


# ГЕОІНЖЕНЕРІЯ ТА ОХОРОНА НАВКОЛИШНЬОГО СЕРЕДОВИЩА

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## **CONSERVATION AND RESTORATION OF UKRAINE'S NATURE RESERVE FUND UNDER MARTIAL LAW: A EUROPEAN DEVELOPMENT VECTOR**

*This article presents a comparative analysis of  
the nature reserve fund systems in Ukraine and*

## **ЗБЕРЕЖЕННЯ ТА ВІДНОВЛЕННЯ ПРИРОДНО- ЗАПОВІДНОГО ФОНДУ УКРАЇНИ В УМОВАХ ВОЄННОГО СТАНУ: ЄВРОПЕЙСЬКИЙ ВЕКТОР РОЗВИТКУ**

*Представлено порівняльний аналіз систем  
природно-заповідних фондів в Україні та*



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the European Union, examining their legislative frameworks, organizational structures, management approaches, and the overall effectiveness of their conservation activities. Special attention is dedicated to the EU's Natura 2000 network as a model for integrated environmental policy, alongside the specific experiences of individual European states – namely Germany, Poland, and Norway – in organizing and managing protected areas. The study is underpinned by the hypothesis that a systemic adaptation of European instruments – specifically the integration of the Natura 2000 network, the digitalization of monitoring via GIS technologies, and the decentralization of management in favor of local communities – will mitigate the institutional and financial deficits of Ukraine's nature reserve fund, thereby enhancing the potential for the ecological restoration of protected sites under wartime and post-crisis threats. The following scientific methods were used: analysis and synthesis – for studying scientific literature, legal acts of Ukraine and the EU on nature protection and the nature reserve fund; comparative legal method – for determining the similarities and differences between nature protection systems in Ukraine and the EU countries; cartographic method – for spatial visualisation of the network of protected areas; statistical method – for summarising quantitative indicators. The results of the comparative study confirmed the proposed hypothesis that the adaptation of European approaches, including German zoning practices, Polish forest management models, and Norwegian mechanisms of community participation, can contribute to overcoming the institutional and financial challenges faced by Ukraine under wartime conditions. The research indicates considerable opportunities for the expansion and improvement of Ukraine's nature reserve network; however, the effective implementation of conservation policy requires further development of legislative frameworks and management mechanisms. The comparison with European Union practices revealed a range of effective solutions that could be introduced in Ukraine, such as the integration of the Natura 2000 network principles, enhanced involvement of local communities in environmental governance, the application of digital monitoring tools, and the promotion of environmental education initiatives. Effective conservation management also depends on stable financial support, clear legal regulation of protected areas, and the establishment of efficient monitoring and control systems based on geographic information technologies. Given the current environmental risks associated with military activities, strengthening nature protection measures has become increasingly important. In this regard,

Європейському Союзу, в якому досліджено їхні законодавчі рамки, організаційну структуру та ефективність природоохоронної діяльності. Особливу увагу приділено європейській мережі "Натура 2000" як моделі інтегрованої екологічної політики, а також практичному досвіду Німеччини, Польщі та Норвегії в управлінні заповідними територіями. Дослідження базується на гіпотезі, що системна адаптація європейських інструментів – зокрема інтеграція мережі "Натура 2000", цифровізація моніторингу через ГІС-технології та децентралізація управління на користь місцевих громад – дозволить нівелювати інституційні та фінансові дефіцити природно-заповідного фонду України, посилюючи потенціал екологічної реставрації заповідних об'єктів в умовах воєнних і післякризових загроз. Використано такі наукові методи: аналіз та синтез – для вивчення наукової літератури, нормативно-правових актів України та ЄС з питань охорони природи і природно-заповідного фонду; порівняльно-правовий метод – для визначення подібностей і відмінностей між системами охорони природи в Україні та країнах ЄС; картографічний метод – для просторової візуалізації мережі природоохоронних територій; статистичний метод – для узагальнення кількісних показників. Результати порівняльного дослідження підтвердили запропоновану гіпотезу про те, що адаптація європейських підходів, включно з німецькою практикою зонування, польськими моделями управління лісами та норвезькими механізмами участі громади, може сприяти подоланню інституційних і фінансових викликів, з якими стикається Україна в умовах воєнного часу. Дослідження вказує на значні можливості для розширення та вдосконалення мережі природних заповідників України; проте ефективна реалізація політики охорони природи потребує подальшого розвитку законодавчої бази та механізмів управління. Порівняння з практикою Європейського Союзу виявило низку ефективних рішень, які можна було б впровадити в Україні, таких як інтеграція принципів мережі "Натура 2000", посилення залучення місцевих громад до екологічного управління, застосування цифрових інструментів моніторингу та просування ініціатив з екологічної освіти. Ефективне управління природоохоронними територіями також залежить від стабільної фінансової підтримки, чіткого правового регулювання охоронних територій і створення ефективних систем моніторингу та контролю на основі геоінформаційних

