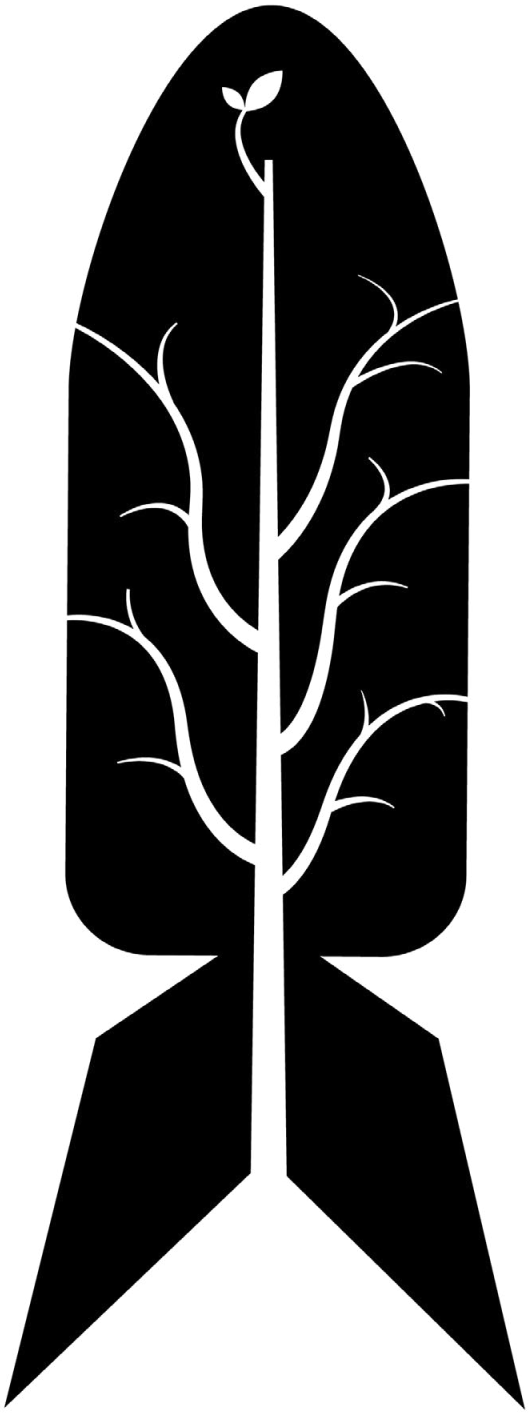


UWEC

Ukraine War Environmental Consequences Work Group

Issue #25

2024 UWEC work group

Dear Friends!

The mission of our work group is to report on the environmental consequences of Russia's full-scale war in Ukraine. Together with experts from all over the world, we not only analyze the consequences, but seek solutions that will ensure nature protection when conflict activities end. With this aim, UWEC team members attend conferences, participate in seminars, and provide expert commentary. A couple of months ago two large events took place, at which the environmental consequences of the war in Ukraine were discussed – World Water Week in Stockholm and the conference of the European Society for Ecosystem Restoration in Tartu, Estonia. Special attention was paid to the problem of **restoring the ecosystem of the Kakhovka Reservoir**. *Our expert* **Eugene Simonov** *took part in the discussions. You can read about the results of the conference in more detail in his article:*

- **How restoration of Ukraine's ecosystems is being discussed at European conferences**

*A post-war response that is Green Deal-oriented requires coordinated work at various levels. The most important thing, however, is that local people are engaged and involved. Imported ideas and solutions that are not adapted to the needs of local communities (known in Ukraine as "***hromady***"), will not be effective. It is crucial, therefore, not only to engage with, but also to hear the demands of the local population. UWEC Work Group journalist and expert* **Viktoria Hubareva** *traveled to the shores of the former* **Kakhovka Reservoir**, *whose bed is now covered by the "green sea" of a recovering forest ecosystem, to learn about the needs of local communities and the challenges they face:*

- **After the deluge: Life on the banks of the Kakhovka Reservoir now the water is gone**

Every month, the UWEC Work Group's editorial board and experts prepare a review bringing together the most important events related to the environmental consequences of the war and the search for solutions. In the latest issue, you can read about a study of the impact of pollution on groundwater in Ukraine resulting from military activity, as well as the potentially disastrous environmental impact of the "shadow fleet" used by Russia to bypass sanctions in the Baltic Sea, and also the importance of Ukraine becoming a signatory of the Rome Statute to support efforts to recognize ecocide as an international crime.

- **Environmental consequences of the war in Ukraine: September 2024 review**

Over the past year, there has been a sense from global media coverage that there have been fewer high-profile events in Ukraine. This is not the case. Environmental pollution in Ukraine and Eastern Europe is continuing at the same pace, if not increasing. Military action is already occurring on the territory of both Ukraine and Russia. Industrial facilities, oil storage facilities, and forests are burning, and it is believed that an accident at a plant in Russia's Kursk Region has led to a transboundary **catastrophe and pollution of the Seim River**. *The river flows through Russia's Belgorod and Kursk regions, as well as the Sumy and Chernihiv regions of Ukraine. The pollution of the Seim has also led to pollution of the Desna River, which feeds the Kyiv Reservoir. Read more about the consequences of environmental pollution in this article by UWEC Work Group journalist and expert Viktoria Hubareva:*

- **Dead water from Russia: Fish and other life perish in the polluted waters of the Seim River**

As we analyze the environmental consequences of Russia's war in Ukraine, our experts are increasingly coming to understand that it may take years to overcome them. In particular, solving the issue of the pollution of the environment with military waste will take a significant amount of time, since **vast areas of the country are now heavily mined**. *The issue of landmines is one of the chief threats to both infrastructure restoration and the development of agriculture in Ukraine, as well as for conservation areas, some of which are currently not able to provide their recreational services. Read* **Oleksiy Vasyliuk's** *analysis of the long-term effects of landmines in Ukraine:*

- **Danger! Mines! The terrible environmental and human cost of Ukraine's minefields**

You can find more texts and news about the environmental consequences of Russia's full-scale invasion of Ukraine on our website, as well as on Twitter (X), Facebook, Telegram and BlueSky.

We wish you strength and peace!
Alexej Ovchinnikov
Editor, UWEC Work Group

How **restoration of Ukraine's ecosystems** is being discussed at European conferences

Eugene Simonov

At the end of August, the fate of Kakhovka Reservoir was the subject of detailed consideration at two major international conferences that took place in Stockholm (Sweden) and Tartu (Estonia). Prior to that, although the fact of the dam's destruction had, of course, long aroused international interest and sympathy, there had been no detailed discussion of what to do next and what kind of support Ukraine needs in Europe. Such a discussion with European partners is extremely important, given that restoration of the Lower Dnipro region will take place in the context of European integration and with the assistance of European institutions.

World Water Week

On 25 August, during World Water Week in Stockholm, experts discussed the issue during an event called "Destroyed Kakhovka Dam in Ukraine – Current and Future Challenges" on 25 August, organized by the Ukrainian Nature Conservation Group, the

National University of Kyiv-Mohyla Academy, and the Swedish University of Agricultural Research. The discussion was moderated by Brian Kuns, a Swedish scientist with experience in agricultural and environmental research in southeastern Ukraine. The diversity of presenters at this event was a pleasant surprise.

In a pre-recorded video, the chair of the High-Level Commission on the Environmental Consequences of the War in Ukraine **Margot Wallström** emphasized to participants that despite the horrors of the war and its severe economic consequences for Ukrainians, future quality of life depends on the extent to which restoration solutions are environmentally friendly and cutting edge for Ukraine. It is impossible to simply restore what was in the past; support is needed to build a better future for Ukraine and this is in fact the Commission's task.

In this sense, the Kakhovka Reservoir is the most well-known example. All restoration options must be considered and publicly discussed, a process that is explicitly laid out in the "Green Deal for Ukraine" – a set of the Commission's primary recommendations.

A perfect example for Wallström's thesis is the expediency of restoring the past. Ukrhydroenergo representative **Oksana Hulyaeva** spoke about the importance of the Kakhovka hydropower plant (HPP) for the Soviet Union and Ukraine. The plant primarily regulated water supply to municipalities, fed an irrigation system, and supported the ecological state of ecosystems downstream.

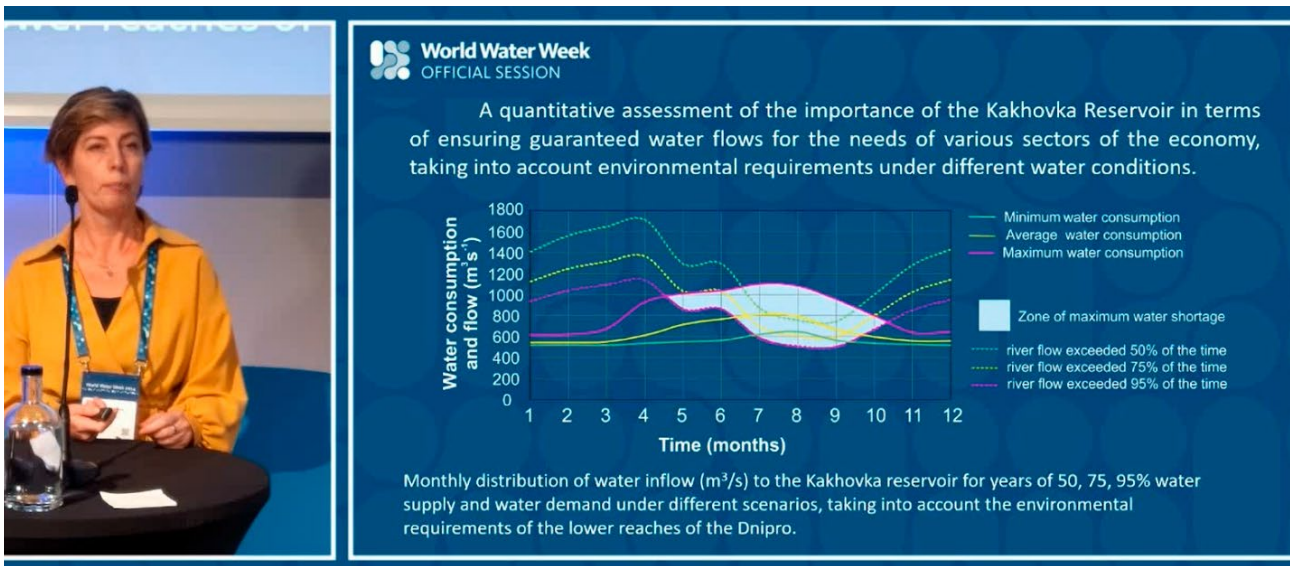
The presentation showed that the reservoir supplied up to four km^3 of water per year to population and industry, and up to an additional six km^3 of water per year for agriculture.

