

The State of Ukraine's Protected Areas: An interim update on damages from the full-scale invasion:

Supplementary online case studies

Case study: Meotyda NNP military exercises destroy bird colonies

Meotyda (ID: 555719499) is a presently occupied NNP, it overlaps with an EN, Ramsar site and KBA. The RF have staged military exercises on the Kryva Spit Ramsar site, where important bird colonies are located, including the pink pelican (*Pelecanus onocrotalus*) and the only known colony of the Ruffed Tern (*Thalasseus sandvicensis*) in the Black Sea region. After the "exercises", which also reportedly included shooting birds as target practice, the colony disappeared and has not returned to the national park or the Sea of Azov more broadly (Bronskov, 2022; Petrovych, 2023). These practices have destroyed the largest colony of the Pallas's gull (*Ichthyaetus ichthyaetus*) in the Azov-Black Sea region, along with nesting sites of Dalmatian pelicans (*Pelecanus crispus*), thousands of gulls, terns and waders (Petrovych, 2023). In addition, the RF has fenced off the shallow waters of the Kryva Spit Bay for fish farming. Along the entire shore of the Azov Sea (which is part of the NNP), where Resolution 4 BC habitats are located, Russian soldiers have built fortifications and farmers of the self-proclaimed Donetsk People's Republic are ploughing up the steppe gullies of the NNP. Thus, in Meotyda NNP, all the protection objects that were the most important reasons for the creation of the NNP are being destroyed (pers comms with conservationists in the region, 2023).

Case Study: The Kakhovka dam explosion's impacts on three PAs: Kamianska Sich, Velikiy Lug and Nyzhnodniprovskiy

The Kamianska Sich NNP (ID: 555719433) and Velikiy Luh NNP (ID: 555719471) overlap with the Kakhovs'ke reservoir KBA, EN and Ramsar sites, and are directly upstream from the Kakhovka dam. The Nyzhnodniprovskiy NNP (ID: 555719364) covered the entire territory downstream from the Kakhovsky Dam to the end of the Dnieper Delta and also includes EN and Ramsar sites (Nikolaieva, et al., 2023).

The Velikiy Lug is still under occupation. Kamianska Sich was occupied in April 2002 and liberated in November 2022. Nyzhnodniprovskiy was occupied since the beginning of the FSI and has been on the line of destruction since November last year. The territories of these parks are mutilated by trenches, bombings, fires and are still mined (Petrovych, 2023).

After the dam explosion, the wetlands of Kamianska Sich and Velikiy Lug were drained (including Ramsar site Archipelago Velyki and Mali Kuchugury), which led to the death of 28,000 fish (Shumy, et al., 2023), the destruction of wetland breeding grounds and habitat of tens of thousands of waterfowl birds. Meanwhile, the Nyzhnodniprovskiy NNP was entirely flooded and the Dnipro river's islands in the NNP were partially destroyed by the force of the incoming wave: extirpating all terrestrial animals and destroying nesting colonies of birds that fell into the flooding zone. Uncountable fish and amphibians also died after being swept into the salty waters of the estuary and the sea (MEPNR, 2023).

The destruction of the Kakhovka dam and Kakhovsky Reservoir will have significant long-term consequences; this constitutes a separate and urgently needed body of research. With the dam and reservoir no longer in existence, EPL have established and are coordinating the Kakhovska Platform, civil-society coalition of roughly twenty organisations and initiatives, as well as representatives of scientific institutions, aiming to assess the damages of the dam explosion and design sustainable future options for the now-drained wetland and the entire region. Depending on findings, the platform may agree to restore the flow of the Dnipro without a dam and support a transition to more sustainable livelihoods in southern Ukraine away from arable farming or install pumping stations for irrigation to avoid rebuilding a dam (UNCG, 2023). The platform will take into account a comprehensive assessment of ecosystem services and plan further actions based on the principles of sustainable development (Environment People Law, 2023).

Case Study: Mining preventing fire management in Sviati Hory (ID: 555719463)

Sviati Hory protects several rare habitat types including edaphic chalk pine forest habitat with several endemic plants protected under the Bern Convention (Evans, 2018). The PA was occupied from April to October 2022. A large portion of the park is considered mined, only 1.5% has been surveyed and considered safe (Petrovych, 2023). The PAs chalk pine forests suffered significant damage due to constant fighting, the passage of the front line through the area and numerous fires which also consumed a neighbouring PA and village (Environment People Law, 2023). The presence of explosive objects in the PA has made firefighting impossible and the potential for explosions also increases the risk of re-ignition.