cooperation with European partners represents a significant opportunity for advancing the sustainable development of Ukraine's environmental sector. Future research should focus on improving methodologies for assessing environmental damage using EU experience and on developing GIS-based tools for transboundary monitoring of protected ecosystems affected by armed conflict. The study identifies key similarities and differences in biodiversity conservation approaches, the deployment of digital monitoring tools, public participation mechanisms, funding models, and international cooperation practices. Furthermore, a geoinformation model illustrating the spatial distribution of Ukraine's nature reserve fund objects, including those located within temporarily occupied territories, is presented and analyzed. The paper delineates critical discrepancies in financing and digitalization, analyzes the GIS model of the spatial distribution of Ukraine's NRF objects, and outlines the large-scale environmental damages resulting from the full-scale Russian military aggression (estimated at over USD 15 billion). Based on this comprehensive analysis, actionable recommendations are formulated for adapting effective EU practices to strengthen the resilience and sustainable development of Ukraine's natural heritage.

*Keywords:* nature reserve fund, nature protection, land management, land protection, European Union, environmental policy, Natura 2000, biodiversity, military aggression, ecosystem restoration.

технологій. З огляду на сучасні екологічні ризики, пов'язані з військовою діяльністю, посилення заходів з охорони природи стає дедалі важливішим. У цьому контексті співпраця з європейськими партнерами є значною можливістю для просування сталого розвитку екологічного сектору України. Майбутні дослідження мають бути зосереджені на вдосконаленні методологій оцінки шкоди навколишньому середовищу з використанням досвіду ЄС та розробці інструментів на основі ГІС для транскордонного моніторингу охоронюваних екосистем, що постраждали від збройного конфлікту. Визначено ключові розбіжності у фінансуванні та цифровізації, проаналізовано ГІС-модель просторового розподілу об'єктів природно-заповідного фонду України, а також окреслено значні екологічні збитки внаслідок повномасштабної російської військової агресії (на суму понад 15 млрд дол. США). На основі аналізу сформовано рекомендації щодо адаптації ефективних практик ЄС для зміцнення стійкості та сталого розвитку природної спадщини України.

*Ключові слова:* природно-заповідний фонд, охорона природи, управління земельними ресурсами, охорона земель, Європейський Союз, екологічна політика, "Натура 2000", біорізноманіття, військова агресія, відновлення екосистем.

### Introduction

Modern global challenges related to biodiversity loss, ecosystem degradation, climate change and military operations necessitate strengthening protection measures for natural areas. The nature reserve fund is a key tool for preserving unique natural landscapes, flora and fauna.

In Ukraine, as well as in the European Union, there are protected areas systems in place, but their development, legislative framework and implementation efficiency have both common features and significant differences. In the context of Ukraine's European integration, it is especially important to study the EU experience in nature protection and to adapt national policy to the requirements of European directives. One of the prerequisites for a new country's accession to the European Union is the adaptation of national legislation to Directive No. 2009/147/EC on the conservation of wild birds and Directive No. 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, which, in particular, provide for the creation and functioning of the NATURA 2000 network of protected areas.

The article analyses the key environmental risks that have arisen for the territories and objects of the Nature Reserve Fund (NRF) of Ukraine in the regions where active hostilities are taking place, in particular, in Kharkiv,

Sumy, Kyiv, Donetsk, Luhansk, Mykolaiv, Kherson, Zaporizhzhia, Chernihiv and Odesa regions.

As of April 2022, since the full-scale war began on 24 February 2022, about 900 protected areas have suffered significant environmental and economic losses. The estimated area of the damaged protected areas is 1.2 million hectares. The key biosphere reserves, such as the Black Sea, Danube and Askania-Nova, where unique populations of steppe endemic plant and animal species are protected and restored, are under serious threat (Strokal et al., 2023).

Many studies have been devoted to monitoring the ecological status of the country's protected areas. A number of scientific publications describe the problems of biodiversity decline and ways to improve the ecological situation by expanding the country's protected area network. An analysis of the scientific literature has shown that there is a lack of information on violations of the environmental safety of Ukraine's sites with special protection status during the war period (Koshel & Kolhanova, 2023; Koshkalda et al., 2024; Valerko et al., 2023; Vasyliuk et al., 2026; Vasyliuk et al., 2024; Mikhno et al., 2024).

The purpose of the study is to conduct a comparative analysis of nature protection systems in Ukraine and selected European countries (Germany, Poland, and Norway) based on the criteria of regulatory frameworks, models for managing private and state ownership within protected lands, levels of GIS-based digitalization, and local community engagement, as well as to identify key directions for harmonizing national legislation with European standards to foster long-term post-war ecological restoration.