> **Half of the water destined for agriculture was lost en route to consumers, and another two km3 of water evaporated from the reservoir's surface annually.**

In addition, operation of the Kakhovka and Dnipro HPPs, as well as the Zaporizhzhya Nuclear Power and Thermal Power plants – Ukraine's largest power plants – depended on the reservoir. The Kakhovka hydroelectric complex met 40% of the nation's freshwater needs.

> **Listening to the report, one could only be amazed at the vulnerability of the centralized system, the critical needs of which were met by a single giant hydroelectric complex.**

According to Hulyaeva, if it is assumed that Ukraine's future economy will remain water-intensive and fixated on a single source without restoring



A slide from Oksana Hulyaeva's presentation showing the reservoir's important role in redistributing the annual flow for economic and environmental needs. Source: video recording of the conference in Stockholm

the reservoir, then the entire output of the Dnipro River would be diverted in July and August in low-water years. Accordingly, the main role of a restored Kakhovka reservoir would be environmental, redistributing water to support the needs of unique ecosystems along the Lower Dnipro and the delta estuary, in other words to meet the environmental flow demands (defined as no less than 500 m3/second). Reading the report between the lines then, it could be understood that Ukrhydroenergo calculated environmental flow standards within the framework of HPP operations, an example of the company's high environmental awareness.

Ecology Department Chair at the Kyiv-Mohyla Academy Viktor Karamushka, who grew up on the banks of the Kakhovka Reservoir, devoted his presentation to the terrible immediate consequences of the sabotage of the Kakhovka HPP. He listed the human casualties, ecosystem and industrial losses, area of agricultural land deprived of irrigation water, etc. Nevertheless, when asked if the dam should be restored, he answered that it depended on the needs of residents and economic activity taking place there post-war, and that a decision now would be premature.

Watch the webinar recording:
"Environmental consequences of the destruction of Kakhovka HPP's dam"

Marine biologist **Halyna Minicheva** (Director of the Institute of Marine Biology of the National Academy of Sciences of Ukraine) emphasized in her talk that despite the enormous stressors, the marine ecosystem quickly coped with the short-term environmental

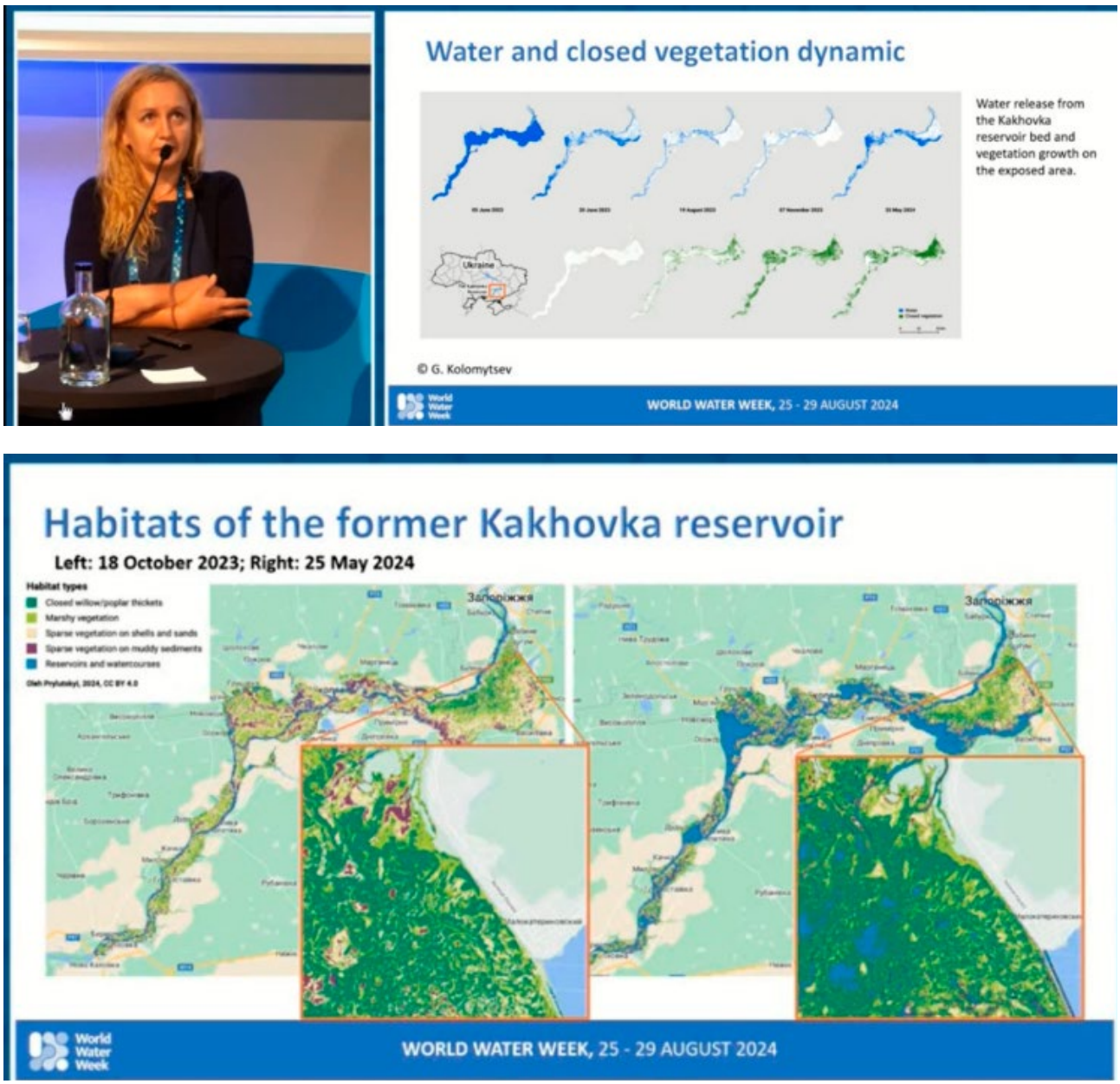
Presenter Professor Viktor Karamushka. Source: conference video recording

Halyna Minicheva discusses invasive organisms. Source: conference video recording

consequences of the emptying of Kakhovka Reservoir. Nevertheless, the long-term consequences of the large volume of organic waste that settled on the bottom of the Black Sea after the flood can be seen in the excessive spread of alien, invasive marine organisms and that that may have a long-term negative effect on the marine ecosystem. When asked about the desirability of restoring the dam, Minicheva answered that this is a difficult question, but continued by noting that the reservoir was an important barrier to the removal of pollutants into the sea, and therefore its restoration could reduce the level of pollution.

Forest on the reservoir bed: log or protect?

The last to join the debate was geobotanist **Anna Kuzemko**, who represented Ukrainian Nature Conservation Group (UPG) and the Institute of Botany of the Academy of Sciences of Ukraine. She spoke about monitoring the restoration of ecosystems



Slides prepared by Anna Kuzemko illustrating ecosystem dynamics on the bed of the former reservoir, 2023-2024. Source: conference video recording

on the former reservoir's bed, work which is being carried out along the front line by scientific and community organizations.

Plant communities on the reservoir's bed began to recover rapidly just a few weeks after the dam was destroyed. Water conditions in 2024 favored the restoration of floodplain ecosystems, and new willow forests have already reached three to four meters in height, a rapid growth rate of over one centimeter per day. Anna Kuzemko suggested that prior to advocating for the reservoir's restoration, the cost and value of the services provided by these newly formed ecosystems must be calculated along with any damages resulting from their

Speakers during the Q&A session. Source: Conference video recording

loss in the event of repeated filling of the reservoir.

An interesting plenary discussion followed the presentations and offered additional information:

- Although the Ukrainian government spoke hastily in favor of restoring the Kakhovka HPP, no justification for this can be provided until the war is over. Millions of people who previously depended on the reservoir have left the vicinity. Whether they will return after the war is unknown, as are the questions of whether destroyed industrial enterprises will resume operations or how quickly agricultural lands will be cleared of mines.
- It is clear that when it comes to power generation, the most urgent task is to restore the Dnipro HPP's maneuvering capacity, but that is possible without the need to reestablish the underlying reservoir.
- It is important that the question of whether or not to restore the dam has already become a subject of constructive discussion between opponents. High-quality and detailed information is needed in order to evaluate options for future decisions, and that sort of data is difficult to collect during a war. The most critical aspect of the discussion is meaningful comparison of different types of water use in the region. At present, water is delivered to villages in tanks; water pipelines from other sources are extended to cities, and many sites have begun to use groundwater, but this is not always cost-effective. Urgent measures taken today are not necessarily sustainable water supply mechanisms for the future;
- If future farming methods remain rooted in the past, there won't be enough water in any case. It is very likely that different types of agriculture will develop in southern Ukraine. In particular,

Florian Clays: Nature Restoration Law is interconnected with all of the European Union's environmental laws. Source: UWEC

Viktor Karamushka recalled that prior to commissioning the hydropower plant, livestock farming was much more developed in the region. Livestock agriculture can be expected to experience a renaissance in the future.

- When asked how the international community could help, Halyna Minicheva suggested collaboration to conduct a basin-wide strategic environmental assessment. Anna Kuzemko endorsed scientific cooperation, but said that today support for the Ukrainian Armed Forces is first and foremost, in order for it to liberate the country's lands from invaders.

Conference on ecosystem restoration

On the following day, the 14th conference of the European Society for Ecosystem Restoration – SERE-2024 – got underway in the Estonian city of Tartu. This was the first specialized conference to occur after the European Union's Nature Restoration Law (NRL) came into force on 18 August. As a result, the conference was dedicated to professional discussions on how to jointly support the law's implementation at all stages, from planning to assessing the effectiveness of restoring ecosystems.

