptera*), beetles (*Coleoptera*), butterfly (*Lepidoptera*) and flies and mosquitoes (*Diptera*).

Fishes. The lagoon and the marine environment associated with the lagoon have significant quantities of fish. The ichthyofauna consists of many species of fish, such as the three species of mullet (*Mugil cephalus*, *Liza ramada*, *Liza saliens*), eel (*Anguilla anguilla*), red mullet (*Mullus barbatus*), common sole (*Solea vulgaris*), gilt-head bream (*Sparus aurata*), European seabass (*Dicentrarchus labrax*) etc.

Amphibians and reptiles. Amphibians and reptiles (Herpetofauna) are found mostly in the forests, swamps, and canals around the lagoon. In the area of the wetland complex, 8 species of amphibians are known, 3 of which are frogs (*Rana*), 2 are toads (*Bufo*), 1 is the European tree frog (*Hyla arborea*) and 2 species are newts (*Triturus*). The loggerhead sea turtle (*Caretta caretta*) often approaches shallow sea waters, but the presence of green sea turtles (*Chelonia mydas*) is also found. The rest of the reptile species are grouped into 10 lizards and 10 snakes.

Birds. The condition of birds in the wetland complex changes during winter, spring, summer and autumn. **During winter**, out of 70 bird species, 27 species are waterfowl, while another 43 species are found in forests and agricultural lands, of which the largest number are passerine birds. **During the spring**, 179 bird species were counted, of which 76 species or 42% are waterfowl and 103 species belong to birds of shrubs, forests, pastures, dunes, agricultural lands, etc. The most common birds are little egret (*Egretta garzetta*), northern shoveler (*Anas clypeata*), red-footed falcon (*Falco vespertinus*), curlew sandpiper (*Calidris ferruginea*), caspian gull (*Larus cachinnans*), great reed warbler (*Acrocephalus arundinaceus*), etc. Among the most interesting water birds are the pelican (*Pelecanus crispus*), pygmy cormorant (*Phalacrocorax pygmaeus*), white stork (*Ciconia ciconia*) and eurasian spoonbill (*Platalea leucorodia*). **During the summer**, most of the nesting birds in the entire area belong to the passerine order (*Passeriformes*). From the order of passerines found in the lagoon and which are the largest group, we can single out the western yellow wagtail (*Motacilla flava*), zitting cisticola (*Cisticola juncidis*), eurasian reed warbler (*Acrocephalus scirpaceus*). **During autumn**, the first place is again taken by the order of passerine (*Passeriformes*) with 40%, followed by shorebirds (*Charadriiformes*) with 22%, ducks (*Anseriformes*) with 8%, storks (*Ciconiiformes*) with 6% and raptors (*Falconiformes*) 8%.

Mammals. Of the mammals, the largest group are bats with 8 known species, mice with 5 species, and carnivores with 6 known species. The most common species of carnivorous mammals are the jackal (*Canis aureus*), fox (*Vulpes vulpes*), otter (*Lutra lutra*), badger (*Meles meles*), weasel (*Mustela nivalis*) and polecat (*Mustela putorius*).

Results and Discussion

Ecological evaluation of the lagoon

Influence of physico-chemical characteristics on fish growth

pH values obtained from water samples are a good indicator of the lagoon quality, because they constitute one of the main parameters that affect aquatic life and fish growth (Abowei, 2010). In the case of the lagoon studied, the pH ranges from 8.19-7.96, with an average of 8.04 and a highest recorded value of 8.19 (Fig. 3). According to Abowei, 2010, a pH between 7 and 8.5 is ideal for biological productivity and fish life, while a pH lower than 2 is considered harmful to aquatic life. Therefore, it is noted that our values fall within normal pH ranges.

However, the amount of dissolved oxygen required varies from one species to another. Benthic biota requires minimal amounts of oxygen (1-6 mg/L), while shallow water biota require higher oxygen levels (4-15 mg/L) (Osmond et al, 1995). In our case, the average value of dissolved oxygen at the surface of the lagoon water is 3.65 mg/L, with a maximum value of 4.2 mg/L and a minimum value of 3.16 mg/L, as shown in Fig. 4. Therefore, dissolved oxygen is in the range of normal values.

