CONSIDERATIONS ON THE PRIMARY PRODUCTIVITY AND THE TROPHIC STATE OF THE VILUNI LAGOON (VELIPOJA REGION, SHKODRA)

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SUMMARY
The Viluni lagoon is situated in the Northern Albanian Adriatic coast, as an integral component of the Buna River Delta. The whole area is distinguished for its biodiversity values, such as a wide variety of terrestrial and aquatic flora and fauna species. Since 2005, the Albanian part of Velipoja wetlands including Viluni lagoon and the Shkodra Lake hold the protection state of a Managed Natural Reserve (IUCN Category IV), and since 2006 the zone is included in the RAMSAR list. The primary productivity and the trophic state of Viluni lagoon has been assessed periodically (during years 2005, 2006, 2007, 2009 and 2010) through chlorophyll content. Data shows that the trophic state appears to be mesotrophic and sometimes oligotrophic, depending on the period, location of the sampling site and other factors.Based on the results of the performed study, recommended measures are provided to conserve or improve the trophic state and the general ecological situation in this ecosystem.

Keywords: Viluni lagoon, Buna Delta, chlorophylls, trophic state, rehabilitation measures

INTRODUCTION

The system complex of Velipoja-Buna-Shkodra shelter a wide range of habitats, communities and landscapes, consisting of transitional habitats of Velipoja wetlands and Buna delta, Buna River, closely related with freshwater ecosystems along Buna River and Shkodra Lake. Due to the variegate habitats the wetland complex shelters a high proportion of biodiversity not only of Albania (Fig. 1), but of South-Western Balkan as whole, especially for aquatic plants, birds, reptiles, amphibians, mammals and fishes (Schneider-Jacoby *et al*., 2006). Therefore, in 2005 the Albanian part of the Shkodra Lake and of the Velipoja wetlands is declared Managed Natural Reserve (IUCN Category IV) (DCM, 2005). In 2006, the authorities of the Ramsar Convention included also the Albanian part of Lake Shkodra with the River Buna and the Velipoja Reserve (surface of 496 km^2) in the Ramsar list (*Anonimous*, 2006).

The Viluni lagoon is situated within the Buna river delta, 2 km east of the Velipoja beach and 7 km away from the Buna estuary (Fig. 2). The lagoon has a surface of 16.3 m^2 and an average depth of 1 m. It communicates with the sea through a channel that is deeply influenced by the dynamics of the coastline in the area. Two channels discharge their water in the Viluni lagoon: the Murteme drainage channel and Velipoja discharge channel (Kabo, 1990-91; *Anonimous*, 2006).
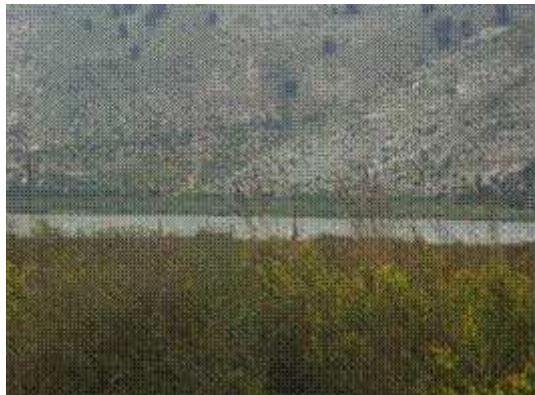
Figure 1: *Above*, view from Viluni lagoon; *below*, bird colony in Viluni lagoon.

The hydrodinamic processes are historically made up by alluvial deposits of Buna Rriver. The Murteme drainage channel collects waters of Dajci lowlands. The Velipoja Hydrochannel collects waters of Velipoja lowland discharges also near the Viluni strait (Fig. 2). The coastal area near the Viluni lagoon is situated about 6 km nearby the Buna delta.

Water exchange processes within the Viluni lagoon are influenced by seasonal factors. During the dry seasons the water exchange mainly consists on the sea-lagoon communication through the existing channel. During the wet season all rainy waters are discharged in the lagoon through the existing channels, for the area extend at the sea level altitude. The lagoon is relatively shallow and during the summer

months, due to high evaporation, the lagoon-sea communication is reduced.
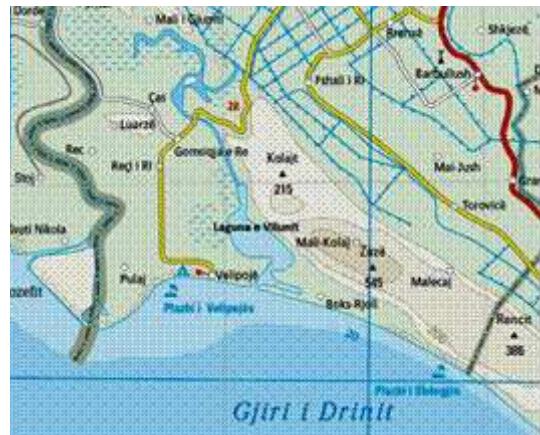
Figure 2: Topographical map of Velipoja area (Buna delta and Viluni lagoon).

