

Mon23-226

Ecological risks of the impact of war on nature reserves in Ukraine (using the example of the Azovo-Sivash National Nature Park)

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SUMMARY

Since the beginning of Russia's full-scale invasion of Ukraine and the occupation of the peninsula, control over the jackal population has ceased. The increase in the number of jackals may be contributing to the predation on young deer, indirectly supported by the increase in grassland cover. Deer and mouflon are not attractive prey for jackals due to their size, so their populations remain stable, as does the level of shrubs.

These changes create conditions for potential risks to the ecosystem, including the possible decline in the population of certain ungulate species or even their complete disappearance. The situation requires immediate attention and active measures to restore the ecological balance. Natural reserves like the Azovo-Sivash National Nature Park require additional monitoring and management to preserve species diversity and ecosystem stability. This may include the restoration of predator population control programs and research into their impact on ungulate populations to avoid the negative consequences of this dynamic.

The methodology involves processing raster images of objects from different layers of the Dynamic World V1 subprogram, calculating pixel loads for specific types of objects using built-in program layers, and transforming the obtained data into ratios of actual object areas to the total area of the territory. Monthly averages were calculated for each object type. The observation period was selected from December 2015 to April 2023, taking into account the maximum capabilities of the Dynamic World V1 program for data reproduction.



Introduction

The relevance of this research is driven by the fact that with the onset of Russia's full-scale invasion into Ukraine, significant damage has been inflicted on our country's natural ecosystems. Therefore, it is imperative to start identifying pathways and directions for post-war restoration today. The destructive impact of war on natural ecosystems has been ongoing for over 9 years since Russia's aggression against Ukraine began. Unfortunately, since February 2022, the geography and scale of this impact have significantly expanded. Nature reserves deserve special attention in this context.

Method

In the analysis, general-scientific methods (analysis and synthesis, induction and deduction) and special methods of phenomena and processes analysis (abstraction, econometric and econometric-mathematical modelling) have been used.

Results

A study on the dynamics of land cover changes within the Azovo-Sivash National Nature Park (Figure 1) was conducted. A 8 by 8 square kilometer area centered at the geographic coordinates [35.10227, 46.15100] was selected for analysis. Data were obtained using the Google Earth Engine software. The methodology involves processing raster images of objects from different layers of the Dynamic World V1 subprogram, calculating pixel loads for specific types of objects using built-in program layers, and transforming the obtained data into ratios of actual object areas to the total area of the territory. Monthly averages were calculated for each object type. The observation period was selected from December 2015 to April 2023, taking into account the maximum capabilities of the Dynamic World V1 program for data reproduction.



Figure 1 Aerial photograph of the Azovo-Sivash National Nature Park territory with the highlighted red area under investigation.

The dynamics of land cover were also analyzed, excluding marine water bodies. The research results are graphically presented in Figures 2 to 7.

It has been observed that there is a seasonal cyclicity in the change of land cover within the Azovo-Sivash National Nature Park territory. The largest percentages of non-water-covered areas (up to 20.73%) are predominantly occupied by shrubs throughout most of the year, which is influenced by the climatic conditions of this area. The impact of periodic flooding, which is a common cyclical phenomenon, significantly alters the distribution of land cover types, primarily affecting grassland cover and agricultural field areas. Water resources exhibit variability depending on the season, with higher levels during colder months (Figure 2). According to the data for the years 2020-2023



inclusive, we can outline the general trends observed in the period after the start of the full-scale invasion (Figure 3). Firstly, the bare land area was higher in winter and autumn of 2022, as well as for all indicators in 2022 compared to previous years. Up until 2022, clear seasonal fluctuations were observed, which did not exceed the 20% mark (Figure 4).

