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PROTECTION OF THE LAKES ON MOUNT DURMITOR

Abstract: Mount Durmitor and the town of Žabljak as a unique hub of Montenegro, the first ecological state in the world, must also base their identity on the lakes in which they see their reflections multiplied as in crystal mirrors. The more thoroughly we learn about the lakes and evaluate them in a proper way, the more dazzling they appear to be. The lakes are not all that numerous. They will not be there for ever. They are evolutionary water bodies of low selfpurification potential.

Key words: Mount Durmitor, lakes, Montenegro, ecological state, protection.

Извод: Дурмитор и Жабљак, као јединствена средишта Црне Горе, прве еколошке државе на свету, свој идентитет морају заснивати и на језерима у којима се огледају и умножавају, као у бистрим огледалима. Иста ће бити утолико блиставија, уколико их боље и више упознамо и на прави начин валоризујемо. Језера ипак нема превише. Она нису дата једном за сва времена. Еволутивни су хидрографски објекти мале моћи самопречишћавања.

Кључне речи: Дурмитор, језера, Жабљак, Црна Гора, еколошка држава, заштита.

Introduction

Only a few mountains in Montenegro and in the vast expanses of the Balkans attract the attention of explorers the way Durmitor does. Generations of scientists have come and gone. The written material on Mount Durmitor is growing into a library. From general to specific, from relief to vegetation, from climate to hydrography, the pieces are fitted into a unique mosaic

The lakes that originated in different parts of the mountain, with their picturesque scenery and unique environment, represent its singular feature. The Durmitor lakes are an element of identification for naturalist and tourists, a basis for investigations into a series of phenomena and processes, a key to solving numerous problems in science and practice. They were first mentioned in the descriptive, scientific and other papers on the nature of Mount Durmitor and of Montenegro one hundred years ago. These two have always been considered inseparable in their impressiveness, tranquility and silence that they introduce into the space dominated bu rocky cliffs, sky jutting peaks, defiles and canyons, meadows and pastures, forest complexes and smal settlements.

The fundamentals for exploring the lakes on Mount Durmitor were set by Jovan Cvijić in 1899. His studying of the traces of Pleistocene glaciers enriched the world scientific thought by new data on glaciology and limnology. His papers that were published in the editions of the Serbian Academy of Sciences and exchanged with many institutions in

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the world, attracted the attention of numerous foreign explorers. This is why the list of scientists who studied Mount Durmitor contains a large number of foreigners.

Fig 1. Black Lake, the tourist symbol of mount Durmitor

Though, at first sight, the lakes on Mount Durmitor may seem small in size, heavily accessible, of minor economic importance, and uninteresting for science and practice, they are coming into light as significant, continuously changing components of the highland area which they endow with a number of unique features. As the lakes are highly interesting from the aspects of genesis, hydrography, biology and tourism, they are frequently taken as research subjects. Particularly interesting in this respect is Crno jezero (Black Lake) which, in the course of the last several years, have been the subject of many research studies of hydrographic character that have proved more useful than any of the proceding.

Durmitor national Park

Vast expanses on Mount Durmitor were proclaimed a national park after a decision of the Assembly of the People's Republic of Montenegro in 1952. Some time later (1962) the territory of Durmitor National Park came under the jurisdiction of the Forest Administration of Žabljak. In 1978, Durmitor National Park acquired its present appearance, area and boundaries by the Act on National Park in Montenegro. The Community of Durmitor National Park was instituted and seated in Žabljak, its responsibility being to protect this unique mountain in their care.

Durmitor National Park covers an area of 39,000 hectares and extends over the territories of five municipalities: Žabljak, Pljevlja, Plužine, Šavnik and Mojkovac.The largest areas in the National Park are the canyon of the Tara River (15,804 ha) and the central part of Mount Durmitor (8,710 ha). Smaler in area are the lands around the village of Crna Gora (Montenegro), the canyon of the Sušica River, Mlinski Potok (creek), Barno Lake, Lake Zmijinje, and Zabojsko Lake on Mount Sinjajevina. By its basic organization the Park resembles the natural preserves in America. This means that it is open to tourists all year round. It offers wonderful opportunities to domestic and foreign tourists, such as excursions in summer, and winter sports in winter when, under a snow cover, this mountain turns into an exceptional ski centre.

