



VARIATIONS OF PHOTOSYNTHETIC PIGMENTS OF THE SPECIE NAJAS MARINA RELATED TO THE WATER QUALITY IN THE OPPOSITE SHORE OF SKADAR LAKE

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ABSTRACT

Skadar Lake is the largest natural shallow lake on the Albanian-Montenegro border. Approximately two-third (229 km²) of the lake lies in Montenegro and one third(142 km²) lies in Albania. The lake has a particular water regime causing water level fluctuations. This changes the shore line generating a unique landscape type with wetlands and numerous aquatic habitats. Skadar Lake is known as a high biodiversity ecosystem. According to the authors the submerged and emerged macrophytes are the most characteristic features of the littoral in Skadar Lake. The most important association of the vegetation type are Najadetum marinae, Potameum perfoliati, Potametum lucem, Potameto-Najadetum, Myriophyllo-Nupharetum lutei, Trapaetum natantis, Phragmitetum australis, Thyphaetum latifolia. Submersed macrophytes are more developed in the eastern part of the lake which go as far as 3 m deep such P.perfoliatum, P.lucens, Vallisneria spiralis, Najas marina, Najas minor, Ranunculus trichophyllus. Submerged macrophytes constitute the food base of fish in Skadar Lake. One of the most important associations is Najadetum marinae dominated by Najas marina occurring at the depth 2-3m. Najas marina was found as a part of the association Najadetum marinae in three sampling points (stations) during the year 2014. In the field was measured temperature and pH. Samples of water were used for determination of orthophosphates and nitrites. It was made determination of photosynthetic pigment of Najas marina specie collected in western and eastern stations. At a general conclusion it is stated that the shore lines differentiate in the concentration of nutrients and in the content of the photosynthetic pigment of the same Najas marina sp.

Keywords: Skadar Lake, Najas Marina, Macrophytes, Photosynthetic Pigments, Nutrients.

Introduction:

Skadar Lake is the largest natural shallow lake on the Albanian-Montenegro border (40° 10' N; 19° 15' E) and one of the most interesting and attractive of the Balkan Lake. The lake is located in a carstic terrain in the outer part of the south eastern Dinaric Alps (Fig 1). The surface area fluctuates seasonally from approximately 370 to 600 km². The lake's water level varies seasonally from 4.7 to 9.8 m above sea level. Its precise origin is unknown. The lake probably formed during Tertiary and/or Quaternary Periods. Approximately two-third (229 km²) of the lake lies in Montenegro and one third(142 km²) lies in Albania.



Figure 1. View of Skadar Lake (Photo by wikimapia.org)

Several physical factors influence the water quality and the abundance of all life associated with the lake. Skadar lake has one outlet the Bojana river. Yet it receives the inflow of a number of rivers (Karaman & Beeton 1981). The lake has a particular water regime causing water level fluctuations of up to 5 m. This changes the shore line generating a unique landscape type with wetlands and numerous aquatic habitats like floating meadows different shallow water shore lines and open surface water zone. The great variety of habitats and its closeness to the Adriatic sea make Skadar Lake to a unique eco-system of international relevance in particular for birds and fish life (Anonymous 2009). Skadar Lake is known as a high biodiversity ecosystem. The variety of the species per 100 m² is $S/A = 0.8752$. The northern shore stretches on wetlands is covered in green reed vegetation. Water lilies (*Nymphaea alba*, *Nuphar luteum* and water walnuts

(*Trapa natans*) which are characteristic for the lake. The most important association of the vegetation type according to Pulevic et al (2000) are *Najadetum marinae*, *Potameum perfoliati*, *Potametum lucem*, *Potameto-Najadetum*, *Myriophyllo-Nupharetum lutei*, *Trapetum natantis*, *Phragmitetum australis*, *Thyphaetum latifolia* (REC 2009). The function of macrophytes in ecosystems lake, rivers is related to their structural attributes like species, composition, distribution abundance and diversity which in turn relies on various environmental factors such as light, water temperature, substrate composition, water level, quality of lake and sediment nutrients (Barko et Smart 1986 ; Wetzel 2001). Aquatic plants provides food shed shelter and breeding places for fish (Madsen et al 1993; Doyle Rd, &Smart RM 1995) and absorb many harmful nutrients and pollutants from water as a buffer strip. Macrophytes are photosintetic organisms. The production of these pigments depend upon certain factors, some of which are internal and other external. The effects produced by certain external factors may be direct or they may be indirect, in so far they affect the protoplasm, which itself may be immediately responsible for the formation of pigments. Seasonal variations in the pigment content of leaves might well be expected since the significant factors which influence the production of pigments in plants vary during a year. It is probable that the intensity of light and the temperature are factors of greater significance than the wave length of light or the moisture conditions (Beck , A W & R. Redman 1940). According to the autors the submerged and emerged macrophysics are the most characteristic features of the littoral in Skadar Lake. Submersed macrophytes are more developed in the eastern part of the lake (Kamice , Shegan) which go as for as 3 m deep such *P.perfoliatum*, *P.lucens*, *Vallisneria spiralis*, *Najas marina*, *Najas minor*, *Ranunculus trichophyllus*. Submerged macrophytes constitute the food base of fish in Skadar Lake (Anonymous 2013). One of the most important associations is *Najadetum marinae* dominated by *Najas marina* (Fig 2) occurring at the depth 2-3m (REC 2009).It is part of submerged angiospermes choosing freshwater and brackish aquatic habitats. The stems are slender fragile, 1-4.5 mm in diameter mostly armed with spines (Le Roy Holms et al 1996). *Najas marina* is adapted to submersed life with a low light compensation point (Agami et al 1980). As a submerged macrophyte *Najas marina* founded in both sides of Skadar Lake exhibits spatial variations in photosynthetic pigments related to different water quality parameters.