The study tests the hypothesis that transitioning to EU-integrated management models (such as Natura 2000), implementing cross-border digital monitoring (GIS), and empowering local communities in land management serve as a foundational prerequisite for compensating for war-induced financial deficits and establishing an operational framework for the long-term ecological recovery of damaged ecosystems. The following scientific methods were used in preparing the article: analysis and synthesis – for studying scientific literature, legal acts of Ukraine and the EU on nature protection and the nature reserve fund; comparative legal method – for determining the similarities and differences between nature protection systems in Ukraine and the EU countries; cartographic method – for spatial visualisation of the network of protected areas; statistical method – for summarising quantitative indicators.

In accordance with the Law of Ukraine "On the Nature Reserve Fund of Ukraine" (No. 858-IV, 1992, June 16), the nature reserve fund consists of land and water areas, natural complexes and objects of which have special environmental, scientific, aesthetic, recreational and other value and are allocated for the purpose of preserving the natural diversity of landscapes, the gene pool of flora and fauna, maintaining the overall ecological balance and ensuring background monitoring of the environment.

## 1. Current state and assessment of institutional risks to the functioning of Ukraine's nature reserve fund objects under wartime conditions

In this regard, Ukrainian legislation protects the nature reserve fund as a national treasure, subject to a special regime of protection, reproduction, and use. Ukraine considers this fund as an integral part of the global system of natural areas and objects under special protection.

According to Article 1 of the Law of Ukraine No. 858-IV (1992, June 16), the task of the legislation of Ukraine on the Nature Reserve Fund of Ukraine is to regulate social relations regarding the organization, protection and use of territories and objects of the Nature Reserve Fund, the reproduction of their natural complexes, and management in this area.

Protected areas are the most crucial link in forming an ecological network, which entails changes in the structure of the city's land fund. This is achieved by reclassifying (based on environmental safety and economic expediency justifications) a portion of commercially used lands into categories subject to special protection, while restoring the inherent diversity of their natural landscapes.

The Nature Reserve Fund of Ukraine comprises 8512 territories and objects with a total area of 4.418 million hectares within the territory of Ukraine (actual area of 4.085 million hectares) and 402 500.0 hectares within the Black Sea aquatory (Ministry of Environmental Protection and Natural Resources of Ukraine, n.d.). During 2015–2023, the total area of Ukraine's nature reserve fund grew steadily by over 380 thousand hectares. This raised the country's overall conservation rate from 6.3% to 6.93%, primarily driven by objects of national importance. However, the share of nature reserve lands in Ukraine remains insufficient and significantly lower than in most European Union member states, where the average proportion of such lands reaches 21% of their total territory (*Table 1*).

*Table 1*

Characteristics of the nature reserve fund of Ukraine

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023
Area of territories and objects of the nature reserve fund, thousand ha	3803.13	3985.60	3985.02	3991.64	4082.2	4105.5	4117.6	4173.02	4183.71
The area of territories and objects of the nature reserve fund in the Black and Azov Seas, thousand hectares	612.8	612.8	612.8	612.8	625.9	627.6	627.6	627.6	627.6
Area of territories and objects of the nature reserve fund in mountainous regions, thousand hectares	656.72	657.15	658.80	659.24	683.80	717.22	766.25	774.85	780.46
Share of the area of territories and objects of the nature reserve fund in the total territory of the country, %	6.3	6.6	6.6	6.61	6.76	6.80	6.82	6.91	6.93

End of Table 1

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023
Share of the national ecological network in the total territory of the country, %	38.16	38.16	38.16	38.16	38.16	38,17	38.17	38.17	3817
Area of the nature reserve fund of national importance, % of the country's territory	3.72	4.10	4.10	4.10	4.24	4.27	4.27	4.35	4.35
Area of territories and objects of the nature reserve fund of coastal regions, % of the territory of coastal regions	5.81	5.82	5.82	5.84	5.93	6.69	6.69	7.09	7.09

Source: compiled by the authors based on State Statistics Service of Ukraine (n.d.)

According to Article 3 of the Law of Ukraine No. 858-IV (1992, June 16), the nature reserve fund of Ukraine includes: natural territories and objects; artificially created objects; reserves, natural monuments, botanical gardens, dendrological parks, zoological parks and parks-monuments of landscape art.

As of early 2022, more than half (62.7%) of the total area of the nature reserve fund of Ukraine was occupied by territories and objects of national significance. These included 19 nature reserves and 5 biosphere reserves; 53 national nature parks (31%); 328 nature sanctuaries (32%); 136 natural monuments; 85 regional landscape parks; 18 botanical gardens; 20 dendrological and 7 zoological parks; and 90 parks-monuments of landscape architecture. The total area of the nature reserve fund territories of national significance amounts to 2 977 006.19 hectares, while those of local significance cover 1 910 517.58 hectares (*Figure 1*).