This must be observed because the Tara River, as an integral component of Durmitor National Park was classified as an ecological preserve of our planet biosphere by the 1977 UNESCO ″Man and Biospere″ programme. Also, at the session of the International Committee for World Cultural and Natural Heritage, held in Paris, September l-6, 1980, Durmitor National Park was placed on the list of world cultural and natural heritage under the auspices of the United Nations. Among numerous tributes we proudly mention the award for preserving the Tara River environment that was presented to Durmitor National Park by the International Association of Tourist and Travel Agencies on the 37th Congres in Lisbon in 1987.

The lakes on Mount Durmitor

Seven land complexis of unique values and specific ecosystems have been singled out in Durmitor National Park. A special regime of protection applies to forests of juniper and fir trees in the Mlinski Potok drainage basin, to black pine forests on the Crna Poda site, to Black Lake with the surrounding forests, to the Škrke cirque with Škrčka Lakes and a section of the Sušica River basin, to Barno Lake and its immediate vicinity, to Zabojsko Lake and vicinity, and to the canyon section of theTara River Basin.

Most of Mount Durmitor and the area which is by geological and morphological features similar to it are formed of Mesozoic and Tertiary limestone and dolomite, Upper Cretaceous flysh, clastic sediments of the Paleozoic and Middle Triassic ages, diabase hornstone formations, igneous rock and verfen sandstone. Rock masses differ in water-bearing properties and correlations, so that even on a short stretch of land one may come across extremely contrasted water bodies and peculiar hydrographic systems on the surface and in underground sectors which, beside the lack of superimposed orographic and hydrographic drainage basins, cause the unique bifurcation of Black Lake waters (Bešić Z. 1969)

High and vast, built of rock of different ages and petrographic properties, Mount Durmitor underwent strong glaciation in the Pleistocene. Mighty glaciers of great eroding and accumulating power and long duration created numerous shapes in the relief and enabled the development of interesting hydrological bodies, the lakes being particularly notable among them. There were more lakes in the past than today. They used to cover vaster expanses, they were deeper and richer in water. As they have an exceptional ability to evolve, even though they have been reduced to the present state they still represent one of the main natural characteristics of the mountain.

Fig. 2. Zmijinje Lake and ist hilly surroundings.

Table 1. The lakes on Mount Durmitor (Stanković S, 2005)

Lake	AL. in m	MDP. in m	AR. in m^2	VOL. in m^3
Crno	1.422	49,1	516.200	8.716.726
Zmijinje	1.520	7,1	16.740	41.773
Malo (Jablan)	1.791	8,5	17.470	52.828
V. Škrčko	1.686	17,2	56.800	334.940
M. Škrčko	1.711	15,2	10.800	63.560
Pošćensko	1.487	3,6	15.300	15.000
Modro	1.609	3,3	7.300	7.000
Valovito	1.695	3,5	11.600	10.540
Vražje	1.411	10,6	118.310	470.179
Riblje	1.409	5,5	42.400	85.280

AL. = Altitude; MDP. = Maximum depth; AR. = Area; VOL. = Volume.

Protection of the Lakes on Mount Durmitor

The preservation of the lakes on Mount Durmitor is a complex and responsible task, particularly because the lakes are situated within a national park which is a part of the world heritage of natural beauties and culture. As lakes are evolutive water bodies they have to be studied in detail if preservation and evaluation actions are to meet the purpose. Problems are numerous and varying: the majority of the lakes are small and some of them are difficult to reach; some lie on limestone bedrock; some are attacked by hydrophilic vegetation; information on water balance and heat regime is lacking; and, there is

discordance between requests to solve water supply problem for Žabljak and the planned degree of lake preservation. Naturally, lake preservation does not mean their full conservation, but the best way for their evaluation without impairing the present situation and hindering the development processes in the future.

