

U W

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**Ukraine War
Environmental
Consequences
Work Group**

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Dear Friends!

In this issue, we draw your attention to the impact of the war on water – rivers, seas, lakes, small and large reservoirs and streams. Unlike soil, forest, or steppe, water knows no boundaries. It is always mobile, and therefore water pollution caused by the military invasion of Ukraine spreads throughout the region. We have repeatedly noted that the war's direct environmental consequences relate to water bodies and not only in Ukraine. Pollution is documented to be occurring in the Black Sea, while research has yet to be carried out in, say, the Danube River delta. Mediated (indirect) consequences are noted all over the world, even countries as far away from the conflict zone as

Mongolia, about which you can learn more on our [website](#).

War transforms landscapes. This is well-established, and UWEC Work Group has previously examined the consequences of the [draining of the Oskil reservoir](#). In this issue, UWEC's editorial team has collected a variety of opinions on possible solutions for Irpin River management. Readers will recall that at the beginning of the invasion a dam was blown up in Kyiv suburbs, resulting in flooding of the river and nearby villages. The dam was destroyed in order to stop the advance of enemy troops. Today's active disputes about the flooded Irpin River will contribute to tomorrow's development of balanced decisions about the area's future.



• [Plans to rebuild Ukraine shaped by solutions for Irpin](#)

The war's impacts on rivers are difficult to capture and analyze until the conflict has ended. That said, we can draw some preliminary conclusions today. We spoke with UWEC Work Group's experts coordinator, co-founder of the Green Silk Road Network, and rivers expert Eugene Simonov about the direct and indirect consequences of the war for rivers. We discuss how it affects water bodies, how we can collect data today, and what indirect effects are being recorded that are infrequently discussed.

• [War and Rivers: a conversation with Eugene Simonov](#)

Indirect consequences, some of which we have already examined more than once, include the weakening of environmental practices in the most vulnerable areas, at points of "environmental stress." Under the pretext of war, a predatory and consumerist attitude towards those natural areas environmental activists wish to protect is again developing. Read our article about the



problems facing Lake Baikal, protection of which is now complicated due to the war unleashed by Russia.

- **Lake Baikal at War**

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- **War and the Sea: How hostilities threaten the coastal and marine ecosystems of the Black and Azov Seas**

All rivers flow into the seas. This means that all toxic and harmful substances sooner or later end up in the sea. In a war in Ukraine, all waters flow to the Black Sea. Today, that sea suffers both from hostilities taking place directly on its territory and from industrial pollution. Read Ukrainian expert Sofia Sadogurska’s analysis of the war’s effects on the Black and Azov Seas.

- **Mass dolphin mortality in the Black Sea: a military perspective**

Last but not least, we started a collaboration with the Conflict and Environment Observatory (CEOBS). Special for UWEC Work Group, leader of our expert department Oleksij Vasyliuk, together with CEOBS expert Eoghan Darbyshire, prepared an article exploring pollution of the Bug estuary as a result of damage to primary water treatment facilities in the city of Mykolaiv.

- **Pollution of the Bug estuary following damage to Mykolaiv’s main wastewater treatment facility**



We welcome information sharing about the war’s environmental consequences. Only reliable analyses can empower us to find and develop solutions to overcome this crisis.

Join us on our [website](#), [Twitter](#), and [Facebook](#).

*Peace and strength to you,
Aleksei Ovchinnikov
Editor in Chief
UWEC Work Group*



Plans to rebuild Ukraine shaped by solutions for Irpin

Compilation by [Eugene Simonov](#) and [Oleksii Vasyliuk](#)
Translated by Jennifer Castner

Ukraine's path to Europe will undergo a comprehensive program for the country's "green" recovery. UWEC Work Group [concluded earlier](#) that the plan presented in Lugano contains only a few scattered environmental measures (and many anti-environmental initiatives).

At the same time, the European Union is now [adopting a law](#) on the restoration of all ecosystems in Europe and is preparing to invest hundreds of millions of euros for the program's implementation.

In this article, we will study approaches to restoring Ukraine's ecosystems using the case of the Irpin River, a river which has rendered the country a huge service by blocking the enemy's advance on Kyiv's outskirts.