On May 12th 2023, we investigated the conditions of the chalk pine forest: thirty to forty percent of the trees have been broken by explosives and almost all trees have been cut by shell fragments. The surviving trees have been severely damaged by wildfires which have also damaged the sparse shrub layer (Figure 1). Forty to fifty percent of the herbaceous and soil cover has suffered significant degradation due to increased erosion and numerous sinkholes caused by explosions, creating “gap microhabitats” for invasive species. The large amount of dry and broken wood also increases the risk of more intense fires. In conclusion, these damages amount to a catastrophic decline in the representativeness and value for nature. Management of the area is currently not possible due to the dangers posed by mines.



FIGURE 1 THE RESULT OF A FOREST FIRE CAUSED BY THE INVASION IN SVIATI HORY NNP (© KATERYNA POLYANSKA)

Case study: The burning of Biloberezhzhia Sviatoslava NNP (ID: 555719424)

The Kinburn Peninsula has been affected by hostilities almost since the beginning of the FSI. There has been much speculation over the cause of fires that scorched the peninsular and its unique biodiversity between 2022 and 2023; the largest fires in decades (Figure 7). The peninsula is occupied by RF, it is likely that RF equipment ignitions started fires in the Biloberezhzhia Sviatoslava NNP, EN, Ramsar site and KBA (Panchenko, 2023) but as the RF has been using the Kinburn peninsula to mount shell attacks on the city of Ochakiv, this has attracted defensive attacks from the Ukrainian military which may also have resulted in fires (Panchenko, 2023).

Local villagers initially tried to put the fires out, loading buckets of water into their cars as the RF had seized local fire trucks. Eventually, the RF military restrictions on movement of local residents and the mining of roads and forests made civilian control of military fires impossible (Petrovych, 2023). Throughout the spring and summer, fires have caught almost every day (Panchenko, 2023) and have burnt just under 6,000 ha of the peninsular's vegetation (Kasyanov, 2023), much of which is valuable rare plants and wetland habitat for birds and bats (Petrovych, 2023; MEPNR, 2023).



Figure 2 The Kinburn peninsular showing the fires (red) between March 2022 and August 2023, and protected areas in green (Kasyanov, 2023)

Case Study: Physiological damages to Chornobylskyi Radiation Ecological Biosphere Reserve (WDPA ID: 555719480)

The Chornobylskyi Radiation Ecological Biosphere Reserve is the country's youngest and largest biosphere reserve. It overlaps with the Kyivs'ke Reservoir KBA, and is known internationally as the 1986 site of the world's most significant nuclear accident. For 36 years, nature has been restoring itself in the exclusion zone, locking contaminated radioactive materials into the soils and under vegetation, now 300 vertebrate species live freely on almost 227,000 ha, of which 75 species are listed as threatened.

On the first day of the FSI the reserve was used as an entry point for RF troops to gain proximity to Kyiv (Weir, 2022). The PA was liberated on April 1st, after five weeks of occupation. In these five weeks major damage was sustained by the extremely fragile PA. Six hectares of fortifications, including trenches, disturbed this habitat. The RF troops logged forests and removed sand to build fortifications and buried explosive mines in the soils. The RF troops did avoid deviating from highways but rows of heavy vehicles and military equipment that crossed the reserve and helicopters, attack aircrafts and cruise missiles that crossed the airspace at low altitude likely also caused some damage. The most extreme consequence of the occupation was forest fires: over 14,000 ha of the forest burned during occupation and over 15,000 ha after liberation (confirmed by our team, 2023), during which PA staff and local fire fighting units could not control the fires due to the risks posed by mines; firefighters were forced to extinguish the fire only from roads checked by de-miners. There is significant concern that these disturbances to ground cover could release radioactive dust (Drapaljiuk, et al., 2023).

Case Study: Chemical impacts on Kamianska Sich NNP (ID: 555719433)

The organisation Environment People Law conducted analyses on soils taken from a Grad anti-aircraft missile shell impact site in Kamianska Sich NNP on March 27th, 2023. When compared to a background sample of soil taken from a nearby site, the soil from the shell impact site contained an excess of concentrations of petroleum products (39x the background sample concentrations), lead (4.8x), nickel (3x), gallium (2.6x), arsenic (2.5x), chromium (2.3x), iron (2x), fluorides (1.7x), cobalt (1.6x), magnesium (1.4x), zirconium (1.3x), molybdenum (1.3x) and manganese (1.2x).

The sample exceeded the maximum permissible concentrations (MPC) of lead, sulphur and phosphorus according to Ukrainian law. Numerous fragments of shrapnel were also found at the site of the explosion.

Soil samples were also taken from an S-300 missile crater and analysed in a laboratory in Bern, Switzerland. This sample exceeded the MPC of zinc by 48 times, copper by 25 times, nickel by 6 times and lead by 2 times. In other parts of the NNP, soil samples were taken from the locations of burned military equipment, where it was found that the MPC was exceeded for the content of lead, antimony, sulphur, barium, and phosphorus.

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