

Transformation of habitats of birds listed in the Red Data Book of Ukraine in the de-occupied territories of the nature reserve fund in the north and northeast of the country as a result of the russian-Ukrainian war

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abstract

The article analyses habitat transformation affecting rare bird species in de-occupied protected areas (NRF) of northern and north-eastern Ukraine, which are critical for avifaunal life cycles. The study covers eight sites with a total area of 424,414 hectares that were severely impacted by the full-scale russian invasion in 2022. It evaluates the condition of ecosystems after the liberation of territories that had been under temporary occupation. Because of extensive mine contamination, unexploded ordnance, and strict security restrictions, conventional fieldwork and standard bird census techniques were not feasible. Therefore, the study applies an integrated methodological approach combining remote monitoring with retrospective data analysis. This includes long-term monitoring records from reserve scientific departments, data from the Red Data Book of Ukraine, high-resolution satellite imagery, and operational fire monitoring systems (notably EFFIS). Such an approach enabled comparison between pre-war ecological baselines and the large-scale landscape transformations that occurred during the occupation period. The findings reveal profound and unprecedented impacts on biodiversity. Key drivers include extensive habitat destruction caused by artillery shelling and large-scale fires. For example, 3,200 hectares burned in the Drevlyansky Nature Reserve, while more than 22,171 hectares were affected in the Chernobyl Exclusion Zone, including critical nesting habitats and migratory stopover sites for rare bird species. Persistent disturbance from explosions, heavy military equipment, and low-altitude aircraft resulted in mass abandonment of breeding sites and widespread reproductive failure in 2022. Additionally, gamekeeper reports documented cases of poaching by occupying forces. Long-term ecological risks are further intensified by landmine contamination and the construction of fortifications, which have damaged soil cover. In areas such as the Chernobyl zone, this has also contributed to local increases in radiation exposure. Comprehensive monitoring of species populations and the development of restoration strategies are urgently required; however, their implementation will only be possible after complete demining and mitigation of the environmental damage caused by the war.

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Трансформація середовищ існування птахів, занесених до Червоної книги України, на деокупованих територіях природно-заповідного фонду на півночі та північному сході країни внаслідок російсько-української війни

Вадим Яненко

Резюме. Стаття присвячена аналізу трансформації місць існування рідкісних видів птахів на деокупованих територіях природно-заповідного фонду (ПЗФ) півночі та північного сходу України, що мають важливе значення для життєвих циклів орнітофауни. Дослідження охоплює вісім об'єктів ПЗФ загальною площею 424 414 га, які постраждали внаслідок повномасштабного вторгнення російської федерації у 2022 році. У роботі розглядається стан екосистем після визволення територій, що перебували під тимчасовим контролем агресора. Через надзвичайно високу щільність мінування, наявність вибухонебезпечних предметів та відповідні безпекові обмеження, повноцінні польові експедиції та класичні методи обліку птахів наразі були неможливі. Тому наш методологічний підхід базувався на поєднанні дистанційних методів моніторингу та аналізі ретроспективних архівних матеріалів. Зокрема, використовувалися багаторічні дані моніторингових обліків наукових відділів заповідників, відомості Червоної книги України, а також супутникові знімки високої роздільної здатності та оперативні дані систем моніторингу пожеж (зокрема EFFIS). Це дозволило зіставити довоєнний екологічний стан територій із масштабними змінами ландшафтів, що сталися за час окупації. Дослідження демонструє, що бойові дії спричинили безпрецедентні негативні наслідки для біорізноманіття. Серед ключових факторів впливу виділено масштабну руйнацію біотопів внаслідок артилерійських обстрілів та пожеж. Зокрема, зафіксовано вигорання 3200 га територій у Древланському природному заповіднику, а в Чорнобильській зоні відчуження вогнем було знищено понад 22 171 га територій, що є важливими місцями гніздування та передміграційних зупинок для багатьох рідкісних видів птахів. Окрім того, постійні звуки вибухів, пересування важкої військової техніки та низькі польоти авіації змушували птахів масово покидати місця гніздування, що призвело до провалів у репродуктивних циклах у 2022 році. Окрім того, працівниками егерських служб, були відмічені випадки браконьєрського відстрілу тварин окупаційними військами. Забруднення територій вибухонебезпечними предметами, риття фортифікаційних споруд (окопів), які в зоні ЧАЕС та на території Древланського природного заповідника, призвели до порушення ґрунтового покриву та локального підвищення радіаційного фону, створює довгострокові екологічні ризики. На сьогодні, повноцінний моніторинг стану популяцій та розробка стратегій їх відновлення на деокупованих територіях є надзвичайно актуальним завданням, проте їх практичне виконання можливе виключно після повного розмінування та ліквідації наслідків екологічної катастрофи, спричиненої агресором.

Ключові слова: орнітофауна, деокупація, природно-заповідний фонд, російсько-українська війна.

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Introduction

The russian-Ukrainian war, which began in the eastern regions of Ukraine in 2014, transformed into a full-scale, high-intensity war in February 2022. Throughout 2022–2023, as a result of successful counter-offensive operations, a number of regions in the north, east, and south of the country that had been under the temporary control of the aggressor were liberated (Fig. 1). Currently, the active phase of liberating the occupied territories continues.

As of today, the efforts of the Armed Forces of Ukraine have led to the de-occupation of territories that are of critical importance for the preservation of the avifauna. In particular, this concerns eight objects of the nature reserve fund (NRF) with a total area of 424,414 hectares (<https://pzf.land.kiev.ua/>). These territories play a key role in supporting the life cycle of birds, serving as sites for nesting, molting, and resting during seasonal migrations (Fig. 2).

In these territories, we focused particular attention on monitoring endangered bird species listed in the Red Data Book, whose populations were already a cause for serious concern before the onset of hostilities. Under the conditions of full-scale war, these species have faced the threat of total extinction due to the destruction of ecosystems and constant disturbance factors.

