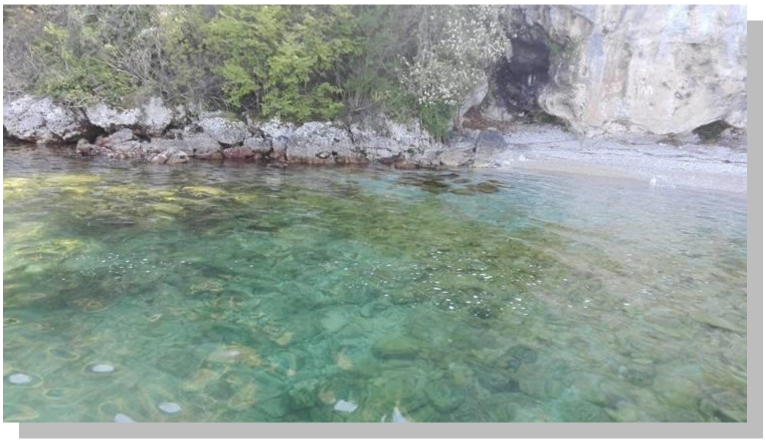

VELIDAB, LAKE OHRID MACEDONIA

Sampling May and July 2017

Association for ecology EKOMENLOG Ohrid
Project: Conservation of Velidab - Biodiversity Heaven in Lake Ohrid (COVEL-BIOHEVLO)

EKOMENLOG OHRID
Association for ecology

COVEL-BIOHEVLO

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Aknowledgments

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Association for ecology EKOMENLOG (2018). *Conservation of Velidab - Biodiversity Heaven in Lake Ohrid (COVEL-BIOHEVLO)*. [online] Ohrid: Association for ecology EKOMENLOG. Available at: http://ekomenlog.mk/activities/

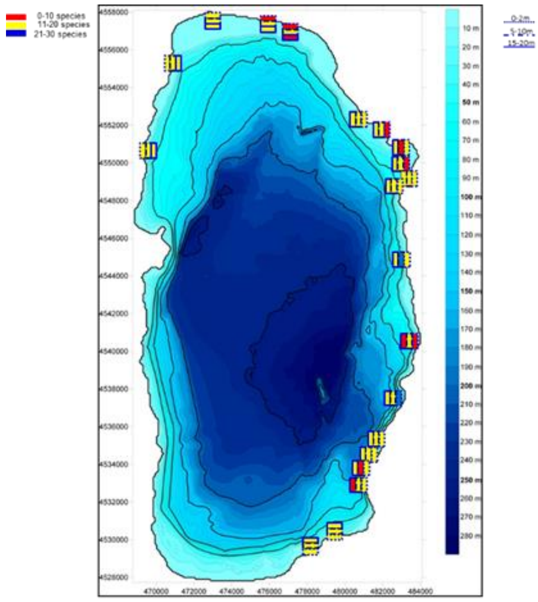
Introduction

For centuries Lake Ohrid has been famous for its specific flora and fauna, their origin, diversity and relic character created by the synergic action of the general Lake's conditions, such as its long-term isolation and continuous existence under undisturbed conditions and the process of intralacustine speciation which still occurs. With its enormous biodiversity and more than 212 endemic species Lake Ohrid (Albrecht & Wilke, 2008) has been designated as an aquatic ecosystem with the highest endemism per unit square among the other worldwide ancient lakes. Following the shoreline from the western to eastern, i.e. south-eastern part the level of both biodiversity and endemism vary reaching their highest values in the area of the sloppy terrain on the south-eastern part. Here the locality of Velidab has been considered as the most important hotspot of biodiversity in the same time harboring many endemics among which is *Gocea ohridana*, an endemic snail whose areal of distribution is strictly limited to this locality. Here in an area of few hundred meters squared, during the research activities in the past an increased number of species from the macrophyte vegetation, macrozoobenthos and the benthic diatoms have been registered giving the place a mark of hotspot of biodiversity.

Besides this, the results from the past researches (Trajanovski, 2005; Budzakoska, 2012; Levkov, 2006) and the recent ones in 2010-2011 (Project report: Developing tools for monitoring according to WFD, 2012) that included 20 localities along the littoral of the Lake once again have contributed in designating Velidab as one of the most remarkable hot spot of diversity and endemism in Lake Ohrid.

