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Prokoško Lake – A monument to man

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Abstract

Natural resources are much diversified. This natural rarity, according to one object, in this case Prokoško Lake, situated in central Paleozoic morphostructures of Vranica in Bosnia and Herzegovina, gets different ranges of protection. They range from the lower taxonomic levels, to the higher, even though the natural habit of the lake, its basin and water quality are altered by anthropogenic activities. Lacustrine ecosystem experienced number of changes from the typical natural, when it was placed in the fifth level of protection as a nature park. When the natural landscape diversity ambient is replaced with anthropogenic lake, it was declared by a rigorous higher level of protection - natural monument. In the near past the same lacustrine system is 'protected' as the park of wilderness. The lake has lost its natural habit and became an anthropogenic lake, which we ironically call it a 'monument to man'.

Prokoško Lake is the highest lake in Bosnia and Herzegovina (1,636 m). F. KATZER (1902) postulated that the modification of a lake basin is occurred under the influence of Würm glaciers, as it confirmed in recent works by M. SPAHIĆ (2001). The lake was known by the indigenous sort of aquatic lizards *Triturus alpestris Reiser Werner* (1902). Due to human error by intrusion of salmonids in lake water, endemic species of lizards are completely disappeared.

Keywords

Prokoško Lake, Vranica, nature park, natural monument, park of wilderness, monument, endemic, triton.

Introduction

Natural state of Prokosko Lake is defined according to the earlier work of geologists, geographers – limnologists, hydro biologists and others. First scientific reasearch of Prokosko Lake is dating back to the beginning of the 20th century and can be considered as a benchmark for its natural condition.
The first geological study of the mountain Vranica which mentions, among others, the Prokosko Lake, comes from F. KATZER (1902) in the form of extensive work named Paleozoic of Vranica.
Significant scientific results of research on Prokosko Lake were given by D. PROTIĆ (1924-1926) in hydrobiologic and plankton-studies on the lakes of Bosnia and Herzegovina, which included Prokosko Lake as well, and which was published in the Journal of the National Museum of Bosnia and Herzegovina in Sarajevo.
Among other scientists who were important for the research of the Prokosko Lake and other mountain lakes in Bosnia and Herzegovina, it is important to mention J. CVIJIĆ (1899).
Complete and personal limnological research of natural lakes in Bosnia and Herzegovina was published in the limnological monograph of M. SPAHIĆ (2001), the author and promoter of these conclusions on Prokosko Lake.

Figure 1: Prokoško Lake – recent state

For the purposes of assessment of the genesis and evolution of natural conditions of Prokosko Lake, other than the palynological analysis of the coastal belt of Prokosko Lake and other mountain lakes in Bosnia and Herzegovina, Austrian cartographic and planning documents from the years 1884 and 1910 were used.

All forementioned and other works were the basis on which the current status of the lake was rated, with the purpose of evaluating its future perspectives. In addition, the paper deals with lake's natural condition, the state of anthropogenic pressing, legislation and legal issues of renaturalization of this aqual complex.

Retrospective settlings in the basin of the Prokosko Lake were documented using the mapping method, which included the analyses of periodically supplemented maps with cartographic content from the beginning of the last century to today. For this purpose, topo-graphic maps were used, first from the Austro-Hungarian era and then renewed topographic maps of the former Yogoslavia which were supplemented with modern cartographic content of each decade. Cartographic method has been supplemented by the modern methods which include aircraft method and cosmic detection. The last one is completely new and it provides numerical screening of new facilities and weekend facilities, which has replaced the old method. In addition to mapping method, analysis of the text was used, which dates from different time sections of last and the beginning of the 21st century. Mostly, it is about scientific papers and articles, scientific-popular texts and newspaper articles, which describe Prokosko Lake using text and images. All used methods have allowed a comparative analysis of the origins of anthropopressing on the natural-aqual complex of the Prokosko Lake.

The paper used the empirical field prospections as well, which were related to the geological, geomorphological, hydrographic, biogeographic, demographic and other geographical component contents. These prospections, especially from the first author of conclusions, refered to the comparative geographic component analysis of the development of natural-aqual complex since 80s of the last century. Paper includes other methods of which the most important are: interview, comparison, cartographic, historical and empirical method.