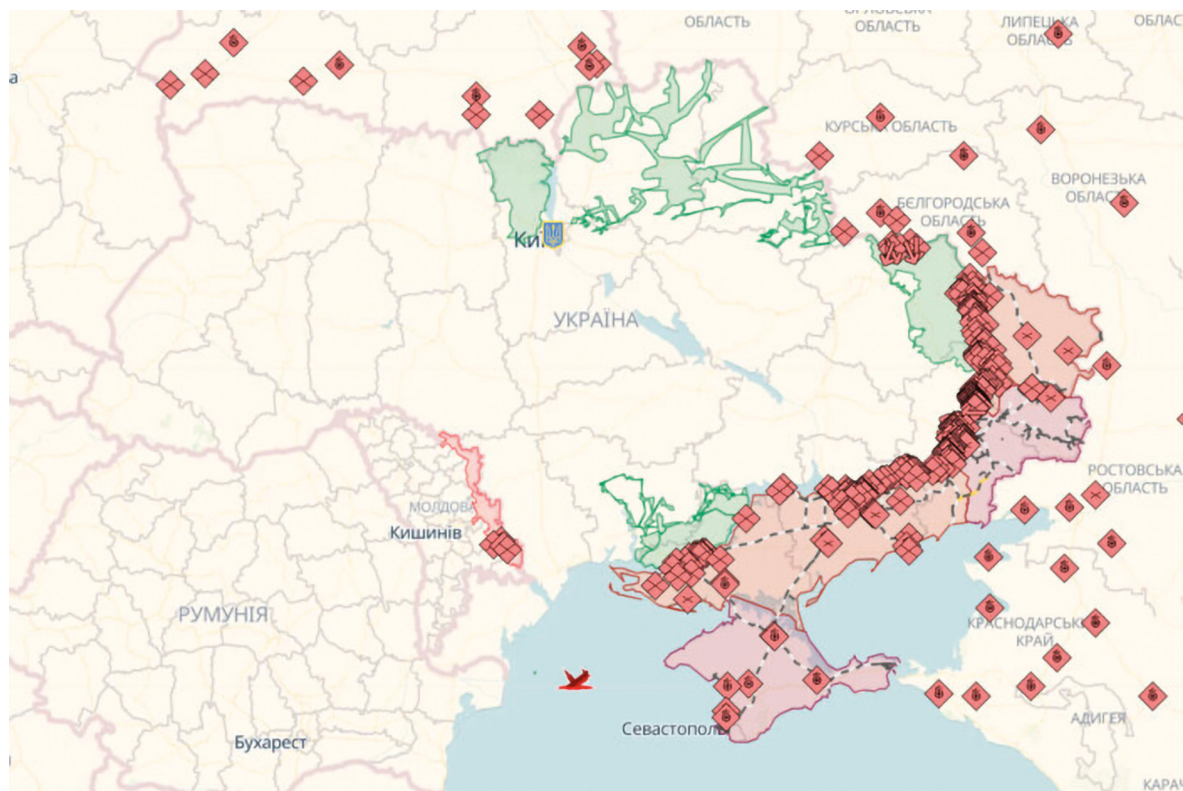


Fig. 1. Map of Ukraine with marked territories: green — de-occupied territories, red — territories under occupation from 2014–2022. (<https://glavcom.ua/country/incidents/onlajn-karta-bojovikh-dij-v-ukrajini-na-26062024-situatsija-na-fronti-1006991.html>).

Рис. 1. Карта України з позначеннями територій: зеленим кольором — деокуповані території, червоним кольором — території під окупацією у 2014–2022 рр. (<https://glavcom.ua/country/incidents/onlajn-karta-bojovikh-dij-v-ukrajini-na-26062024-situatsija-na-fronti-1006991.html>).

The objects of study are the avifauna and ecosystems of eight objects of the Nature Reserve Fund (NRF) of Ukraine with a total area of 424,414 ha, which were de-occupied in 2022 and play a critical role in ensuring the life cycle of birds (nesting, molting, resting during migrations and wintering).

Research methods

To assess the transformation of habitats for rare bird species listed in the Red Data Book of Ukraine, a methodology of remote sensing and analytical research was applied, as full-scale field expeditions in the de-occupied territories were rendered impossible due to the high density of landmines and safety risks. The baseline for the assessment consisted of retrospective data: archival materials from the scientific departments of NRF institutions (Chronicles of Nature), results of long-term monitoring censuses up to 2022 (scientific publications), and information from the Red Data Book of Ukraine. The assessment of changes in the state of the avifauna and the degree of biotope degradation was carried out by combining remote sensing data collected during 2022–2024. The methodology included the analysis of up-to-date satellite imagery, monitoring of fire hotspots (based on data from systems such as EFFIS), and a comparison of the current state of the territories with pre-war ecological characteristics.

In parallel, reports of the administrations of national parks and reserves on infrastructure damage, the state of forest massifs, and the results of visual monitoring conducted by the institutions' employees after de-occupation were processed. Comparing these data with pre-war ecological characteristics allowed us to assess the losses of areas suitable for nesting and the general transformation of