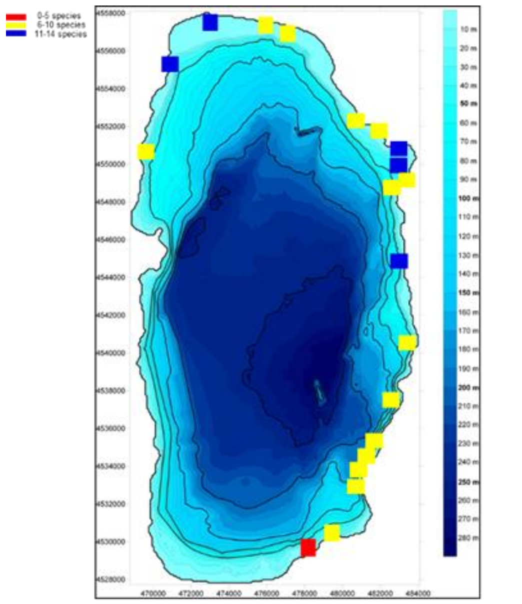
The map (Figure 1) below clearly depicts the top position of the locality Velidab regarding the species richness from the group of macroinvertebrates on different depth points along the vertical profile of the littoral zone of the Lake (Trajanovski, 2017 unpublished). Though the highest biodiversity has been recorded from 0-2m, and is negatively correlated to the depth, the general biodiversity is still higher than in any other sampling sites along the Lake. Velidab locality is not a place where the other two components: benthic diatom algae and macrophytic vegetation are in their highest expression in terms of the biodiversity, yet species number is within the range from 6-10 makes (macrophytes – Figure 2) and 16-40 (diatom algae – Figure 3) Velidab being considered as significant diversity spot for macrophyte and especially benthic diatom algae.

Figure 1: Macrozoobenthos in Lake Ohrid



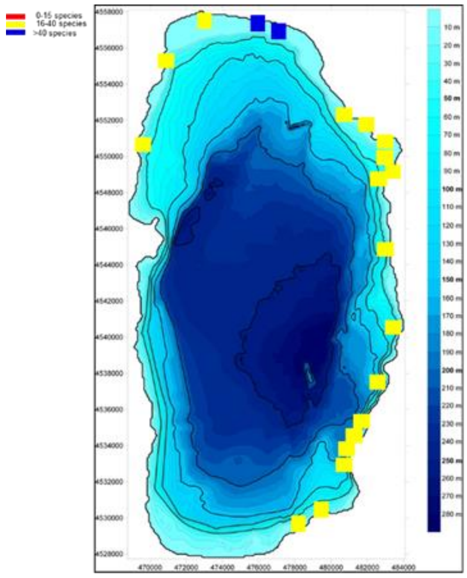
Biodiversity of the benthic fauna (macrozoobenthos) at different depths in the littoral of Lake Ohrid

Figure 2: Macrophytes in Lake Ohrid



Biodiversity of the macrophyte vegetation in the littoral of Lake Ohrid

Figure 3: Diatom algae in Lake Ohrid



Biodiversity of the diatoms in the littoral of Lake Ohrid (0.5m)

Before the implementation of the Project and undertaking any kind of sampling and analyzing activities, there has been prepared a list of already registered species at the locality of Velidab. This list included information collected from different time-periods and obtained results of investigations following different methodologies. The idea of the preparation of this list has been to have a baseline analysis for comparing the newly collected data. However, during the recent investigations it has been concluded that the collected information while creating the list does not allow for the results to be fully compared. In fact, there have been so high differences in some cases of sampling and analysis, which would result in a mendacious comparison. However, the data has been compared regarding the presence of those species during the Project`s samplings, but not to the abundances despite we have also followed the species abundances. The table below depicts some of the registered species in the locality of Velidab in the past.

Analyzing the total biodiversity, by focusing deeper into the species composition (Table 1; Trajanovski, 2005; Budzakoska, 2012; Levkov, 2006; Report, 2012) there is total of 50 spices distributed in an area, which in size is less than five hundred meters squared. As it is going to be elaborated further on and presented by the maps, the highest biodiversity is registered for the group of macroinvertebrates. In fact, 29 out of 50 species are from the group of macroinvertebrates, 11 benthic diatom algae, while 10 belong to the macrophytic vegetation. All 29 species from the benthic fauna are from the class of Gastropoda, class being known by its highest diversity among the macrozoobenthic groups (72 species in total) and endemism (56 endemic species). The biodiversity of Gastropoda at Velidab amounts to 40,28% of the total Lake Ohrid gastropod diversity. Even 27 out of the total 29 gastropod species on the list are endemics, i.e. the endemism reaches amazing 93.10 %. More specific, the endemism level of Gastropoda in the range of the total class endemism is 48.21, meaning that almost half of the endemic gastropod species in Lake Ohrid inhabit locality Velidab.

Only one endemic has been registered among the macrophytic species, the Balkan endemic *Chara ohridana* (Trajanovska, 2009), while 10 from the total of 11 registered species from the benthic diatoms have been considered as endemics (Levkov, 2006).

Table 1: Registered species at Velidab and IUCN Classification

No.	Scientific Name	End.	Cosm.	IUCN
1	*Theodoxus fluvaiatilis dalmaticus*		√	LC
2	*Viviparus viviparus*		√	LC
3	*Valvata stenotrema*	√		NT
4	Valvata rhabdota	√		NT
5	*Valvata relicta*	√		V
6	*Xestopyrgula dybowskii*	√		V
7	*Chilopyrgula sturanyi*	√		NT
8	*Ohridopyrgula macedonica macedonica*	√		NT
9	*Macedopyrgula pavlovici*	√		V
10	*Macedopyrgula wagneri*	√		V
11	*Trachyochridia filocincta*	√		CE
12	*Ginaia munda*	√		V
13	*Pyrgohydrobia grochmalickii*	√		V
14	*Polinskiola sturanyi*	√		NT
15	*Polinskiola polinskii*	√		V
16	*Lychnidia hadii*	√		CE
17	*Gocea ohridana*	√		CE
18	*Neofossarulus stankovici*	√		V
19	*Limnaea stagnalis*		√	LC
20	*Radix relicta*	√		LC
21	*Pisidium edlaueri*	√		E
22	*Acroloxus macedonicus*	√		CE
23	*Lyhnidia gjorgjevici*	√		E
24	*Buprestis splendens*		√	E
25	*Coretus corneus (Planorbarius corneus)*		√	LC

