



## **DESTRUCTION OF THE NATURAL ENVIRONMENT CAUSED BY THE WAR IN UKRAINE: IMPACT ON ATMOSPHERE, LAND, AND WATER ECOSYSTEMS**

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### **Abstract**

The most powerful destructive factor affecting the settlements, infrastructure and natural environment of Ukraine is the full-scale invasion of the armed forces of the RF, which began on February 24, 2022. From the first months of this tragic period in the history of Ukraine, we focused our attention on registration and assessment of the impact of military activity on the natural environment, which in some cases had catastrophic consequences. The purpose of this study is to determine the specifics of the impact of military operations on the land surface, water bodies, and vegetation of the affected territories based on the field research, remote monitoring and analysis of available published data. This paper describes results of the examination of affected areas after explosions of the missiles in forest zone (Buda-Babynetska case study) and deterioration of oil depots (Kalynivka case study).

Pollution and clogging of the atmosphere air and land surface were observed in all cases. Polluting substances were products formed as a result of ammunition explosions and burning of target materials. Our estimates show that the shock release of combustion products into the atmosphere after damage to the Kalynivka oil depot amounted to more than 40,000 tons of pollutants. Monitoring of the consequences of this case showed pollution of the soils and underground water by oil derivatives. The concentration of pollutants in affected land areas exceeded background concentrations by 28 or more times. The migration of polluted underground water ended up loading into surface water bodies. As a result, the average concentration of oil product in the affected pond was 40 times more than the maximum allowable concentration six months after the incident. This pollution had a detrimental effect on the coastal vegetation of the pond. We recorded pioneer species in this area a few months after registering the pollution load. In this case, atmospheric air pollution had a temporary, dynamic nature, while soil and water pollution, in particular, by oil products, has the long-term consequences.

Physical destruction of natural and anthropogenic landscapes was registered near Buda-Babynetska and Moshchun Villages, Kyiv Region. Explosion of missiles, bombs, shells in forest and agricultural areas caused the formation of deep craters, destruction of the soil cover, flora and fauna species with long-term recovery. In addition to this impact, fires in forest ecosystems caused emissions of significant amounts of combustion products into the atmosphere and complete or partial destruction of biotopes.

Paper describes the case studies of the incidents, demonstrates specifics of the assessment of different forms of environmental damages, and discusses the possible approaches to restoration of the disturbed environment.

### **Keywords**

Military impact on the environment; pollution of air, soil and water; fires in ecosystems; landscapes destruction