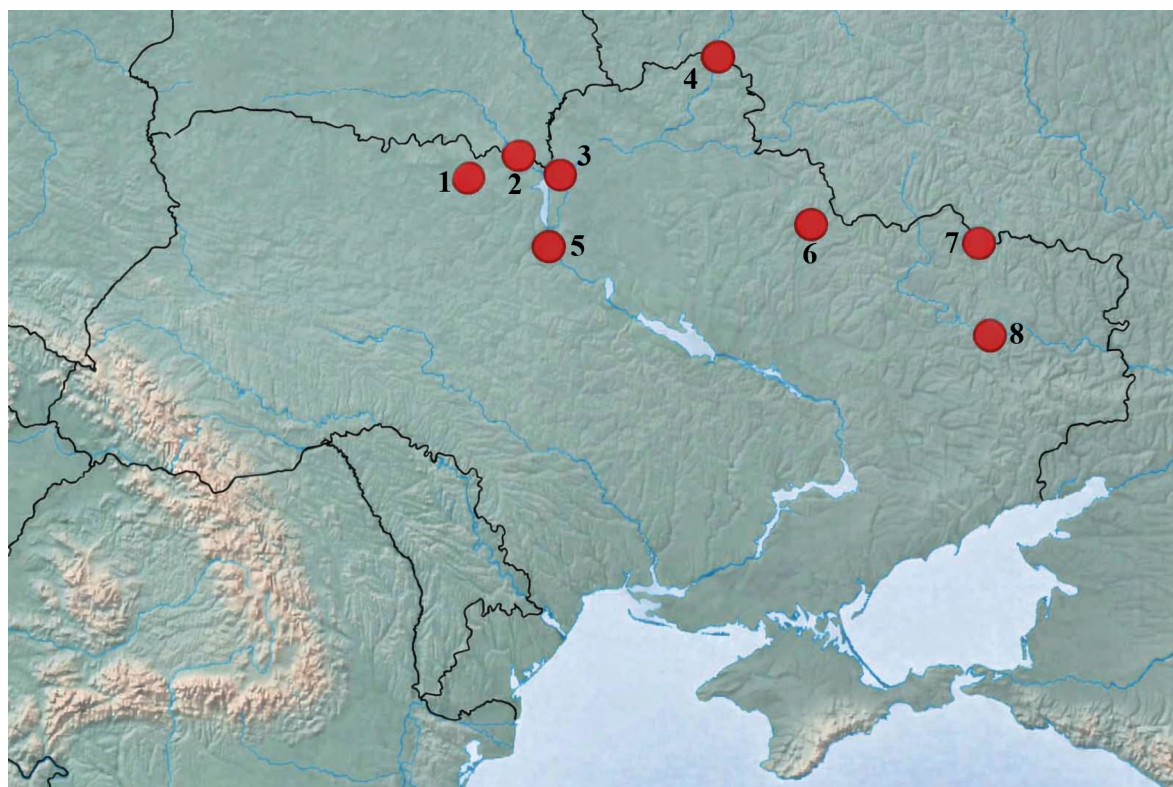


Fig. 2. Nature Reserve Fund objects of critical importance for birds that were de-occupied in 2022: 1 — Drevlianskyi Nature Reserve; 2 — Chornobyl Radiation-Ecological Biosphere Reserve; 3 — Mizhrichynskyi Regional Landscape Park; 4 — Desniansko-Starohutskyi National Nature Park; 5 — Holosiivskyi National Nature Park; 6 — Hetmanskyi National Nature Park; 7 — Dvorichanskyi National Nature Park; 8 — Sviati Hory National Nature Park.

Рис. 2. Об'єкти природно-заповідного фонду, важливі для птахів, що були деокуповані у 2022 р.: 1 — Древліанський природний заповідник; 2 — Чорнобильський радіаційно-екологічний біосферний заповідник; 3 — Міжрічінський регіональний ландшафтний парк; 4 — Деснянсько-Старогутський національний природний парк; 5 — Голосіївський національний природний парк; 6 — Гетьманський національний природний парк; 7 — Дворічанський національний природний парк; 8 — Національний природний парк «Святі Гори».

populations of rare bird species, without exposing researchers to the danger associated with physical presence in zones that require demining.

The taxonomy follows Stepanyan (1990), and the species names are given according to the annotated list of Ukrainian scientific names (Fesenko & Bokotey, 2007).

Results

Below, we present the objects of the Nature Reserve Fund that fell under russian occupation, with a brief description of their territory and the composition of their Red Data Book avifauna, as well as the consequences of this occupation.

1. Drevlianskyi Nature Reserve. The nature reserve is located in the Korosten district of the Zhytomyr Oblast (Fig. 2). Its territory borders the Chornobyl zone and, as a result, is contaminated with radionuclides. Forests cover almost half of the reserve, primarily pine forests, with small patches of birch, black alder, and oak. The hydrographic network of the reserve consists of the Uzh River with its tributaries, as well as a number of lakes, swamps, and ponds. River floodplains are occupied by large meadows.

The avifauna of the reserve numbers 106 species of nesting birds, among which the most common are: barn swallow *Hirundo rustica* Linnaeus, 1758, common starling *Sturnus vulgaris* Linnaeus, 1758,

sand martin *Riparia riparia* (Linnaeus, 1758), common chaffinch *Fringilla coelebs* Linnaeus, 1758, mallard *Anas platyrhynchos* Linnaeus, 1758, common wood pigeon *Columba palumbus* Linnaeus, 1758, red-backed shrike *Lanius collurio* Linnaeus, 1758, whinchat *Saxicola rubetra* (Linnaeus, 1758), Eurasian blackcap *Sylvia atricapilla* (Linnaeus, 1758), and common cuckoo *Cuculus canorus* Linnaeus, 1758 (Kostiushyn, 2021).

Nine bird species listed in the Red Data Book of Ukraine (Akimov, 2009) have been recorded in the territory of the Drevlianskyi Nature Reserve: short-toed snake eagle *Circaetus gallicus* (Gmelin, 1788), booted eagle *Hieraetus pennatus* (Gmelin, 1788), gadwall *Anas strepera* Linnaeus, 1758, lesser spotted eagle *Clanga pomarina* Brehm, 1831, Montagu's harrier *Circus pygargus* (Linnaeus, 1758), black stork *Ciconia nigra* (Linnaeus, 1758), common crane *Grus grus* (Linnaeus, 1758), stock dove *Columba oenas* Linnaeus, 1758, and great grey shrike *Lanius excubitor* Linnaeus, 1758. All the above-mentioned species were recorded during the breeding and post-breeding periods (Kostiushyn, 2021).