26	*Gyraulus macedonicus*	√		E
27	*Gyraulus albidus*	√		V
28	*Zaumia sanctizaumi*	√		CE
29	*Ancylus lapicidus*	√		E
30	*Potamogeton perfoliatus*		√	LC
31	*Potamogeton pusillus*		√	LC
32	*Zannichellia palustris*		√	LC
33	*Myriophyllum spicatum*		√	LC
34	*Elodea canadensis*		√	LC
35	*Vallisneria spiralis*		√	LC
36	*Ranunculus trichophyllus*		√	LC
37	*Chara ohridana*	√		E
38	*Chara tomentosa*		√	LC
39	*Chara globularis*		√	LC
40	*Navicula perturbata*	√		NL
41	*Diploneis ovalis*		√	NL
42	*Aneumastus albanicus*	√		NL
43	*Cocconeis robusta*	√		NL
44	*Cyclotella bifacialis*	√		NL
45	*Cyclotella verrucosa*	√		NL
46	*Cyclotella bifacialis*	√		NL
47	*Cyclotella thienemanni var. minuscula*	√		NL
48	*Fragilaria micra*	√		NL
49	*Placoneis subgastriformis*	√		NL
50	*Cymbopleura juriljii*	√		NL

Concerning the IUCN status (IUCN, 2017) only the species from the Gastropoda have been assessed whereby 5 species have been assessed as EN (endangered) and 4 have been given a status of critically endangered (CE) including the species *Gocea ohridana*, an endemic species famous by its small areal of distribution, small size and specific shape of its shell.

No invasive species have been listed among the groups of benthic diatoms and macroinvertebrates. Regarding the group of macrophytes there was registered the invasive *Elodea canadensis*.

There should be noted that the above presented list hasn't included the other representatives from the group of macroinvertebrates as well as there were some differences in the dynamics of collecting and the methodology which probably resulted in high diversity of the macroinvertebrates (Gastropoda) in the earlier period of researches. In other words, during the researches from 2010-2011 based on which the list has been created, the sampling dynamics has had a monthly character during the whole period while besides the method of sampling along depth transect, the samples have been collected perpendicularly to the transect, i.e. parallel to the shore.

The goal of this study was to assess the diversity and endemism status in order to initiate conservational activities under the national framework followed by a procedure of designation of this biodiversity and endemism hotspot of Lake Ohrid as Strict Nature Reserve.

2017 Research

The inventory samplings have been performed twice during 2017. The first samples have been collected in May (spring) while the second sampling has been completed in July, during the intensive vegetation period. The samples have been collected using the methods as proposed in the Project proposal and which are generally accepted for each of the groups, whereby:

Physical chemical parameters

Using standard limnological methods, in accordance with EU Water Framework Directive 2000/60/EC (WFD) the water samples have been collected from 2 m depth. Several basic physical chemical parameters as well as nutrients have been examined: pH, temperature, conductivity, dissolved oxygen, BOD, Total Nitrogen and Total Phosphorous.

The results are presented by the Table below.

Table 2: Physicochemical parameters at Velidab 2017

Velidab	TN (µg l-1)	TP (µg l-1 TP)	Temp. (oC)	Conduct. (mS cm-1)	pH	DO (mg l^{-1} O_2)	BOD mg l-1 O2)	Transp. (m)
Season	spring	spring	spring	spring	spring	spring	spring	spring
Result	248	6	10.9	205	8.17	12.8	1.42	11
Season	summer	summer	summer	summer	summer	summer	summer	summer
Result	556	9.1	23.6	219	8.46	9.1	1.3	12

In both seasons, the quality of the water based on the concentrations of the followed parameters (TP, DO, BOD) is in the range of oligotrophic waters with low concentration of nutrients and high concentration of dissolved oxygen (OECD, 1982). The ecological status also based on the WFD referent values for TP, DO and BOD has been assessed as high (UK Environmental standards and conditions, 2008). The differences in the concentration of the nutrients in two different seasons could be as a result of increased releasing of these two nutrients due to the intensified decomposition of the organic matter originated by the process of disintegration of some macrophytes and phytoplankton organisms.

The water trophic status and the ecological status based on the results for the physical chemical parameters that indicate high ecological status, i.e. oligotrophic character is in collision with the results for the metrics (indices) dealing with the structure and health of the biotic components, which, on the other hand indicate lower ecological and trophic state of the water. Such inconsistency could be explained with the intake of the nutrients especially TP from the water by the macrophytes and other primary producers which (Schneider et al., 2013) results with higher production (biomass, diversity of species indicative for lower trophic state) apparently with decreased concentration of the nutrients which gives a distort picture regarding the real trophic status of the water.