Policy officer at the European Commission's Directorate-General for the Environment and Nature Restoration

Poland's Permanent Representative to UNESCO H.E. Mariusz Lewicki: "The lack of ecological connectivity is exacerbated by the modernisation of the fence in Belarus and can only be restored in cooperation with the State Party of Belarus, including the need to address illegal human migration affecting the property." Source: UNESCO

Law Florian Clayes explained the schedule and process for implementing the law's requirements in EU countries. National ecosystem restoration plans must be drawn up by August 2026 for review and subsequent approval by EU bodies in 2027.

The law sets rather ambitious targets for the restoration of 30% of key habitats by 2030, 60% by 2040, and 90% by 2050. That noted, the target for restoring river ecosystems to the state of "free-flowing rivers" by 2030 remains the same as that adopted five years ago: 25,000 km.

At first glance, that target seems less ambitious than the 30-60-90% targets for other ecosystems. Rivers are, however, the most difficult to restore, since water is the most sought-after resource and rivers have many conflicting users. Criteria are currently being developed and tested to assess whether a particular restoration project for a particular section of a river achieves the goals of restoring free-flowing rivers as set out in the law. It would be interesting to conduct such a test for the Lower Dnipro.

> In the context of future decisions related to farmland in southern Ukraine, presentations discussing the effectiveness of subsidies for environmentally friendly agriculture were extremely interesting. The European Union pays a lot of money to farmers

> whose productive agricultural lands maintain high species diversity or preserve specific rare species of plants and animals. At the same time, "all-seeing" drones – junior peaceful siblings of those flying machines that haunt the aggressor on Ukrainian fields today – are being used successfully to monitor plant species diversity. It is quite possible that the EU's subsidization system will render less intensive dryland (without irrigation) farming and forage cultivation more profitable types of agriculture in Ukrainian steppes than restoration of irrigation systems.

Sessions in conference halls alternated with excursions and training sessions in field conditions. In total, participants chose from a selection of 30+ field trips over the course of the conference.

On the very first day, an excursion dedicated to river restoration showed participants several already demolished dams, as well as the largest dam in Estonia – Linnamae on the Jagala River – a site where hydroelectric generators with a total capacity of just 1.5 MW are installed. The dam is a historical monument, built at the beginning of the 20th century. In 1941, retreating Russian troops blew it up, similar to the recent history of Kakhovka Hydropower Plant. During the years of Soviet occupation the Linnamae stood, full of holes, but in the first years of independence, some enthusiasts found the means to restore it (apparently, as a symbol of the nation's revival).

Subsequently, Lithuania's environmental agency has spent 20 years suing the owners of the ineffective hydropower plant with an eye to restoring fish migration along one of Estonia's largest salmon rivers. At the same time, Estonian colleagues confidently state that fish ladders do not work and full restoration of fish migration can only be achieved by dam removal. To date, roughly 40 dams have been demolished in Estonia for this purpose, mostly on the most promising salmon rivers.

> Many aspects of river restoration experience in this small nation can serve as an important lesson for Ukraine and other countries preparing to join the European Union, as they too will have to comply with the Nature Restoration Law and other EU environmental directives.

Ukrainian rivers

On the penultimate day of the conference, a session on the restoration of large ecosystems took place, including two reports on Ukraine. Although the organizers discounted registration fees for Ukrainian participants by two-thirds

Linnamyame Dam on the Yagala River (1921-present). Source:UWEC

and emphasized the importance of this topic in every possible way, Estonia's distance from Ukraine and the war meant these were the only reports from Ukraine at the entire huge conference and those focused on the restoration of the Danube and Dnipro river ecosystems.

Mikhail Nesterenko of Rewilding Ukraine explored restoration of the natural dynamics of water exchange and biodiversity in estuary lakes Kartal and Katlabukh in the Danube Delta. Restoration of natural ecosystem processes also decreases salinization and improves water quality, contributing to improved living conditions and economic indicators for local residents.

UWEC Work Group expert **Eugene Simonov** presented a report on possibilities and organizational needs for restoration of Lower Dnipro River ecosystems in the context of implementing European legislation on ecosystem restoration. He described various post-war development scenarios offered by Ukrhydroenergo, Russian occupation authorities, and various research and public organizations. The process of restoring natural floodplain ecosystems at the site of the Kakhovka Reservoir and a complex of scientific, economic, and socio-political measures necessary to ensure it were analyzed in detail.

Eugene Simonov's presentation:

The event's expert participants were keenly interested in the option of using

standard field methods, such as camera traps and drone observations, in the area around Kakhovka. The use of drones for non-military purposes is, of course, strictly prohibited along the line of contact at the front line.

In response to the question of what assistance was needed from those gathered, the speaker asked the international community of experts in the field of ecosystem restoration for assistance in assessing prospects for restoring ecosystem functions as well as assistance in interpreting and using European laws and programs in order to position restoration of the Lower Dnipro as a long-term priority project during Ukraine's accession to the European Union.

> Restoring natural ecosystems along a 250-km stretch of the Lower Dnipro could become the largest freshwater ecosystem restoration project in Europe and possibly serve as a decisive contribution by Ukraine to meeting EU commitments to restore rivers to their natural state by 2030.

Read more: After the deluge: One year on, can the ecosystems disrupted by the destruction of the Kakhovka Dam recover? •

Translated by Jennifer Castner

Main image: Discussion partners. Right to left: geobotanist Anna Kuzemko, marine biologist Halina Minicheva, environmentalist Viktor Karamushka, hydrologist Oksana Hulyaeva. Source: conference recording

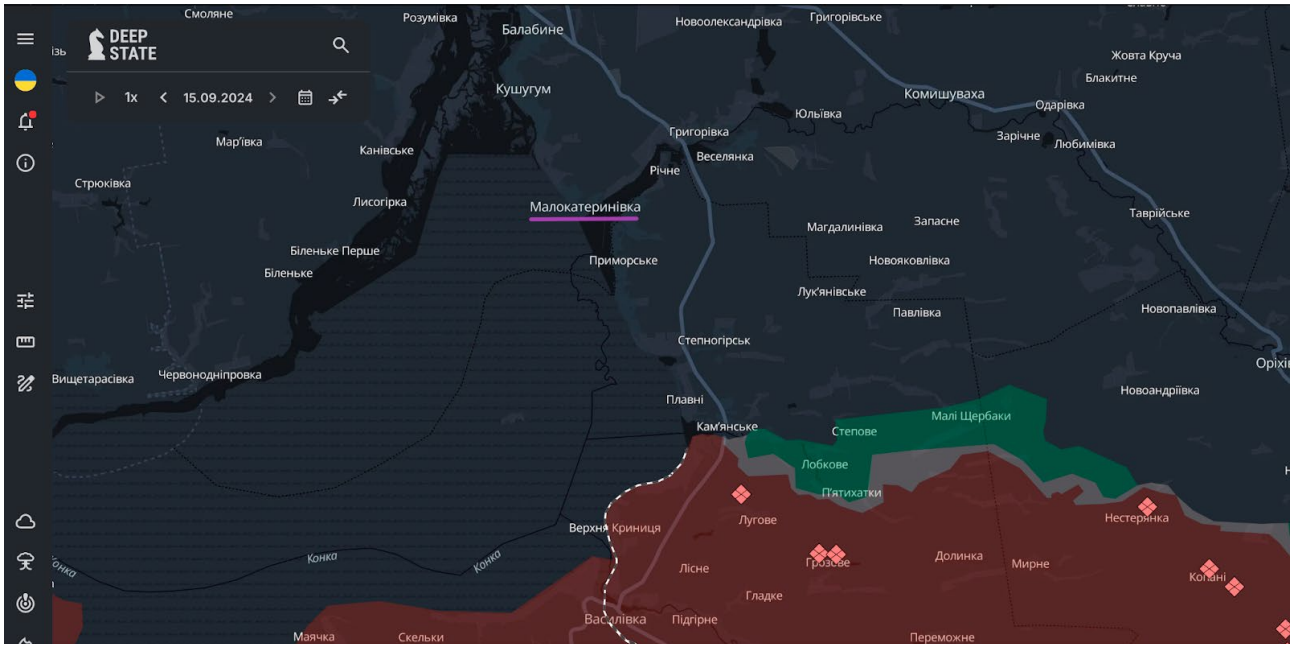
After the deluge: Life on the banks of the Kakhovka Reservoir now the water is gone

Viktoria Hubareva

On a visit to the eastern shore of the former Kakhovka Reservoir in Zaporizhzhia Region, UWEC staff writer Viktoria Hubareva found out how life has changed for local communities (hromady), who have been deprived of access to water for over a year now. A lack of drinking water, slow-burning peat fires and collapsing businesses are all contributing to a sense of desperation, coloring local attitudes to preserving the "green sea" that has appeared on the bed of the reservoir and the tough decisions that await.

We are standing on a high bank. Beneath us, the wind moves in waves across a sea of green leaves that stretches almost to the horizon. This is the former Kakhovka Reservoir, which completely dried up after the destruction of the dam by Russian forces in 2023 and is

The "Green Sea" on the site of the former Kakhovka Reservoir. The reservoir's opposite shore is under the control of Russian occupying troops. Source: Viktoria Hubareva



A map of the war in Ukraine from September 16, 2024. Malokaterynivka can be found in the center of the map, near the top. The gray striped areas show the territory formerly occupied by the Kakhovka Reservoir. Source:DeepStateMap

now covered with millions of young willow saplings. In the distance, on the reservoir's far shore, currently occupied by the Russian army, is visible. Here and there, gray smoke rises, marking places where shells have exploded. The sound of artillery fire is almost continuously audible from afar.

This is the view from the village of Malokaterynivka in Ukraine's

Cisterns like this were used to store water for technical purposes. It was supplied continuously and local residents could use the water for watering their vegetables. Since the Kakhovka dam was blown up, however, the system no longer works. Source: Viktoria Hubareva

Zaporizhzhia Region. Before the loss of the reservoir, Malokaterynivka thrived. It was home to a fish farm, residents grew vegetables in greenhouses for sale, and the area was popular with summertime vacationers, when they came here to spend time in the dacha cooperatives located along the reservoir. Since the loss of the reservoir, life for the community has changed completely. Business has dried up, Ukrainian tourists no longer come here for their summer vacations (including because of the war) and local residents are suffering from a lack of water.