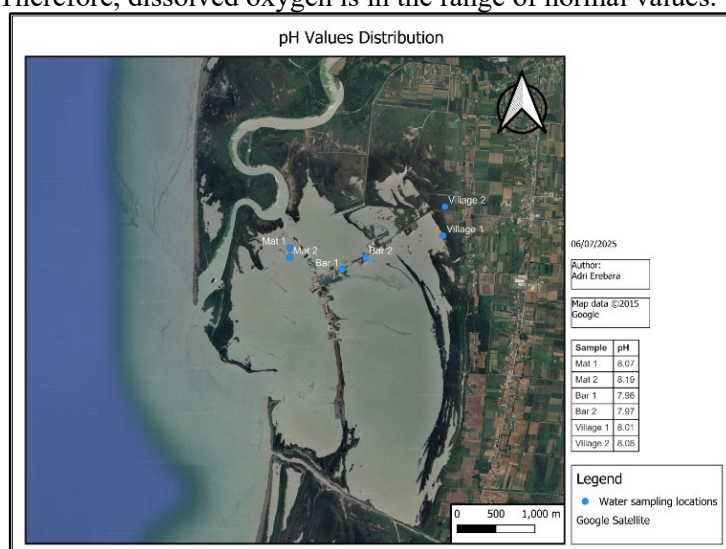


Figure 3. Distribution of pH Values in the Patok Lagoon (map data: Google Earth, QGIS, 3.34.7-Prizren)

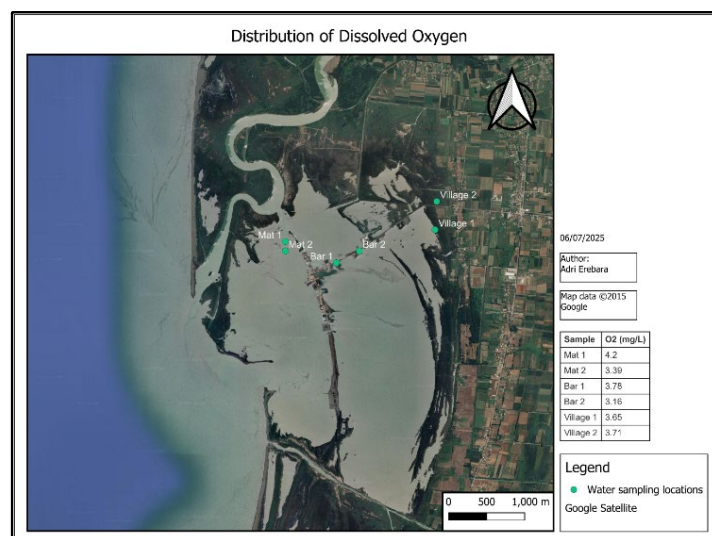


Figure 4. Values of dissolved oxygen in the sampling points (map data: Google Earth, QGIS, 3.34.7-Prizren)

Regarding total suspended solids, which is the mass of suspended particles in the water column, its average value is 84.3 mg/L. With a maximum value of 171 mg/l measured at station Bar 2 and a minimum value of TSS of 11 mg/L, measured at station Village 2 (Fig. 5). Since normal values for suspended solids range from 100 mg/L - 200 mg/L, we are below the value of normal conditions. The values of the results of the physical - chemical parameters are given in Table 2. Table 3. Results of

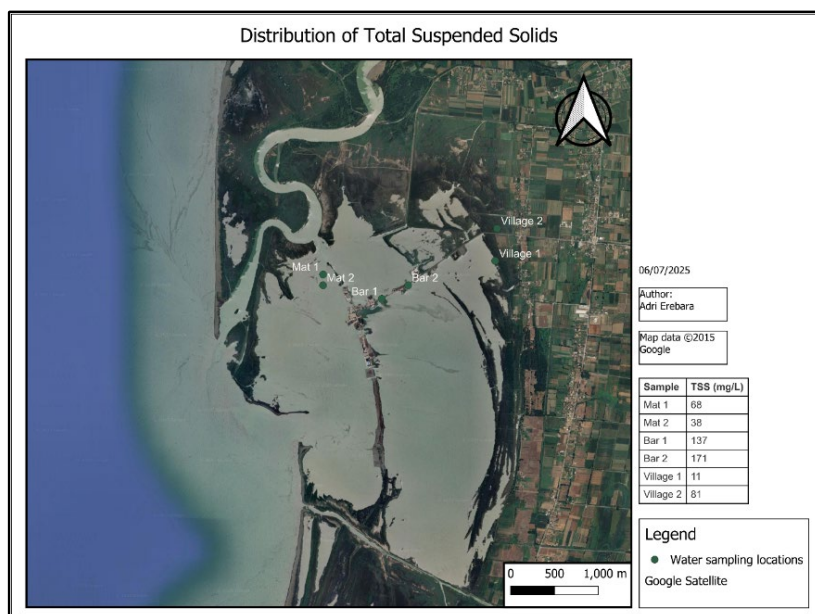


Figure 5. Values of TSS in the water of the lagoon complex (map data: Google Earth, QGIS, 3.34.7-Prizren)