The territory of the Drevlianskyi Nature Reserve was one of the first to fall under the occupation of the Russian Federation's armed forces. De-occupation of the reserve's territory by the Ukrainian armed forces took place in early April 2022. During this time, the reserve was subjected to massive shelling from tanks, artillery, aircraft, and helicopters. As a result of active hostilities, 3,200 hectares of the reserve's territory burned down (<https://zmina.info/news/rosijski-okupanty-znyshhyly-45-ga-pyrodno-go-zapovidnyka-drevlyanskyj/>). Since the beginning of the full-scale invasion, animals, including birds, have been forced to migrate to adjacent territories – into the Republic of Belarus — due to the noise of explosions. Reserve staff noted repeated cases of poaching, where Russian military personnel shot animals and birds for amusement. Facts of animals detonating anti-personnel mines have been recorded (<https://www.ukrinform.ua/rubric-regions/3497257-vijna-v-zapovidniku-drevlanskij-pozezi-mini-ta-radiacia.html>).

Today, the territory of the Drevlianskyi Nature Reserve remains mined and contaminated with military ammunition, remnants of military equipment, excavated trenches, and remnants of military strongholds. For a detailed assessment of the damage caused to the park's avifauna, it is necessary to plan future studies, which are extremely relevant and possible only if the territory is completely cleared of explosive devices.

2. The Chornobyl Radiation and Ecological Biosphere Reserve is located within the Ivankiv and Poliske districts of the Kyiv Oblast, inside the Chornobyl Nuclear Power Plant Exclusion Zone (Fig. 2). It is the largest unit of the nature reserve fund in Ukraine and one of the most important territories for birds. According to various authors, 233–253 bird species have been recorded within the reserve (Gashchak *et al.*, 2006; Domashevsky, 2024). Among them, the nesting of 163 species has been confirmed, with an additional five species potentially nesting there (Domashevsky, 2024). During the winter, the reserve's habitats serve as a refuge for 65 bird species (Gashchak *et al.*, 2006). According to the latest data, 41 of the aforementioned species are listed in the Red Data Book of Ukraine (Akimov, 2009), and 42 species are expected to be included in its next edition (Domashevsky, 2024).

Prior to the full-scale invasion of Ukraine by the Russian Federation on February 24, 2022, and specifically before the occupation of the Chornobyl Radiation and Ecological Biosphere Reserve, the following species nested there: more than 20 pairs of the black stork *Ciconia nigra* (Gashchak, 2002); 18 breeding stations of the western capercaillie *Tetrao urogallus* Linnaeus, 1758, with a population not exceeding 30–40 individuals (Gashchak & Yastremsky, 2019; Domashevsky, 2024). The reserve hosts arguably the largest population of the black grouse *Lyrurus tetrix* Linnaeus, 1758 in Ukraine, with flocks of up to 70 individuals observed in winter (Domashevsky, 2024). The hazel grouse *Tetrastes bonasia* Linnaeus, 1758 is uncommon in the reserve during the nesting season (Domashevsky, 2024).

Rare and endangered diurnal birds of prey recorded include: the hen harrier *Circus cyaneus*; the Montagu's harrier *Circus pygargus* — up to 10 breeding pairs (Gashchak *et al.*, 2006); the short-toed snake eagle *Circaetus gallicus* — 4–6 breeding pairs (Domashevsky, 2024); the greater spotted eagle (*Clanga clanga*) — five breeding pairs; the lesser spotted eagle *Clanga pomarina* — 10 breeding

pairs (Domashevsky *et al.*, 2012; Domashevsky, 2024); and the white-tailed eagle *Haliaeetus albicilla*. Estimates for the breeding population of the latter vary by author: from four–six pairs (Legeyda *et al.*, 1996), to five (Gashchak *et al.*, 2006), up to eight pairs (Panov, 2004), with the latest data indicating 10–14 breeding pairs (Domashevsky *et al.*, 2012; Domashevsky & Gashchak, 2022; Domashevsky, 2024).

Nocturnal birds of prey recorded as nesting include: the Eurasian eagle-owl *Bubo bubo* (Linnaeus, 1758) — 10–15 breeding pairs; the short-eared owl *Asio flammeus* (Pontoppidan, 1763) — up to three breeding pairs; and the great grey owl *Strix nebulosa* Forster, 1772 — from five to 15 breeding pairs (Domashevsky *et al.*, 2012; Domashevsky, 2024). The uniqueness of this territory for birds also lies in its absolute protected status and the absence of human interference. The whooper swan *Cygnus cygnus* (Linnaeus, 1758) has been recorded nesting here, making it one of the few nesting sites for this species in Ukraine (Gashchak *et al.*, 2006). Other species recorded include the Eurasian oystercatcher *Haematopus ostralegus* Linnaeus, 1758 — up to three breeding pairs; the stock dove *Columba oenas* — up to five pairs; and the European roller *Coracias garrulus* Linnaeus, 1758 — up to 15 breeding pairs (Domashevsky & Chizhevsky, 2011; Domashevsky, 2024). The reserve's territory was occupied by the armed forces of the Russian Federation from February 24, 2022, until early April 2022. During the occupation, the reserve's territory was mined, forests were logged, and poaching occurred. Furthermore, trenches were dug in radioactively contaminated areas, which in turn increased radiation levels. Since the beginning of the full-scale invasion, over 22,171 hectares of territory vital to the reserve's rare avifauna have burned down in the Chornobyl Exclusion Zone, including approximately 14,000 hectares during the occupation, according to data from the European Forest Fire Information System (EFFIS) (<https://ecopolitic.com.ua/ua/news/nazvani-kolosalni-vtrati-dlya-pirodi-chornobilskoi-zoni-za-chas-vijni/>).

3. Mizhrichynskiy Regional Landscape Park. The Mizhrichynskiy Regional Landscape Park (RLP) is one of the largest in Ukraine, situated in the interfluvium of the Dnieper and Desna rivers within the Kozelets and Chernihiv districts of the Chernihiv Oblast (Fig. 2). Due to its vast territory and diversity of biotopes, the Mizhrichynskiy RLP is characterized by a rich avifauna. The creation of the Kyiv Reservoir and the establishment of restricted military training grounds within the park have made significant areas of the interfluvium sparsely populated. This restricted access has created ideal conditions for the survival of rare fauna species.