The main activities in Velipoja zone are agriculture (crops, vegetables and fruits), livestock rising (cattle, sheep, goats, pigs and horses), fishery (Buna River and Velipoja lagoons) and tourism (Velipoja beach). During the last two decades, the coastal area and dunes in Velipoja are continuously occupied by the tourism infrastructures, hotels, restaurants, etc. The activity seems to take less care on the sensitivity of the coastal habitats, not properly controlled, with scarce sustainable rules of territory planning and urbanization. All the above mentioned activities probably influence in the quality of the coastal waters and the related wetlands, as well as on their biodiversity health.

The photosynthetic pigments measured in our survey and inorganic nutrients characterize the primary productivity and also the trophic level of waters. Based on chlorophyll content, the trophic level is grouped into four classes, from lowest to highest: oligotrophic (0—2.6 µg/L), mesotrophic (2.6—20 µg/L), eutrophic (20—56 µg/L) and hypertrophic (56—155+ µg/L) (Carlson & Simpson, 1996).

Based on the data, rehabilitation measures are recommended in order to conserve and improve further the state and the general situation of the ecosystem.
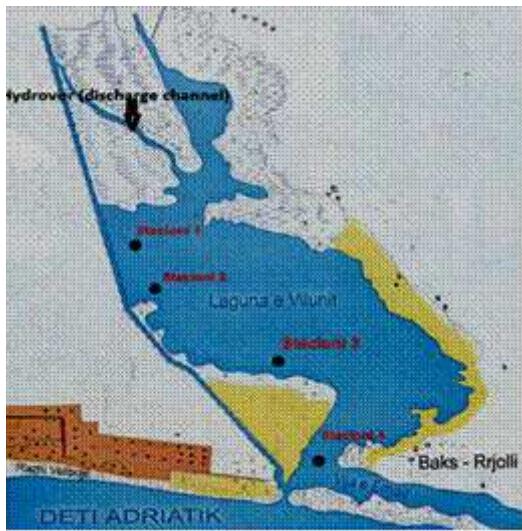
Figure 3: Map of the Viluni lagoon with sampling stations (October 2010)

MATERIALS AND METHODS

The chlorophyll content, temperature and pH in Viluni lagoon was assessed in October 2010. Sampling stations have been selected deliberately in order to represent different water exchange profiles and different physical parameters such as urban activity, proximity to the water exchange channel, etc. (Fig. 3)

Station 1 is is farthest from the communication channel sea-lagoon. Station 2 is located inside the lagoon. Station 3 is situated inside the lagoon but it is closer to the communication channel. Station 4 is also situated near the communication channel.

The chlorophyll content was assessed, based on standardized spectrophotometric and fluorimetric methods (Lorenzen, 1967; Babani, 2007). Temperature and pH were measured on site at each station.

RESULTS AND DISCUSSION

The chlorophyll content is a bioindicator of the trophic state (Carlson & Simpson, 1996). The assessment made in October, 2010 showed relatively low values (Tab. 1). But they varied from one station to the other. During the study it was

noticed that the increase of temperature and pH becoming more basic, negatively influence the trophic state in Viluni lagoon.

Parameters / Stations	1	2	3	4
Temperature, $^{\circ}$C	19	19	18	19
pH	7	7	6.8	6.8
Chlorophyll a, µg/l	1.24	1.16	0.754	0.811
Trophic Class	Oligotrophic			

Table 1: Chlorophhyll content, temperature and pH values at 4 sampling stations in Viluni lagoon, in October 2010

The chlorophyll content at station 1, the farthest to the communication channel sea-lagoon, appears higher compared to other stations. High value was also noticed at station 2, also located inside the lagoon. At station 3, situated inside the lagoon but closer to the communication channel, lower value was measured (Tab. 1). Although station 4 is situated near the communication channel, in this area there exists a noticeable urban and tourism activity compared to station 3. At this station, the chlorophyll content was low, but higher than in station 3.

It may be noticed that the temperature at station 3, closest to the communication channel, was lower (Tab. 1). It corresponds to a lower value of chlorophyll and may be due too the better circulation of water. PH appears to be more basic towards stations 1 and 2, both the farthest to the communication channels, corresponding also higher values of chlorophyll.