Benthic Diatoms

Benthic diatom algae have been sampled by removal of diatom community from the substratum by vigorous brushing of the upper surface and preserved in formalin (3-4 %) then cleaned off from organic and inorganic materials based on acid method by Krammer & Lange – Bertalot (1986 – 2001). Benthic diatoms, cleaned of cell contents and mounted in Naphrax are identified and counted with optic microscope. The determination of species is using different keys for determination such as: KRAMMER & LANGE-BERTALOT (1986–1991) keys and other available literature for benthic diatom algae.

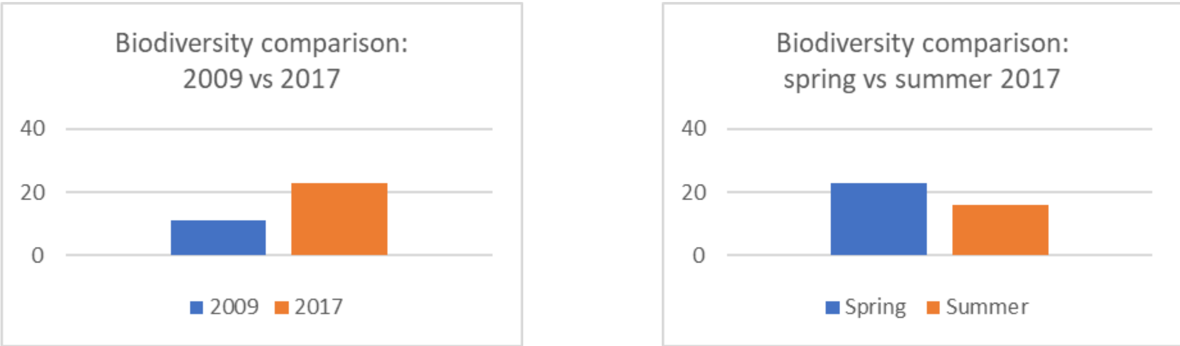
The table below depicts the preview concerning the diversity of the benthic diatom at Velidab locality.

Table 3: Benthic Diatoms at Velidab 2017

		May	*July*
1	*Amphora ovalis Kützing*	+	
2	*Amphora aequalis Krammer*	+	+
3	*Amphora sancti-naumii Levkov et Metzeltin*	+	+
4	*Cavinula scutelloides (W. Smith) Lange-Bertalot*	+	+
5	*Cocconeis pediculus Ehrenberg*	+	+
6	*Cocconeis placentula Ehrenberg*	+	+
7	*Cocconeis placentula var. euglypta (Ehrenberg) Grunow*	+	
8	*Cyclotella ocellata Pantocsek*	+	+
9	*Cymbella ohridana Levkov et Krstic*	+	+
10	*Diploneis alpina Meister*	+	+
11	*Diploneis domblitensis Cleve*	+	
12	*Encyonema prostratum (Berkeley) Kützing*	+	+
13	*Epithemia ohridana Levkov et Metzeltin*	+	+
14	*Epithemia sorex Kützing*	+	+
15	*Epithemia adnata (Kützing) Brebisson*	+	
16	*Gomphonema minutum (Agardh) Agardh*	+	+
17	*Gomphonema olivaceum (Hornemann) Brébisson*	+	+
18	*Gomphonema angustum Agardh*	+	
19	*Hantzschia abundans Lange-Bertalot*	+	
20	*Navicula tripunctata (O.F. Müller) Bory*	+	+
21	*Navicula radiosa Kützing*	+	
22	*Rhoicosphenia abbreviata (C. Agardh) Lange-Bertalot*	+	+
23	*Planothidium lanceolatum (Brébisson) Lange-Bertalot*	+	+

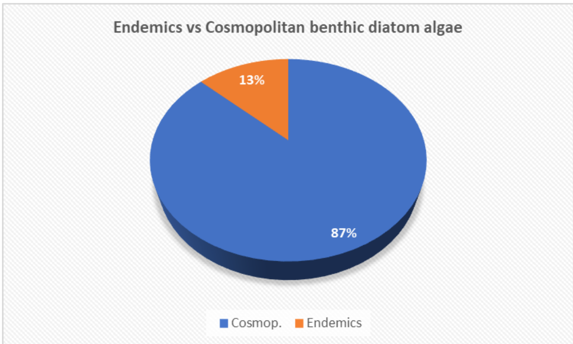
The biodiversity of benthic diatom algae is noticeably richer in comparisons with the last official list of diatoms registered in the research period 2010-2011. The total of 23 species have been identified in the flora of the benthic diatom algae from the locality Velidab during both sampling periods. As shown in the Table, diversity varies in different seasons, therefore, in spring (May) the number of species is higher than in summer (July), i.e. during the summer sampling where the diversity was poorer by 7 species. None of the species of diatoms from the list obtained during the research 2009 (Levkov, 2006) have been recorded.

Figure 4: Benthic diatom algae diversity in two different periods and seasons of research: A- 2009 vs 2017; B-Spring vs Summer 2017



Regarding the endemism, it should be noted that only 3 species (Fig.5) have been considered as endemics (Loshkoska, 2017 unpublished).

Figure 5: Benthic diatom algae endemism at Velidab locality.