The local community is in favor of restoring the reservoir, but this is an unlikely prospect. In an interview with UWEC, Volodymyr Sosunovsky, a local resident and chairman of the Kushuhum village council, talked about how they are coping with the situation, what solutions they see and what action can be taken.

Not a drop to drink all summer

Water was always a valuable resource for the local population, but there had been no problems with it since the 1970s. An 18-kilometer pipe with a diameter of 1 meter, built between 1967 and 1975, initially provided enough water for local state farms. Water was supplied from Zaporizhzhia to the settlements of Balabyne and Kushuhum, and further to Malokaterynivka. From the 1990s onward, people began to actively pipe water to their individual homes from the centralized water supply, which eventually led to shortages. Water

Vladimir Sosunovsky, local resident and head of the Kushuhuma community (hromada), on the banks of the former Kakhovka Reservoir. Source: Viktoria Hubareva

continued to flow from Zaporizhzhia but was no longer enough for all needs.

Eventually, a solution was found: water piped from Zaporizhzhia was used as drinking water, and a pumping station was installed for technical needs. Water was also taken from the Konka River using pumps. The pumping station worked around the clock, replenishing large metal tanks with a capacity of 240-280 cubic meters each. This met the needs of the population, particularly when it came to watering vegetables. The system worked smoothly for many years until Russian forces blew up the dam of the Kakhovka Reservoir. The Konka dried up, leaving nowhere else to obtain water.

At present, only Balabyne has running water. Kushuhum is partly supplied. A water tank has improved the situation, but five and a half streets in the village have been without water since the beginning of summer. Malokaterynivka has been without water for a second year now, since the water supply simply does not reach the settlement (probably due to weak water pressure).

The large metal cisterns now stand empty. The one on the shore is riddled with holes from shelling.

Life is hard and so is the water

Deliveries of water are now organized with the help of the State Emergency Service and the regional water utility company (oblvodokanal). Every day, 20 cubic meters of water are delivered

(though at the peak of the heatwave in July, this rose to 80 cubic meters). In an attempt to find a way out of the situation, the local population is trying to ensure access to water on their own by boring wells.

"But at a depth of 60-70 meters, the water has a high lime content, and this is a problem," says Volodymyr Sosunovsky. *"It's possible to solve the problem by using artesian wells, but this is very expensive. The depth of wells where there's water reaches 103 meters, though analysis shows that it has a high lime content all the same, albeit less critical than at shallower depths. Besides, this kind of solution isn't an option for everyone. The granite layers that need to be drilled through make the drilling costs very high,"* he explains.

Called "hard water," water with a high lime content leaves scale on the walls of a kettle and has a particular aftertaste. Washing regularly in this kind of water regularly results in dry hair and skin, and if used for drinking water, it can lead to a whole range of different diseases.

Hard water is also unsuitable for watering plants. Although it contains calcium and magnesium, which are used for the "deoxidation" of soil, when these are present in high concentrations, nutrients are unable to dissolve in the water. As a result, plants do not receive adequate nutrition: herbage begins to die, and leaves dry out and fall off. Such plants may not even survive until the flowering period.

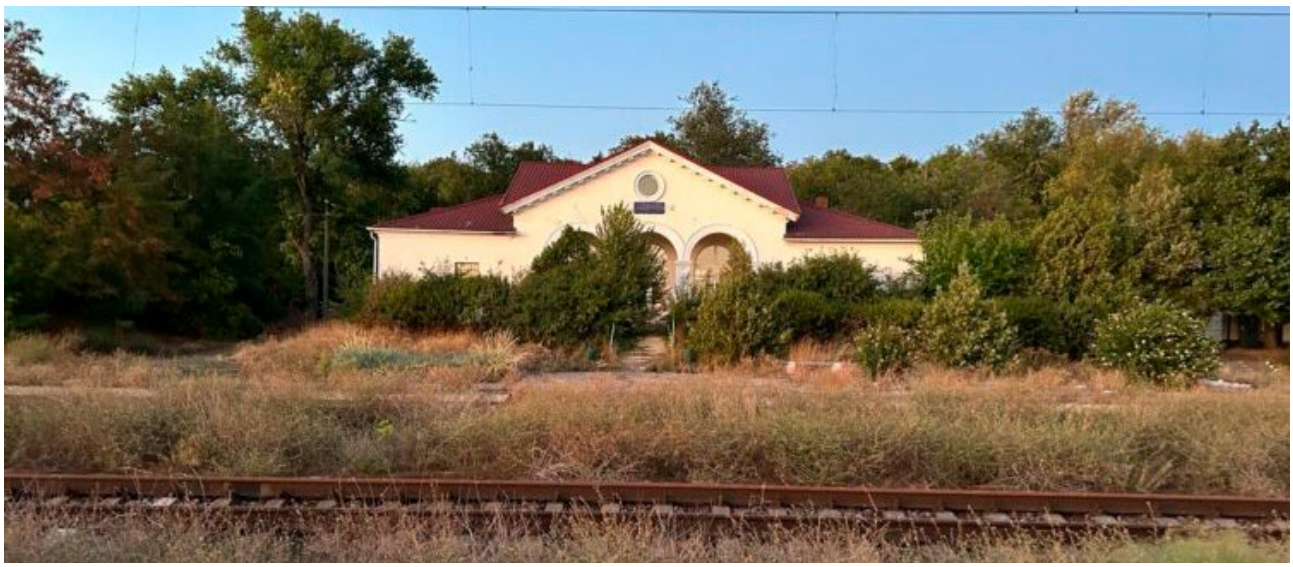
In order to use this kind of water, special filters need to be installed, and this means additional costs, which most of the population cannot afford.

All of this has had a huge impact on the established way of life for local residents.

Where is the 5:05 train?

Right beneath the steep slope on which we are standing runs a railway. It has stood idle since the beginning of the full-scale war. Later, when we reach the Malokaterynivka station, we see that saplings are already growing on the steps. The station looks a little surreal, which is no surprise — it has not been used for two and a half years.

"Everyone does what they can to earn a living, and our population raised vegetables in greenhouses. Not small ones, like families use, but big ones, 50 meters long," explains Volodymyr Sosunovsky. "In this way, local residents earned enough money to feed themselves and their families for a year. In the main this was pensioners. When the railway was operational, almost all of our residents sold vegetables at Zaporizhzhia 1 [Editor's note — the name of a railway station in the center of the city of Zaporizhzhia]: *tomatoes, cucumbers, onions, and so on. Everyone would quietly board the first local train to depart at 5:05 a.m., passing four stops: Malokaterynivka, Osetrivka, the center of Kushuhum, Kushuhum and Balabyne, and then Zaporizhzhia 1. They would arrive, and the city folks would buy up these goods in a few hours,"* says Sosunovsky, adding that this went on year in, year out.



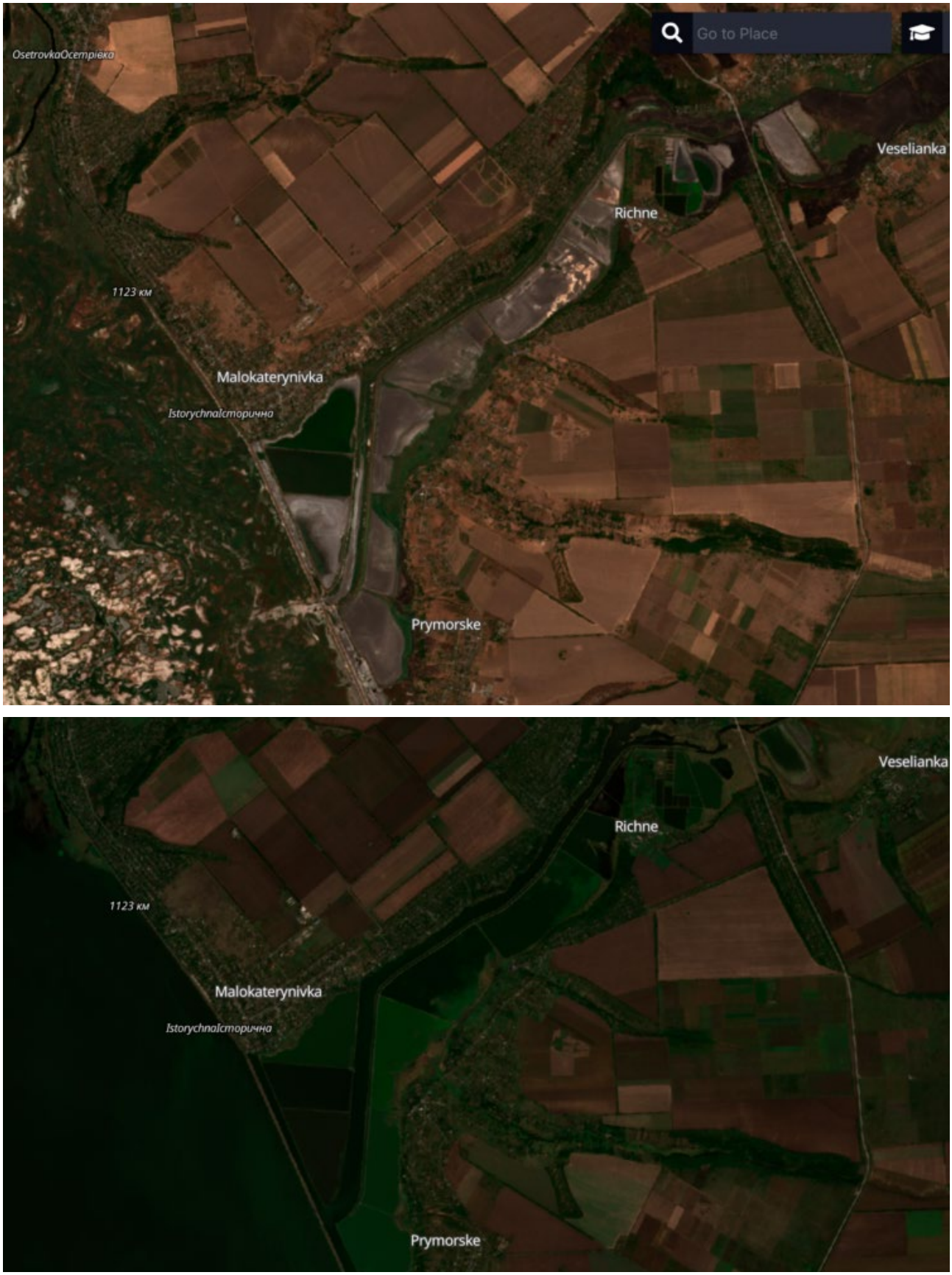
The station at Malokaterynivka, already inactive for two years. Source: Viktoria Hubareva

The fish farm in Malokaterynivka relied on water from the Kakhovka Reservoir. The owner is now unsure whether the business will survive to next summer. Source: Viktoria Hubareva

The same timetable, the same stations. Until the Kakhovka disaster, when the water disappeared.