The chlorophylls, temperature and pH in Viluni lagoon have been monitored periodically during the period April-October, at the same four assigned sampling stations in the previous years (2004, 2005, 2006, 2007 and 2009) (Babani, 2007; *Anonimous*, 2010; Çako & Babani, 2011). The data show that the trophic state appears on average mesotrophic. The highest trophic level was observed in 2009, average value of chlorophylls 4.97 µg/L corresponding to

mesotrophic class (Fig. 4). A tendency towards improvement of the trophic state was observed in 2010. It may depend on the station location in relation to the communication channel, as well as pH and climate (i.e. temperature). The stations located near the communication channel appear to be in a better state.
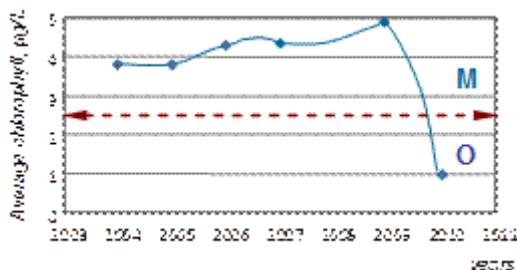

Figure 4: Average chlorophyll content in Viluni lagoon during the period 2004-2010. M, mesotrophic; O, oligotrophic

As mentioned above, the urban activities (tourism included) on the proximity seems to influence on the trophic state. Viluni seems the most sensitive and disturbed ecosystem; Domni and Murteme marshes collect high amount of freshwater from the marshes of Buna in eastern part, rich in nutrients, from large agricultural and industrial areas; two pumping stations discharge continuously water into lagoon system. There exist some confirmations about algal blooms in the lagoon (*Anonimous*, 2006). In the past the lagoon was called Lagoon of Otter, for the high amount of otter, an aquatic mammal that used to catch fishes in the lagoon. Nowadays, it is used also for fishing; most of the fish catch is composed of grey mullets and eel. In the past years, due to unfriendly behavior of the people, afforested zone around lagoon was heavily damaged; nevertheless, still exist about 0.37 km^2 of forest area of sea-pine.

Therefore, rehabilitation measures must be implemented in order to conserve the state and avoid the increase of trophic state, as in the following:

- Maintenance of the communication of the lagoon with the sea through the existing channel.

- In order to avoid the impact of urban activities and tourism, appropriate measures for urbanization and waste management must be implemented. Placement of waste collection tanks in inhabited and beach areas, as needed and if possible, installment of septic tanks in newly constructed bars and restaurants is another recommended measure.

- Organization of further monitoring of the wetland system, in order to know better and consciously the state.

BIBLIOGRAPHY

Anonymous (2006): Information Sheet on Ramsar Wetlands (RIS) – Albania, Lake Shkodra-River Buna-Velipoja Coast. 1-21. http://www.wetlands.org/reports/ris/3AL003_RISen06.pdf

Anonimous (2010): Vleresimi i gjendjes trofike dhe cilesise se ujerave ne lagunat e ekosistemit Kune-Vain dhe ne Liqenin e Shkodres. Universiteti i Tiranes. Fakulteti i Shkencave Natyrore. Departamenti i Bioteknologjise.

Babani F. (2007): Photosynthetic pigments of phytoplankton. INTERREG IIIA. Transfrontaliero Adriatico. Presentation of progress. METEA-Universita di Bari, 2007

Çako V., Babani F. (2011): Evaluation of the trophic state in Vilun lagoon. Advances in Bioscience and Biotechnology, 2, 311-314. doi: 10.4236/abb.2011.24045. http://www.SciRP.org/journal/abb/

Carlson R. E., Simpson J. (1996): A Coordinator's Guide to Volunteer Lake Monitoring Methods. North American Lake Management Society: 1-96 (http://dipin.kent.edu/tsi.htm)

DCM (2005): (2005): Decision of the Council of Ministers Nr. 683 . dt. 02.11.2005, Fletorja Zyrtare 91. Pg. 2907 , 2005

KABO M., Ed. (1990–91): Gjeografia Fizike e Shqipërisë, Vol. I (400 pp.) dhe II (590 pp.). Albanian Academy of Sciences. Geographic Centre, Tirana.

Lorenzen C. J. (1967): Determination of chlorophyll and phaeopigments: spectrophotometric equations, Limnol. Oceanogr., 12

Schneider-Jacoby M., Schwarz U., Sackl P., Dhora D., Saveljic D., Stumberger B. (2006): Rapid assessment of the Ecological Value of the Bojana-Buna Delta (Albania / Montenegro). Euronatur, Radolfzell.