

MONITORING OF CHANGES IN ECOSYSTEMS AS A RESULT OF HOSTILITIES ON THE TERRITORY OF UKRAINE (ON THE EXAMPLE OF THE DVORICHANSKYI NATIONAL NATURAL PARK, KHARKIV REGION)

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Abstract. The Dvorichanskyi National Natural Park (hereinafter referred to as the NNP) is an environmental, scientific, recreational institution located in the north-eastern part of Kharkiv region. Obtaining information about damage during hostilities allows you to assess the consequences and develop recovery ways. Thus, the article considers the consequences of hostilities on the territory of Ukraine, namely on the territory of the Dvorichanskyi NNP. The impact of catastrophic actions on the flora and fauna of the studied territory has been discovered. Images of the territory using NDVI, True Color, False Color and NDWI are analyzed. Possible causes of dehydration of the Oskol River have been found.

Keywords: Natural Park, flora, fauna

Geographic coordinates of the study area: 49°51'07" N, 37°43'59" E (located in the Dvorichanskyi district of Kharkiv region and lies within two village councils: Kamensky and Peskovsky. From the north, it is bounded by the state border with the Russian Federation. Several settlements are adjacent to the territory of the park, in particular, it is located by the only massif in the river valley Oskol between the villages of Novomlynsk (in the south), Krasnoe First (in the east), Petrovka, Peski (in the west) and Topol (in the northern part)).



Fig. 1. The area of protected territories affected by the war

To date, a number of scientific and methodological works are used in the State Border Service of Ukraine as a scientific and methodological base for environmental monitoring. In [1] provides a detailed analysis of the environmental legislation in force at that time Ukraine, the main issues of organizing environmental protection in the troops were considered. An overview of the main environmental protection measures and the peculiarities of the organization of environmental education in the Armed Forces is also presented Ukraine. Similar work, judging by the available publications, was carried out abroad [2; 3]. Thus, in the United States, on the basis of Civil Defense authorities, in 1979 it was established The

Federal Agency for Crisis Management (FEMA), where a system of computer modeling of solutions (PARM) was developed to improve the sustainability of the economic complex as a whole and the safety of its vital facilities in a special period. The geography and climate of Ukraine have endowed it with an amazing wealth of flora and fauna. Its territory accounts for 35% of Europe's biodiversity [4]. These are

70,000 species of plants and animals, many of which are rare or endemic, that is, they are present only in this area. However, the war to date has affected about a third of the entire nature reserve fund, according to (Fig. 1).

The Dvorichanskyi NNP has been under occupation for a long time, so no one extinguished fires at these places, which caught fire en masse in the places of operation of jet artillery. The territories of the Dvorichanskyi NNP are no exception and also suffer from such actions. From the first days of the war, they suffer injuries that cannot be restored in the near future.

That is, a full-scale invasion Russia has caused and continues to cause huge damage not only to people and infrastructure, but also to nature. So after such a brief acquaintance with the general situation, we can proceed to the analysis of catastrophic phenomena on the territory of the Dvorichanskyi NNP.

Thanks to the tools and opportunities to work on the EO website -Browser, which stores a large archive with many types of satellite images from Sentinel, Landsat, etc. There are analyzed catastrophic changes and consequences of changes in military influence on natural objects of the territory of NNP Dvorichanskyi, where the basis was satellite images from the Sentinel - 2 for 2021 and 2022, respectively.

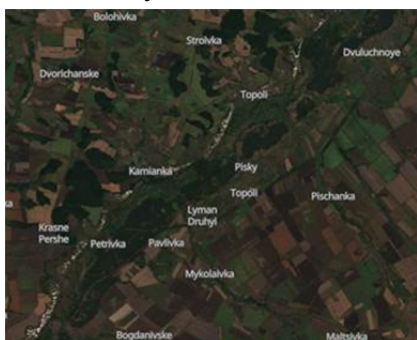


Fig. 2. Picture from 2022-08-24(True color)



Fig. 3. Picture from 2021-08-26(True color)

Even with the first visual analysis of the images (Figures 2 and 3), we can see changes in flora and not only in this area. The first thing that catches the eye is the lower planting of the circumferential fields. Unfortunately, the situation in Ukraine made this process impossible in certain territories.