Taken as a whole the lakes on Mount Durmitor have been well preserved till the present. Almost all of them have remarkably pure water and are far from pollutants from town and village settlements and industrial facilities. However, the karst processes are doing their bit. At the bottom and in the shore area of some lakes, ponors are widening and new ones appearing. Unknown and uncontrollable quantities of water are lost. Quantities of eroded materials drift into some of the lakes filling their basins and decreasing space for water accumulation. Due to small depth, heat regime is changed, hydrophilic vegetation growth is accelerated, and the fauna undergoes changes. The overgrowth of hydrophilic plants and decreasing of the lake water volume increase organic matter decay and carbon dioxide content, the negative indicators of water purity.

Natural processes and Man's impact upon the environment on Mount Durmitor and its lakes lie at the root of the changes of the original properties of these water bodies and unique ecosystems. Natural changes are party consequences of global changes in the climate and development of erosive and accumulative processes in the relief and, as a rule, they are long lasting.

In contrast to these, the anthropogeneous changes and other actions in nature provoke such disturbances that cannot be fully comprehended in a chort time. ″The processes prompting mountain lakes vaniching have different rates, but compared with the antropogeneous influences they are very slow. This gives a chance to evolutionary biocenosis of these ecosystems to follow and adjust themselves to changes or experience the fate of the lake and vanich themselves. Today there are tehnical possibilities for the revitalization of highland lakes and the continuation of their existence, but large investments are needed. Besides the mentioned negative natural influences and slight pollution, the aquatic ecosystems are subjected to violent ichtiological pressure as people have endeavoured for centuries to spawn all the bodies of water, even the smallest and most inaccessible ones. There are data that spawning was started during the reign to King Nikola. The main blow came in the fifties and could not be stopped though there existed timely and argumented resistance to introducing allochthonous species to the water ecosysteme on Mount Durmitor. The common view of biologists has always been that the introduction of new species to the highland lakes in Montenegro may provoke irretrievable damages not only to the population of neotenic newts (Triturus alpestris) that are the only autochtonous inhabitants of these ecosystems and the sole representatives of the vertebrates in them, but to the entire biocenises″(Džukić G,1991, 60).

Black Lake was also studied from the aspect of water supply for Žabljak. Different from the above projects that were based on theory and calculations, these projects were based on the results of extensive and definite investigations of the basic elements of the water balance in Black Lake important for the solving of the Žabljak water supply problem, that were carried out by a team of experts from the Institute for Geological Investigation, Titograd, Montenegro, and the Republic Institute of Hydrometeorology, Titograd in the period 1985/1988. In 1987, water was pumped from some earlier bored wells on the left bank of Mlinski Potok, at its inlet to Black Lake.

″In the period September 11-23, 14 lit/s of water on average was pumped. Then the level of Veliko Lake fell from the level of 1,417.46 to 1,417,41, namely the volume of water decreased by 12,159 m^3 and the quantity pumped from the undergound was 15,725 cu. m. The records of water balance pointed to negative subterranean inflow of only 9 lit/s in Veliko Lake which, superposed by pumped quantities would become positive. It means that most adverse values for Qr did not coincide with the lowest lake water stages. The pumping

of up to 25 lit/s of water went on until November 19, but fortunately there were other factors that caused the water stage to increase and bring about other positive features. So, it can be concluded that the quantities of water up to 20 lit/s could be taken from Veliko Lake groundwater table and intercepted with wells on the left bank of Mlinski Potok without any risk as to the lake existence. The fact that in principle all glacier lakes gradually dry up should not be connected with this intake″(Bošković M., Živaljević R. 1989).

Fig. 3. A view of Vražje Lake

High altitude and abundant water quantity of the Black Lake makes it interesting for power generation. In 1962, upon an order of Electricity Board of Montenegro, the experts from Elektroprojekt Ljubljana prepared a preliminary study titled ″Usage of the Waters of Black Lake for the Storage Reservoir at Šavnik″. As they lacked chronological data of hydrologic indicators, the study was based on extremely unreliable calculations. The study proposed to build intake structures and take water from Black, Pošćensko, Vražje and Riblje lakes, Ševarita fen, and weak periodical brooks and springs in the eastern hills of Mount Durmitor, and to form a stronge reservoir at Marića swamps on Jezerska Plateau. It would be necessary to build a dam on Branovo brook and plug up with concrete numerous ponors and air outlets on the location of the storage reservoir. From the Branovo storage reservoir the water would be taken along a channel and a through a tunnel into the valley of the Bukovica River and used for power generation.