Natural state of the Prokoško Lake

The basin of Prokosko Lake is undoubtedly a tectonic depression, which has been modified during the tectonic history, and in the Pleistocene with the glacial modifications, as well as significant reshaping in Holocene caused by snow and debris avalanches, nival, fluvial and lacustrine modificators.

Limited glacial modifications are confirmed by the absence of rudimental fluvial-glacial sediments in the valley lowland levels of the valley of Jezernica. In addition, chaotic situated blocks around the lake, in the opinion of F. KATZER (1902), represent erosional limestone remains, although the mineralogical and petrographic analysis confirmed their origin from destructed Glavica hillsides.

All above mentioned indicates that the lake's basin is polygenetic, polyphase and polymorphic creation, which has evolved since the Pleistocene, when the lake water was accumulated in it. The youngest morphological members such as alluvial valleys, slope and nival delluvial, colluvial morpho forms, fluvial sediments and coastal sapropel bents belong to the holocene stage of natural self-development of the lake.

In addition, lake slopes are fluvially very active and are dotted with smaller river valleys. Since there is a case of a dissenting longitudinal profile of lake tributaries, their deep valleys in the lake are used for the transportation of drawn and suspended sediments. Draft and sediments, in the southwest part of the lake basin formed spacious accumulation flat area of 1500 m². In its pre accumulation stage, it was an integral part of the bottom of the Prokosko Lake, as suggested by the subsequent valley vertical articulation of lake tributaries.

Figure 2: *Triturus alpestris reiseri*

The negative natural processes that affect the natural evolution of the lake are fluvial sediments production from the immediate tributary area of lake and the regression of the lake's river. Lake's talus, alluvial and colluvial slopes are, fluvially, very unstable and dotted with small river valleys, inconsistent according to the longitudinal fairway, which end up in the lake. Through them, the flowing water does deep and lateral erosion and transports in the lake plenty of towed an suspended sediments, which rise the bottom of the lake and reduce its volume. On the other side, by the regressive erosion of the lake's river from its end to the lake's accumulation, the riverbed was continously deepened, which abstracted more lake water and resulted in a decline of its level, and thus the reduction of the volume of water accumulation.

Such evolution of the Prokosko Lake is confirmed by the past and present of Suho jezero, located near the borders of the accumulation wall, on the northwest side of the Prokosko Lake. Suho Lake doesn't have lacustrine function and through paleolimnic valley flows a steady stream.

Natural stage of lake's development had a diverse phytobenthos and herbal communities such as *Juncus articulatus carex leporina, Carex flava, Angelica silvestris, Juncus alpinus* et al. (SMLATIC, S. 1973). Herbal communities, especially those of the species *Carex*, from the coastal areas are spread into the coastal waters from which they are either floating or are attached to the shore. Once they had a limited extent, but today they are spred over the large areas.

Biodiversity during the natural exi-stence of naturalaqual complex Prokosko Lake is famous for its endemic species of water lizards named Raizerov triton (*Triturus alpestris Reiser*). Because of the natural diversity of indirect basin of Prokosko Lake and the presence of endemic Triton, it was protected by the law from the 1954, as well as some other lakes in Bosnia and Herzegovina and included in the level of protection rank: Regional Park of Nature.