Unfortunately, public discussion of differing approaches to restoration of the Irpin floodplain have not yet taken place. Meanwhile, the way in which the fate of this heroic river will be decided could affect all subsequent decisions to restore the natural and economic potential of other war-affected river basins in Ukraine.



We have collected a range of opinions from various authors, experts, and environmental activists. The multitude and variety of their positions allows us to see the full spectrum of prospects for the Irpin's restoration. We don't offer a sole correct option, but rather believe presenting a variety of representations will make it possible to find the best solution.

Hydraulic war: History of the Irpin River's role in defending Kyiv in 2022

On 26 February, at the very start of Russia's invasion when Russian columns were en route to Kyiv, Ukrainian troops destroyed the bridge over the Irpin River near the village of Demydiv, a suburb of the Ukrainian capital.

Faced with this challenge, the aggressor tried to break through Kozarovychi dam that protects the Irpin River's reclaimed floodplain from being flooded by waters from the Kyiv reservoir. At that point, the Ukrainian military partially destroyed the dam separating the Irpin River from the Kyiv reservoir. The water that rushed into the river valley created a wide impregnable barrier against enemy troops and thus greatly facilitated Kyiv's defense. 2,500 hectares of floodplain lands were engulfed, radically changing both the location's ecology and Kyiv's defense strategy overnight. Russian troops were unable

to conduct a forced crossing of the floodplain wetlands and the entire offensive bogged down.

In the 1960s, when the Kyiv reservoir first gradually reached its full capacity (103 m above sea level), the floodplain of the Irpin's lower reaches turned out to be three meters lower than the reservoir. The floodplain was protected from flooding by building both a protective dam and a pumping station that transferred water from the Irpin into the reservoir. Water is similarly pumped from other Dnipro River tributaries (Trubezh, Tyasmin, etc.) that share the same relative position.

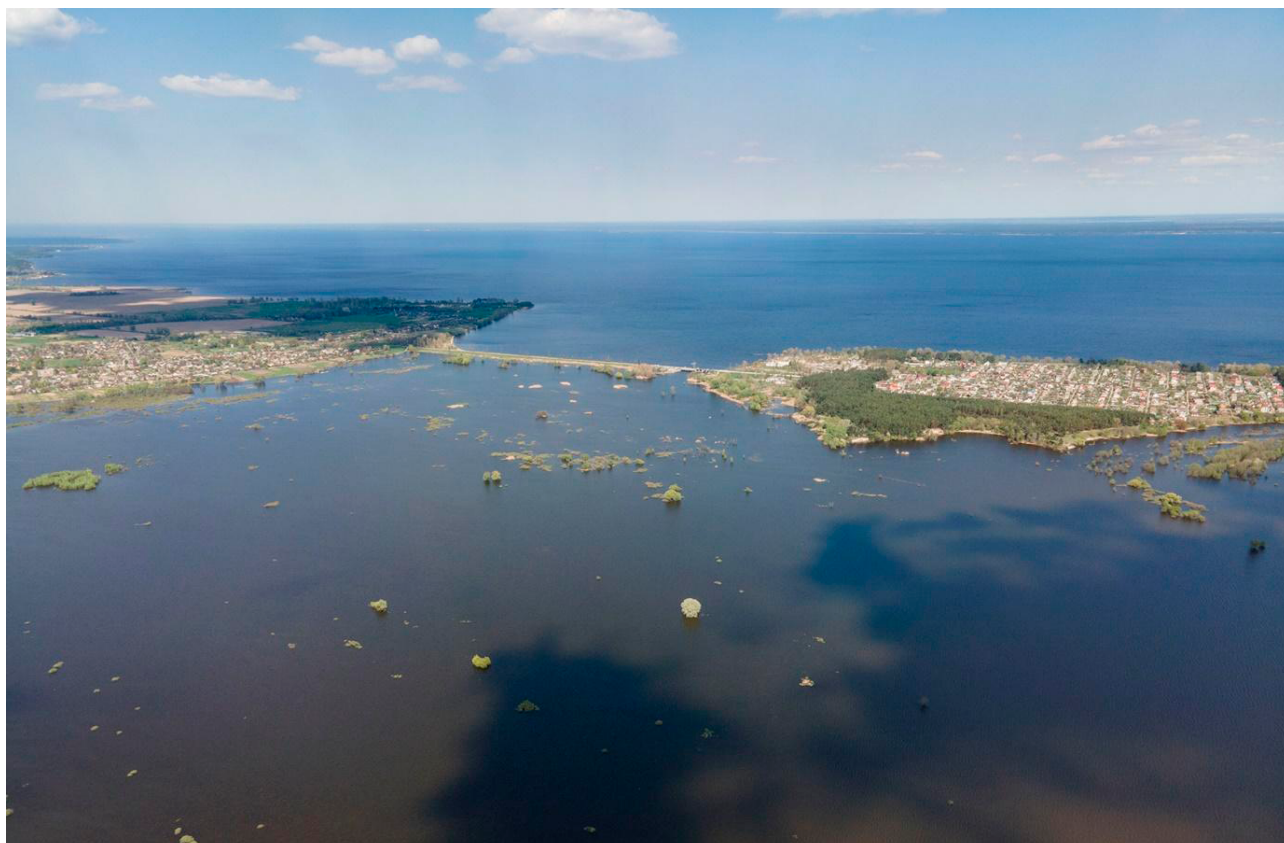
In the first month and a half after the dam's destruction, water from the reservoir flooded the Irpin floodplain for over 20 kilometers upstream. At its broadest, the Dnipro's flooded tributary (near Demydiv) is two kilometers wide.