Figure 2. Photo of *Najas marina* sp (Photo by doris.ffess.fr © Cathy Andres)

Material and methods

Najas marina was found as a part of the association *Najadetum marinae* (Fig 3) in three sampling points (stations).



Figure 3. View of association of *Najas marina* collected in Zogaj (Station 1,Photo by A. Temali)

The stations extend in a shore line with natural biotopes formed by water including floating and emerging habitats,reed beds,soft wood forest zones. In western part of Skadar lake prevails rocky formations and grovel sands in contrast with the typical sandy terrains of the eastern part of the lake. The sampling occurred during the year 2014 . Three sampling site were distributed in western portion Zogaj village station 1 and eastern portion Vranka village station 2 and Koplík Town station of the lake (Fig 4).



Figure 4.View of sampling points (Google Maps)

In the field water temperature was measured directly through waterproof Tester HI 98130 Combo (Hanna Instrument). Water samples for measurements of nutrients are collected and transported according to the procedures of the Standard Methods for examination of Water and Wastewater APHA, AWWA, WEF 1999. Orthophosphates and nitrites were determined according to the methodology described in Filippini & Calabresi 1995 immediately after the transportation in laboratory. The amount of oxygen dissolved is made through Winkler method making in advance the fixation procedure in field. The content of photosynthetic pigments chlorophyll a, chlorophyll b carotenoids (x+c) is determined in 80% acetone extract solutions and measured in four major bands (470,645,652,663) using Rabelein equations.

Plant specimens collection

Najas marina was collected using a specify equipment for field survey including

Plastic bags for collection with additional waterproof label

GPS

Rake with extendable rod

Boat suitable for local conditions

Field protocol in sufficient number of copies

Preliminary check list of plant species

Plant material was transported in dark containers washed free of debris and was measured the length of aerial part. Plant material was submit to treatment for determination of photosynthetic pigments chlorophyll a, chlorophyll b and carotenoids (x+c) using 80% acetone.

Results

The results of parameters measured in the respective stations are given in the tables 1 and 2. In the present study the values of temperature varied from 24.07 in the station 1 to 24.55 in station 3 (Fig 5). The values of pH ranged between 8.26-8.38. The highest value was observed in sampling station 1 situated in west shore line (Fig 6). Dissolved oxygen concentration varied from 8.8 in station 1 to 9.57 in station 3. In the east shore was observed higher values of dissolved oxygen. The values of DO did not dropped under 7 mg/l (Fig 9). Concern to nutrients the values of orthophosphates are higher in sampling station 1 (Fig 7). In the sampling station 3 was reported the highest value of nitrites (Fig 8). Photosynthetic pigments chlorophyll a, b and carotenoids evaluated in the sampling stations had higher values together in the sampling station 1. The lowest values of photosynthetic pigments are reported in the sampling station 2 in the east part of the lake (Fig 10). The values of Chla/Chlb ratio and Chla+Chlb/Carotenoids ratio are calculated and were higher in sampling station 3 in east shore of the lake (Fig 11,12). The measurements of the Najas marina plant resulted that the areal part of the plant collected in the station 1 is longer than other stations (Fig 13).

Discussion

Skadar Lake is considered a subtropical shallow lake (Beeton 1981). Small differences indicate the absence of thermal stratification. The values of pH indicate that water of Skadar lake is slightly alkaline due to bicarbonates and calcium ions reported from different studies (Petrovic, G & A Beeton, 1981; Bekteshi, A 2000). The lake is abundant in oxygen. The water of Skadar lake due to values of dissolved oxygen is adequate to support different kind of aquatic organisms also reported from studies (Ylli et al 2011). A considerable variety of fish fauna is mostly guaranteed from these values. The values of nutrients suggest that the water is mainly oligotrophic-mesotrophic.