The values of the Trophic Diatom Index (TDI) and the Saprobic index (SI) have not changed significantly in the period from 2010-2011 until now, thus the value of 1.8 for the TDI indicates mesotrophic character of the water, same as SI which values is 1.8 and indicates β mesosaprobic conditions of the water.

Figure 6: Endemic and abundant representatives from the flora of diatom algae from Velidab: A- Hantzschia abundans Lange-Bertalot; B- Diploneis alpina Meister

A B

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Comparing the results of different research periods (2010-2011) or even more from different consecutive sampling periods points out to the conclusion that the benthic diatoms composition is not persistent throughout the time (year). If one takes into consideration their size, short period of generation and ecological adaptability, it is easy to understand the changes and successions in the composition of the communities of the benthic diatoms. The water level, water currents and waves, temperature and food availability are the major factors influencing change in the species composition of the benthic diatoms (Göthe et al., 2013). In fact, the whole spectra of environmental factors could influence the benthic diatom algae structuring (Whittaker, 1970). The water currents and the waves as well as the water level are of primarily importance in their distribution and factors that could easily relocate the substrates the benthic diatom algae are attached to. Beside the environmental (ecological) the biological factors such as interspecies relationships (especially food competition) have certainly play a role in the algal distribution, diversity and abundance.

Macrophytic vegetation

Macrophytic vegetation has been sampled using the WISER method of transects-CEN (Comité Europeén de Normalisation) [CEN 2002, 2003]. The transects were approximately 10 meters wide - perpendicularly to the shoreline - from the upper littoral to the lower vegetation limit.

Each transect is divided into depth zones: 0-2 m, 2-4 m, 4-10 m, and >10 m depth. In deeper waters, plants are collected by a Van-veen grab, while in the shallow waters by snorkeling. Determination of the vascular macrophytes is conducted by different floristic books (floras) in accordance to the protocols and the surveyed water bodies. The macrophyte index has been calculated according to the formula described by Melzer (1999), but with updated indicator values and class boundaries as described by Melzer and Schneider (2001).

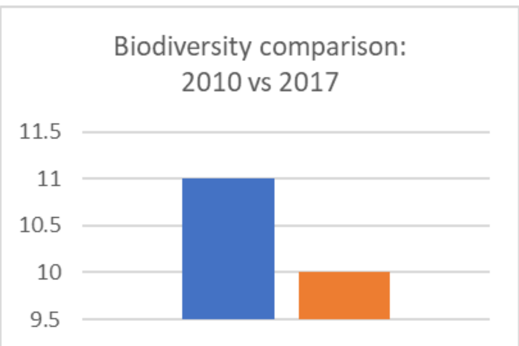
The Table below indicates the macrophyte species diversity at Velidab locality.

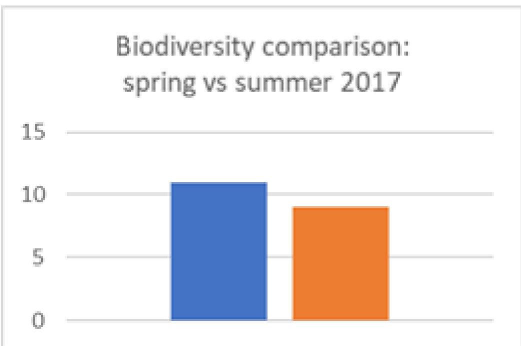
Table 4: Macrophytes at Velidab 2017

		May	*July*
1	*Chara globularis*	+	+
2	*Chara ohridana*	+	+
3	*Chara tomentosa*	+	
4	*Cladophora sp.*	+	
5	*Elodea canadensis*	+	+
6	*Myriophyllum spicatum*	+	+
7	*Potamogeton perfoliatus*	+	+
8	*Potamogeton pussilus*	+	+
9	*Ranunculus trichophyllus*	+	+
10	*Vallisneria spiralis*	+	+
11	*Zannichelia palustris*	+	+

11 macrophyte species have been identified in the samples in both sampling campaigns during the research period. All 11 have been present in the spring period while the diversity in the summer has been "decreased" by two, i.e. 9 species have been identified in July. Unlike the benthic diatom algae where there were not overlapping of the species from different research period or seasons, in the case of macrophytes there has been registered totally same biodiversity results as during the period 2010-2011. In other words, all 10 species identified in the previous period have been present in our research. If one compares the diversity in two different seasons, it is noticeable that the qualitative composition is slightly poorer in July when 9 species have been recorded.

Figure 7: Macrophytes` diversity in two different periods and seasons of research: A-2009 vs 2017; B-Spring vs Summer 2017

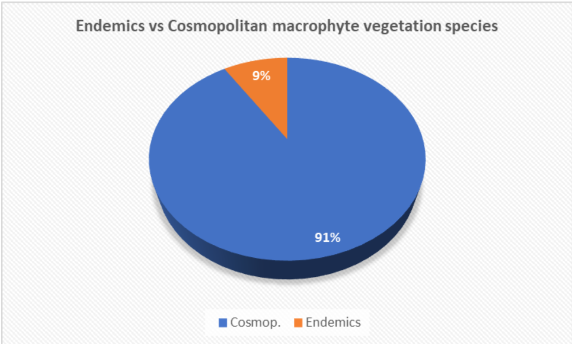




Regarding the "no difference" status in the diversity in two different periods, it has been expected if one takes into consideration that macrophytes are wide group of vascular plants that are sessile, i.e. rooted to the bottom of the Lake, hence their distribution is more stable.