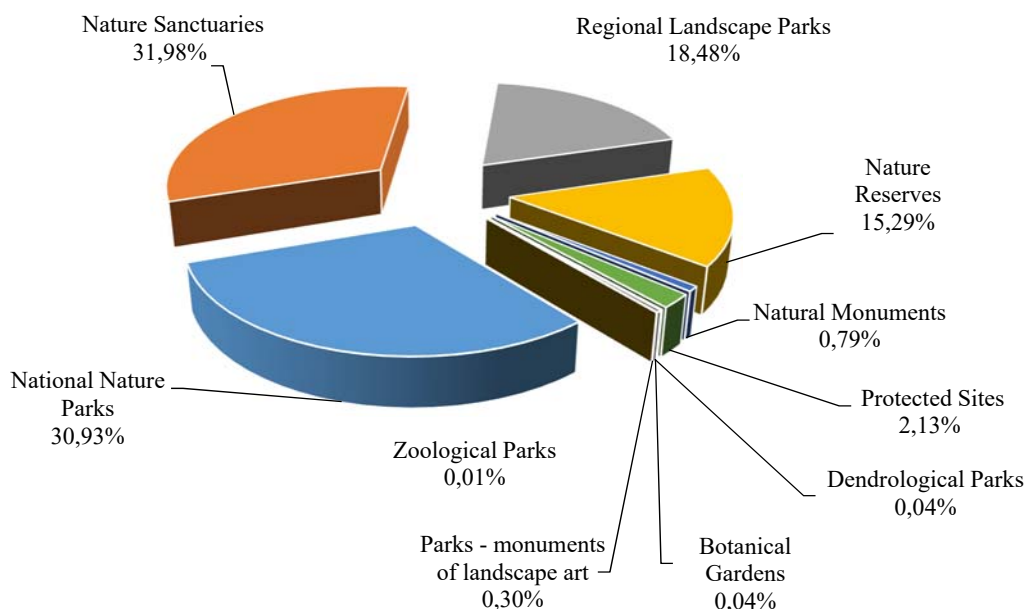


Figure. 1. Structural distribution of objects of the nature reserve fund of Ukraine\*

\* Source: compiled by the authors based on Ministry of Environmental Protection and Natural Resources of Ukraine (2020).

The Law of Ukraine No. 2697-VIII (2019, February 28) aimed at ensuring the sustainable development of Ukraine's natural resource potential, envisions an increase and expansion of the nature reserve fund territories to 9095.1 thousand hectares of protected areas by 2030 (specifically, including core protection zones within national nature parks and regional landscape parks). It further establishes the creation – on land and within the waters of the Black and Azov Seas – and ensures the conservation and proper functioning of a representative, effectively managed system of nature reserve fund territories and objects, including transboundary sites and those of European and international significance.

## **2. Analysis of EU nature conservation systems and Instruments for adapting European practices in Ukraine**

The European Union is currently one of the world's leaders in international environmental cooperation. At the same time, the EU's environmental policy and activities are, in general, inextricably linked to global environmental protection measures, including those carried out under the auspices of the United Nations (Kyryliuk & Bondarenko, 2022; Koshkalda et al., 2024).

First of all, it should be noted that a country such as Germany has extensive and positive experience with nature reserves, which may be important for Ukraine as well. First, Germany has the skills to protect privately owned natural areas. Secondly, Germany, like Ukraine, is a country with a so-called continental legal system, i.e. the provisions of its legislation are more suitable for adoption into Ukrainian law than the provisions of any country with an Anglo-Saxon legal system.

According to German Federal Law, the declaration of the protection of a part of nature and landscape defines the object of protection, its purpose, the requirements and prohibitions necessary to achieve the purpose and, where appropriate, measures for the care, development, restoration or contains the relevant powers in this regard. The form and procedure of protection, the significance of violations of the form and procedure, and the possibilities for their correction, as well as the preservation of the regime of already protected parts of nature and landscape, are determined by the law of individual federal states of Germany.

It should be noted that, in most cases, the land within protected areas is privately owned. The declaration of a protected area does not lead to the termination of ownership of the land plot, but certain restrictions on the use of the land plot are introduced by adopting a relevant legal act. The general legal basis for this is the social function of property provided for by the German Constitution.

Once a protected area is declared, information about the protected area is entered by the environmental authority into the registers maintained by the federal state's environmental, boundary and nature conservation office. The institution publishes the consolidated register and its amendments in electronic form, and lower-level environmental authorities ensure that everyone can access them (Tucker et al., 2023; Lehn & Bahrs, 2018).