Table 2. The values of the results of the physical - chemical parameters

Sample ID	pH	O ₂ mg/L	TSS mg/L	Salinity
Mat 1	8.07	4.20	68.00	26.40
Mat 2	8.19	3.39	38.00	10.36
Bar 1	7.96	3.78	137.00	32.50
Bar 2	7.97	3.16	171.00	32.60
Village 1	8.01	3.65	11.00	33.70
Village 2	8.08	3.71	81.00	21.80
Mean	8.05	3.65	84.33	26.23
Median	8.04	3.68	74.50	29.45
Min value	7.96	3.16	11.00	10.36
Max value	8.19	4.20	171.00	33.70
Std. Devi.	0.09	0.36	60.15	9.02
Coefficient of Variation (%)	1.07	9.73	71.32	34.41

Assessment of nutrient values

Pollution with soluble nitrogen (N) and phosphorus (P) is one of the most important environmental problems related to the deterioration and degradation of water quality as they determine the harmful phenomenon of eutrophication. Ammonium, nitrite and nitrate are reactive, ionic inorganic forms of nitrogen in aquatic systems. These ionic forms are present as a result of surface leaching, dissolution of nitrogen deposits, soil erosion and biological degradation of organic matter, which can enter ecosystems as a result of human activities. Meanwhile, the inorganic forms of phosphorus (P) present in surface waters are orthophosphate (PO_4^{3-}).

The total concentration of inorganic forms in the aquatic environment of $\text{NO}_3\text{-N} > 30\text{-}40$ mg/L and the total concentration of $\text{P} > 1\text{-}2$ mg P / L can cause environmental problems, of which the most detrimental is eutrophication (Camargo & Alonso, 2006). Orthophosphates in the water were not detectable, having values below the limit, while total phosphorus was in minimal values (below 0.1 mg/L), as shown in Fig. 6.

It was also observed that inorganic forms of nitrogen were good, which means that we do not have the eutrophication process in the lagoon. Both nitrites, nitrates, and ammonia showed values below 1 mg/L (Fig. 7, 8 and 9). Nutrient Parameters and COD/BOD

Table 3. Results of Nutrient Parameters and COD/BOD

Sample ID	NO ₂ -N	NO ₃ -N	NH ₄ -N	PO ₄ -P	P total	COD	BOD
	mg/L	mg/L	mg/L	mg/L	mg/L	mg O ₂ /L	mg O ₂ /L
Mat 1	0.007	0.46	0.18	LD	0.021	60	40
Mat 2	0.006	0.275	0.05	LD	0.023	<10	<5
Bar 1	0.017	0.642	0.09	LD	0.032	100	67
Bar 2	0.038	0.638	0.16	LD	0.025	95	64
Village 1	0.01	0.513	0.18	LD	0.018	105	70
Village 2	0.012	0.355	0.11	LD	0.018	45	30
Mean	0.02	0.48	0.13	LD	0.02	81.00	54.20
Median	0.01	0.49	0.14	LD	0.02	95.00	64.00
Min value	0.01	0.28	0.05	LD	0.02	45.00	30.00
Max value	0.04	0.64	0.18	LD	0.03	105.00	70.00
Std. Devi.	0.01	0.15	0.05	LD	0.01	26.79	18.01
Coefficient of Variation (%)	79.55	30.92	41.65	LD	23.08	33.07	33.22

*LD - Limit of Detection

COD and BOD content

BOD determines the amount of oxygen consumption (mg O₂ L⁻¹) by aerobic biological organisms to oxidize organic compounds. While COD is an indicative measure of the amount of oxygen that can be consumed by reactions in a given solution, the standard amount is 120 mg/L. Based on EU standards, BOD standard value for coastal surface waters is ≤ 4-5 mg/L and the COD standard amount is ≤ 5 times higher than BOD, which is giving ≤ 20-25 mg/L as standard value of the European Water Framework Directive ([European Parliament & Council, 2000](#)).