Anthropogenic phase of development of Prokoško Lake

The beginning of the significant anthropogenization of the Prokosko Lake dates back to the times of intensive animal husbandry and grazing on Vranica, where transhumant livestock way was replaced by the constant summer stays of herders in the immediate basin of Prokosko Lake. This way of animal husbandry includes grazing on Vranica, and overnight stays of the cattle in the cattle pens and livestock herders in apartments and bacilli in the direct basin of the Prokosko Lake. From the cattle pens and livestock buildings, the organic sludge was transported into the lake and then accumulated at the bottom. In addition to the periodic presence of herders in the vicinity of Prokosko Lake, whose water was used for the cattle needs, the negative tendencies of anthropogenization of this natural-aqual complex include artificial ranching as well, which has arisen as a result of ichytiobiological research by the Institute of Fisheries of Republic of Bosnia and Herzegovina in 60's of last the century. These studies were focused on artificial intrusion of salmonid fish (Californian trout), which completely disrupted biological diversity with elimination of some living organisms from the lake water into the surrounding lake puddles, especially Raizerov triton (*Tritinus alpestris Reiser*). This made the natural aquatic biological balance endangered, especially the habitat of the endemic triton. Another negative effect for the Triton was the tendency of continuous income of organic waste, which was transported by the water from the immediate basin to the lake. Significant changes in the immediate environment of Prokosko Lake were created by the active presence of humans, when the folds and flats were substituted by the weekend-settlements, which were particularly pronounced at the beginning of the first decade of this century. In order to illustrate this trend we will use cartographic documents that clearly show the rural transformation from the early 20th century to today.
During the first cartographic representation of Vranica from 1902, in the immediate vicinity of The Prokosko Lake, there were registered only 2 objects. From that year forward, the number of cattle huts was increasing, so, according to the data from the renewed maps, in 1914, there were 6 cattle huts near the Prokosko Lake and in 1950 that number increased on 10 cattle huts.

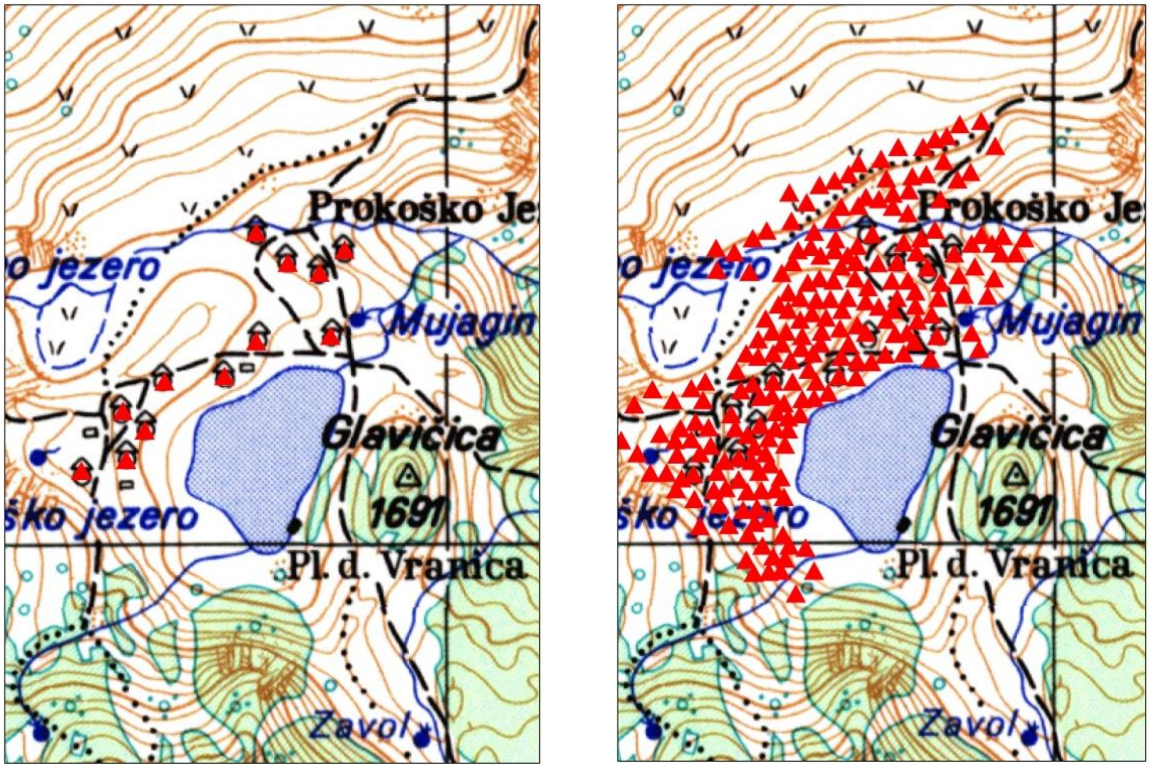

Figure 3: Prokosko Lake in 1960. (left picture) and 2015. (right picture). The difference of usurpation with occupied buildings is obvious, especially with weekend houses in todays situation. Despite the intense natural modification with anthropo pressing, the lake was declared a Monument of Nature in 2005 and thus included in the third category of protection. (right picture). In the middle of the last century when the immediate basin had, almost, natural habitat, with several livestock barns and apartments, which have neen used only in summer, this lake was declared only a Regional Park of Nature, which, according to today's nomenclature of protection suits the Nature Park and belongs to Fifth from Six categories of protection. (left image.)