In Germany, protected areas must be designated and taken into account in urban planning documents, such as the master plan of a municipality (Bauleitplanung) and building plans (Bebauungsplänen). In this case, we are talking about the so-called "notification-based consideration" ("nachrichtliche 38 Übernahme"). This term refers to the principle in Germany that urban planning documentation only reflects the legal regime of the protected area. Thus, the relevant provisions are binding only in connection with the act declaring the area a protected area. The expiry or amendment of the act on the basis of which a certain territory was granted the status of a protected area necessitates the reflection of this event in urban planning documentation. The positive effect of this approach is that there is a clear rule for avoiding conflicts between different types of documentation regulating land use: the act declaring a protected area and urban planning documentation (Mühlen & Yavuz).

Forest ecosystems are the most valuable and numerous component of all forms of nature protection, covering 33% of the country's land area. Almost half (43.6%) of the country's protected areas are forests. The area covered by forests is 9 million hectares, which corresponds to a forest cover of 28.8%. The stock of commercial timber in forests of all forms of ownership is 1.86 billion m<sup>3</sup>. The threat from abiotic, biotic and anthropogenic factors to Poland's forests is one of the largest in Europe.

Most biodiversity protection sites are localised on the territory of state forests. According to the Act on Forests and Forest Policy of the State, all valuable forms of biodiversity are inventoried in state forests.

The state forests have created: 1182 nature reserves with a total area of 106 302 ha, including 66 strictly protected reserves with a total area of 2939 ha; 10 144 natural monuments (8023 single trees, 1316 groups of trees, 156 alleys, 478 stones, 171 rocks, grottoes, caves), including 125 monuments with a total area of 267.68 ha; 8618 ecological objects with a total area of 26 681 ha; 186 ecological points with a total area of 695 ha; 89 natural landscape complexes with a total area of 31 044 ha.

It should be noted that private forestry is highly fragmented. On average, there are 1.43 hectares of forest per owner (in some EU countries, from 30 to 60 hectares). Private forests are often part of agricultural enterprises. Out of 839 thousand private owners, more than 523 thousand (62.3%) have less than 1 hectare of forest, and only 4.2% have more than 5 hectares. The state of private forests is a cause for concern. The main problems remain fragmentation, low management, and often neglect. The issue of providing adequate financial and advisory support for private forest owners and strengthening control over the management of private forests is relevant (Strzelecka et al., 2021).

The countries of the European Union have committed themselves to creating a network of protected areas "Nature 2000" in order to preserve the natural heritage in a natural or close to natural state. In Poland, 72 Special Protection Areas (SPAs) with a total area of 3312 thousand hectares, including 2414.2 thousand hectares on land, were approved under this

programme, and 184 Special Protection Areas (SPAs) with an area of 1135.3 thousand hectares were submitted to the Directorate-General for the Environment under the European Commission. Most of the sites of the Nature 2000 network, especially the SPAs, are located or planned in forest areas, mainly in state forests (Tucker et al., 2021).

There are 47 national parks in Norway, 40 of which are on the mainland and 7 on Svalbard. National parks in Norway are stricter than in many other countries, and almost all motorised vehicles are prohibited. The freedom to roam is extended, so hiking, skiing and camping are allowed throughout the park. Roads are located outside the national parks. The parks are managed by the Norwegian Directorate of the Environment and the local county governor.

At least 60% of Norway's land area is covered by mountains, lakes or marshes (uncultivated land, some of which is used as pasture); 37% is forests of various types; and only 3% is arable land. It is estimated that between 1900 and 2003, areas more than 5 km away from intensive construction activity in Norway decreased from 48% to 12%.

Until about a hundred years ago, there were relatively few threats to ecosystems in Norway. The first initiatives to protect the land were launched in 1904 by Ingvar Nielsen, the leader of the Norwegian Mountain Hikers' Association (DNT). The association continued to lobby in 1923 and 1938. The Nature Conservation Act of 1954 prepared the legal basis for the establishment of protected areas, and the first two national parks were established in 1962 and 1963. The 1954 law also established the Statens naturvernråd ("Government Council for Nature Conservation") as an advisory body to the government. The Council presented a project for further nature protection in 1964, proposing 16 national parks. These proposals were approved by the Storting. It took 25 years, until 1989, for 15 of their proposals to be implemented. The 16th proposal was a nature reserve. The Council submitted another proposal in 1986 and this was approved by the Storting in April 1993. After this approval, a "second generation" of national parks was created in 2001, along with boundary extensions to the old ones.

The post-industrial era, which began in the late 1960s, saw areas protected as national parks or other protected status as a means of regulating the construction of holiday homes, roads, fishing, hunting and harvesting of plants. This trend has accelerated over the past 10 years. In addition to preserving rare plant and animal environments, areas are protected to maintain landmarks for environmental research, recreational resources for Norwegians and as a heritage for future generations. The Directorate of Nature Management maintains indicators of nature's health in Norway, including measures of biodiversity, erosion, and pollution.

