Enkeleda NIKLEKA (LLUKOVI)*, Spase SHUMKA*

ROTIFERS BASED EVALUATION OF THE LAKE SHKODRA WATER QUALITY

Përmbledhje: Disa organizma ujorë, si bimë dhe kafshë, shërbejnë si indikatorë të rëndësishëm për ndotjen në mjediset ujore. Megjithatë, ndryshimet brenda komuniteteve të makroorganizmave janë shpesh të vërejtur shumë vonë për të kundërvepruar (p. sh. vdekshmëria në peshq dhe korale). Në krahasim me këtë, mikroorganizmat zotërojnë karakteristika morfologjike, fiziologjike dhe gjenetike, që i bëjnë ata „indikatorë të shqetësimeve të hershme" shumë të mirë ndaj problemeve mjedisore. Ata mund të sinjalizojnë ndyshime negative mjedisore, kur ndaj këtyre ndryshimeve mund të kundërveprohet. Në këtë mënyrë, ne përdorëm rotiferët në Liqenin e Shkodrës me qëllim që të vlerësojmë cilësinë e ujit për periudhën pranverë- vjeshtë 2009. Analizat cilësore dhe sasiore të rotiferëve të Liqenit të Shkodrës janë bazuar në materialin e mbledhur në periudhën pranverë – vjeshtë 2009. Në total, janë identifikuar 27 lloje për zonën litorale të liqenit. Mbi 50% e tyre janë beta dhe beta- alfa mezosaprobik dhe 30% janë oligosaprobik. Grumbullimet e llojeve rotifere u dominuan nga lloje të gjinive: Asplanchna, Kellicotia dhe Brachionus, që ishin dhe llojet më të përhapura, duke përbërë 20%, 20% dhe 5% të densitetit total të rotiferëve. Rezultatet e „mënyrave ose rrugëve bio-indikatore" duhet të përfshijnë veç të tjerash, një listë me përbërje të ndryshme taksonomike të organizmave indikatorë, që shfaqin një përgjigje unike (të njëjtë) ndaj disa kategori stresorësh të intervaleve të ndryshme, po ashtu dhe disa nga organizmat e selektuar, që janë në gjendje të dallojnë stresues specifikë ndaj një shqetësimi të veçantë duke përcaktuar dhe programet monitoruese.

Fjalë kyçe: *Liqeni i Shkodrës, cilësia e ujit, zooplankton, indeksi saprobik, rotiferë*

Abstract: Some aquatic organisms, both plants and animals, are valuable indicators of pollution in aquatic systems. However, changes in communities of macro-organisms are often observed too late to reverse (*e. g.* fish and coral mortality). In comparison, micro-organisms possess morphological, physiological and genetic characteristics making them very good „early warning indicators" for environmental problems. They can to signal negative environmental changes, when these environmental changes could still be reversed. In that way, we used the rotifers of the Shkodra Lake in order to assess the water quality for the spring-autumn 2009. The qualitative and quantitative analysis of the rotifers of Lake Shko-

* Enkeleda Nikleka (Llukovi), Spase Shumka, Agricultural University of Tirana, Faculty of Biotechnology and Food, Kodër Kamëz, Tirana, Albania

dra, are based on materials collected in the period sprig-autumn 2009. In total, 27 species were identified for the littoral zone of the lake. More than 50% are beta and beta-alpha mesosaprobic and 30% are oligosaprobic. Rotifer species assemblage was dominated by species of genus Asplanchna, Kellicotia and Brachionus that were the most abundant species, comprising 20%, 20% and 5% of the total rotifer density. Results of „bio-indication approaches" should also include a taxonomically-diverse group of indicator organisms, that shows a unique response to several different broad categories of stressors, as well as a select few organisms which are able to detect specific stresses of particular concern to individual monitoring programs. The great lake of Albania, where Shkodra is of primary interest should include such assets for water quality assessment.

Key words: *Shkodra Lake, water quality, zooplankton, watershed, saprobiology, rotifers*

INTRODUCTION

This study presents the results of an investigation of planktonic rotifers in the littoral zone of Lake Shkodra. The aims of the study were: (1) to update the existing species list of rotifers in the lake; (2) to identify groups of dominant rotifers and analyze their spatial distribution within the lake, and (3) to use rotifer species diversity for the ecological zoning of Lake Shkodra.