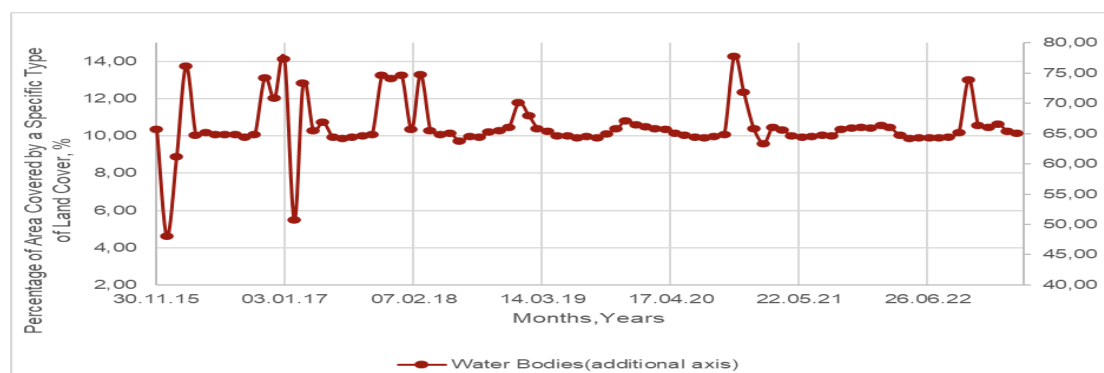


Figure 2 Dynamics of the percentage ratio of water body areas depending on the month for the period from December 2015 to April 2023 within the territory of the Azovo-Sivash National Nature Park

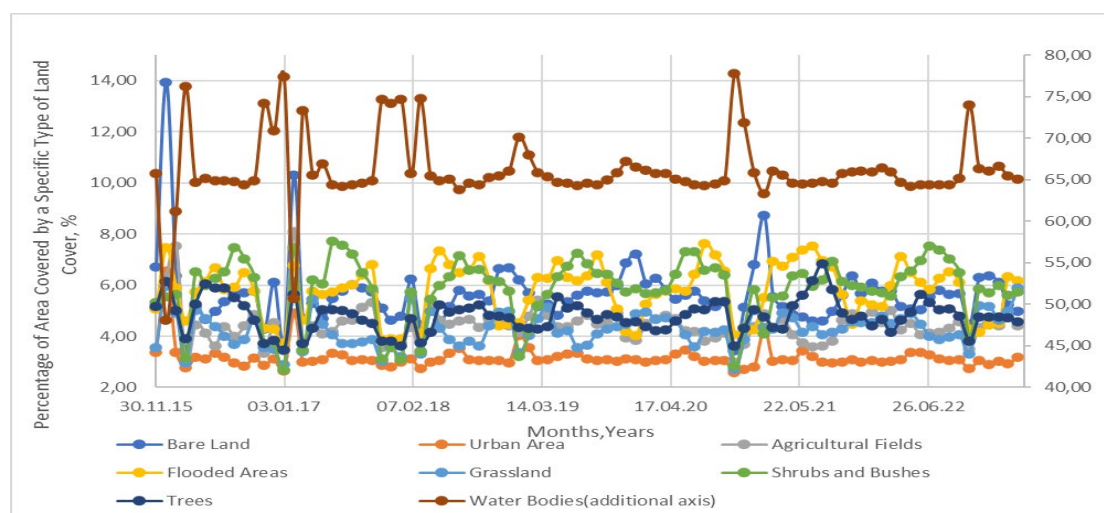


Figure 3 Dynamics of the percentage ratio of land cover areas depending on the month for the period from December 2015 to April 2023 within the territory of the Azovo-Sivash National Nature Park

This could indicate changes in climatic conditions, which could be attributed to both natural factors and the impact of military activities. The extent of flooding decreased during the spring and summer months of 2022 compared to 2021 and was slightly lower for the same period in 2020 (Figure 5). The cultivated areas showed a tendency to increase until the end of 2021 but significantly decreased in 2022, which is attributed to Russia's military aggression (Figure 6).

The identified seasonal cyclicity in the distribution of land cover types, as well as their sensitivity to factors such as flooding and possibly military actions, is noteworthy. Significant changes in the area measurements of various land cover types, including the decrease in agricultural cultivation and flooded areas, along with an increase in bare land, suggest potential ecological and anthropogenic influences. All of these findings emphasize the need for ongoing monitoring of the nature reserve's ecosystem to plan effective conservation and restoration efforts.