Growing something in a greenhouse requires quite a lot of water, since rainwater cannot enter the structure. When there is no water or it is supplied irregularly in insufficient quantities, crop yields decrease.

"Those who were able to adapt invested in wells and water filters," says Sosunovsky. "In Kushuhum, for example, people have



Two aerial photographs of the Malokaterynivka fish farm: the upper photo shows the farm in mid-September 2024; the lower photo shows the same period in 2022, when the reservoir still existed. It can clearly be seen that most of the ponds have now completely dried up, as has the bed of the Konka River, which flows between the ponds. Source: SentinelHub

been growing blackberries for over 20 years. They have big 4-hectare fields. It's a former military base. The military also drilled a 200-meter well there. And it's very good. And the water there is different, suitable for watering [crops]. That's how they work."

As for those who can't afford either filters or wells, they are now having to abandon this way of making a living. But it is not only those who made their living from vegetables who have lost their jobs.

A body blow for local businesses

From the high bank where we stand, the fish farm is clearly visible. It's hardly business as usual here: the enterprise is still operational, but the chance of the business surviving until next year is very slim, because water has already disappeared from most of the ponds.

"The water in the ponds was part of a through-flow," explains Sosunovsky. *"It came from the river Konka, which had ponds on both sides, and then entered the reservoir. After the Kakhovka hydropower plant was blown up, the river's water level fell several meters, and now the channel in the Konka has completely dried up. They tried to maintain the water level in the ponds, close off the straits, and gradually pump in additional water. But the effect was insignificant. Two ponds dried out completely; in the others fish are dying because the water isn't moving and there's less and less oxygen. If the situation doesn't change and the winter is dry, then it's possible the fish farm will shut down, since the fish might just disappear."*

"It's logical to assume that in three to four years, willow will appear here," adds Sosunovsky, referring to the same vegetation that now covers the bed of the former reservoir.

This was just one of several fish farms in Malokaterynivka, and the only one which survived until the end of summer 2024. Other ponds have already lost their water, and even dried out completely.

Local business, which was reliant on tourism, is also disappearing. The region used to be more attractive thanks to its opportunities for beach vacations. It was possible to rent a cottage in the dacha cooperatives, and there were recreational outdoor centers in Malokaterynivka. Now the beaches are gone, and the tourist sector is flagging.

"Our attractiveness for tourists, above all, was the dozens of dacha cooperatives between Kushuhum and Malokaterynivka. People used to come here to relax. You could say that half the city of Zaporizhzhia had their dachas here. They used to come with their families, with their kids. This led to the growth of our region's economic potential, since people were buying goods in our stores, which in turn brought in tax revenues. Unfortunately, today we see that stores and kiosks are closing. This has an impact on our budget. For example, the number of individual entrepreneurs has fallen from 400 at the beginning of 2021 to 75 today. The situation with tourism is also getting more difficult," says Sosunovsky.

The fire that burned all summer

The loss of water has affected not only the earnings of local residents, but also the new ecosystems which had successfully taken shape and adapted during the time the reservoir existed. The situation is exacerbated by the proximity of the frontline.

"Look at the smoke over there, in the distance," says Sosunovsky, pointing to the side. A column of smoke is rising into the sky. "That's the result of Shaheds [drones]. This used to be our floodplain with islands but now everything's dried out. The river that flowed out of the Dnieper dried out too. Why did this fire appear? Because everything had turned into peat. When the fire brigade turns up to put it out, they tear up the soil, but the fire continues to smolder at depth. It's very difficult to put out, so until winter starts or rain falls, the situation won't change," he explains.

The floodplain systems that have been created here over the years gradually formed peat bogs. These were not a danger when they were covered with water, but now they have begun to dry out. The fires can go on for months, becoming increasingly active in hot weather. This particular fire has already been burning for two and a half months, i.e. all summer. Extinguishing such fires is almost impossible for two reasons: the areas in question are difficult to access and burning also occurs underground, which is typical of peat fires.

"There used to be a very rich natural complex here with a large number of different animals. During active fires many of them didn't manage to find refuge. As a result deer, elk, and wild boar perished. Whole families died," says Sosunovsky.

'I think about 80% of this willow will dry up'

Despite the fact that the very creation of the Kakhovka Reservoir 70 years ago was an environmental catastrophe involving the forced resettlement of local people and the flooding of historical monuments, over the course of two generations local residents have grown accustomed to the new conditions. Now, when those in green circles are actively discussing the preservation of the "green sea," Sosunovsky voices the interests of the local community, who back the restoration of the reservoir. *"If there was water here, we would be glad of its presence; for us it's very important,"* he says.

As for the "green sea" itself and the potential services it could provide to the ecosystem, Sosunovsky is skeptical and believes that all the trees will gradually die out as a result of drought, which is becoming increasingly more pronounced:

"The willow that has been actively growing here loves water very much, and ideal conditions have developed for it. For example, such a willow can grow as a bush up to three or four meters, but then its growth stops,"

Patches like this in the middle of the "green sea" on the site of the former Kakhovka Reservoir indicate the presence of water last year. By the summer of 2024, the water was gone, but willows have not yet had time to grow here. Source: Viktoria Hubareva

he says, relying on his own experience and personal observations of nature in his native region. *"Do you see the empty sectors?"* he asks, pointing to dark patches amid the green sea where there are no trees. *"A year ago, there was still water there. Now they've dried out; the only moisture left is a meter down. Next year, probably, there won't be any moisture, and I think around 80% of this willow will dry out."*

Sosunovsky also supports his position by pointing to the fact that until it was flooded in the mid-20th century the entire surface area of the former Kakhovka Reservoir was steppe. Willow forests, which require plenty of moisture, have never grown here. However, he also recognizes that the silt that accumulated on the bed of the reservoir for so many years has changed the composition of the soil. Sosunovsky believes that the bed of the Kakhovka Reservoir may be fertile and sees this as very promising.

Whether the trees will survive in the future is unclear for the moment. When the Kakhovka disaster occurred, many environmentalists expressed concern that the former reservoir could become the site of an enormous desert. When young shoots began to appear on the ground, they said that they would not survive the winter. Yet a real forest has now begun to form on the site of the reservoir, and it is impossible to predict what this place will look like in another one, two or ten years.

A future without the Kakhovka Reservoir

Whatever final decision the government takes after the de-

The gaps in the green vegetation mark areas still covered by water by 2023's Kakhovka disaster. They are gradually drying out. Source: Viktoria Hubareva

occupation of the Kherson and Zaporizhzhia regions — to rebuild the reservoir or not — it will take time. When the reservoir was originally filled with water back in the 1950s, the process took more than five years.

So, as Sosunovsky notes, the community needs to find new solutions to restore the region's economic potential and solve the problems with water supply.

"The water problem remains critical. It's very difficult to get water from great depths and purify it. So it's necessary to establish a hydraulic balance to ensure the supply of drinking water. While the situation is still more or less stable for nine months, three months a year without water is critical. Now we're also faced with new problems, like frequent shelling, which adds uncertainty," he says.

The management of land formerly under water is another urgent issue. Some of it belongs to the Kushuhum community (which includes Malokaterynivka, Kushuhumб and Balabyne), but these areas also belong to the Ukrainian Water Fund, which means that local communities are unable to use them at their discretion.

When asked how the community would use this land if given the opportunity, Sosunovsky suggests planting a forest. "Perhaps it would be worthwhile to create a coniferous forest covering 200-300 square meters, which could be a great start," he says. Another option is to attract tourists with new leisure offerings, such as

archaeologically themed walks to places where old Cossack cemeteries and settlements were located before the Kakhovka Reservoir appeared. However, as long as the war continues and the front remains so close – it literally runs along the opposite shore at present – it is obviously difficult to make such decisions.

"I believe that the state's task is to provide serious support. Our mission now is to show international organizations that the situation is critical in order to receive grants and aid. I hope that after our victory and the restoration of peace, legislation will change and allow us to manage these territories more effectively, and we'll continue to think and work on solutions in this situation," concludes Sosunovsky.

The UWEC expert view

Many settlements in Ukraine's frontline areas have found themselves on the threshold of the unknown: their familiar way of life has been destroyed but a new one has yet to be created. It is obvious that the uncertainty caused by the war postpones the solution of problems "until later," primarily for those who live along the frontline.

Volodymyr Sosunovsky is a good example of an active community representative, someone who is involved in international projects, participates in the development of local recovery plans and actively comments on their "new reality" in the media. And the Kushuhum community finds itself at the center of the international media's attention, as this is the closest one can get to the front in the south. The best access to the boundless landscapes of the historic Velykyi Luh meadowlands, which are now recovering on the site of the former reservoir, is also found here. In the end, a UWEC journalist also visited this place.

But we do not understand why the community's water supply from the city of Zaporizhzhia has been cut off in recent months, leaving the part of the south of the Zaporizhzhia Region that is most familiar to international and Ukrainian media without its most critical resource.