Usurpation of the direct drainage basin of Prokosko Lake directly affected the modifi-cation of its natural state. From the group of negative tendencies, harmful, especially to the lake water is the production of organic sludge and waste from pens, barns livestock cottages and weekend-houses. The organic sludge and other sewage, which are the parts of incoming water in the lake, are deposited in the lake and stir the lake's water because of which it is opaque, and colloidal particles fall to the bottom of the lake, where they rott. The decaying process consumes a large amount of oxygen from the water, which is conductive to the coastal eutrophication of the lake.
Sapropelization and eutrophication are phytobenthos from which the coastal pleje (turfs) are made and coalesced with the lake's shore. They significatly reduce the surface of the lake and displace the lake's water through the lake's river. These proce-sses are seen on the first topographic maps from the beginning of the last century, when there were no observed coastal lacustrial plains of larger dimensions.

Figure 4: Prokoško Lake today. Artificial intervention in the riverbed of the lake's river, without legislative approval, raised the level of the lake, which will have unforeseeable negative consequences for its further development.

Changes to the coastline and its granularity are the processes that are noticeably taking place and can be visually registered after a decade. These changes are affected by the water balance as well, which shows the fluctuations of the water levels in the natural conditions, before anthropogenic interventions to a maximum of 0.6 m. These were regulated by the lake's river, which was stable with less regressive shifts caused by the cut.

The first disturbance of the lake river's riverbed dates back to the time of road construction across the river for the purpose od exploitation of forests and for the other needs, when the riverbed was artificially adapted. The latest interventions which were deliberately done in order to create a cofferdam to raise the level of the lake and its volume were undertaken without professional scientific expertise and monitoring works. They significantly changed limnic natural habitat because artificial level of the lake was increased by a maximum of 1.5 m. Artificial water level changed the natural regime, and the flood of the near lake plateau has incalculable harm to the functioning of this aqual complex.

Artificial interventions made on the lake and the anthropogenic usurpation of the lake basin contributed to the impossible naturalization of this aqual complex. We can talk about Prokosko Lake in the past tense only. Prokosko Lake by any criteria does not fulfil the conditions prescribed by international norms and standards for his appointment of monument of nature; its level of protection needs to be redefined to its recent condition to be able to take the necessary measures and actions to save at least some parts of its natural habitus.

Conclusions

Based on the presented analysis concerning the natural, slightly altered and completely altered state of indirect and, in particular, the immediate basin of the Prokosko Lake, it is possible to reduce concluding remarks in several points.

The beginning of the significant anthropogenization of the Prokosko Lake starts from the time of intensive cattle ranching on the mountain Vranica, which included summer stays of the herders in the immediate basin of the Prokosko Lake, which also was the water resource for the cattle. The negative tendencies of anthropogenization of this natural-aqual complex include its artificial ranching of salmonid fish in 60s of the last century. This completely disrupted biological diversity with elimination of the Raizerov triton (*Tritinus alpestris Reiser*) from the lake water in the surrounding lake puddles. The main earlier problems, and in particular the recent ones are the barns, pens and huts (both livestock and weekned ones) that were built in the immediate basin area, on the slopes from which the drains take the organic livestock and human faecal waste into the lake. Decay of organic sludge with oxygen consumption from the lake water has a beneficial effect on the coastal euthrophication of the lake. Sapropelization and eutrophication significantly affected the occurence of the coastal pleje (turfs), which are coalesced with the lake's shore. They siginificatly reduced the surface of the lake and displaced the lake's water through the lake's river. Changes to the coastline and its granularity are the processes that are noticably taking place and can be visually registered after a decade.