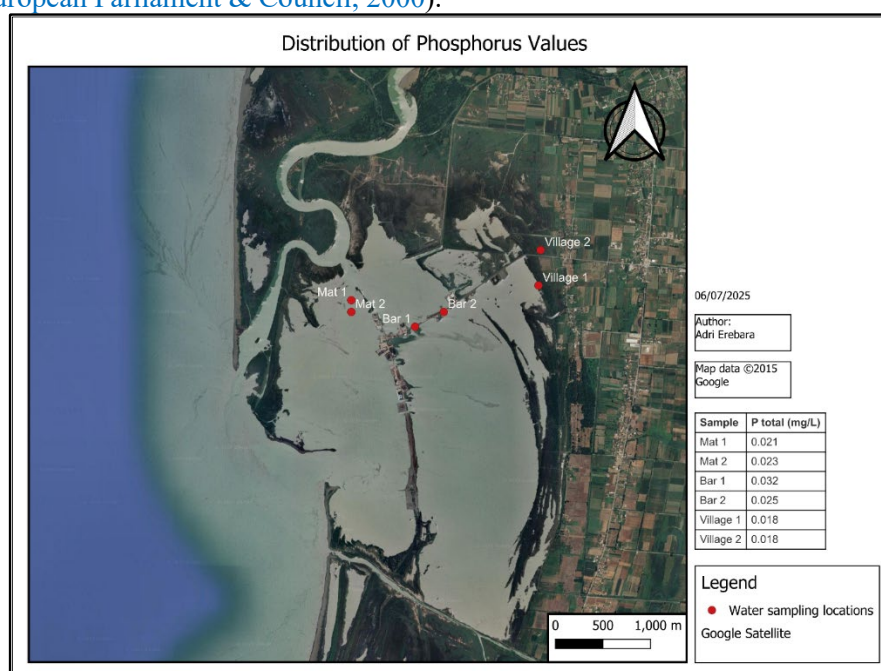


Figure 6. Water phosphorus levels (map data: Google Earth, QGIS, 3.34.7-Prizren)

For the BOD parameter, except for the sampling point at station Mat 2 which had normal values, all other samples showed very high values, with the average value being 54.2 mgO₂/L and the maximum value recorded being 70 mgO₂/L, at sample Village 1 (Fig. 10). Such high values, higher than 10 times the threshold concentration, can be correlated with urban and also agricultural wastewater discharges, typical for the land uses in the area.

The same situation also occurs for the COD values, where values are more than 3 times the contamination threshold concentration according to the Water Framework Directive, with an average of 81 mgO₂/L and maximum value of 105 mgO₂/L at the sampling point Village 2 (Fig. 11). These values of BOD and COD, organic pollutant parameters, determine the water quality status of the lagoon, as according to the Water Framework Directive, the parameter with the lowest values determines the status of the water body.