Lake Shkodra (Fig. 1) is the largest lake on the Balkan Peninsula in terms of water surface. The drainage area of the lake is about 5,500 km^2 (4,470 km^2 in Montenegro and 1,030 km^2 in Albania). The lake area varies between 353 km^2 in dry periods and 500 km^2 in wet periods (at maximum level, 335 km^2 is in Montenegro and 165 km^2 in Albania). The basin of Lake Shkodra is a depression located south of the Dinaric Alps and orientated northwest-southeast, parallel to the current shore of the Adriatic coast. Sometimes the outflow from the lake in Buna-Bojana is impeded due to the increase in the flow in the Drin River. This occurs mostly in the period from December to February, but may also occur during the other months, depending on the water released from upstream reservoirs. Climate in the Shkodra basin is Mediterranean, but with higher rainfall amounts than in general in Mediterranean areas due to the mountains. Rainfall on the lake is between 2,000 and 2,800 mm per year, but within the basin some areas receive over 3,000 mm annually. Humidity levels are low, sunshine hours and temperature in summer is high, giving a high evaporation. Temperature in winter is low, due to the high elevations and predominant easterly and northerly winds.

In this paper we are presenting a comprehensive survey on the use of rotifers as bio-indicators water quality and some ecological parameters analysed as well.

The great diversity of zooplankton species appears to reflect the wide range of pelagic and littoral biotopes, which differ in morphometry, presence or absence of macrophytes, productivity, trophic state and distance from pollution sources (Raspopov *et al.,* 1996). Rotifers constitute an important fraction of the zooplankton. Although usually unimportant in terms of biomass (Ruttner-Kolisko, 1974), rotifers play a major role in energy transfer and nutrient cycling (Wetzel, 2001).

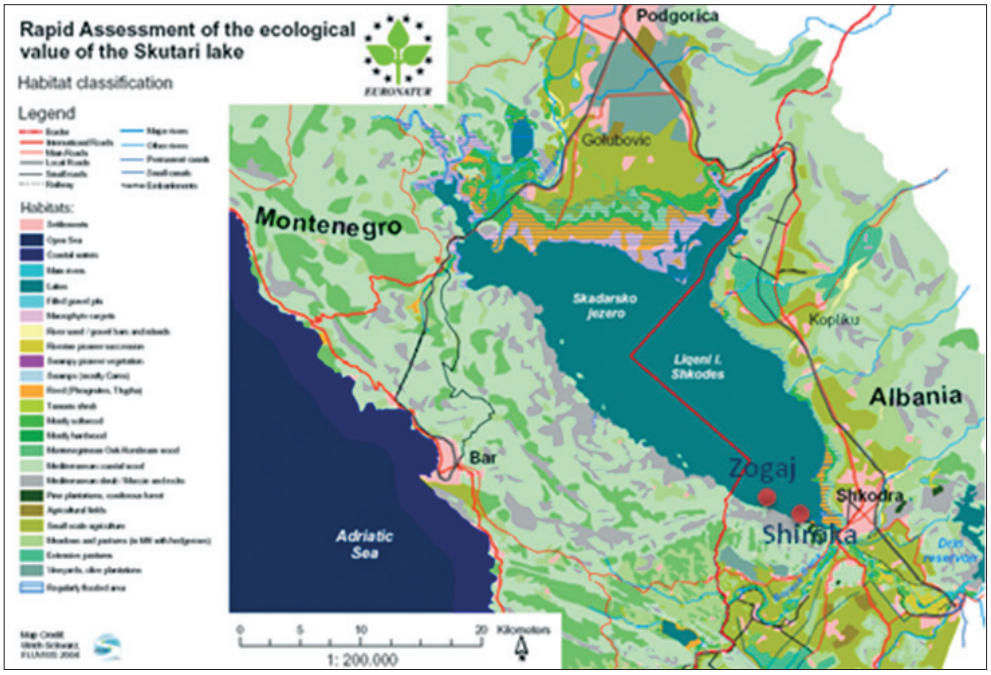

Figure 1. Transboundary Shkodra/Scadar Lake habitats. (Source: Schneider-Jacoby – Euronature, 2006) with sampling sites for zooplankton on Albanian side

MATERIAL AND METHODS

Planktonic rotifers were sampled in the littoral area of Lake Shkodra in period of April – September 2009. Plankton samples were taken with a Nanzen net in the sampling depth of 3 m vertical towel of 0–3 m water column at each of 2 stations (Fig. 1). The sample was filtered through a 50 μm mesh plankton net. The samples were preserved in 4 % formalin. Species identification was made according to Koste & Kutikova, 1970. Rotifer population densities at each sampling site were used for computing a Shannon-Weaver index of species diversity (*H´*) (Shannon & Weaver, 1949) (Table 1). Percentage share of rotifers in the total zooplankton density and biomass was also calculated for each sampling station.