These changes are affected by the water balance as well, which shows the fluctuations of the water levels in the natural conditions, before anthropogenic interventions to a maximum of 0.6 m happened.

These were regulated by the lake's river, which was stable with less regressive shifts caused by the cut. The disruption of the lake's river riverbed was created by the road construction across the river for the purpose od exploatation of forests and other needs, when the riverbed was artificially adapted. The latest interventions which were deliberately done in order to create a cofferdam to raise the level of the lake and its volume were undertaken without professional scientific expertise and monitoring works and they significantly changed limnic natural habitat and at the same time increased the level of the lake by 1.5 m. Artificial water level changed the natural regime, and the flood of the near lake plateau has incalculable harm to the functioning of this aqual complex. Prokosko Lake has preserved its natural framework of evolutionary development until the beginning of the 60s of the last century, when as a natural rarity of this kind on Bosnia and Herzegovina, was declared a regional Park of Nature in 1954. According to the IUCN, the most relevant international organization for the nature protection, this protection rank belonged to the fifth of the six categories of protected areas. It implies a harmonious relationship between people and the natural environment, which allows the preservation of the natural aesthetic diversified values and biodiversity.

This level of protection was in effect until the January of 2005, when the Assembly of the Central Bosnia Canton changed the level of protection to the third, more rigorous category, and the Prokosko Lake was declared a natural monument. This category of protection under the IUCN includes in fact natural heritage of clearly defined area, which was by the Act of state administration put under the protection in order to preserve its original natural values.

When the two levels of protection are compared, where the first one was enacted in 1954, with which Prokosko Lake has been integrated into the fifth category of protection in a time when it had the original natural habitus with the other from the 2005., which changed the level of protection to the natural monument which belongs to the third rigorous level of protection although the natural environment suffered significant anthropogenic modifications. Therefore, it undoubtedly raises the question of how this could have happened? Answer to this question should be found in the professional background/feasibility study, which included a proposal for the category of protection, based on which the Prokosko lake was included in the rigorous ranking than that which preceded it.

In the Act which declared Prokosko Lake a monument of nature, sections that regulate measures and procedures for the revitalization of the lake from predominantly anthropogenic into the natural form so it could be treated by the predicetd level of protection, were not found.

In the Act on announcement of natural monument Prokosko Lake, scientifically unfounded elements of natural diversity were listed, by which this lake is different from other mountain lakes in Bosnia and Herzegovina. In addition, the number of flaws were made that have no scientific foundation, such as: '*...the borders of the natural monument are defined on the basis of the elements of river regime of water supply of the lake and geological composition of the terrain on which the lake basin was built'.; '...the mass of the basic colluvial rock material is downed to the lesser morphological head'; 'paralell direction'; 'geomorphological processes and forms presented with elements of limited karst morphosculpture of erosive and accumulative type'; '...many gravity forms of rock-fall in th form of chaotically distributed boulders are visible in the entire area of the immediate lake alluvial plain'; '...Prokosko glacier lake'*.

Other natural processes were not covered by the Act, and they should have been. It is not clear how were the protection zones defined. The Act provided the accompanying documents: The Plan for the Managemnt of the natural Monument Prokosko and Spatial plan of special purpose of the nature monument Prokosko. Both are not available to the public.

All actions that were done before and after the renaming of the nature park to the monument of nature around the Prokosko Lake, such as: unplanned construction of weekend-settlements, unplanned construction of infrastructure systems; especially sewage, coastal and lake's river rehabilitation, changes in the regime of water runoff and income and other interventions had no basis in Act on Water protection in Bosnia and Herzegovina. If we add to this the laws regulating the issues concerning water approval and water goods, all the deliberate actions made in direct and indirect basin of the Prokosko Lake on his renaturalization have no basis in the legislation.

Artificial interventions made on the lake and the anthropogenic usurpation of the lake basin contributed to the impossble naturalization of this aqual complex. We can talk about Prokosko Lake in the past tense only. Since prokosko Lake by any criteria does not fulfil the conditions prescribed by international norms and standards for its appointment to a monument of nature, its level of protection needs to be redefined to its recent condition to be able to take the necessary measures and actions to save at least some parts of its natural habitus.

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