DIATOMS (BACILLARIOPHYCEAE) AND THE RELATED BIOLOGICAL QUALITY OF WATERS IN KUNE-VAINI, LEZHA

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ABSTRACT

Additional information about the diatoms (Bacillariophceae) from different habitats of Kune-Vaini (Lezha, Albania) is here reported. Periphyton samples were collected from the Ceka and Zaje (Vaini), Merxhani (Kune) lagoons and Drini delta from July 2018 to July 2019. The material was boiled in H_2O_2cc and microscopic slides were embedded with Naphrax to clean up the diatom frustules. The microscope Motic BA310, objective 100x, and a digital camera were used to determine the species. More than 400 frustules were counted, and the IPS was calculated. About 200 species of diatoms were found. 13 out of the 200 species of diatoms were centric, and the reminder was pennate, showing relatively high diversity. There are 79 species found in Ceka, 61 in Zaje, 75 in Merxhani and 112 in the Drini delta. *Halamphora coffeiformis*, a toxic species, was found in all the habitats, relatively abundant in Ceka drainage channel (up to 65% of periphyton community in March 2019) and Ceka lagoon (up to 28% in July 2018). IPS values were relatively low. Their average was 8.85 in Ceka, 8.36 in Zaje, both classified into the ‘poor’ quality class; and 9.55 in Merxhani, 10.34 in Drini, both classified into the ‘moderate’ quality class. But the reliability of quality in Merxhani is rather low, considering the abundant marine species. It somehow shows the anthropogenic impact in water quality to the zone, as confirmed also by the related working groups within the Kune-Vaini Project during the same period. Water quality remains of the greatest concern.
***Keywords*:** Lezha lagoons, diatom diversity, coastal ecology, T SI, water quality

1. INTRODUCTION

Diatoms are the main group of plant protists that populate mostly the aquatic habitats, living in benthos or periphyton (attached to submerged surfaces) and in phytoplankton. They are the primary producers and constitute the first trophic level in the food chain, and at the same time, they enrich the aquatic habitats with abundant amounts of oxygen (Van den Hoek *et al*., 1995). Diatoms are adapted to habitats of good natural state, unpolluted and without high nutrient load. In undisturbed habitats they grow up with high diversity. They are very sensitive not only to the environmental conditions, but also to the content of nutrients (N and P), heavy metals, organic pollution, etc. Therefore, the diatoms are largely used as indicators of surface water quality (WFD, 2000; etc.). Several indexes have been developed for the assessment and classification of fresh water quality. Index of Pollution Sensitivity (IPS) is one of the most frequently used, beside some limitations in certain cases (Trábert *et al*., 2017). It was originally developed at the Cemagref institute by (Coste 1982), using the formula of Zelinka and Marvan (1961). It was elaborated after by Eloranta & Kwandrans (1996). The ecological values (S_i and V*i*) were taken from the OMNIDIA database (Lecointe *et al.,* 1993). The water quality is given into 5 classes. IPS combines the impact of inorganic and organic nutrient loads.

There is little information about the periphyton diatoms on the Kune-Vaini wetlands. The present paper is the first approach on the samples collected from different habitats. A complete information (list of species and plates with microscopic photos) can be found in master theses of Qevani (2020). The work was combined together with the phytoplankton assessment by Kola (2019) in the framework of the Kune-Vaini project (http://kunevain.com).

2. MATERIALS AND METHODS

About 16 periphyton samples were collected from the Ceka, Zaje, Merxhani lagoons and Drini delta from July 2018 to July 2019. The material was with submersed macrophytes: the grass *Ruppia* and green algae (*Chladophora, Chaetomorpha* and *Ulva* species) in Ceka lagoon and/or drainage channel (6 samples: July 2018, January, March, May, and July 2019); the seagrass *Zostera* and/or *Chladophora* and *Ulva* species in Zaje (3 samples: November 2018, March and May 2019); *Ulva* species in Merxhani (3 samples: November 2018, March and May 2019) (Gjata, 2019); *Myriophyllum* sp. (freshwater aquatic plant) and *Ulva* spp. in Drini delta (4 samples: January, March, May, and July 2019) (EN 13946:2003).

The diatom frustules were cleaned by boiling the material in H_2O_2cc (EN13946:2003). The microscopic slides were embedded with Naphrax (1.71). The species were determined using the optic microscope Motic BA310, objective 100x, a digital camera, and abundant information provided in (Sournia, 1978; Krammer and Lange-Bertalot, 1986-2000; Witkowski *et al.,* 2000; Hallegraeff *et al.,* 2004; WoRMS and AlgaeBase 2019). More than

400 frustules were counted (confidence 95%, ±10%), and the IPS was calculated (EN14407: 2004).

3. RESULTS AND DISCUSSIONS

More than 200 species of diatoms (Bacillariophyceae) were found in total. 13 species were centric and 189 were pennate;79 species were found in Ceka, 61 in Zaje, 75 in Merxhani, and 112 in Drini delta. With what was found in phytoplankton by Miho & Mitrushi (1999) and Kola (2019). The total number of microscopic algae found in the Kune-Vaini Lagoon is about 310 species; ca. 280 species are diatoms.

The Table 1 reports about the species per sample found in the Drini delta (62 species in January 2019), Merxhani (43 species in March 2019) and Ceka (40 species in March 2019). The Margalef index, *d* (1958), combines the data of the total number of species (S) and the total number (N) of frustulae counted in each sample community; *d* ranges from 3.27 in Zaje to 9.89 in Drini, corresponding also with the species number.