In Demydiv itself, the water came close to homes, but people courageously accepted this disaster, which also coincided with a temporary occupation by Russian troops. As of 7 April 2022 (40 days after the dam was destroyed), flooding reached the outskirts of Huta-Mezhyhirska, Chervone, Moshchun, Horenka, and Hostomel, flooding all the lands to a height of 103 meters above sea level.

Overnight, the Irpin River became the subject of worldwide discussion. Washington Post [journalists marveled](#) at the return of "hydraulic warfare" to Europe.



September 2022 map of environmental concerns and damage in the Irpin River valley. Credit: ZOI Environmental Network [Environmental Briefing](#) on war-related water issues produced in cooperation with CEOS.



Kozarivychi Dam and flooded area in May 2022, view from Kyiv reservoir.

Credit: [Ukrainska Pravda](#).

In the EUObserver, river and ecology experts [recalled the dire humanitarian consequences](#) of past dam failures, including the Dnipro Hydropower Station during World War II, and urged parties to the conflict to avoid destroying large dams.

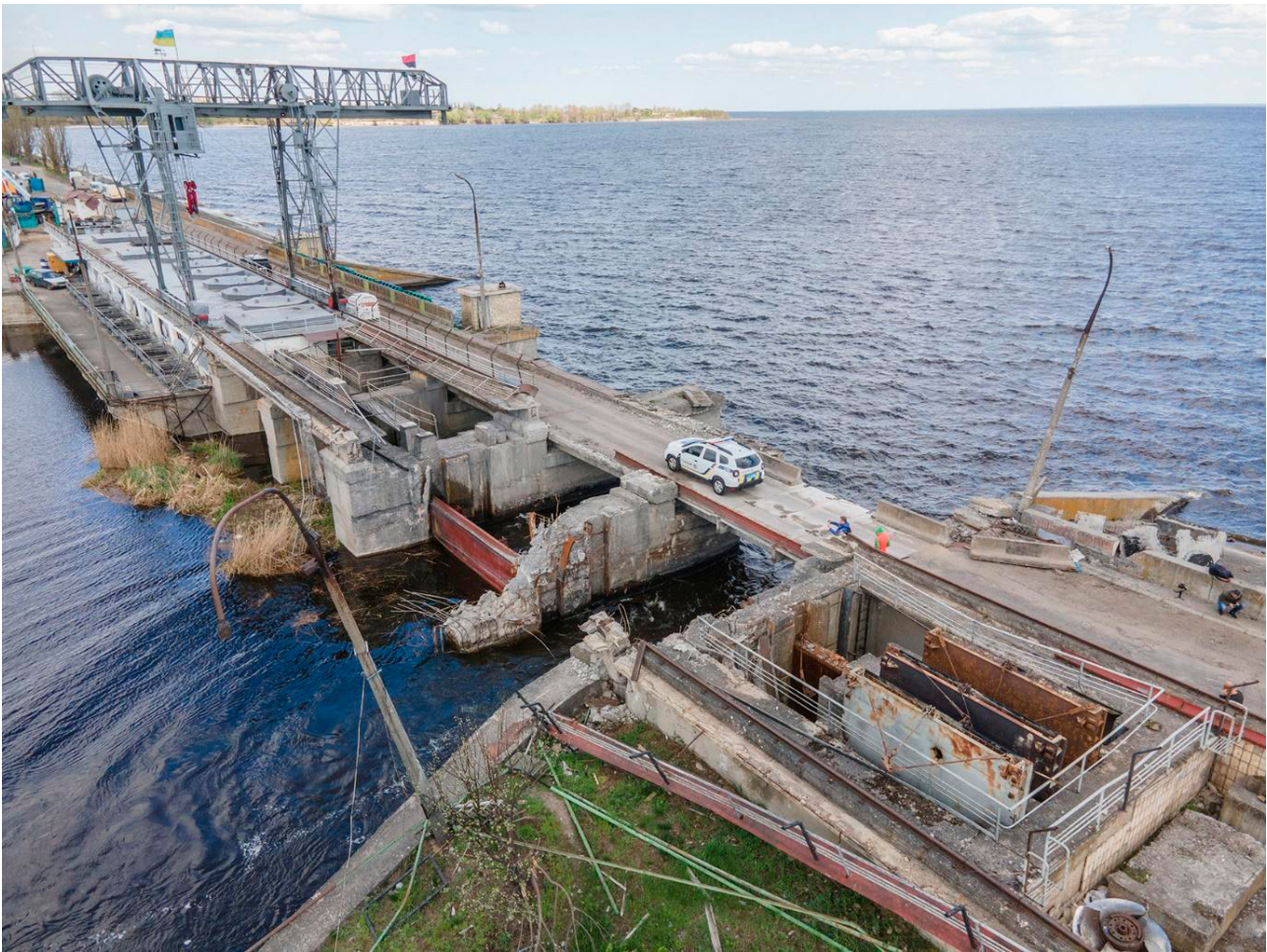
The New York Times published a [multimedia essay](#) about life in the flooded villages freed from occupation. State Russian media used scare tactics almost daily, writing that “Ukrainian nationalists” are preparing to blow up another dam and that it will play out similarly to the Irpin.

In Ukraine, different assessments of the Irpin events were presented and often opposing views were expressed

regarding future ways to deal with the river valley during the country’s “green recovery.”

The disputes continue today, and in order to come up with a balanced recovery plan, all stakeholders must be heard and experts be interviewed.