Their distribution, abundance and diversity depend on various environmental factors such as light, water temperature, substrate composition, disturbance, competitive interactions, herbivory, epiphyte loading, water levels, quality of the lake water and sediment nutrients (Barko and Smart 1981; Duarte et al. 1987; Wetzel 2001; Capers 2010; Trajanovska 2009). Besides these, factors such as composition and properties of sediments also seem to have a significant effect on the diversity and distribution of certain macrophytic species (Dawson and Szoszkiewicz 1999; Heegaard et al. 2004; Makela et al. 2004; Trajanovski et al., 2016a, b).

Figure 7: Macrophyte vegetation endemism at Velidab locality.



Thus, the relatively stable water conditions without any perturbances caused by any anthropogenic activities, have enabled normal phenological change in the composition of the macrophytes in this locality. Thus, during the spring, as a result of the increasing of the water temperature and spring circulation, more nutrients are included in the turnover cycle causing "waking up" of the macrophytes especially in the shallower part of the transect. During this period, the biomass of the macrophyte is still in an initial phase enabling almost equal portion of insulation and dissolved matters to the plant, which is a reason why both *Cladophora sp.* and *Chara ohridana* are present. During the summer, the biomass of the macrophytes increases and suppresses the presence of some species such as *Chara ohridana,* which cannot successfully compete with the other macrophytes that form dense meadows on the Lake`s bottom (*Chara tomentosa* for example). Similarly, after the period of summer stagnation, and depletion of the dissolved resources in the shallow littoral, *Cladophora* disappears.

Figure 8: Two most abundant macrophyte in Velidab locality: Chara tomentosa and Potamogeton perfoliatus (left to right)

Regarding the endemism (Figure 7), as mentioned before, in generally, with an exception of *Chara ohridana,* there are not endemic forms among the macrophytic species in Lake Ohrid. The only endemic species is *Chara ohridana,* and as shown above, it was registered during the spring period only. The fact it was not registered in July, doesn't mean it is not present at the spot. As explained, the dense and more competitive species such as *Chara tomentosa* and *Potamogeton perfoliatus* could simply disable reaching *Chara ohridana* to the samples.

The Macrophytic index varies in different depth transects in the boundaries from oligotrophic to eutrophic 3. The shallowest point of the transect has been assessed as eutrophic 1, while with the increase of the depth the trophic state deteriorates reaching level or immense pollution (eutrophic 3) at 2-4m. Furthermore, in the deeper zone (after 4m depth) the water quality enhances and has been assessed as oligotrophic. The overall trophic state at the Velidab profile has been assessed as eutrophic 1 based on the values of the macrophytic index.

Macrozoobenthos

The samples have been collected using the methods of transects (Plafkin et al., 1989) along the depth gradient starting from 0.2-20 m, i.e. along the whole littoral zone of the Lake at Velidab locality. The Lake's bottom has been examined using echo sounder from the research vessel of the Hydrobiological Institute so the samples have been collected taking into consideration the heterogeneity of the bottom facies as one of the primarily factor affecting distribution of the benthic fauna (Parsons & Norris, 1996). Therefore, samples have been taken from at least 6 different habitat types such as: stony, stony-sandy, sandy, sandy-muddy, muddy-sandy, muddy (shell zone). The presence of vegetation on 2, 5, 10 and 15 m, additionally increased the habitat diversity whereby presence of habitat forming species on 5, 10, 15 and 20 m directly contributed the enhanced biodiversity of the locality.

The inventory list of the macroinvertebrate fauna is given below.

Table 5 Macrozoobenthos at Velidab 2017

Depth (m)	Class	Species	May	July
0.5 Stoney	Turbellaria	*Crenobia alpina montenegrina*	+	+
		Dendrocoelum maculatum	+	+
	Gastropoda	*Gocea ohridana*	+	+
		Radix relicta	+	+
		Ochridopyrgula macedonica	+	+
		Ohridohortia sturanyi		+
		Acroloxus macedonicus	+	+
		Lychnidia hadzii	+	+
		Ancylus lapicidus		+
		Theodoxus fluviatilis	+	+
	Amphipoda	*Gammarus ochridensis*	+	+
	Isopoda	*Asellus aquaticus*	+	+
	Insecta	*Polypedulum pedestre*	+	+
2 Stoney-Sandy	Hirudinea	*Erpobdella octoculata*	+	+
	Gastropoda	*Radix relicta*	+	+
		Valvata relicta		+
		Theodoxus fluviatilis	+	+
		Ancylus scalariformis	+	+
		Ochridopyrgula macedonica	+	+
		Gyraulus albidus		+
		Gyraulus lychnidicus		+
		Ohridohoratia sturanyi	+	+
	Bivalvia	*Dreissena presbensis*	+	+
	Amphipoda	*Gammarus roeseli tetracanthus*	+	+
	Insecta	*Gomphus vulgatissimus*	+	+
5 Sandy	Oligochaeta	*Rhynchelmis komareki*	+	+
	Gastropoda	*Chilopyrgula sturanyi*	+	+
		Valvata rhabdota		+
		Ohridohortia sturanyi	+	+
		Lychnidia hadzii	+	+
	Amphipoda	*Gammarus roeseli tetracanthus*	+	+
	Isopoda	*Asellus aquaticus*	+	+
10 Sandy-Muddy	Turbellaria	*Crenobia alpina montenegrina*	+	+