Mostly the source of nutrients have origin from agricultural activities around the the lake. Macrophytes are considered important for theirs purifications capacities through nutrient retention and transformation and binding pollutants. The station 1 situated in the vestern shore line of the lake Najas marina shown less affected from the unfavorable environmental conditions.

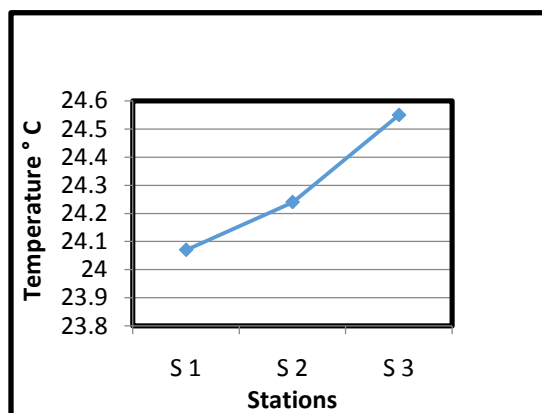


Figure 5. Variation of temperature by stations

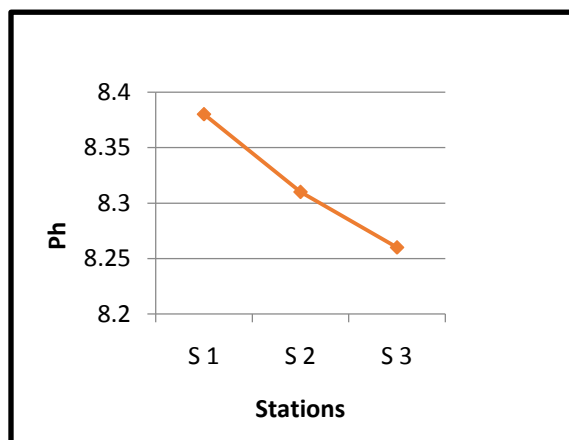


Figure 6. Variation of ph by stations

Table1.Results of parameters measured in respective stations

Parameters	Chla	Chlb	Carotenoids (x+c)	Chl/Chlb	Chla+b/x+c
Unit	mg/g	mg/g	mg/g		
Station 1	0.528	0.190	0.134	3.352	6.466
Station 2	0.331	0.121	0.087	3.294	27.365
Station 3	0.352	0.112	0.093	7.464	98.213

Chla= Chlorophyll a

Chlb= Chlorophyll b

x+c=Carotenoids

Table. 2 Results of parameters measured in respective stations

Parameters	Temp	Ph	PO4 3 ⁻	NO2 ⁻	DO	T.lenth (areal part)
Unit	° C		mg/l	mg/l	mg/l	Cm
Station1	24.07	8.38	0.097	0.0852	8.8	9.55

Station 2	24.24	8.31	0.045	0.080	9.51	5.75
Station 3	24.55	8.26	0.082	0.095	9.57	7.18