Our partners from the Ukrainian Nature Conservation Group public organization have prepared a series of appeals to government agencies that should shed some light on the reasons for the deterioration in the quality of life in the Kushuhum community and perhaps find a solution that is consistent with the "Green Deal" and does not involve the restoration of the reservoir. •

Translated by Alastair Gill

Main image: The "green sea" on the site of the former Kakhovka Reservoir. Source: Viktoria Hubareva

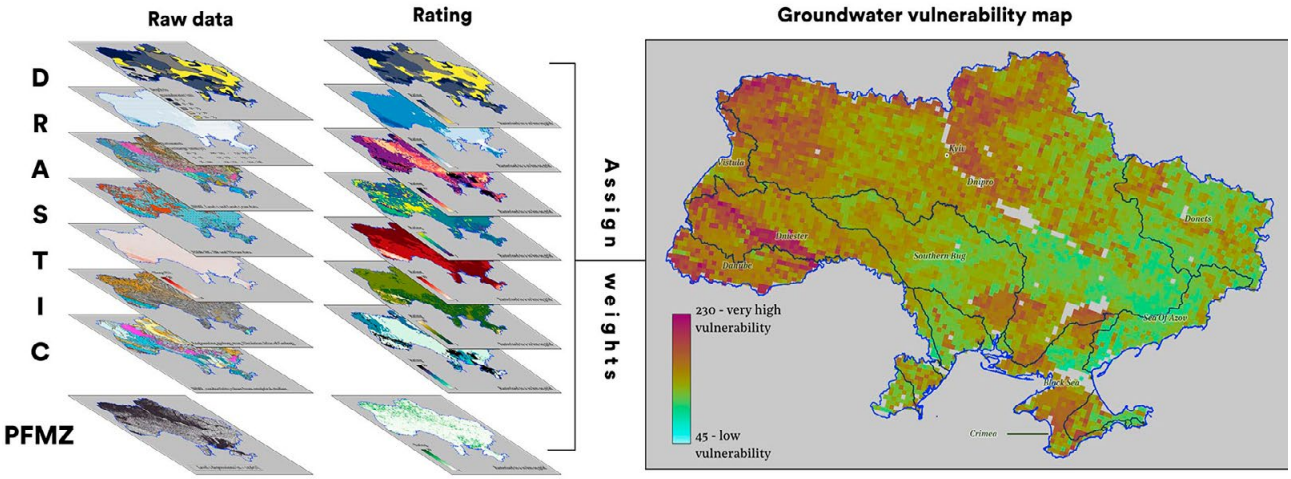
Environmental consequences of the war in Ukraine: **September 2024 review**

Alexei Ovchinnikov

Each month, the UWEC editorial team shares highlights of recent media coverage and analysis of the Ukraine war's environmental consequences with our readers. As always, we welcome reader feedback, which you can leave by commenting on texts, writing to us (editor@uwecworkgroup.info), or contacting us via social networks.

CEOBS study on the impact of the war on groundwater pollution

Experts from the Conflict and Environment Observatory (CEOBS) have carried out research to determine the probability of groundwater being polluted with heavy metals and toxic elements that may have entered the



Schematic diagram showing the DRASTIC approach to modeling (left) and the resulting map of groundwater vulnerability in Ukraine (right). "PFMZ" stands for Preferential Flow Migration Zones. Source:CEOBS

water as a result of military activity, missile or shell bombardments, or the destruction of infrastructure. The findings allowed CEOBS to map groundwater vulnerability in Ukraine.

For its methodology, CEOBS used an approach developed by the United States Environmental Protection Agency known as DRASTIC (D – Depth to groundwater; R – the possibility of Recharging reserves (net recharge); A – Aquifer media; S – Soil media); T – Topography; I – Impact of vadose (the zone water passes through before reaching aquifers); C – hydraulic Conductivity (how easily water flows through the aquifer rocks)).

Not all the criteria are of equal significance: depth to water and net recharge are the most important. Each category was therefore assigned its own significance coefficient and the pollution risk was assessed in accordance with the criteria. This made it possible to create a summary table of the probability of groundwater pollution in Ukraine. The data used for the study was assembled by CEOBS experts from freely available sources, such as the International Hydrogeological Map of Europe), the European Soil Database and the Ukrainian Hydrometeorological Institute).

The map showed a high level of vulnerability for groundwater in the region around the upper Dniester River, parts of the Donets basin, the Danube basin and parts of the lower Dnieper basin, where karst landscapes predominate. There is also a high probability of polluted groundwater in the upper reaches of the Dnipro, around Kyiv. High levels of vulnerability in areas of Western Ukraine are also of note. Although these regions are located far from the frontlines, Russian shelling

of infrastructure – particularly oil refineries – means they are also subject to the risk of pollution.

Groundwater monitoring in Ukraine is very important today, since the destruction of infrastructure frequently leads to situations in which the inhabitants of both cities and villages are forced to rely upon groundwater for their supply of water. UNICEF has already sponsored the drilling of wells with the aim of supplying hospitals in Odesa and Mykolaiv.

Providing water to communities (hromady) that were previously supplied by the Kakhovka Reservoir remains a serious issue. Although, as the analysis of groundwater pollution carried out by CEOBS shows, in this region the likelihood of pollution is medium. Theoretically this allows wells to be bored to supply the hromady with water without the need to rebuild the reservoir.

You can read about the study and other projects for monitoring the environmental consequences of the war in more detail on the Conflict and Environment Observatory website.

Ukraine ratifies the Rome Statute

On 21 August 2024 Ukraine passed a law "On the ratification of the Rome Statute of the International Criminal Court and amendments to it." Ratification of the Rome Statute means that Ukraine recognizes the founding treaty of the International Criminal Court in The Hague, which should simplify the review of war crimes committed following Russia's invasion of Ukraine.

Today the Rome Statute (Article Five) identifies four types of crime that can be considered by the International Criminal Court: genocide, crimes against humanity, war crimes and crimes of aggression. While an active campaign to include ecocide on the list of international crimes is now underway around the world, crimes against nature do not currently have a separate article in the Rome Statute.

Nonetheless, as the Ukrainian organization Environment. People. Law. (EPL) notes, environmental crimes can already be treated as war crimes by the International Criminal Court (Article 8(2)(b)(iv) of the Rome Statute). A war crime is defined as, among others, "intentionally launching an attack in the knowledge that such attack will cause incidental loss of life or injury to civilians or damage to civilian objects or widespread, long-term and severe damage to the natural environment which would be clearly excessive in relation to the concrete and direct overall military advantage anticipated."

Data is currently being gathered on damage inflicted in Ukraine, and a site containing a register of damage has been developed and launched. A special

Greenpeace assessment of the environmental risks during transportation of oil through the Baltic Sea by "shadow fleet" tankers. The arrows indicate the degree of risk: red – maximum; orange – high; yellow – medium; green – low; gray – no assessment. Source:Greenpeace Ukraine

commission has outlined 12 criteria to be used, distributed across three categories (A-Claims by natural persons, B-Claims by the state of Ukraine, and C-Claims by other legal entities). In accordance with these, those who have suffered as a result of the war can submit an application to receive compensation. This concerns forced internal displacement, the death or disappearance of relatives, and the destruction of both private and public property.

The Ukrainian organization EPL not only distributes information about the possibility of receiving this kind of aid, but has also submitted an application

to the secretariat that manages the register through the Ukrainian Ministry of Justice with the aim of including an environmental damage category, B 3.1, to the register.

You can familiarize yourself with the application procedure and learn more about the organization's work on the EPL website.

Russia is continuing to export oil to Europe, putting the Baltic Sea at risk

A Greenpeace study, carried out with the help of satellite monitoring, has shown that since July 2024 around 15 oil tankers have departed Russian ports in the Baltic and Black Sea, bound for Europe.

After Europe banned the import of Russian oil, Russia stepped up oil exports via sea routes, even though sanctions imposed by the G7 nations prevent Western shipping companies from participating in the export of Russian oil worth more than $60 a barrel, and insurance companies are prohibited from insuring the transportation of such cargo. In order to circumvent sanctions, therefore, Russia is using a so-called "shadow fleet" – tankers insured or registered in third countries. These ships are often old and in poor condition, which increases the risk of an accident.

The Baltic Sea is at particular risk today. As Greenpeace notes in its study, last year around 1,000 tankers (roughly two-three daily) carrying Russian oil passed along the German coast. Since January 2021 the total number of such voyages has increased by 70%.

This all represents a threat to the environment in the Baltic Sea, increasing the likelihood of a catastrophe and an oil spill. A good example of the condition of the ships involved in this practice is the cargo vessel Rubin, which was identified moving around aimlessly for several days off the coast of Norway. The ship was carrying 20,000 tons of ammonium nitrate and European ports refused to accept the vessel for a long time. In the end, the authorities in Malta agreed to let the Rubin into port there.

Greenpeace is calling upon European countries to closely monitor the situation, identify the ships that make up the shadow fleet, and determine whether their owners are engaged in trading Russian oil. In the event that proof of such precedents emerges, immediate sanctions will be introduced.

On 10 September, Greenpeace–Central and Eastern Europe opened an office in Kyiv. The organization has been involved in analyzing the environmental consequences of the war in Ukraine for a long time already: it conducted research into the impact of the invasion on the Chernobyl zone, as well as the situation with the Zaporizhzhia nuclear power plant, and also developed a monitoring project in the form of an interactive map. The opening of the Kyiv office will

also allow the organization to become more actively involved in the process of rebuilding Ukraine sustainably.

- **Read more about the effectiveness of sanctions:** Are sanctions against Russia working and if not, why not?

Ukrainian municipalities to work with European cities on climate neutrality

The SUN4Ukraine initiative, which is part of the EU Climate-Neutral and Smart Cities Mission, is inviting Ukrainian municipalities and communities to become leaders in sustainable and climate-neutral development, not only in Ukraine but in Europe as a whole.

As part of the project, ten flagship municipalities will be selected to receive expert support on sustainable development from SUN4Ukraine. They will work in tandem with European partner cities and begin to develop and implement strategies to achieve climate neutrality by 2050, serving as examples for other Ukrainian cities. The project will also run an educational program on climate-neutral cities in other municipalities. Applications to participate can be submitted until 20 October this year.

The way in which urban infrastructure damaged by the war in Ukraine is rebuilt will have a significant bearing on the overall course of the country's development. Like other environmental organizations, UWEC Work Group expects cities to choose environmental and climate-neutral paths toward development and restoration. In this regard, Europe's experience can be of assistance to municipalities and communities in Ukraine. •

Translated by Alastair Gill

Main image: The damaged Irpin dam and the flooded landscape around the village of Demydiv located north to Kyiv, in late February 2022. Credit: Vincent Mundy

Dead water from Russia: Fish and other life perish in the polluted waters of the Seim River

Viktoria Hubareva

Unprecedented pollution of a Ukrainian river caused colossal damage to its ecosystem. Read on to learn what can be expected in the future, how quickly the river can really recover, and what exactly caused the ecological disaster.