Nitzschia and *Navicula*s pecies (up to 24 species each one) were widespread and abundant in periphyton community. *Cocconeislineata* was also present in all habitats, but it was found relatively abundant inZaje (up to 74% in May 2019) and in Ceka (up to 63% in July 2019). *C. scutellum* was present only in the lagoons, relatively abundant in Zaje (up to 82% in November 2018) and in Ceka (up to 67% in May 2019). *C. placentula* var. *euglypta* was present in all the habitats, relatively abundant in Ceka (up to 28% in January 2019). *Halamphora coffeiformis* was present in all habitats, relatively abundant in Ceka (up to 65% in March 2019); worth to mention that *H. coffeiformis* is a toxic species. *Conticribra weissflogii* (scarcely present in Ceka) is also known to be potentially toxic (Hallegraeff *et al.*, 2004).

Other pennate diatoms present in periphyton community of all habitats were: *Navicula gregaria*, relatively abundant in Drini (up to 33% in March 2019); *N. perminuta* abundant in Drini (up to 30% in March 2019). *Navicula recens* was present only in Zaje and Drini (up to 45% in May 2019). *Nitzschia lacuum* was present in all habitats, and relatively abundant in Drini (up to 23% in January 2019). *Tabularia fasciculata* was present in all samples, but relatively abundant in Zaje (up to 72% in March 2019). Relatively present, but less abundant were *Achnanthes adnata, A. armillaris, Cocconeis placentula* var. *euglypta, Navicula gregaria, N. phylleptosoma, Nitzschia incospicua, Tabularia tabulata* and *Tryblionella apiculata* were present in all the habitats. *Halamphora holsatica, Licmophoragracilis, Mastogloia pumila, Nitzschia sigma, Opephora mutabilis, Rhopalodia musculus, Tryblionella granulata* were present only in the lagoons.

Muçaj (2019) said that the three lagoons represent notable differences, based on physico-chemical parameters. The waters were mesohaline (8-18‰) in Zaje, as expectable for its water exchange with the Drini delta. The Ceka waters were polyhaline (18-30‰); whereas the waters in Merxhani were euhaline (25-40‰). Meanwhile, most of diatoms found were fresh waters pecies (82 species). There were 17 marine/freshwater species; 69 marine species and 33 brackish species. Since the IPS and the OMNIDIA database (Lecointe *et al.*, 1993) are valid mostly for freshwater habitats, some of the species counted by us have no ecological values (S_i and V_i) (mostly marine species) and cannot be considered in IPS calculation. In our case, the total percentage of species with ecological values that have contributed in the IPS calculation varied from 79 to 97% in Ceka and Zaje; 74 to 93% in Merxhani, 83 to 99% in Drini; the average was 90.67% in Ceka, 97.33% in Zaje, 83% in Merxhani, and 92.75% in Drini (Tab. 1). Therefore, the IPS values can give somehow the quality of each habitat under interest, even with a certain approximation. The IPS reliability could be considered rather low in the Merxhani Lagoon, where the abundance of marine species (without ecological values) in periphyton community was higher.

Based on the aforementioned statement, the IPS values were relatively low. The lowest value, 5.98 ('poor' quality), was found in the drainage channel outside the Ceka Lagoon. The highest IPS values were found in Zaje (12.77 in May 2019) and Drini (12.39 in January 2019). The average was 8.85 in Ceka, 8.36 in Zaje, both 'poor' quality; and 9.55 in Merxhani, 10.34 in Drini delta, both 'moderate' quality class (Tab. 1). It is somehow a proof of anthropogenic impact on the water quality of the area, as confirmed also by the related working groups within the Kune-Vaini Project (Gjata, 2019; Kola, 2019; Ramaj, 2019) during the same period.

Table 1. Periphyton data from wetland habitats in Kune-Vaini, Lezha. N, species number; d, Margalef index (1958); IPS, Index of Pollution (Coste në Cemagref, 1982); %, percentile with IPS ecological values. Colors after water quality classes of WFD 2000/60/EC.

Ecosystem	**Ceka**						**Zaje**		
Habitat	Lagoon				Lagoon shore	Drainage channel	Lagoon		
Time	*July 2018*	*January 2019*	*May 2019*	*July 2019*	*March 2019*	*March 2019*	*November 2018*	*March 2019*	*May 2019*
N	**27**	**20**	**25**	**25**	**40**	**29**	**25**	**38**	**21**
d	**3.65**	**3.08**	**3.91**	**3.88**	**6.34**	**4.53**	**3.38**	**5.74**	**3.27**

IPS	**9.17**	**10.10**	**7.02**	**10.87**	**9.94**	**5.98**	**6.21**	**6.12**	**12.77**
IPS Classes	**Moderate**	**Moderate**	**Poor**	**Moderate**	**Moderate**	**Poor**	**Poor**	**Poor**	**Moderate**
%	**91**	**96**	**95**	**92**	**79**	**91**	**96**	**97**	**99**

Ecosystem	**Merxhani**				**Drini**		
Habitat	Lagoon				River delta		
Time	*November 2018*	*January 2019*	*March 2019*	*May 2019*	*January 2019*	*March 2019*	*May 2019*
N	**33**	**24**	**43**	**38**	**62**	**63**	**34**
d	**5.19**	**3.77**	**6.90**	**6.02**	**9.66**	**9.89**	**5.36**
IPS	**10.87**	**6.50**	**7.71**	**10.05**	**12.39**	**8.86**	**9.61**
IPS Classes	**Moderate**	**Poor**	**Poor**	**Moderate**	**Moderate**	**Poor**	**Moderate**
%	**82**	**74**	**74**	**93**	**83**	**90**	**99**

Continuous monitoring of the lagoon complex, including biological monitoring is required to improve water quality. In addition, the existing potential risk to wildlife could be reduced, and human health improved. Protection of the three lagoons from urban and agricultural pollution is necessary. It could be achieved through collecting and treatment of wastewaters, and not discharging directly to the drainage system or the Drini River.

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