RESULTS AND DISCCUSION

In total, about 27 rotifer species were identified during the investigation in the littoral zone. In general, the species composition of the rotifer assemblages did not vary significantly in different regions of the lake. The most common rotifer species were usually *Asplanchna priodonta*, *Keratella cochlearis, Polyarthra trigla, Polyarthra major, Trichocerca capucina* and *Trichocerca spp.* None of these species is typical to polluted waters; most are indicators of oligosaprobic or beta-mesosaprobic conditions (Sládeçek, 1973).

Table 1. Diversity index for two stations and periods of sampling

Shanon &Weaner Index (H')		
	ZOGAJ	SHIROKE
APRIL	2.20	2.26
JULY	2.65	2.58
SEPTEMBER	2.46	2.41
TOTAL	2.67	2.58

Table 2. Species list and saprobic values/class that each species show with her presence.

Nr.	Species	si	Sap. Class
1	Ascomorfa afinis Bartsch	1.5	I, II
2	*Ascomorpha saltans* Bartsch	1	I
3	*Asplanchna priodonta* Gosse	1.6	I, II
4	*Asplanchna* sp.	1.5	I, II
5	Brachionus angularis angularis Gosse	2.5	II, III
6	Brachionus calyciflorous Pallas	2.5	II, III
7	*Brachionus leydigi* Cohl	2.2	II
8	Brachionus quadridentatus f. brevispinus Ehrenberg	2.2	II, III
9	Cephalodella catelina O. F. Muller	1.9	II
10	Dicranophorus rostratus Dixon-Nuttal&Freeman	1.2	I
11	*Euchlanis deflexa* Gosse	1.6	I, II
12	*Echlanis dilatata* Ehrenberg	1.6	I, II
13	Filinia longiseta Ehrenberg	2.3	II, III
14	*Gastropus stylifer* Imhof	1.2	I
15	*Kellicottia longispina* Kellicott	1.4	I, II
16	*Keratella cochlearis cochlearis* Gosse	1.9	II
17	*Keratella cochlearis* var. *hispida* Lauterborn	1.3	I
18	*Keratella quadrata quadrata* O. F. Muller	1.7	II
19	*Lecane bulla* Gosse	1.4	I, II
20	*Lepadella acuminata* Ehrenberg	1.3	I
21	*Polyarthra vulgaris* Carlin	2.1	II
22	*Polyarthra major* Burchard	1.2	I
23	*Pompholyx sulcata* Hudson	1.7	II
24	*Synchaeta stylata* Schmarda	1.2	I
25	Testudinella patina Hermann	2.4	II, III
26	*Trichocerca capucina* Wierzejski&Zacharias	1.5	I, II
27	*Tricocherca similis* Wierzejski	1.6	I, II

Table 3. Classification of water quality {after saprobic index (Pantle & Buck, 1955) and O_2 values}, and trophic status {after physical-chemical parameters}

Saprobic Classes	I (oligosaprob)		II (β- mesosaprob)		III (α- mesosaprob)		IV (polysaprob)
Saprobic n/classes	I	I-II	II	II-III	III	III-IV	IV
Saprobicindex (P&B)	1–1.5	1.5–1.8	1.8–2.3	2.3–2.7	2.7–3.2	3.2–3.5	3.5–4
O_2 (mg/l)	>8	>8	>6	>4	>2	<2	<1
Trophic status	ologotroph		mesotroph		eutroph		hypertroph
Light penetr. (m)	>5		1–5		0.5–1		<0.5
Chl. a (mg/m3)	<3		<10		<40		>40
Total P (mg/m^3)	<13		<40		<100		>100
Total N (mg/m^3)	<300		<400		<1000		>1000