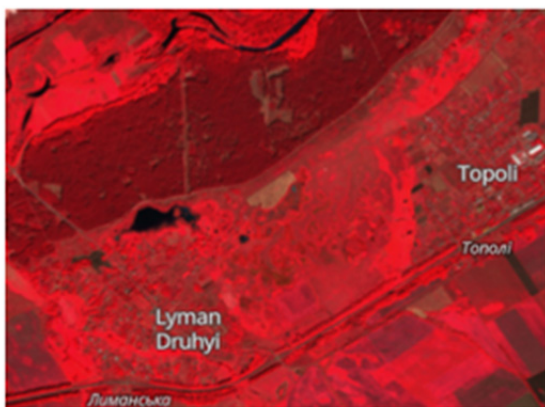


Fig. 4. Picture from 2022-08-24(False color)

In these pictures, it is most convenient to analyze fires by the combination false color (burnt places are highlighted with dark colors, which makes them more visible on a red background) (Fig. 4), but for more accurate and detailed analysis we also use true color (visual determination of affected areas based on real colors) and NDVI (helps to find affected areas by displaying areas with a reduced number of healthy plants).

The use of artillery and strike aviation on the territory of the Dvorichanskyi NNP entails forest fires, which in arid conditions can destroy thousands of hectares of forest and further turn into a fire. In this picture we clearly see these dark spots, meaning forest fires, and this means only one thing - an ecocide against Ukrainian objects of the nature reserve fund, which have now become a stage for hostilities.

Also, we can notice such points of lack of forest cover. Obviously, these are traces of arrivals that did not lead to the ignition of the territory. We can see these catastrophic changes with the help of NDVI (Fig. 5), which once again confirms the above.



Fig. 5. Picture from 2022-08-24(NDVI)

Attention should be paid to the Oskil River, which, due to causal relationships, affects the grassy cover of the area. This river was a decoration of the park - the second largest in the region and the largest left tributary of the Siverskyi Donets. The park includes approximately 24-kilometer section of the bed. As of February 24, 2022, the water level in the Oskil River according to the hydro locust located in the city of Kupyansk, was 617 cm above the zero of the post. To date, the river has become significantly shallower, we see this change in terms of color intensity and the detection of annual deposits in certain places, which also indicates a decrease in the water level (Fig. 6, Fig.7).

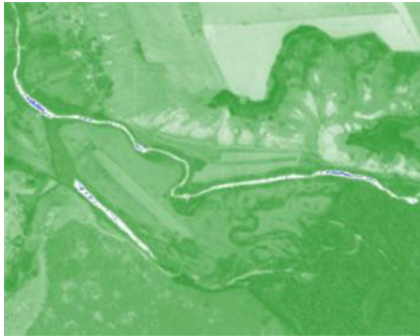


Fig. 6. Picture from 2021-08-26(NDWI)

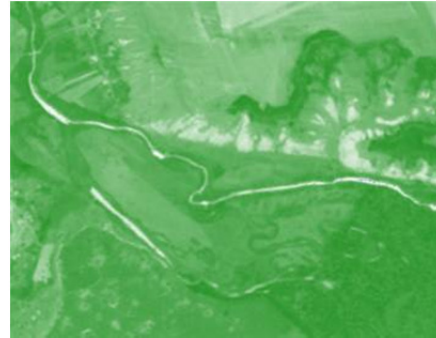


Fig. 7. Picture from 2022-08-24(NDWI)

This situation can be explained by the fact that the reason for the fall in the water level was the explosion of locks on Oskilske and damage to the dam at the Pechenezh reservoirs, respectively. It is also known that there are dams and other places of water regulation in the river upstream on the territory of Russia, which can also explain the decrease in water level.

So, we can say that the Dvorichanskyi NNP, compared to other territories, did not suffer so much, but we still see terrible consequences. First, it is the destruction of a significant area of forest plantations, the restoration of which will take many years. This is the destruction of species diversity of flora and fauna, including many rare species of the Red Book of Ukraine, the European Red List, endangered species.

Combat operations related to the use of air bombs and shells violate the relief and uniformity of soil cover, kill flora and fauna. For example, one kilogram of explosive of an ordinary bomb causes an ecosystem disruption on an area of 12.5 m². Shell explosions pollute soils with a significant concentration of heavy metals. They are toxic even in minimum quantities. they can't stand by processes. Decompositions are concentrated in living organisms, causing different pathologies. Heavy one's metals can gradually move into groundwater, which adversely affects health human.

So these terrible times for the civilized world have become a tragedy not only for people, but also for flora and fauna. After all, events taking place on the territory of our country lead to a decrease in populations of animals and birds, to dehydration of rivers, to a decrease in groundwater levels, to liquefaction of grass and forest cover. That is, they carry huge environmental problems. And when flora and fauna in Ukraine will recover after the local ecocide, no one will predict.

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