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BIOLOGICAL SCIENCES

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ENVIRONMENTAL ASPECTS OF THE KAKHOVSKA HYDROELECTRICAL POWER STATION RECONSTRUCTION IN THE POST-WAR PERIOD

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Abstract. The article examines the main negative ecological consequences of the violation of the water regime of the Lower Dnipro caused by hostilities on the territory of Zaporizhzhia and Kherson regions. Ways to reduce the negative environmental situation in the region by implementing the most effective practical steps during the reconstruction of the Kakhovska HEPS in the post-war period are proposed.

Key words: water regime, water ecosystems, ecological condition, Kakhovska HEPS, post-war reconstruction

The facilities of the hydropower industry are part of the general energy complex of Ukraine and, mainly, serve as an emergency and frequency reserve of the power system aimed at paying off the peak part of the general load schedule. They are also of exceptional ecological importance: they create additional fluctuations in the water level in the water system, restrain negative flood and mudslide phenomena, and are key controlled objects for regulating the water regime of rivers [9-11, 14, 18, 19]. One such hydropower facility is the Kakhovska HEPS, located on the Dnieper River within the city of Nova Kakhovka, Kherson region.

Since the beginning of the full-scale invasion of the Russian troops on the territory of Ukraine, in particular on the Kherson region, the Kakhovska HEPS became one of the first strategic objects of state infrastructure that came under the control of the aggressor country. If in the first months of the temporary occupation of the hydroelectric station, the usual regime of water supply to the lower reaches of the Dnieper was mostly not disturbed, then from the beginning of 2023, due to hostilities in the Kherson region, a significant hole was formed in the body of the HPP dam [18]. Because of this, the water level in the Kakhovka Reservoir and the lower reaches of the Dnieper fell to historic lows since the construction of the Kakhovka HEPS. In fig. 1 shows the course of the water level in the Kakhovka Reservoir from the beginning of the full-scale invasion of Russian troops on the territory of Ukraine to the present time [17].

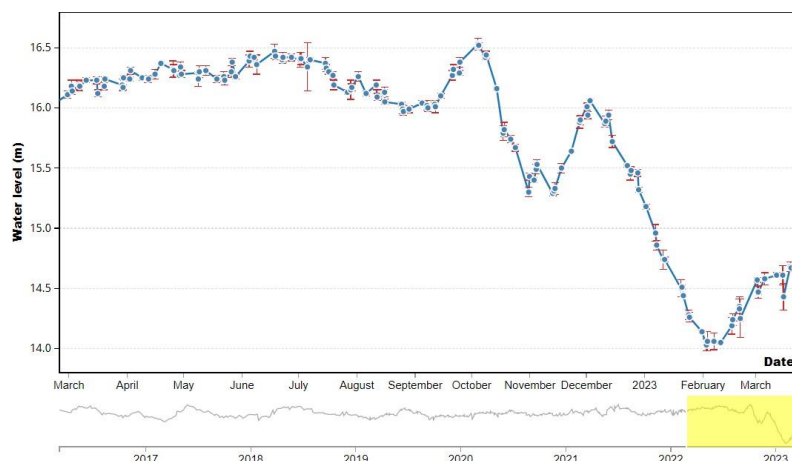


Fig. 1. The course of the water level in the Kakhovka Reservoir in period from February 24, 2022 to March 24, 2023 [17]

The consequence of the drop in the water level in the Kakhovka Reservoir and at the mouth of the river was the dehydration of the floodplain reservoirs of the Dnieper delta, the inflow of salty water from the Dnieper-Buh estuary, periodic fish stasis along the entire extension of the Lower Dnipro [6], a general increase in the content of organic and biogenic substances in water, etc. [2, 7].

In the absence of any action on the part of local communities, the ecological situation on the Lower Dnieper will continue to worsen. First of all, the damage to aquatic ecosystems will occur due to the contamination of the waters of the listed water areas with allochthonous biogenic and organic substances formed in the silted,

dehydrated areas of the Kakhovka Reservoir.

Also, the decomposition products of long-term silt deposits of the reservoir, which are currently decomposing over a large area under the influence of sunlight and positive air temperatures, under the conditions of a rise in the water level in the water ecosystem of the Lower Dnieper, will lead to the arrival of significant volumes of water contaminated with bacteria to the mouth of the river and disease-causing microorganisms that managed to multiply on the bare muddy substrate of the higher sections of the river. Such processes will not only further worsen the ecological situation in the region, but will also lead to a violation of the sanitary-epidemiological situation in reservoirs, watercourses below the Dnieper and the Dnieper-Buh estuary.

The second largest consequence for the lower Dnipro is the inflow of salty (sea) water from the Dnieper-Buh estuary caused by the shortage of fresh Dnieper water. According to local scientists, the value of water salinity in the Dnieper near the city of Kherson at the beginning of February in the surface layer reached 2-3‰ (with normal seasonal values of 0.2-0.4‰). Under conditions of preservation of high-water salinity in the next six months, we can expect the disappearance of most of the aboriginal freshwater species of hydrobionts, which are the fodder base for the local ichthyofauna. Such violations of trophic relationships in the water ecosystem will lead to the inevitable death of a significant number of representatives of aboriginal freshwater flora and fauna and a number of hydrobionts listed in the Red Book of Ukraine.

Numerical materials and materials of our on-site surveys confirm that the Kakhovska HEPS is one of the most influential factors that shapes the hydrological regime of the entire Lower Dnieper and, as a result, determines the ecological state of most water bodies of the Dnieper-Buh mouth region (area: 1440 km² [3]) and the Kakhovka Reservoir (area: 2155 km²).

Having such a significant impact on the water bodies of the region in order to restore and control the good ecological condition of the water areas with an area of about 3600 km², it is the Kakhovka hydropower station that needs priority reconstruction in the post-war period.

Based on modern scientific developments on the researched issue partially described in works [1, 4, 5, 8, 10, 11, 13, 15, 16, 20], we have highlighted the following main ecologically significant steps that must necessarily be included in the reconstruction strategy Kakhovska HEPS in the post-war period:

1) elimination of man-made damage in the body of the Kakhovska HEPS dam caused by the actions of Russian troops;

2) restoration of the Kakhovska HEPS-2 construction project, taking into account all environmental requirements, which were provided in scientific reports during the Environmental impact assessment procedure;

3) development and implementation of an ecologically sound system of water releases through the dams of the Dnipro HEPS and Kakhovka HEPS, which will take into account both the volume of water supply and the amplitude of water level fluctuations in the water body;

4) synchronization of the operation of DniproHEPS-1, DniproHEPS-2 and Kakhovska HEPS-1+HEPS-2, which will allow for more effective regulation of Dnieper flow volumes by shifting them to the peak part of the power system load schedule;

5) development and implementation of methods for managing the state of water ecosystems in the area of influence of the Kakhovska HEPS by regulating the hydrological and hydrochemical regime of local water bodies.

Only through the urgent implementation of all five of the most effective steps mentioned by us in the reconstruction of the Kakhovska hydropower plant is it possible to restore the good ecological condition of the Kakhovka Reservoir, water bodies below the Dnieper and the water area of the Dnieper-Buh mouth region.

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