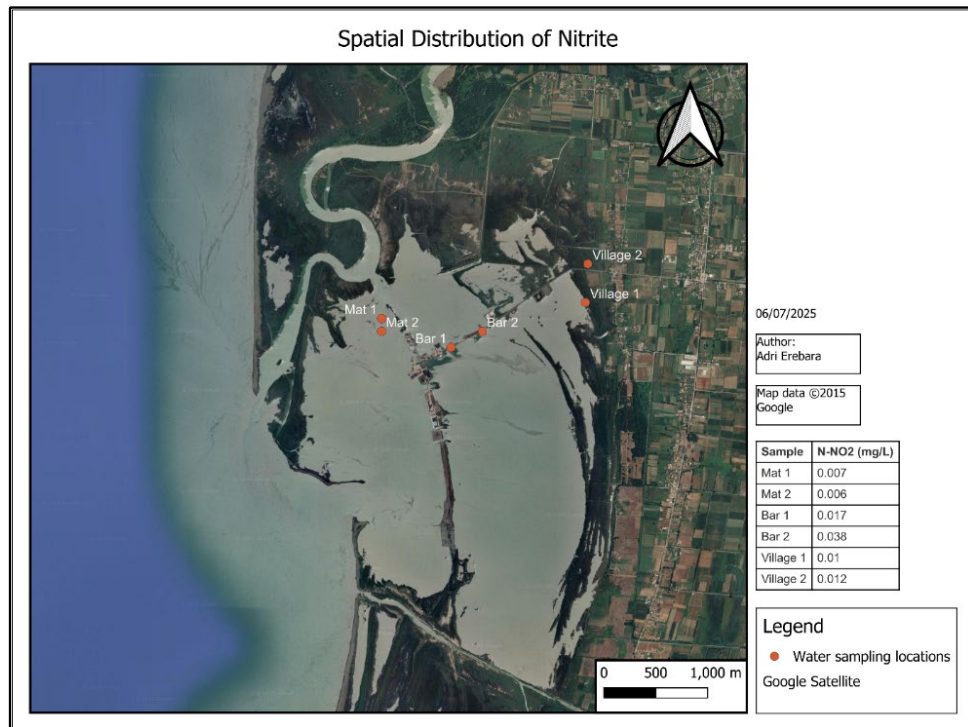


Figure 7. Nitrite variation in the waters of Patok Lagoon (map data: Google Earth, QGIS, 3.34.7-Prizren)

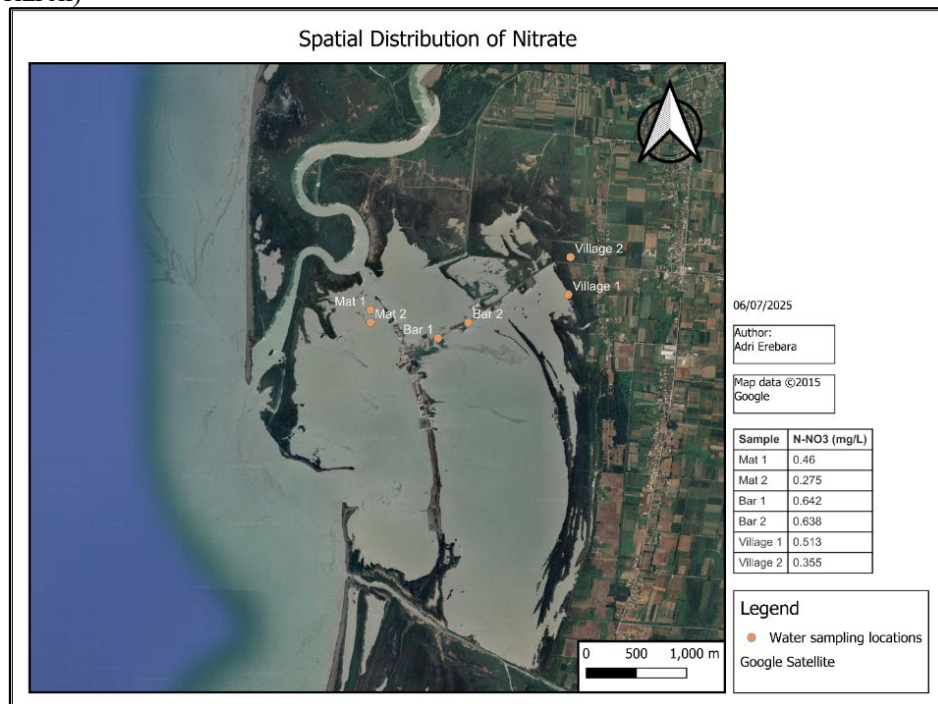


Figure 8. Distribution of Nitrate values in the sampling points (map data: Google Earth, QGIS, 3.34.7-Prizren)

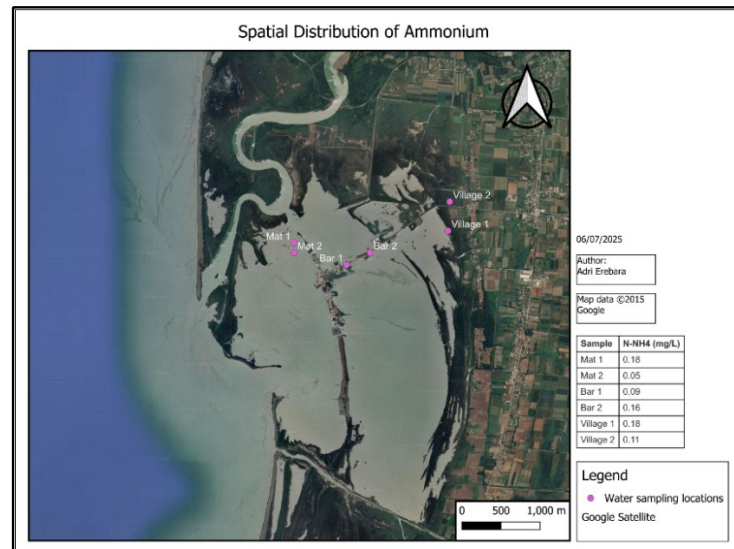


Figure 9. Distribution of Ammonium values in the sampling points (map data: Google Earth, QGIS, 3.34.7-Prizren)