Most national parks are open for hiking, cross-country skiing and camping. Most of them have a limited number of overnight stays.

In addition to national parks, the Norwegian government has designated larger areas for protection. These areas include 153 landscapes covering 14 071 km<sup>2</sup>; 1701 nature reserves covering 3418 km<sup>2</sup>; 24 national parks

covering 21 650 km<sup>2</sup>; 102 nature memorials; and 98 smaller protected areas. This makes up 12.1% of Norway's mainland area (Norwegian Environment Agency, 2021; Fauchald & Gulbrandsen, 2012).

As of April 2022, as a result of the Russian Federation's military actions against Ukraine, the environmental safety of about a third of the area of all protected areas of the state has been violated. Ukrainian biodiversity is under threat of destruction (Figure 2).

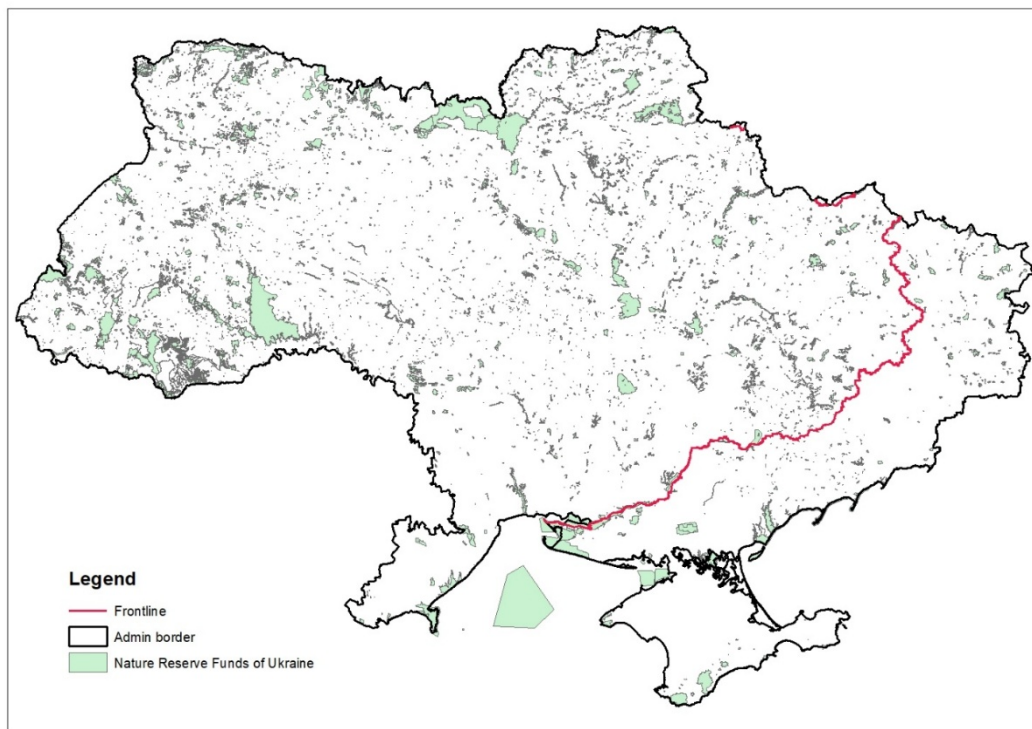


Figure 2. Geoinformation model of the distribution of objects of the nature reserve fund of Ukraine, including those that are temporarily occupied

Source: compiled by the authors using ArcGIS software based on data from the Ministry of Environmental Protection and Natural Resources of Ukraine (n.d.).

It is worth noting that the country's protected areas are an important part of the European nature protection network, which is protected under the European Union (EU) and the Council of Europe. There are 900 protected areas with a total area of 1.2 million hectares under environmental threat. As a result of the hostilities, 14 Ramsar sites (a total area of 397 700 hectares) and 200 areas of the Emerald Network in the country (2.9 million hectares) and Europe as a whole are also under threat of destruction.

The damage to the Ukrainian nature reserve fund (NRF) caused by the war is estimated at USD 15 billion. At the same time, the cost of restoration is currently impossible to estimate: hundreds of thousands of species listed in the Red Book have been lost, and at least 2.5 million hectares of protected areas are under threat of destruction. Given this, the environmental factor is among the top 3 most important when planning restoration measures, along with the economic and demographic factors.

According to the study, out of 80 protected areas, 25 are located in the temporarily occupied territories. In these areas, the enemy deploys military equipment and engages in poaching. In addition, some of them are flooded, and fires periodically break out on others. As a result, nearly 10 million trees and 75 000 wildlife specimens have been destroyed or damaged. And the damage caused by soil contamination with ammunition amounts to almost USD 12 million, and the destruction of Red Book species of flora and fauna – almost USD 15 million (Vasyliuk et al., 2026).