There was also a preliminary design for power generation using waters of the Black Lake. If the water was to be used in this way that would not solve the problem of decreased fluctuations of water stage. On the contrary, the remain at 5 m. The design report states that the waters from Black Lake chould be taken along a 6 km long tunnel and two pipelines,

each 1.3 km long, to the turbines in the Žabljak power plant that would be built in the Tara river canyon, at Tepce village not far from the planned hydroelectric plant of Bijeli Brijeg. The Žabljak power plant would be one of the largest pump-storage power plants in the world. This means that at the times of small power consumption the hydroelectric plant Bijeli Brijeg would be used to drive a tremendous capacity pump. The Tara River water would be pushed up into the Black Lake 770 m above it.

In the periods of peak consumption the Žabljak power plant would take over and use enough pumped-up water as well as its own water to generate power. It was planned to construct an in-out tunnel in the lowest part of the Malo Lake bottom. It would be necessary to dry the lake up and carry out all tunnelling works. This use of water would probably call for concreting a shore belt as almost every day, depending on the emptying and filling of the lake, its water stage would fluctuate by 5 m. In order to accumulate large water quantities it would be necessary to bring a number of periodical streams and permanent lakes from Jezerska Plateau to Black Lake, bar the outflow valley and create an artificial lake (Perić J. 1973).

The ″Elektroprojekt″ study is not acceptable. It calls for great modifications in the environment, especially of the water bodies, and does not guarantee any benefits. As it is not likely that the Šavnik storage reservoir will ever be formed, all the ideas and proposals remain only words on paper. This aplies to the design of J. Perić that calls for almost unbelievable technical and engineering undertakings in the central zone of Durmitor National Park, which is absolutely unpermissible regardless of possible benefits that are not even clearly defined. A water intake for the Žabljak water suply system at the inlet of Mlinski Potok to Black Lake is another unacceptable idea because, at the intake structure at Oko spring, 20 lit a second water is already taken from Mlinski Potok and Black Lake. As water demand in Žabljak is at its highest in summer the water stages of the Black Lake would be low and the negative components of the lake water balance would be even worce.

Complex problems of environment and the evaluation of Bleck Lake should be considered in light of the positive statements that were reported at the symposium devoted to this water body. As plenty of data have been collected in the meantime, possible approaches to further investigations and eventually practical actions are clearer. Priority tasks are to make the water balance as uniform as possible and preserve spring water during summer months. It will also be necessary to determine all the peculiarities of the runoff and of the surface inflow, amount of precipitation, time and way in which the openings at the bottom of Malo Lake function, the filling of the basin with material from Mlinski Potok drainage area, the hydrophilic vegetation, the Čelina spring behaviour, the evaporation column, and other elements. As an attractive tourist sight Black Lake will continue to be most frequented in summer. An organized tourist trade with appropriate information services and tourist guiding predetermine the proper valuation of the lake and near lake country.

Improper and unjustified stocking with fish disturbed the environment of almost all the lakes on Mount Durmitor. Stocking salmonide species (brown trout, lake trout, salmogairdnery) has always been unacceptable. White amur was introduced to Zminičko Lake. Phoximus appeard in some of the lakes as a companion of these species. ″The introduction of salmonidae, first class predators, led to rapid extermination of newt in only four years on average. Three neotenic population Triturus alpestris were exterminated on Mount Durmitor and Sinjajevina before two of them on Vražje and Zabojsko lakes could even be scientifically evaluated, while the population from Zminičko Lake was described as Triturus alpestris serdarus and has been a topic of scientific discussions. The same fate befell the other newt population in the highland lakes of Mount Durmitor - Triturus alpestris and Triturus vulgaris″(Džukić G. 1991).

The lakes on Mount Durmitor are a specific natural feature and value for tourist trade on the mountain. As such, they require specific treatment for the sake of their protection and evaluation. Both actions must be based on detailed scientific investigations. Investigations and implementatiom must be comprehensive and permanent as all the lake are not equally endangered, nor equally accessible and interesting for tourist.