The Seim River flows through Russia's Belgorod and Kursk regions and from there through Ukraine's Sumy and Chernihiv regions. In August, a fish die-off was recorded in the Seim, and analyses showed significant violation of the maximum allowable concentrations of ammonium and suspended solids, among other organic substances. Two weeks later, additional contamination was reported. Moreover, the contaminated water traveled downstream into the Desna River, the waters of which are used in Kyiv for drinking water.

Fish die-off in the Seim River. Source: State Agency of Ukraine for Land Reclamation, Fisheries, and Food Programs

Blackened water, stench, and fish die-off in the Seim at summer's end

On 27 August, Ukraine's State Agency for Land Reclamation, Fisheries, and Food Programs reported that the fish die-off resulted from critically low levels of dissolved oxygen in the river water (<1 mg/l, where the minimum allowable level was 4 mg/l). The decrease in oxygen levels was caused by organic matter in the water. In the last days of August, the State Fisheries Agency had already collected over 17 metric tons of dead fish from the Seim.

Later, the pollution spread throughout the entire Seim River basin in Sumy Oblast and reached the Chernihiv region. The water was black near the city of Baturin, and the air smelled of rot and ammonia; dead fish floated in the river. Concentrations of dissolved oxygen in the water remained critically low for approximately one week throughout the entire section of the river being monitored.

Repeated discharges, contaminated water in the Desna River

A week after the initial pollution, the river water gradually regained its quality, but that pollution had moved downstream along the Seim and from there drained into the Desna River, of which the Seim is a tributary.

At the same time, toward the middle of September, experts began to record the first indications of changes in water color and turbidity levels in the Desna River in the Kyiv region. Experts recommended stocking up on drinking water; residents of the capital receive as much as 60% of their drinking water from the Desna. Despite this, the Kyiv water utility reported that the situation was being monitored and all drinking water indicators were within acceptable limits.

Seim River. Source: Ukrainianworldcongress

But on 14 September, new pollution was reported: *"The water is still black and odiferous at the international border in the Seim watershed. The discharge appears to be recurring,"* wrote **Serhiy Panchenko**, a scientist that had been consistently monitoring the situation. Further deterioration of the situation in Seim was also confirmed in the Sumy region by Ukraine's Ministry of Environmental Protection and Natural Resources.

On 18 September, the Seim's water quality was still deteriorating. Samples collected at a water quality monitoring station located near the village of Chumakovo (sample collection site closest to the border with the Russian Federation) showed the oxygen content of the water to be zero (the minimum level is 4 mg per cubic decimeter (dm3). The water contained 40.5 mg/dm3 of suspended solids (the standard is 0-25

mg/dm3), and had excessive chemical oxygen demand of 86 mg/dm3 (the standard is 15 mg/dm3).

What losses might residents face as a result of Seim's pollution?

For residents of the Sumy and Chernihiv regions, bans on swimming, watering livestock with river water, use of water from the Seim for irrigation, and fishing were announced in early September. These bans are still in effect (as of mid-September). Additionally, there has been no ban on the use of tap water, since both Sumy and Chernihiv use artesian wells.

Ukraine's Ministry of Environmental Protection and Natural Resources has already managed to estimate the damage caused by the Seim pollution incident: 405 million hryvnia (9.8 million US dollars). But since the pollution recurred, the amount will most likely increase.

Scientist Serhiy Panchenko noted that the economic damage to residents could be colossal:

"Pollution of the Seim has affected a huge number of people, even in the capital Kyiv. For villagers living along the river, it is difficult to even water a cow or send their flocks of geese and ducks to water. Someone lost their part-time job due to the fish die-off. All residents along the Seim can smell the water's strong stench. Millions of residents in the capital are at risk of reduced water supply due to possible filtration problems. These issues clearly demonstrate the ecosystem services that the river provided to us. The concept of ecosystem services manifests itself most fully when those services disappear. How can you water a cow or purify water for the capital without the river? So we count in hryvnia: 405 million in losses? Unlikely."

Pollution likely stems from damage to industrial plants

A criminal case was opened in response to pollution in the river. According to the State Fisheries Agency, the pollution's probable source is the discharge of pollutants over the border in Russia. The State Environmental Inspectorate in Sumy region also reported that water turbidity in the Seim near the state border may indicate the discharge of unknown substances in Russia, adding that it is impossible to accurately definitively determine the source of the pollution today, since this requires access for sample collection and examining upstream areas. Of course, these areas are out of reach, either in Ukraine's border zone, where access is very limited and restricted, or in the aggressor's country.

According to information available to the Sumy Inspectorate, sugar and alcohol plants and a tannery in the town of Tetkino were destroyed or damaged as a result of military actions

in Russia's Kursk region. Discharges from these enterprises could have caused the pollution.

Given the lack of any reports in the Russian media about deteriorating water quality in the Seim River in the Kursk or Belgorod regions, it is likely that the pollution event occurred in the border town of Tetkino (or perhaps even closer to the border).

The Seim has "died" before

Deputy Director of the State Water Agency **Igor Hopchak** also supports the theory that the pollution's source is discharges from factories in Tetkino. Furthermore, according to him, this is not the first time:

"In 2011, there was identical pollution caused by the same plant that discharged into the Seim River. At that time, the Russian Federation admitted that they had an emergency situation, and they discharged an additional five million cubic meters from their reservoir to flush the Seim River. Today, of course, our neighbors don't do the same," Gopchak commented.

There were also more recent cases of pollution of the Seim as early as the spring of 2024, but they were not widely covered by the news media. Prior to these August iterations of pollution and dead fish in the Seim, a strong stench and cloudy water were reported in May. The State Environmental Inspectorate reported pollution on 27 May, but this message was not widely publicized.

That pollution was preceded by a report in Russian media on 18 May about the shelling of a sugar factory in Tetkino, but there was no report regarding which of the company's specific facilities were damaged. For this reason direct parallels cannot be drawn between military actions in Tetkino and pollution of the Seim River. For example, although Russian media reported on the shelling of a sugar factory in Tetkino in November 2022, pollution of the Seim did not follow. At the same time, Mark Zheleznyak, a professor at the Institute of Radioecology at Fukushima University, reported that, starting on 13 August—on the eve of the river's pollution event in Ukraine—the sugar factory in Tetkino burned for four days.

"Today, the Seim is lifeless." Can the river's ecosystem services be restored?

Academician of the National Academy of Sciences of Ukraine Sergey Afanasyev noted: *"Today, the Seim River is lifeless. How soon will it be revived? Not only fish died there. All living things died: invertebrates, mollusks, insects. On the one hand, they are food sources for fish, and on the other, they ensure the river's functioning."*

The river will not be completely cleaned up anytime soon. In places where water quality has returned to

acceptable levels for now and dead fish have been removed, traces of pollution nevertheless remain. Chernihiv resident Natalia Pavlenko-Voskresenskaya used a Facebook post to describe the situation on the Seim after the first discharge event. According to her, before the pollution, there were many fish, frogs, and birds in the river. "Now it seems like the river is dead," Natalia wrote. She also wrote that silt on the riverbed is black, the stench remains, and there is "green slime" in the water.

Nevertheless, Academician Afanasyev states that nature is capable of self-purification, and the river's water flow will gradually dilute the pollution. This only relates to water quality in the river itself. When the conversation turns to cleaning and restoring the whole ecosystem, much more time may be required. Fish must return to the river, and other organisms need to recover. These processes may take much more time, and how much time exactly remains unknown. The scale of pollution was unprecedented and indisputable. Ukraine has yet another subject area for conducting future scientific research on the restoration of ecosystems.

As of the day this article was published, the water quality monitoring station located near the village of Chumakove (the closest to the border with the Russian Federation among those that show results), all water quality indicators in the Seim are normal, but the damage remains. •

Translated by Jennifer Castner
Main image: Polluted river Seim
Source: hromadske.radio

Danger! Mines! The terrible environmental and human cost of Ukraine's minefields

Oleksiy Vasyliuk

Almost three years into Russia's full-scale invasion, Ukraine is now the most heavily mined country on earth, with up to 26% of its territory thought to contain mines and unexploded ordnance. Much of Ukraine's agricultural and conservation land is likely to be inaccessible for years to come, raising difficult questions about the future of these areas and their inhabitants.

Military action causes comprehensive degradation to the environment and destroys ecosystems. Exploding ammunition, construction of fortifications, wildfires, pollution, and heavy tracked vehicles all damage natural habitats for many species and cause their numbers to rapidly decline. However, perhaps the most long-term negative impact on the environment is caused by minefields, which not only contribute to pollution but also make both agricultural and protected areas inaccessible.

A tractor destroyed after running over unexploded ordnance in the Donetsk Region. Source:ua.korrespondent.net

Forestry workers encountered unexploded ammunition in the Zhytomyr Region. Source:zhitomir.info

These factors all have different active periods: some, such as explosions, have a short-term impact, while others—pollution, erosion, large-scale fires—produce long-term consequences.

Some consequences may only become apparent over time. For example, the saturation of the territory of Ukraine with landmines creates problems that will take at least decades to resolve. According to some experts, the process of demining Ukraine could take up to 750 years—almost a year of demining work for every day of the war so far.

Ukrainian and foreign media alike have been describing Ukraine as the most heavily mined country on earth since the end of 2022. At the beginning of Russia's full-scale invasion of Ukraine in February 2022 the first "effectively" mined areas were areas hit by shelling where some of the ammunition remained undetonated, creating the risk of future explosion. This is seen in forests, fields, and populated areas where particularly intense fighting has occurred and the frontline has moved to and fro. Cases in which unexploded ordnance causes the deaths of farmers, forestry workers, or other local inhabitants are unfortunately now widespread.

If we consider all territories where demining activities have yet to be carried out to be effectively mined (not only minefields, but also the possible location of bombs, missiles, or ammunition that did not detonate as a result of military activity or shelling), such areas occupy 156,000 square kilometers or 26% of Ukrainian territory. Other estimates predict that as much as a third of Ukraine's territory will need to be de-mined. For comparison, this is approximately equal to twice the size of Bulgaria or four times the size of Slovakia.