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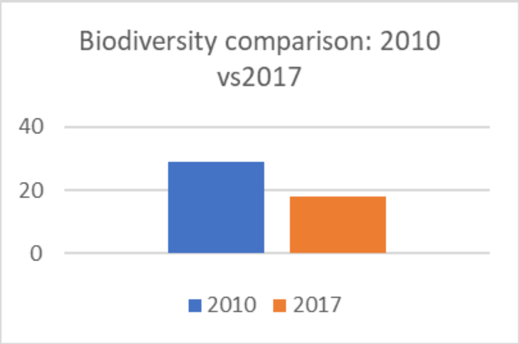
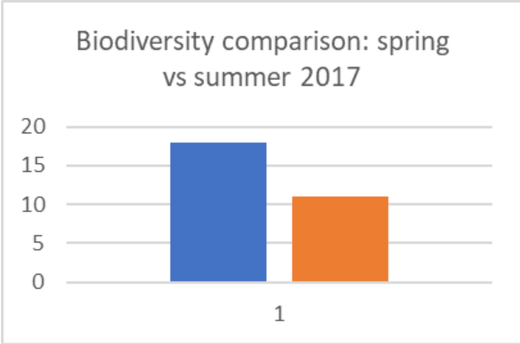
	Gastropoda	*Radix relicta*	+	+
		Valvata stenotrema	+	+
		Ohridohortia sturanyi	+	+
		Ochridopyrgula macedonica	+	+
		Ancylus scalariformis	+	+
		Chilopyrgula sturanyi	+	+
		Lychnidia hadzii	+	+
		Stankovicia pavlovici	+	+
	Amphipoda	*Gammarus ochridensis*	+	+
	Insecta	*Chironomus plumosus*	+	+
15 Muddy-Sandy	Turbellaria	*Dendrocoelum magnum*	+	+
	Hirudinea	*Dina krilata*	+	+
		Dina kuzmani	+	+
		Neofossrulus stankovici		+
	Gastropoda	*Ginaia munda*	+	+
	Bivalvia	*Dreissena presbensis*	+	+
	Amphipoda	*Gammarus roeseli tetracanthus*	+	+
	Isopoda	*Asellus aquaticus*	+	+
20 Muddy (shells)	Hirudinea	*Dina krilata*	+	+
	Gastropoda	*Chilopyrgula sturanyi*	+	+
		Ancylus scalariformis	+	+
	Bivalvia	*Dreissena prespensis*	+	+
	Amphipoda	*Gammarus roeseli tetracanthus*	+	+
	Isopoda	*Asellus remyi acutangulus*	+	+

As expected the community of macroinvertebrates has been assessed with highest biodiversity and endemism in comparison with the macrophyte vegetation and flora of diatom algae. In total, 33 species have been registered whereby 26 were identified during the spring period and 33 during the summer. Species from 8 different groups from the fauna of macroinvertebrates have been identified whereby the most diverse is the fauna of Gastropoda with 18 species. Turbellaria, Hirudinea and Insecta share the second position each presented by 3 species while least diverse are Oligochaete and Bivalvia with one species each. The general endemism (all groups) of locality Velidab is still impressive and reaches 73% (Figure10).

Doubtless and as expected, the most diverse is the group of Gastropoda. By comparing the last existing inventory list with the one from our research, a decrease in the diversity level is noticed for 33 %, i.e. we have registered 9 species less.

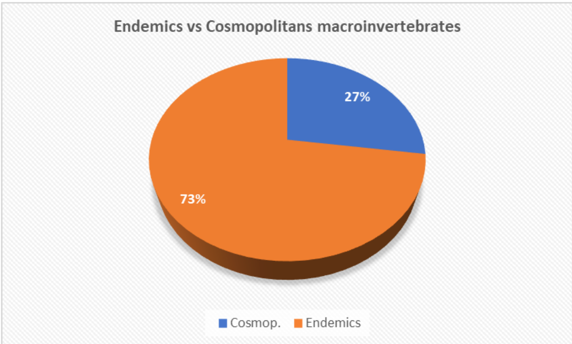
Figure 9: Macrozoobenthos diversity in two different periods and seasons of research: A- 2009 vs 2017; B-Spring vs Summer 2017





Regarding the level of endemism among the Gastropoda fauna, it is still extremely high: 17 species have been identified as endemic vs. one cosmopolite (attaining level of 95% endemism). Furthermore, 16 species, all of which were endemic is the same as during the inventory in 2010-2011. Two species have not been registered in the earlier period*: Ancylus scalariformis* and *Gyraulus lychnidicus.*