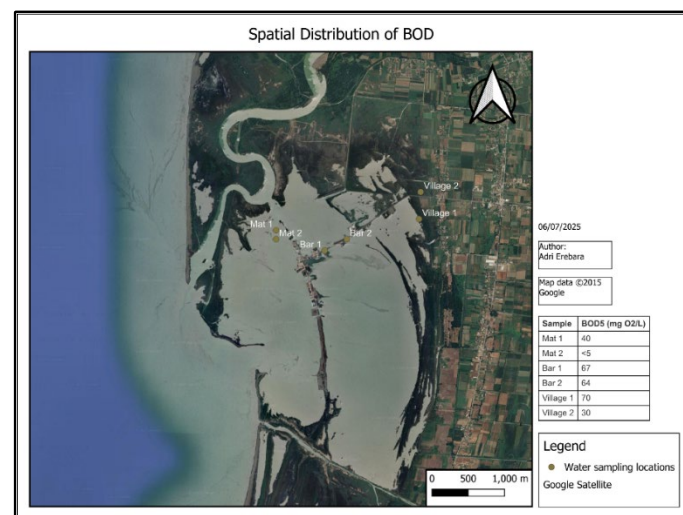


Figure 10. Distribution of BOD values in the Lagoon of Patok (map data: Google Earth, QGIS, 3.34.7-Prizren)

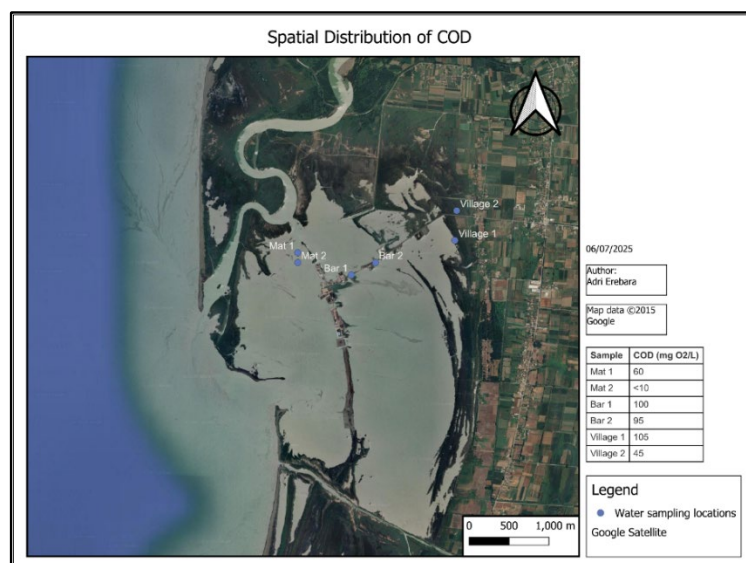


Figure 11. Lagoon water COD level (map data: Google Earth, QGIS, 3.34.7-Prizren)

Conclusions

From the study conducted for the ecological evaluation and analysis of the Patok – Fushe Kuqe Lagoon complex, for sustainable management of the lagoon, it results that:

- By analyzing and evaluating several key environmental indicators such as physical-chemical parameters, the level of pollution from river discharges and the level of nutrients in the water, it turns out that the condition of the lagoon is poor. The physical-chemical parameters are around normal values, with the exception of BOD and COD, which was in average 10 and 3 times higher than the threshold concentration, respectively. These values of the organic pollutant parameters (BOD and COD) determine the overall state of the lagoon's water quality, since according to the Water Framework Directive, the status of the water body is determined by the status of the parameter with the lowest values in the assessment.

From the identification and analysis of the problems related to the management of the lagoon complex for sustainable development, it results that:

- The current management of the Patok – Fushe Kuqe Lagoon complex is not in accordance with the required level (according to [Millennium Ecosystem Assessment, 2005](#)) and this requires the intervention of local and central institutions and awareness of the local community for the conservation and sustainable management of the lagoon.

Given the state of wetlands and the ongoing pressure on them from multiple factors, local and regional authorities as well as other local stakeholders need to make transformative changes towards more sustainable management of wetlands to increase their resilience through the interaction and integration of natural ecosystems linked to human-modified terrestrial and aquatic ecosystems. ([Dudley et al., 2021](#)).

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