Landmines in natural and agricultural landscapes

Unexploded ordnance is especially dangerous because its threat is so unpredictable. You can hit a mine while driving along a forest road, while reversing onto the side of the road to do a U-turn, or while harvesting in a field.

The expansion of military operations has led to a rapid increase in the types of ammunition used and the means of deploying them. Along the frontlines, soldiers deploy an assortment of minefields, tripwires, etc. The Russian army also has the capacity to deploy mines remotely on a large scale using artillery that can scatter thousands of explosive objects over a distance of dozens of kilometers.

The same goes for the cluster munitions used by the Russian army to strike Ukrainian cities, some of which have a delayed-action mechanism and only explode when a person approaches. Explosive objects have also become common finds in buildings liberated by Ukrainian defense forces in populated areas.

A boobytrap rigged using a grenade on a tree: this type of trap explodes when a person walks into an inconspicuous metal wire. Source: armyinform.com.ua

> When the front began to stabilize, large minefields were deployed along it. Similarly, minefields are also being created along Ukraine's state borders with Russia and Belarus, adding ever larger areas of natural and agricultural lands to the list of territories that will need to be de-mined in the future.

Minefields—or simply the presence of explosive objects in the ground after shelling or military action—have therefore become a new reality for Ukrainians. And in this new reality, it is often no longer possible to feel safe in natural or agricultural areas, even in prosperous regions far from areas where fighting is taking place. Dying as a result of a mine or a cluster munition explosion has become a brutal everyday possibility in Ukraine.

State of the environment in mined areas

It remains difficult to talk about the state of the environment in mined areas today. Since the majority of these areas are inaccessible, it is simply impossible to obtain most of the information needed to assess the state of damaged areas. This applies not only to chemical analyses of soil or water, but also to studies of the state of ecosystem restoration, conservation of rare species, etc. This kind of research is essential for making decisions on whether to restore areas or limit their use, as well as assessing the damage caused by military action on Ukrainian territory.

The status of effectively mined areas is becoming an important economic factor, suspending activity in large areas and thereby removing them from agricultural and general economic use.

It is important to note that this primarily concerns Ukraine's southern regions, which until recently were the most agriculturally developed. At least 30% of Ukraine's arable land is found in temporarily occupied regions or is effectively mined.

No more sunbathing

Mining has also had a serious impact on opportunities for recreation and domestic tourism.

Primarily of course, this concerns the Crimean Peninsula, traditionally Ukraine's main resort destination. The coastlines of the Azov and Black seas were also popular—now large parts are under occupation, while the rest is mined and no longer accessible to vacationers. Only some city beaches in Odesa have been cleared of mines and are open for use.

The Azov region aside, domestic tourism and recreation in eastern Ukraine were concentrated along the valley of the Siverskyi Donets River. One of the most popular areas was around the Sviati Hory National Park in the Donetsk Region, which is today one of the areas that has suffered the most from fighting and is partly located on the frontline. In the Sumy Region in northeastern Ukraine, residents used to vacation along the Desna River near the city of Novhorod-Sivers'kyi, currently a militarized border zone. In the northwest of the country, outdoor recreation was concentrated around the Shatskyi National Park, but this is now a border zone.

> Essentially, then, the majority of all areas in Ukraine suitable for outdoor recreation, as well as the majority of resort areas that were not previously captured by Russian troops, have become inaccessible to Ukrainians as a result of mining. Only the Carpathian region and the Podillia canyon area (in the Khmelnytskyi and Vinnytsia regions) remain open to visitors.

New challenges for biodiversity

Aside from the economic significance of mined areas, they also create challenges for protecting biodiversity. Environmental aspects are critical when it comes to making decisions on where, when, and how to de-mine areas and must be carefully considered.

Military action leads to the spread of explosive objects, destroys landscapes and soil cover, and also results in the erosion and disruption of the hydrological regime in affected areas, as well as to significant chemical

contamination of soils. This means that the further use of such areas should be decided not only within the context of restoring their economic potential, but must also consider soil pollution and threats to biodiversity. It is possible that such pollution may make relatively large areas unsuitable for agricultural use.

The presence of landmines is not a significant factor influencing biodiversity in itself, since only large animals can be physically harmed by landmines. Small fauna, birds, flora and mushrooms do not experience direct consequences from the placement of explosive objects. In addition, the mining of land suspends agricultural and economic activity on that land, and therefore also suspends any negative impact this had on local wildlife.

The exception is spontaneous fires, which cannot be extinguished in mined areas and therefore entail large-scale destruction of biodiversity. The most dangerous are large-scale forest fires, which usually result in the complete destruction of ecosystems over large areas.

- Read more: Flames of war: How Ukraine lost over 1,000 square kilometers of forest

The absence of economic activity, as well as the physical damage to most mined areas, lead to the mass spread of invasive species—among both herbaceous plants and trees. Weed seeds accumulated in the soil actively germinate and result in massive overgrowth everywhere where no agricultural activity occurs. This scenario is widespread, be it in populated areas destroyed by military action, abandoned fields under occupation, or other locations that have suffered military damage. Seeds that have accumulated in the soil germinate, resulting in areas where there is no agricultural activity becoming heavily overgrown with weeds. This scenario occurs everywhere, in populated areas destroyed by military action and in abandoned fields, whether they are in occupied zones or have simply suffered military damage.

- Read more: Invasive species threat resulting from Russia's full-scale invasion of Ukraine

The spread of invasive species is also facilitated by the prior degradation of native vegetation as a result of intensive farming practices. Large-scale use of herbicides in the past, the small percentage of surviving natural ecosystems capable of acting as donors for biodiversity, as well as fresh chemical pollution resulting from military activity, make these areas unsuitable for many species

and a convenient environment for the spread of aggressive invaders. These include common ragweed (Ambrosia artemisiifolia), horseweed (Erigeron canadensis), black locust (Robinia pseudoacacia), tree of heaven (Ailanthus altissima), and Russian olive (Elaeagnus angustifolia).

Biodiversity is not only disappearing, it is also advancing

A significant part of the areas now considered to be effectively mined are experiencing intensive overgrowth with vegetation. This situation will complicate future de-mining efforts and also have a negative impact on the remnants of natural ecosystems, initially lost amid agricultural landscapes, and now again among the endless thickets of invasive species.

One of the most intriguing aspects of this new state of affairs, however, is that invasive plant species could hypothetically become agents for phytoremediation and soil restoration. Long-term overgrowth of mined areas with wild vegetation will potentially lead to an improvement in soil quality, as well as the extraction of pollutants that entered the soil as a result of exploding munitions. Additionally, in the medium- and long-term perspectives natural vegetation should restore itself in such areas, since the vast majority of invasive species are annual and are eventually displaced as perennial species of native flora spread.

The new reality for protected areas

Some mined and temporarily inaccessible territories have protected status as conservation areas. These include nature reserves, national nature parks, and wildlife sanctuaries, as well as internationally protected sites with the status of UNESCO biosphere reserves. In a situation in which mining and occupation make them completely inaccessible, protected areas can no longer be supervised and are abandoned to the random course of natural processes.

Mining has affected the Black Sea Biosphere Reserve and national parks all over the country. Some, such as the Velykyi Luh, Nyzhn'odniprovs'kyy, Biloberezhia Sviatoslava, Kamianska Sich, Kreminski Lisy and Dvorichansky reserves, are located along the frontline. Others, like the Dzharylhats'kyy, Charivna Gavan and Krymskiy Nature Reserve national parks, are in coastal areas now under occupation. There are also many conservation areas located along Ukraine's northern borders: the Chernobyl Radiation and Ecological Biosphere Reserve, and the Polissia, Rivne and Drevlianskyi nature reserves. In addition, no fewer than 140 smaller nature conservation areas in border areas or zones of intense military activity have been mined.

A mine that washed up on a beach in the Odesa Region. Source: novynarnia.com

Sea mines

It is also worth mentioning the mining of the Black Sea. Different types of sea mines can be laid by ships, boats, and even aircraft. Russia has laid at least hundreds of sea mines in the Black Sea. Some of them are fixed on the seabed, while others drift, following sea currents. There are already documented cases of such mines washing up on beaches in the Odesa region.

Sea mines can pose serious threats to international cargo vessels, as well as ports and coastal settlements. But they pose a much greater threat to biodiversity, because the explosion of powerful munitions in water kills most living organisms within a large radius of the detonation site. This primarily concerns animals that are especially sensitive to sound waves, particularly cetaceans. Detonation of a sea mine can harm them at great distances.

Just as on land, mines and other explosive objects at sea will remain a threat for a long time and can cause human casualties and significant damage to the environment, both in the coming years and the more distant future. This situation in particular reflects the war's impact on neighboring countries and creates threats for residents of Bulgaria, Romania, Georgia, and Turkey, as well as for ships from dozens of countries that use Danube ports.

Mines washed down the Dnipro

Another event in the war in Ukraine has written a bleak new page in the history of landmines—the blowing up of the dam at the Kakhovka hydropower plant on 6 June 2023. The release of

A minefield in the south of Ukraine after the destruction of the Kakhovka dam. Workers from the international humanitarian demining organization HALO tag mines, allowing their movement and detonation to be tracked. Source: The Halo Trust

water on such a huge scale destroyed many settlements, infrastructure, and ports, and carried a large amount of soil, bottom sediments, and vegetation great distances—in some cases, across hundreds of kilometers of open sea to the shores of the Odesa Region. Among other things, the floodwaters washed away large-scale fortifications and minefields that Russian troops had created on the left bank of the Dnipro in anticipation of a possible counteroffensive by the Ukrainian army.

Will landmines paradoxically allow us to protect nature from humanity in these parts of Ukraine, just as, for example, the status of the Chornobyl exclusion zone turned radiation-contaminated areas into important natural areas that were later awarded the status of a biosphere reserve? Or will nature in mined areas degrade in the near future, since it will be impossible to take measures to prevent the spread of invasive species and wildfires? It is possible that we will only learn the answer dozens of years in the future.

UWEC Work Group will examine possible future scenarios related to mined areas in the next issue. •

Translated by Alastair Gill

Source of main image: atn.ua

UWEC
Ukraine War Environmental Consequences Work Group