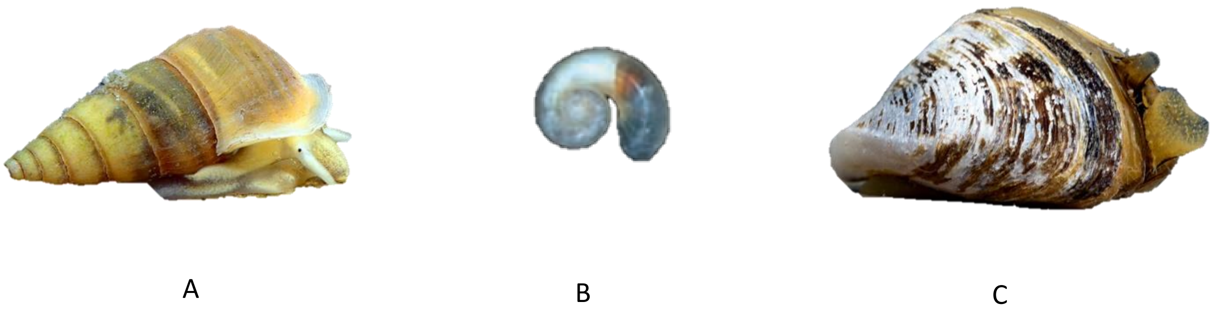
Figure 10: Macroinvertebrates endemism at Velidab locality.



Regarding the density, there have been noticed decreasing trend along the depth gradient with an exemption in the density of *Dreissena presbensis,* which at the highest depth point reaches its highest density. All other species show positive trend in their density`s levels going from 0.5 to 10 m, and then, the density drastically drops. Same is with the diversity but without any exemptions. The number of species is highest on the shallowest point (0.5 m) while after 10 m, the diversity drastically drops to 6 species (20 m).

Out of the total benthic fauna inhabiting Velidab locality, the most abundant (Figure 11) are *Dreissena presbensis* and *Chilopyrgula sturanyi*. Essentially the species are uniformly distributed, i.e. they are present from 0.5-10 while only few species inhabit the deeper littoral zone. Among the species, we have registered the very specific, endemic species with certainly narrowest areal of distribution-*Gocea ohridana.* It has been only registered on 0.5 m, in a very small density-25 ind/m^2. There are few other species with lower densities but all of them are wide distributed along the shoreline of the Lake. The limited areal of distribution of Gocea and its low density should be sufficiently appealing for immediate measures for conservation of this species altogether with its habitat which would collaterally result in conservation of all species inhabiting this place.

Figure 11: A-C Two the most abundant and endemic representatives from the benthic fauna of Velidab locality: A-Chilopyrgula sturanyi; C-Dreissena presbensis. B-The endemic Gocea ohridana inhabiting only Velidab locality.



Based on the structure of the macroinvertebrate, the ASPT index has been calculated as a tool for assessing the ecological status of the water. According to the values of the ASPT, the ecological status varies within the boundaries from 4.1 (moderate) to 5.7 (good). In fact, 0.5 depth point has been assessed as point with good ecological status while on 2 and 5 the status has been assessed as moderate. Deeper points are all with good ecological status. The overall ecological status has been assessed as good.

Decreasing in the diversity and fluctuations in the density are natural phenomena in the structure of the benthic fauna and they are affected by the periodicity of the environmental factors and species ecological adaptivity capacity (Barnes, 1980; Wetzel, 1974, 2001; Trajanovski, 2005, 2016a, b). As mentioned in the beginning, there were some slight differences in the methodology in the research from 2010-2011 and the current one. During our research only the transect method along the depth gradient has been applied, while in 2010-2011 several samples have been collected perpendicularly to the shore, left and right of the main transect in Velidab. This could be one of the reason for the decreased diversity of the general benthic fauna at Velidab.

Conclusions and Recommendations

On the other hand, if one compares the quality of the water assessed by the values of ASPT, we see that unlike the previous period, when all depth points have been assessed either with good or high status, now at 2 and 5 the water quality has decreased and moderate status has been assessed. Changing of the ecological status is a significant sign that should be carefully considered as one of the factors that could impact the health of the macroinvertebrate and other biological communities and influence on appearance/disappearance of certain species from this locality. Having in mind the level of endemism as well as presence of one of the most specific species in this locality, *Gocea ohridana*, further extensive analysis should be immediately undertaken in order to track the factors/variables that has resulted in a change of the water quality. However, what wouldn't be neglected is the fact that we have identified the species *Gocea ohridana* again in very low density and only on one depth point, now under changed environmental (water) conditions. The question is when, from scientific point of view, under which chemical and physical circumstances (ph, O saturation, total P, N, etc) the already assessed critically endangered *Gocea ohridana* will stop resist the surrounding pressure and become a species we talk about in past tense.

Measures for urgent protection and conservation:

1. Extensive chemical monitoring to detect the origin of pollution.
2. Immediate initiative to the relevant Ministries for increasing the status of protection.
3. Immediate conservational methods: DNA barcoding and invitro cultivation.
4. Physical protection by setting up visual barrier 200 m from the shore.
5. Public awareness increase.

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