For better knowledge of the lakes on Mount Durmitor and in order to develop tourist trade and carry out preservation of unique ecosystems, it is necessary to conduct systematic and detailed ichtiologic investigations regardless of the generally known fact of poverty in fish in highland lakes. Blak Lake, as mentioned before, was spawned in 1901 with brown trout (Salmo trutta) from the Bukovica River. The young of Phoximus phoximus were brought to it in 1936 and of brook trout (Salvelinus alpinus) in 1959. Some time later Salmo gairdneri was spawned. It was intended for sports fiching, but this spawning action proved to be unjustified. In the eighties the lakes on Mount Durmitor were spawned with Salmonidae that mostly came from the Blagaj nursery.

It is interesting that D. Kažić, while investigating into endohelminate (parasite) fiches in the waters of Black Lake, Riblje Lake, Vražje Lake, Zmijinje Lake and Modro Lake, caught 100 brown trouts, 66 Salmogairdneri, 114 brook trouts, and 265 Salvelinus alpinus. Having determined 10 species of endohelminates, he pointed out that a weak invasion of parasites existed in the majority of cases, therefore the health of the fiches was not endangered, but the problem was combined high extensity and high intensity of invasion of pathogen species such as Neoechinorhynchus rutili in all fish species in Black Lake and Crepidostomun species in Blak, Modro and Riblje lakes. These facts should be considered when selecting species and times for stocking as phases of a plan of more intensive fishing. The fishes that are less invaded in water courses should be used for stocking the streams when free of young parasites . This way fast invasion of the stocked fishes would be avoided and this would facilitate their acclimatisation and ensure success (Kažić D. 1988).

By applying the concept of active environmental protection, which means prevention and preservation and not healing and rehabilitation of damages, satisfactory results are possible. Some errors from the past (stocking, non-functional water intake, uncontrolled cattle grazing, roads) should be overcome. Concrete actions and permanent control of the activities that bear risks for the lakes, other water bodies and the environment in general can now give appropriate results. Large funds are needed for some actions and they will have to be provided since from the viewpoint of the present and future generations even the smallest endangering of the nature on Mount Durmitor is inforgivable. Once impaired, the natural balance can hardly be reinstated. It is known that only the original and well preserves environment is a true tourists and general value for the society and that it is a national property that must be rationally managed (Stanković S. 1995).

This particularly applies to the lakes as they are the mirrors of Mount Durmitor and of Man's attitude towards nature. As the lakes are the eyes of the mountain, their size, appearance and degree of preservation speak of the past of Mount Durmitor. Staring at them, we measure the depth of our souls.