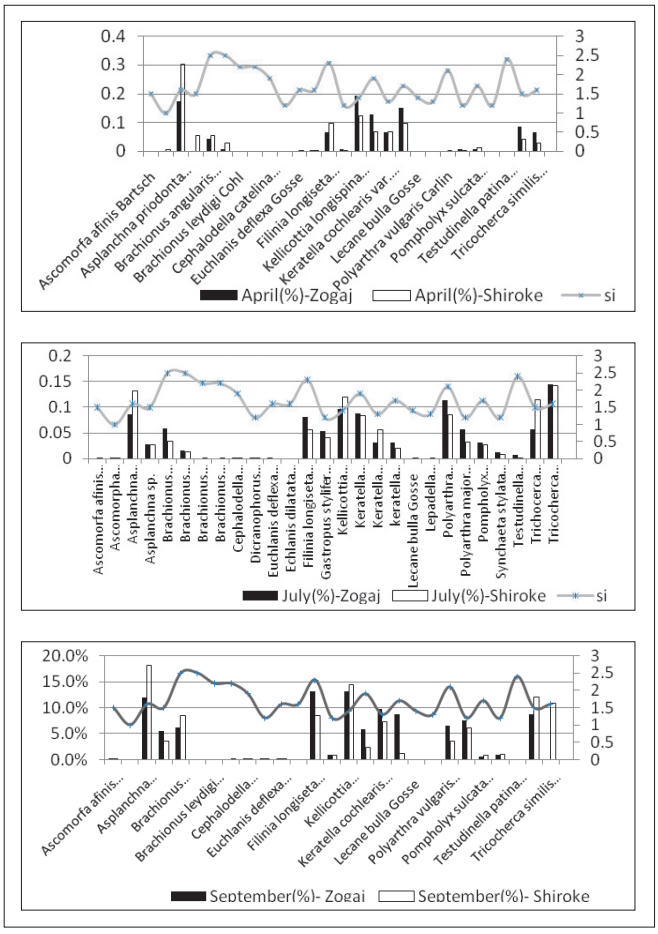

Figure 2. Seasonal variation of Rotifera species in two stations and saprobic values of species.

As it is shown from Table 2 and 3, ratifera species found takes place more at the I (oligosaprob, and II (β- mesosaprob), or III (α- mesosaprob) saprobic classes, in some cases. Since there is not enough identification of indicator species, but also the quantity of them found in samples, we have shown by three graphs quantities (in %) & saprobic values for every species in sampling months comparing two stations (Zogaj & Shiroke) (Fig. 2). Species that have the higher *si* (more polluted water), don't have higher values.

CONCLUSION

In order to achieve good water quality standards is an advantage to have a set of priory agreed parameters and monitoring program. Use of rotifers as indicator of water quality of Shkodra basin is in line with EU Water Framework Directive.

From the investigation conducted there is evidently an increased human impact reflected through presence of cosmopolitan and pollution state species (see species in category II, III).

Lake Shkodra is a unique lake with a rich fauna, including some endemic species. It is an important breeding ground for the rare species and was therefore declared a Ramsar site in 2000 (Ramsar, 2008). Being transboundary with the management responsibility shared between three countries does not seem to have been an advantage in the past. It is hoped that the implementation of the WFD will cause renewed national responsibility for the relevant authorities in Albania and Montenegro, and as such, that harmonised monitoring can be implemented in order to ensure sound transboundary management of the lake.

REFERENCES

[1] Kutikova, L. A., 1970. *Rotifer fauna of the USSR, subclass Eurotatoria.* Zoologicheskiy Inst. Akademii Nauk SSSR, 104. Leningrad, 744 pp. (In Russian).
[2] Pantle, E. & H. Buck, 1955. *Die biologische Überëachung der Geëässer und die Darstellung der Ergebnisse,* Gas und Ëasserfach, 96 (18): 604.
[3] Raspopov, I. M., Andronikova, I. N., Dotsenko, O. N., Kurashov, E. A., Letanskaya, G. I., Panov, V. E., Rychkova, M. A., Telesh, I. V., Tchernykh, O. A. & Vorontsov, F. F. 1996. *Littoral zone of Lake Ladoga: ecological state evaluation.* Hydrobiologia 322: 39–47.
[4] Ruttner-Kolisko, A. 1974. *Plankton rotifers: Biology and taxonomy.* Die Binnengewässer, 26, Suppl., Schweizerbart, Sutttgart. 146 pp.
[5] Sládeçek, V. 1973. *System of water quality from the biological point of view.* Arch. Hydrobiol. Beih. Ergebn. Limnol. 7: 1–218.
[6] Schneider-Jacoby, M. U., Schwarz, P., Sackl, D., Dhora, D., Saveljic, A. & Stumberger, B. 2006. *Rapid assessment of the Ecological Value of the Bojana-Buna Delta (Albania/ Montenegro).* Euronatur, Radolfzell.
[7] Wetzel, R. G. 2001. *Limnology: Lake and River Ecosystems.* 3rd ed. Academic Press, 1006 pp.