In total, 240 bird species have been registered within the Mizhrichynskiy RLP and its immediate surroundings, 41 of which are listed in the Red Data Book of Ukraine (Domashevsky & Grishchenko, 2011; Akimov, 2009). No fewer than 5–7 pairs of the black stork *Ciconia nigra* nest within the park, near its border in the Kyiv part of the Vydra swamp (Domashevsky & Grishchenko, 2011).

The park's territory is vital for the nesting and migration of rare diurnal and nocturnal birds of prey listed in the Red Data Book. The park hosts 8–10 breeding pairs of the black kite *Milvus migrans* in the Desna floodplain. The Montagu's harrier *Circus pygargus* is rare during the nesting season but common during migration; 2–4 pairs nest within the park. Furthermore, the area hosts 10–12 pairs of the short-toed snake eagle *Circaetus gallicus*, up to two pairs of the booted eagle *Hieraaetus pennatus*, one pair of the greater spotted eagle *Clanga clanga*, 12–15 pairs of the lesser spotted eagle *Clanga pomarina*, four pairs of the white-tailed eagle *Haliaeetus albicilla*, and one pair of the saker falcon *Falco cherrug* Gray, 1834 (Domashevsky, 2008). The Eurasian pygmy owl *Glaucidium passerinum* (Linnaeus, 1758) and the great grey owl *Strix nebulosa* have also been recorded within the park (Kuzmenko, 2003).

According to the park's game wardens service, the black grouse *Lyrurus tetrix* population within the RLP consists of 150 breeding individuals (Domashevsky & Grishchenko, 2011). The common crane *Grus grus* has been recorded nesting in forest swamps and the Desna floodplain. On the border of the Kyiv and Chernihiv Oblasts, 15–20 pairs have been registered (Grishchenko & Havryliuk, 1993, 1996). In the lower Desna region in 2007, a census recorded 14 adult and 15 juvenile individuals of

the Eurasian oystercatcher *Haematopus ostralegus* (Grishchenko & Yablonovska-Grishchenko, 2007). Since the beginning of the full-scale invasion by the Russian Federation armed forces, the territory of the Mizhrichynskiy RLP was partially occupied (only the northern areas of the park were under occupation). The occupation lasted from February to April 2022. The park was not fully occupied due to natural biotopes that hindered the movement of military equipment — swamps, the Dnieper-Desna interfluvium, and the waters of the Kyiv Reservoir. This regional landscape park suffered perhaps the least damage from the Russian occupation. However, even the limited impact of the occupation on the RLP and its avifauna cannot be fully assessed due to the mining of the de-occupied territory and its contamination with other unexploded military ordnance.

4. Desniansko-Starohutskiy National Nature Park. The park is located in the extreme north-eastern part of Ukraine, in the Shostka district of the Sumy Oblast, within the Desna River valley (Fig. 2). A total of 207 bird species have been recorded within the park, 35 of which are listed in the Red Data Book of Ukraine (Akimov, 2009). Prior to the full-scale invasion by the armed forces of the Russian Federation, up to 10 pairs of the black stork were recorded nesting in the park (Gavrys *et al.*, 2007). Among the protected ducks, the common goldeneye *Bucephala clangula* (Linnaeus, 1758) is an uncommon migrant; up to 500 individuals are recorded during spring migration, and up to 50 during the autumn (Gavrys *et al.*, 2007).

The majority of the Red Data Book species belong to diurnal and nocturnal birds of prey. The national nature park and adjacent areas host several rare species of the order Accipitriformes listed in the Red Data Book of Ukraine: the black kite *Milvus migrans* is represented by a population of five–six breeding pairs; the hen harrier *Circus cyaneus* is considered a probable breeding species, with over 20 individuals recorded during migration; the Montagu's harrier *Circus pygargus* is a rare breeding species with a population of up to 10 pairs; the short-toed snake eagle *Circaetus gallicus* is represented by two reproductive pairs; the lesser spotted eagle *Clanga pomarina* breeds in numbers of 4 pairs; the eastern imperial eagle *Aquila heliaca* Savigny, 1809 is extremely rare, with one breeding pair confirmed; and the booted eagle *Hieraaetus pennatus* is represented by two breeding pairs (Gavrys *et al.*, 2007).

The black grouse *Lyrurus tetrix* is an uncommon resident species. In 1995, 53 individuals were recorded in the park (Kliestov *et al.*, 1998). In total, during 2004–2005, there were about 50–80 black grouse in the Stara Huta forest massif. The western capercaillie *Tetrao urogallus* is an uncommon resident; currently, about 45–75 individuals reside in the Desniansko-Starohutskiy NNP (Gavrys *et al.*, 2007). The hazel grouse *Tetrastes bonasia* is also an uncommon resident. In the late 1990s, about 30 pairs were counted in the Stara Huta area (Kliestov *et al.*, 1998). In 2004–2005, a total of 155–185 individuals of this species inhabited the entire Stara Huta forest massif (Gavrys *et al.*, 2007).

The common crane *Grus grus* is a rare breeding species that inhabits various types of forest swamps within the park region. During the spring migration on the Desna in 2001, 124 individuals were recorded in 11 flocks, with the largest flock comprising 45 individuals. The breeding population in the region is 3–5 pairs (Gavrys *et al.*, 2007; Karpenko *et al.*, 1999).

The Eurasian oystercatcher *Haematopus ostralegus* is a rare breeding species inhabiting the riparian area of the Desna. An increase in the species' population and its expansion upstream along the Desna has been observed. Within the park, four to ten breeding pairs have been recorded (Gavrys *et al.*, 2007). The avifauna of protected nocturnal birds of prey is represented by the short-eared owl *Asio flammeus* — rare during breeding, with two–four breeding pairs; the boreal owl *Aegolius funereus* (Linnaeus, 1758) — a rare resident, partially nomadic bird; and the Eurasian pygmy owl *Glaucidium passerinum* — also a fairly rare resident bird (Kuzmenko, 1998; Gavrys *et al.*, 2007). Among the protected Passeriformes recorded in the park are the great grey shrike *Lanius excubitor* — rare during breeding (one–five pairs), and the redwing *Turdus iliacus* Linnaeus, 1758 — an uncommon breeding species until 2005, after which nesting was not confirmed (Gavrys *et al.*, 2007).