According to the available data from the analysis of aerial photographs provided by the Dynamic World V1 software product, there has been a trend of increasing areas covered by grassland and the percentage of areas occupied by shrubs has been maintained on Biryuchyi Island within the Azovo-Sivash National Nature Park since 2022 (Figure 7).



Figure 4 Dynamics of the percentage ratio of non-vegetated land cover areas depending on the month for the period from December 2015 to April 2023 within the territory of the Azovo-Sivash National Nature Park

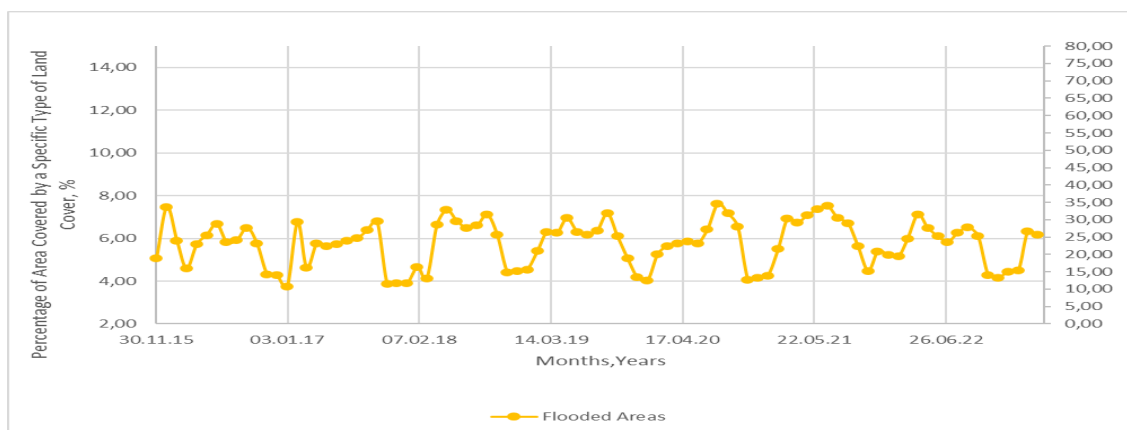


Figure 5 Dynamics of the percentage ratio of areas partially or completely flooded depending on the month for the period from December 2015 to April 2023 within the territory of the Azovo-Sivash National Nature Park

The grassland on Biryuchyi Island serves as a primary food source for deer and roe deer, while deer (*Cervus elaphus*, *Cervus nippon*) and moose prefer shrubs and bushes. Jackals, which are natural predators of roe deer, find the island a comfortable habitat, leading to their migration to Biryuchyi and an increase in their reproductive rates. This information is also noted in the explanatory memorandum for the "Project for the Organization of the Azovo-Sivash National Nature Park Territory, Conservation, Reproduction, and Recreational Use of Its Natural Complexes and Objects" (Project, 2009).

Conclusions

Since the beginning of Russia's full-scale invasion of Ukraine and the occupation of the peninsula, control over the jackal population has ceased. The increase in the number of jackals may be contributing to the predation on young deer, indirectly supported by the increase in grassland cover.



Deer and mouflon are not attractive prey for jackals due to their size, so their populations remain stable, as does the level of shrubs.