The environmental aspect of restoration can be considered one of the most important and, at the same time, the most difficult in rebuilding Ukraine, as this process can take from several decades to hundreds of years.

### **Conclusions**

The comparative analysis fully validated the hypothesis: the adaptation of European instruments – specifically Germany’s zoning models, Poland’s forest management systems, and Norway’s community engagement practices – demonstrates that digitalization and management decentralization are key prerequisites for overcoming Ukraine’s wartime institutional and financial deficits.

The study has shown that Ukraine has strong potential to expand and optimize its nature reserve fund, but implementing nature conservation policy requires significant improvement at both the legislative and managerial levels.

A comparative analysis with the EU system has identified successful practices that can be adapted in Ukraine: integrating the Natura 2000 network, increasing the role of communities in nature conservation, using digital monitoring technologies, and implementing environmental education programs.

To ensure effective environmental protection, it is important to ensure adequate funding, a clear definition of protected area status, and the creation of effective control mechanisms, including the use of geographic information systems.

In the context of current threats, including military operations, environmental protection is becoming even more important, and cooperation with European partners can drive the sustainable development of Ukraine’s environmental sector.

Prospects for further research in this area include a detailed analysis of financial valuation mechanisms for environmental damage using EU methodologies, alongside the development of applied GIS interfaces for the transboundary monitoring of protected ecosystems disrupted by wartime operations.

### **REFERENCES / СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ**

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European Environment Agency. (2026). Official website. <https://www.eea.europa.eu/en>

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Fauchald, O. K., Gulbrandsen, L. H. (2012). The Norwegian reform of protected area management: a grand experiment with delegation of authority? *Local Environ*, 17(2), 203–222. <https://doi.org/10.1080/13549839.2012.660910>

Koshel, A., & Kolhanova, I. (2023). Geoinformation support of management of lands of nature reserve fund within Kyiv region. *Land Management, Cadastre and Land Monitoring*, (4), 89–94. <https://doi.org/10.31548/zemleustriy2022.04.09>

Koshkalda, I., Dombrovska, O., Gurskienė, V., Kniaz, O., & Stoiko, N. (2024). Areas of the nature reserve fund use in the context of sustainable development. *IOP Conference Series: Earth and Environmental Science*, 1415(1), 012050. <https://doi.org/10.1088/1755-1315/1415/1/012050>

Kyryliuk, M., & Bondarenko, E. (2022). Geoinformation mapping of the nature reserve fund of Ukraine based on national geospatial data infrastructure. In *16th International Conference Monitoring of Geological Processes and Ecological Condition of the Environment* (pp. 1–5). European Association of Geoscientists and Engineers. <https://doi.org/10.3997/2214-4609.2022580060>

Law of Ukraine "On Nature Reserve Fund of Ukraine" № 858-IV (1992, June 16). <https://zakon.rada.gov.ua/laws/show/2456-12#Text>

Закон України "Про природно-заповідний фонд України" № 2456-ХІІ (1992, 16 червня). <https://zakon.rada.gov.ua/laws/show/2456-12#Text>

Law of Ukraine "On the Key Principles (Strategy) of the State Environmental Policy of Ukraine for the Period till 2030" No 2697-VIII (2019, 28 February). <https://zakon.rada.gov.ua/laws/show/2697-19#Text>

Закон України "Про Основні засади (стратегію) державної екологічної політики України на період до 2030 року" № 2697-VIII (2019, 28 лютого). <https://zakon.rada.gov.ua/laws/show/2697-19#Text>

Lehn, F., & Bahrs, E. (2018). Land-Use Competition or Compatibility between Nature Conservation and Agriculture? The Impact of Protected Areas on German Standard Farmland Values. *Sustainability*, 10(4), 1198. <https://doi.org/10.3390/su10041198>

Mikhno, P. B., Kyselov, Yu. O., Bakharev, V. S., Halchenko, N. P., Shelkovska, I. M., & Kozar, V. I. (2024). Nature reserve fund condition within Kirovohrad oblast in relation to regional development objectives. *Journal of Geology, Geography and Geoecology*, 33(3), 531–543. <https://doi.org/10.15421/112449>

Ministry of Environmental Protection and Natural Resources of Ukraine. (n.d.). <https://mepr.gov.ua/>

Міністерство захисту довкілля та природних ресурсів України. (б. д.). <https://mepr.gov.ua/>

Ministry of Environmental Protection and Natural Resources of Ukraine. (2020). *Information and analytical materials of the Ministry of Environmental Protection and Natural Resources of Ukraine on the issue "Analysis of the areas of the nature reserve fund of Ukraine by administrative-territorial units for 2020"*. <https://surl.li/anrqvc>