From the very beginning of the full-scale invasion by the Russian Federation armed forces on February 24, 2022, the park's territory was occupied until early April of the same year. During this time, the Desniansko-Starohutskyi National Nature Park suffered from active combat operations, mining, and contamination with anti-personnel mines and other munitions. Due to its direct proximity to the border, the park's territory has been regularly subjected to attacks by the Russian Federation even after liberation, continuing to this day.

5. Holosiivskyi National Nature Park. Holosiivskyi National Nature Park, located within the city of Kyiv and its surroundings, is characterized by significant heterogeneity of natural complexes. (Fig. 2). The park's central cluster (Holosiivskyi Forest, Teremky, and Bychok tracts) is represented mainly by broad-leaved forest massifs. In contrast, the southern part covers a sandy supra-floodplain terrace of the Dnieper River, dominated by pine forests and a branched hydrographic network of the Siverka River, in whose valley hygrophilous alder forest massifs have formed. The northern sector (Sviatoshynsko-Bilychanskyi massif) is represented primarily by boreal pine communities (Gavryś *et al.*, 2003).

A total of 119 bird species belonging to 17 orders and 40 families were registered in the park. The undisputed leader in terms of the number of species is the order Passeriformes with 65 species. The other orders are significantly less represented: Piciformes and Falconiformes — nine species each, Ciconiiformes and Anseriformes — five species each, Charadriiformes and Columbiformes — four species each, Gruiformes — three species, Coraciiformes — two species; all other orders are represented by only one species each (Pryadko *et al.*, 2023).

Five bird species listed in the Red Data Book of Ukraine have been registered within the park. Four of these are diurnal birds of prey: the black kite *Milvus migrans*, the hen harrier *Circus cyaneus*, the lesser spotted eagle *Clanga pomarina*, and the white-tailed eagle *Haliaeetus albicilla*. Additionally, the stock dove *Columba oenas* has been recorded within the park (Tsvelykh, 2022; Pryadko *et al.*, 2023; Davydenko, 2024; Prychepa & Kovalenko, 2025).

Due to the location of the Holosiivskyi NNP directly within the city of Kyiv, its ecosystems have experienced specific impacts from the war. In the period from February 24 to April 2, 2022, the north-western part of the park (Sviatoshynsko-Bilychanskyi massif), bordering the cities of Irpin and Bucha, was in the zone of active combat operations and partial occupation. During this time, the forest massifs suffered significant mechanical damage due to constant artillery shelling. Today, the main negative factors for the territory remain mine contamination, the presence of unexploded ordnance, and soil surface disturbance caused by dug trenches and the remains of military fortifications. This transformation of natural areas requires further monitoring to assess the potential for the recovery of the damaged forests.

6. Hetmanskyi National Nature Park. The Hetmanskyi National Nature Park, located in the southern part of the Sumy Oblast (Okhtyrka, Trostianets, and Velyka Pysarivka districts), is one of the largest protected areas in Ukraine (Fig. 2). This conservation area covers the Vorskla River valley, the lower reaches of the Boromlia and Vorsklitsia rivers, and adjacent forest massifs. The park was established on the basis of several nature reserves ("Bakirivskyi", "Klymentivskyi", "Khukhrianskyi", "Yamnyi") and the "Lyтовskyi Bir" tract (Sklyar & Knysh, 2016). About 150 bird species have been recorded within the park, 98 of which are considered rare or poorly studied. According to various data, 22 to 33 bird species encountered in the park are listed in the Red Data Book of Ukraine, including: the great white pelican *Pelecanus onocrotalus* Linnaeus, 1758, black stork *Ciconia nigra*, red-breasted goose *Branta ruficollis* (Pallas, 1769), lesser white-fronted goose *Anser erythropus* (Linnaeus, 1758), ruddy shelduck *Tadorna ferruginea* (Pallas, 1764), gadwall *Mareca strepera*, ferruginous duck *Aythya nyroca* (Güldenstädt, 1770), common goldeneye *Bucephala clangula*, red-breasted merganser *Mergus serrator*, osprey *Pandion haliaetus*, black kite *Milvus migrans*, hen harrier *Circus cyaneus*, pallid harrier *Circus macrourus* (Gmelin, 1770), Montagu's harrier *Circus pygargus*, long-legged buzzard *Buteo rufinus* (Cretzschmar, 1827), short-toed snake eagle *Circaetus gallicus*, booted eagle *Hieraaetus*

pennatus, greater spotted eagle *Clanga clanga*, lesser spotted eagle *Clanga pomarina*, golden eagle *Aquila chrysaetos* (Linnaeus, 1758), white-tailed eagle *Haliaeetus albicilla*, cinereous vulture *Aegypius monachus* (Linnaeus, 1766), saker falcon *Falco cherrug*, peregrine falcon *Falco peregrinus*, common crane *Grus grus*, Eurasian oystercatcher *Haematopus ostralegus*, marsh sandpiper *Tringa stagnatilis* (Bechstein, 1803), great snipe *Gallinago media* (Latham, 1787), Eurasian curlew *Numenius arquata*, black-tailed godwit *Limosa limosa* (Linnaeus, 1758), stock dove *Columba oenas*, short-eared owl *Asio flammeus*, great grey shrike *Lanius excubitor*, and rosy starling *Pastor roseus* (Linnaeus, 1758) (Akimov, 2009; Sklyar & Knysh, 2016; Sklyar *et al.*, 2018).

The black stork *Ciconia nigra* has been repeatedly observed within the park during the nesting season and seasonal migrations (Sklyar, 2008; Sklyar & Knysh, 2016).