PO4 3⁻ = Ortophosphates

NO2⁻ =Nitrites

DO =Dissolved Oxygen

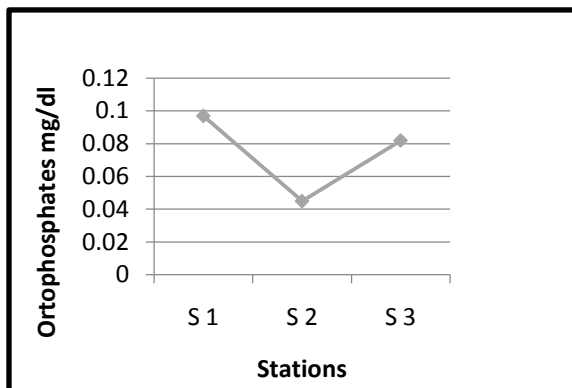


Figure 7. Variation of orthophosphates by stations

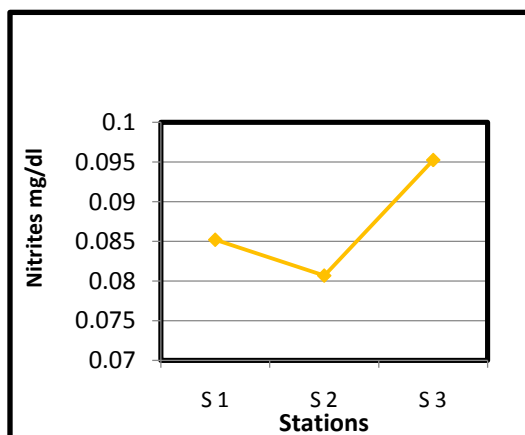


Figure 8. Variation of nitrite by stations

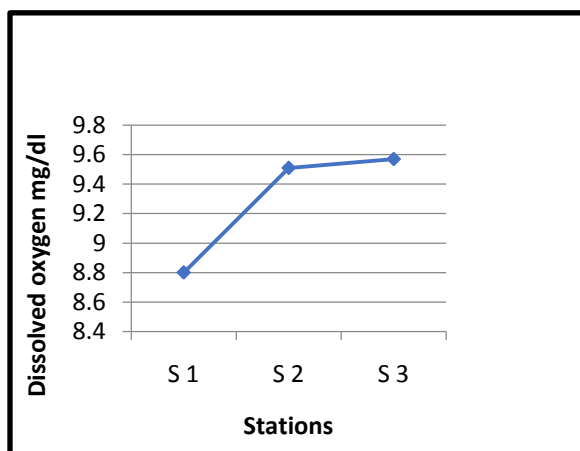


Figure 9. Variation of Dissolved Oxygen by stations

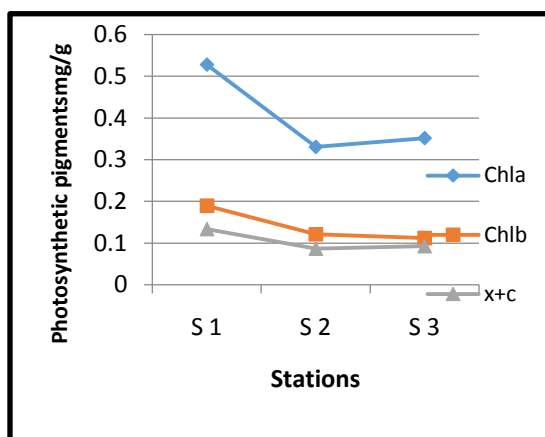


Figure 10. Variation of photosynthetic pigments by stations

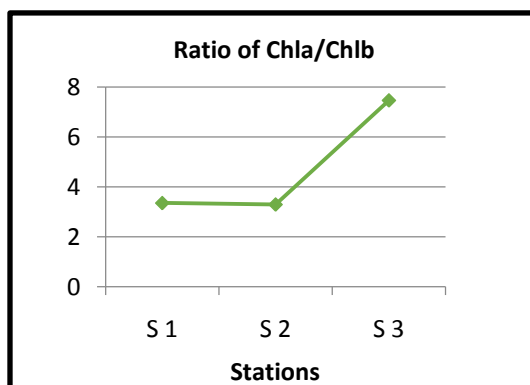


Figure 11. Variation of ratio Chla/Chlb by stations

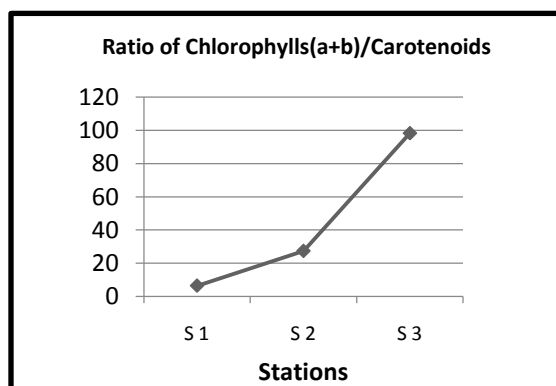


Figure 12 Variation of ratio a+b/x+c by stations

Legend

Chla=Chlorophyll a

Chlb= Chlorophyll b

x+c = Carotenoids

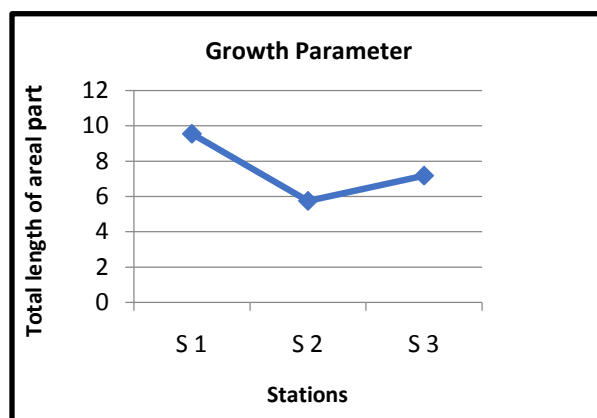


Figure 13. Variation of growth of areal part for the specie *Najas marina* by stations

Conclusions

Aquatic macrophytes are the most conspicuous features of the littoral of Skadar Lake having important functions as integrators of environmental conditions.

According to observed values of pH and nutrients one can conclude that the water of Skadar Lake is slightly alkaline and remains in oligotrophic-mesotrophic level. Dissolved oxygen content on the water of Skadar lake is appropriate to support the life of the entire biota.

The west coast differentiate from the east coast not only on the type of habitats, typology of terrains but also by the water quality.

The species *Najas marina* has different values of photosynthetic pigments depending on which part of shore line it growth. It exhibit different sensitivity toward environmental enrichments.

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