Міністерство захисту довкілля та природних ресурсів України (2020). *Інформаційно-аналітичні матеріали з питання "Аналіз площ природно-заповідного фонду України в розрізі адміністративно-територіальних одиниць за 2020 рік"*. <https://surl.li/anrqvc>

Mühlen, F., & Yavuz, M. A. *German planning law: Defence projects and municipal planning*. DLA Piper. <https://www.dlapiper.com/en/insights/publications/real-estate-gazette/real-estate-gazette-defence/german-planning-law>

Norwegian Environment Agency. (2021). *Protected areas in Norway: National parks, nature reserves and landscape protection areas: State of the environment report*. Miljødirektoratet. <https://www.norgesnasjonalparker.no/en/other-protected-areas/>

State Statistics Service of Ukraine. (n.d.). <i>Sustainable Development Goals: Ukraine</i> [National platform]. <a href="https://sdg.ukrstat.gov.ua/">https://sdg.ukrstat.gov.ua/</a>	Державна служба статистики України. (б. д.). <i>Цілі сталого розвитку: Україна</i> [Національна платформа]. <a href="https://sdg.ukrstat.gov.ua/">https://sdg.ukrstat.gov.ua/</a>
Strokal, V. P., Berezhniak, Ye. M., Naumovska, O. I., Vahaliuk, L. V., Ladyka, M. M., Serbeniuk, H. A., Palamarchuk, S. P., & Pavliuk, S. D. (2023). <i>The impact of Russian aggression on the state of natural resources of Ukraine</i> (V. P. Strokal, Ed.). Publishing Center of National University of Life and Environmental Sciences of Ukraine.	Строкаль, В. П., Бережніак, Є. М., Наумовська, О. І., Вагалюк, Л. В., Ладика, М. М., Сербенюк, Г. А., Паламарчук, С. П., & Павлюк, С. Д. (2023). <i>Вплив російської агресії на стан природних ресурсів України</i> (В. П. Строкаль, Ред.). Видавничий центр НУБіП України.
Strzelecka, M., Rechciński, M., Tusznio, J., Akhshik, A., & Grodzińska-Jurczak, M. (2021). Environmental justice in Natura 2000 conservation conflicts: The case for resident empowerment. <i>Land Use Policy</i> , (107), Article 105494. <a href="https://doi.org/10.1016/j.landusepol.2021.105494">https://doi.org/10.1016/j.landusepol.2021.105494</a>	
Tucker, G., Hart, K., Farmer, A., Dunn, E., & Baldock, D. (2023). Nature conservation policy, legislation and funding in the EU. In G. Tucker (Ed.), <i>Nature conservation in Europe: Approaches and lessons</i> (pp. 59–105). Cambridge University Press. <a href="https://doi.org/10.1017/9781108654647.006">https://doi.org/10.1017/9781108654647.006</a>	
Valerko, R. A., Dobrovolskyi, S. K., & Khmelnytskyi, S. A. (2023). Assessment of fire damage in the conditions of the nature reserve fund. <i>Taurida Scientific Herald</i> , (129), 263–269.	Валерко Р. А., Добровольський С. К., Хмельницький С. А. (2023) Оцінка збитків від пожеж в умовах природно-заповідного фонду. <i>Таврійський науковий вісник</i> , (129), 263–269.
Vasyliuk, O. V., Temchenko, Ye. A., Hubareva, V. R., Parkhomenko, V. V., & Kolomytsev, H. O. (2026). <i>Nature reserve fund of Ukraine: Consequences of the full-scale war</i> (V. V. Kolodezhna, Ed.). Druk Art. (Conservation Biology in Ukraine, Issue 46).	Василюк, О. В., Темченко, Є. А., Губарева, В. Р., Пархоменко, В. В., & Коломицев, Г. О. (2026). <i>Природно-заповідний фонд України: наслідки повномасштабної війни</i> (В. В. Колодежна, ред.). Друк Арт. (Conservation Biology in Ukraine, Вип. 46).
Vasyliuk, O., Hubareva, V., & Parkhomenko, V. (2024). <i>Environment of Crimea: Changes and losses during the full-scale war</i> . NGO CrimeaSOS. <a href="https://surl.li/uocssk">https://surl.li/uocssk</a>	Василюк, О., Губарева, В., & Пархоменко, В. (2024). <i>Довкілля Криму: зміни та втрати в період повномасштабної війни</i> . ГО КРИМСОС. <a href="https://surl.li/uocssk">https://surl.li/uocssk</a>

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Bavrovska, N., Kolhanova, I., & Koshel, A. (2026). Conservation and restoration of Ukraine's nature reserve fund under martial law: a European development vector. *Commodity science. Technologies. Engineering*, 1(57), 4–16. [https://doi.org/10.31617/2.2026\(57\)08](https://doi.org/10.31617/2.2026(57)08)

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