Among the protected birds of prey nesting in the park are: the black kite *Milvus migrans* — a rare, possibly breeding species; the Montagu's harrier *Circus pygargus* — a rare breeding species; the long-legged buzzard *Buteo rufinus* — which has shown population growth and colonization of new territories in recent decades, with nesting first recorded in 2010 (Stativa & Knysh, 2010; Sklyar & Knysh, 2016); the booted eagle *Hieraaetus pennatus* — a rare, likely breeding species; and the lesser spotted eagle *Clanga pomarina* — a rare passage migrant and potentially a breeding species (Sklyar & Knysh, 2016).

The nesting of the common crane *Grus grus* has been documented in floodplain swamps and specific areas of the Vorskla River pine terrace. The local population is estimated at 0–23 pairs. The Black-tailed godwit *Limosa limosa* rarely nests in the wet meadows of the Vorskla floodplain, with an estimated one–two breeding pairs in the park. The stock dove *Columba oenas* has been regularly encountered in the park since 2013; nesting cannot be ruled out (Sklyar & Knysh, 2016). All other protected species listed above use the park's territory during migration, molting periods, and wintering.

From February 24, 2022, to the end of March 2022, the park was under occupation and subject to constant shelling by Russian forces. According to official data, among all protected areas in the Sumy region, the Hetmanskyi National Nature Park suffered the most from hostilities (<https://ecopolitic.com.ua/ua/news/vijna-proti-dikoi-prirodi-rosiya-znishhuie-ukrainski-zapovidniki/>). The northern and north-eastern parts of the park were under massive fire from the occupiers: airstrikes, artillery, tanks, and mortars. Currently, an objective assessment of the damage caused to the park's avifauna by the Russian military aggression is significantly complicated. The primary obstacles are the widespread mining of the territory and its contamination with remnants of munitions, including rocket warheads, aerial bombs, artillery shells, anti-tank and anti-personnel mines, and hand grenades.

7. Dvorichanskyi National Nature Park. The Dvorichanskyi National Nature Park is located in the Dvorichna district of the Kharkiv region, bordered to the north by the state border with the Russian Federation (Fig. 2). The functioning of the park is aimed at preserving the integrity of the natural complexes of the Forest-Steppe zone and the rational management of their recreational resources. The chalk slopes of the Oskil River valley are of particular scientific value, as they contain unique communities of rare plant and animal species, which are a priority for protection within the park (Atemasova *et al.*, 2014).

Currently, 188 bird species have been registered within the Dvorichanskyi National Nature Park and its surroundings, 133 of which are confirmed breeders (Banyk *et al.*, 2013, 2014). Twenty-five bird species are listed in the Red Data Book of Ukraine, 11 of which are recorded as breeding. Protected breeding species include: the red-necked grebe *Podiceps grisegena* (Boddaert, 1783), ruddy shelduck *Tadorna ferruginea*, black kite *Milvus migrans*, short-toed snake eagle *Circaetus gallicus*, Montagu's harrier *Circus pygargus*, lesser spotted eagle *Clanga pomarina*, booted eagle *Hieraaetus pennatus*, common crane *Grus grus*, stock dove *Columba oenas*, Eurasian scops owl *Otus scops* (Linnaeus, 1758), and short-eared owl *Asio flammeus* (Banyk *et al.*, 2013; Vysochyn & Banyk, 2019; Kletyonkin, 2024).

Due to its immediate proximity to the state border with the Russian Federation, the park's territory was occupied from the first days of the full-scale invasion. The occupation lasted for seven months, until the park was liberated during the counter-offensive of the Armed Forces of Ukraine in the Kharkiv

region in September 2022. Currently, the territory remains critically dangerous due to dense mining and contamination with unexploded ordnance. As a result of active combat operations, airstrikes, and large-scale fires, the park's ecosystems have suffered significant damage. Furthermore, cases of poaching by Russian military personnel have been documented during the occupation (<https://wownature.in.ua/koly-yshly-helikoptery-to-khovalysia-po-kushchakh-iak-zaytsi-iak-dvorichansky-pryrodnyy-park-perezhyv-okupatsiiu/>).

8. Sviati Hory National Nature Park. The National Nature Park is located in the northern part of the Donetsk region, within the Sloviansk, Lyman, and Bakhmut districts (Fig. 2). The institution was established to ensure the protection, restoration, and sustainable management of the unique ecosystems of the Left-Bank Forest-Steppe, which play a key role in preserving biodiversity, promoting recreation, and supporting environmental education.

The park's avifauna consists of 214 bird species, 34 of which have conservation status and are listed in the Red Data Book of Ukraine: the Slavonian grebe *Podiceps auritus*, black stork *Ciconia nigra*, glossy ibis *Plegadis falcinellus* (Linnaeus, 1766), ruddy shelduck *Tadorna ferruginea*, osprey *Pandion haliaetus*, black kite *Milvus migrans*, white-tailed eagle *Haliaeetus albicilla*, short-toed snake eagle *Circaetus gallicus*, hen harrier *Circus cyaneus*, pallid harrier *Circus macrourus*, Montagu's harrier *Circus pygargus*, long-legged buzzard *Buteo rufinus*, lesser spotted eagle *Clanga pomarina*, greater spotted eagle *Clanga clanga*, booted eagle *Hieraaetus pennatus*, eastern imperial eagle *Aquila heliaca*, golden eagle *Aquila chrysaetos*, great bustard *Otis tarda* Linnaeus, 1758, common crane *Grus grus*, demoiselle crane *Anthropoides virgo* (Linnaeus, 1758), Eurasian oystercatcher *Haematopus ostralegus*, black-winged stilt *Himantopus himantopus* (Linnaeus, 1758), pied avocet *Recurvirostra avosetta* Linnaeus, 1758, Eurasian curlew *Numenius arquata* (Linnaeus, 1758), little tern *Sternula albifrons* (Pallas, 1764), stock dove *Columba oenas*, Eurasian eagle-owl *Bubo bubo*, Eurasian scops owl *Otus scops*, short-eared owl *Asio flammeus*, European roller *Coracias garrulus*, lesser kestrel *Falco naumanni*, saker falcon *Falco cherrug*, peregrine falcon *Falco peregrinus*, and great grey shrike *Lanius excubitor* (Dyakov & Skubak, 2012). Among rare protected waterfowl, up to 5 breeding pairs of the ruddy shelduck *Tadorna ferruginea* have been recorded nesting in the park. Additionally, during seasonal migrations and molting periods, 50–100 individuals of the common goldeneye *Bucephala clangula* have been repeatedly counted on the park's water bodies (Dyakov, 1998, 1999; Dyakov & Skubak, 2012).