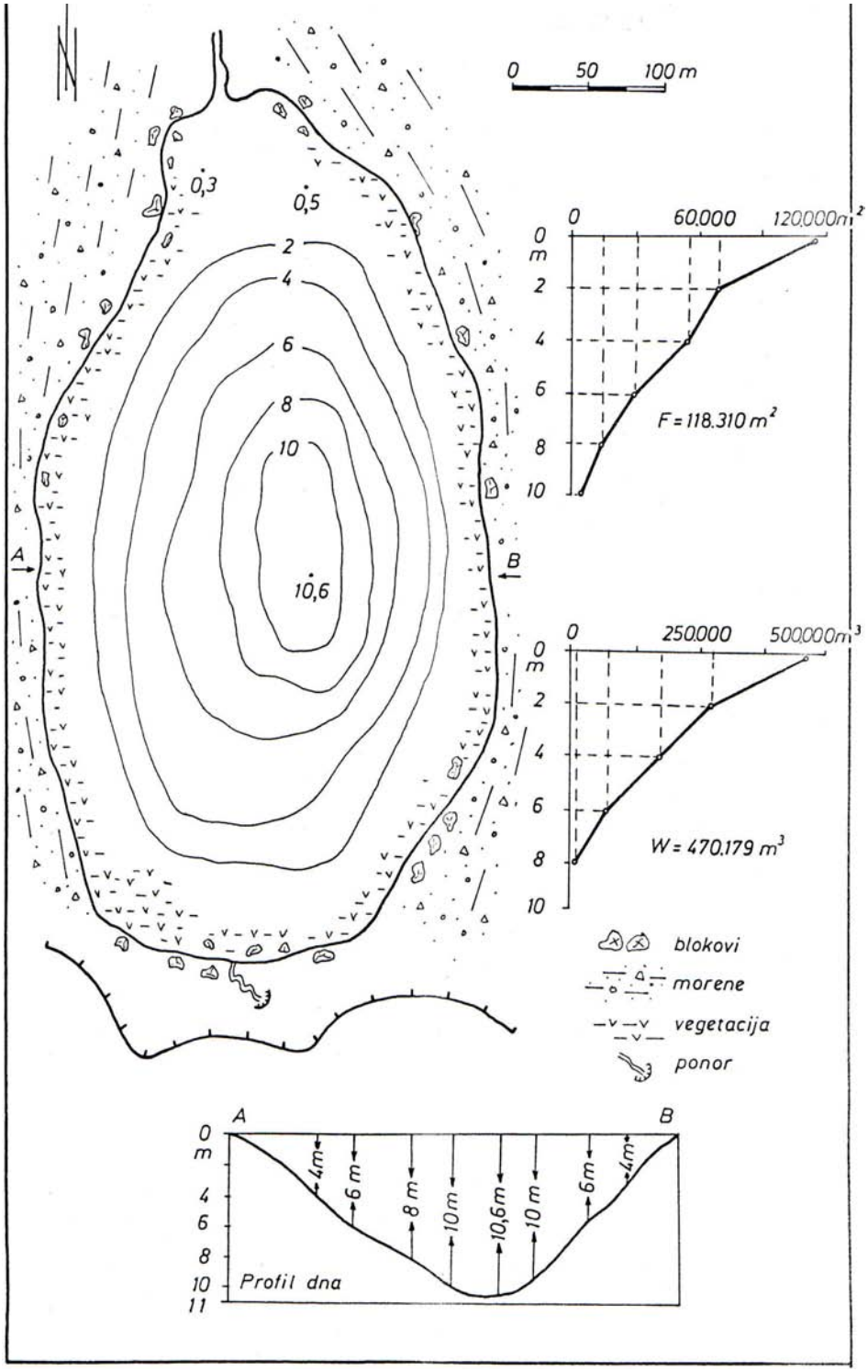

Fig. 4. Map of Vražje Lake

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СТЕВАН М. СТАНКОВИЋ

Р е з и м е

ЗАШТИТА ЈЕЗЕРА ДУРМИТОРА

Међу планинама Црне Горе, Дурмитор се истиче низом природних специфичности. Основне одлике ове планине су њена велика вертикална рзграна рељефа и различити односи кречњака и воодржвих стена, флувијалних, глацијалних и крашких облика рељефа. Највећи део Дурмитора изграђен је од мезозојских и терцијарних кречњака и доломита, горњекредног флиша, кластичних седимената палеозојске и средње тријаске старости, дијабаз рожначких творевина, еруптива и верфенских пешчара. Стеновите масе Дурмитора су различитих водоносних својстава и међусобних односа, те се на кратким растојањима срећу контрасни хидрографски објекти и необични хидрографски системи површинских и подземних сектора, који уз неподударање орографског и хидрографског развоја, условљавају појаву бифуркације воде Црног језера.

Заштита језера Дурмитора (Црно, Змијиње, Мало, Вражје, Рибље, Пошћенско, Модро, Валовито, Велико Шкрчко, Мало Шкрчко, Сушичко), сложен је и одговоран посао, јер су језера еволутивни хидрографски објекти мале моћи самопречишћавања. На језерима Дурмитора јавља се бујна хидрофилна вегетација. На дну и у приобаљу неких језера постоје понори, чија пропусна моћ још увек није довољно позната. Басени ледничких језера засипају се еродираним материјалом, те им се смањује запремина воде. Има примера антропогеног загађивања језерске воде, као и елабората о захвату језерске воде за хидроенергетске и друге потребе. Посебно је угрожено Црно језеро, најпривлачнији хидрографски објекат Националног парка Дурмитор и елемент за препознавање ове планине. Изразито ниски водостаји током летњих месеци 2007. године јасно указују на одмаклу еволутивну фазу у развоју језерског басена, те је потребно предузети одговарајуће мере санације нежељених ефеката. Ово посебно због тога што је Дурмитор национални парк и објекат светске природне баштине.