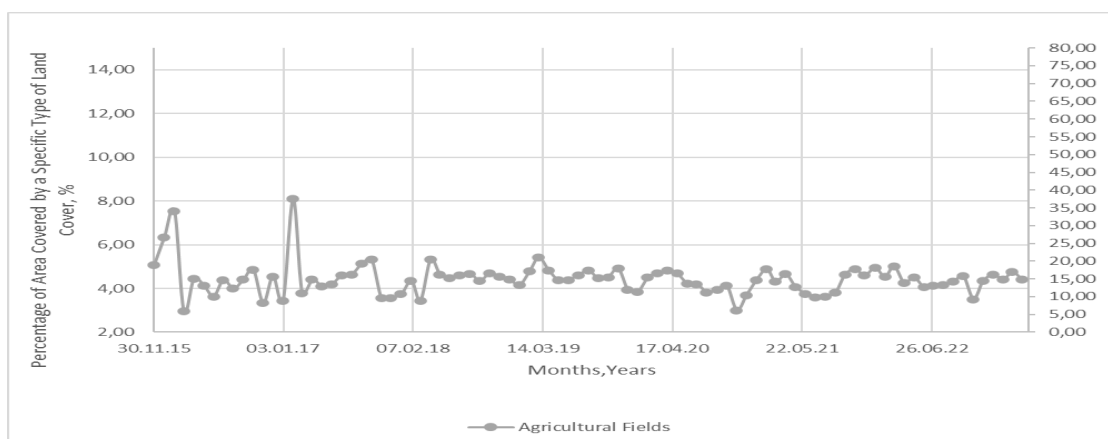


Figure 6 Dynamics of the percentage ratio of land cover areas occupied by cultivation depending on the month for the period from December 2015 to April 2023 within the territory of the Azovo-Sivash National Nature Park

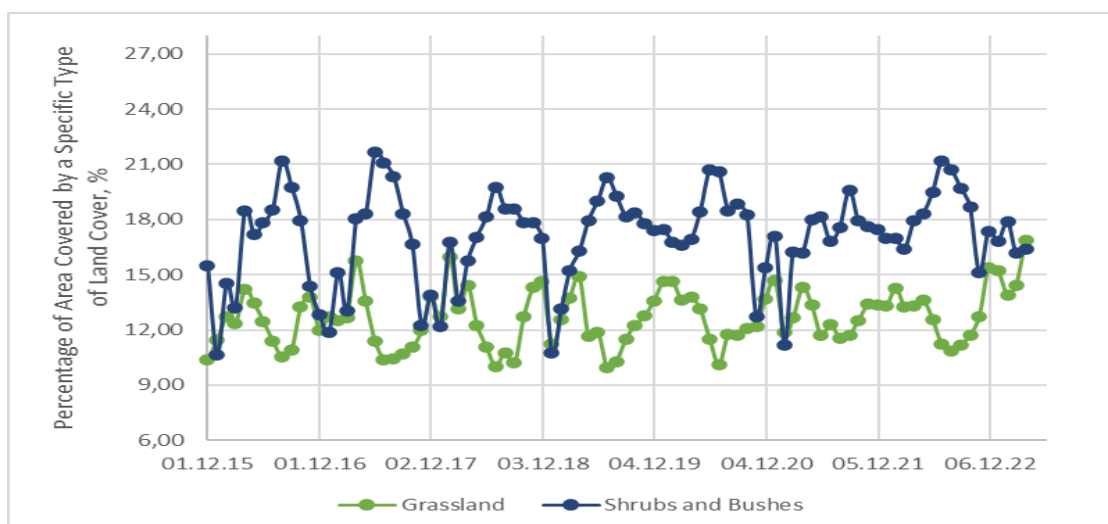


Figure 7 Dynamics of the percentage ratio of land cover areas (grassland, shrubs, and bushes) depending on the month for the period from August 2015 to April 2023 on Biryuchyi Island within the Azovo-Sivash National Nature Park

These changes create conditions for potential risks to the ecosystem, including the possible decline in the population of certain ungulate species or even their complete disappearance. The situation requires immediate attention and active measures to restore the ecological balance. Natural reserves like the Azovo-Sivash National Nature Park require additional monitoring and management to preserve species diversity and ecosystem stability. This may include the restoration of predator population control programs and research into their impact on ungulate populations to avoid the negative consequences of this dynamic.

Reference

Project for the Organization of the Azovo-Sivash National Nature Park Territory, Conservation, Reproduction, and Recreational Use of Its Natural Complexes and Objects. (2009). Melitopol: Center for Environmental Management LLC.



XVII International Scientific Conference “Monitoring of Geological Processes and Ecological Condition of the Environment”

7–10 November 2023, Kyiv, Ukraine