The park's territory is of exceptional importance for the preservation of nesting groups of rare and endangered birds of prey. Diurnal raptors listed in the Red Data Book of Ukraine that nest here include the long-legged buzzard *Buteo rufinus*, the booted eagle *Hieraaetus pennatus* — four pairs, and the white-tailed eagle *Haliaeetus albicilla* (Dyakov, 2001). Furthermore, the nesting of the short-toed snake eagle (*Circaetus gallicus*) — two pairs, and the eastern imperial eagle *Aquila heliaca* — three pairs, has been confirmed, while the nesting of the lesser spotted eagle (*Clanga pomarina*) — one pair, is considered probable (Dyakov, 1999).

The breeding population of the common crane *Grus grus* within the park is small, ranging from 9 to 15 pairs depending on the year (Dyakov & Skubak, 2010). Rare waders are represented by breeding species such as the black-winged stilt *Himantopus himantopus* and the Eurasian oystercatcher *Haematopus ostralegus*. During migration, the pied avocet *Recurvirostra avosetta* and the great snipe *Gallinago media* are consistently recorded in the park (Dyakov & Skubak, 2011).

The park's breeding avifauna also includes such rare nocturnal birds of prey listed in the Red Data Book of Ukraine as the Eurasian eagle-owl *Bubo bubo*, short-eared owl *Asio flammeus*, and Eurasian scops owl *Otus scops* (Dyakov & Skubak, 2008, 2012).

All other protected species mentioned above occur in the park outside the breeding season. The park hosts one of the largest colonies of the grey heron *Ardea cinerea* Linnaeus, 1758 in Ukraine, numbering over 400 nests (Dyakov, 2001). From March 24 to October 12, 2022, the vast majority of the national park's territory (about 95%) was in the zone of active hostilities, leading to a complete cessation of its activities due to threats to staff safety.

As of today, preliminary estimates indicate that about 80% of the protected areas have been damaged or destroyed as a result of the armed aggression of the Russian Federation. The forest massifs suffered the greatest losses: up to 60-70% of pine stands, covering an area of about 5,000 hectares, have been destroyed by fire and shelling (<https://socportal.info/ua/news/rossiiskie-okkupanty-pochti-pol-nosti-unichtozhili-natsionalnyi-park-svyati-gori-v-donetskoi-oblasti/>). Although it is too early to draw final conclusions, preliminary data already point to a critical situation. It is known that between 2023 and 2024, birds of prey listed in the Red Data Book of Ukraine disappeared from their nesting sites (according to park employee S. Kurmaz). Assessing the full extent of the damage to the bird population will require thorough research, which will only be possible after the territory is fully demined and cleared of unexploded ordnance.

Discussion

An analysis of the data we obtained indicates that the transformation of habitats of birds listed in the Red Data Book of Ukraine in the de-occupied areas of the Nature Reserve Fund in the north and northeast of the country is complex and is determined by a combination of direct and indirect factors of war. In areas where massive hostilities occurred, large-scale fires, destruction of forests, ammunition pollution, and mining were triggered, which significantly reduced the areas suitable for nesting, summering, and migratory gatherings of birds. It is important to note that even short-term occupation had long-term consequences: poaching, deforestation, and the disruption of hydrological regimes caused habitat degradation. In the case of the Chornobyl Radiation and Ecological Biosphere Reserve and the Drevlianskyi Nature Reserve, an additional factor was the mobilization of radioactive contamination due to the digging of trenches in contaminated soils. Populations of rare birds of prey (white-tailed eagle, spotted eagles, short-toed snake eagle, great grey owl) proved to be particularly vulnerable, as their numbers were already limited prior to the war. At the same time, in some regions (e.g., Mizhrichynskyi Regional Landscape Park), natural conditions — such as swamps and reservoirs — partially mitigated the negative impact of the occupation, which underscores the importance of preserving natural barriers as factors of ecosystem resilience. Overall, the results demonstrate that the war has not only reduced the population numbers of certain species but has also disrupted their ecological niches, which may lead to long-term changes in the structure of the avifauna. The recovery of these populations will require not only demining and habitat restoration but also systematic monitoring to assess real losses and the potential for recovery.

Conclusions

Active combat operations in the de-occupied territories of Ukraine's Nature Reserve Fund have caused significant ecosystem degradation, which has critically impacted populations of bird species listed in the Red Data Book of Ukraine. The most vulnerable species were those with low population numbers and specialized ecological requirements (diurnal and nocturnal birds of prey, the black stork, and the common crane). Active hostilities, large-scale fires, mining, and poaching by Russian military personnel have been the key factors contributing to population declines and the destruction of nesting sites. The unique natural conditions of certain territories (swamps, reservoirs, river floodplains, and dense forests) partially mitigated the negative impacts, highlighting the importance of preserving natural barriers. The recovery of these populations requires the following: complete demining of the territories; restoration of forest and wetland habitats; systematic monitoring of the population numbers and status of rare species; and international cooperation in nature conservation to secure resources for ecosystem rehabilitation. Thus, the war has become a powerful negative driver in the transformation of the avifauna, and only comprehensive conservation measures can ensure the survival of Red Data Book bird populations in the de-occupied territories of Ukraine.

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