As far as UWEC Work Group can establish, the destroyed dam is currently being restored. This was inevitable, given that it is also transportation infrastructure important to local residents and for Kyiv and included in plans for the city’s defense. Its restoration is accompanied by a promise to pump water out of the river valley, the expediency of which is ambiguous, both from environmental and defense perspectives.



Kozarovychi Dam, shown here with restored roadbed in May 2022, was built in the 1960's where the Irpin drains into the Dnipro River. Credit: [Ukrainska Pravda](#).

Outraged minister: Official position expressed in terms of damage

According to the [Ecopolitika](#) portal, Ukraine's Minister of Environmental Protection and Natural Resources Ruslan Strelets [used his Facebook page to state](#) that the destruction of the Irpin dam during hostilities caused enormous damage to the environment and population centers.

According to the minister, this led to the release of more than 117.5 million cubic meters of water from the Kyiv reservoir. Those floodwaters entered floodplain lands previously protected by

the dam. Residential buildings, forests, and meadows in the Irpin floodplain were flooded. Strelets added that the amount of damage is almost 27.4 million hryvnia. According to the minister, those who suffered from the flood were still happy about it, because "a flood is better than life under Russia."

Scientists seek to balance interests

Scientists from Ukraine's National University of Bioresources and Nature Management – Doctor of Biological Sciences Vladimir Starodubtsev and



Candidate of Agricultural Sciences Maryna Ladyka – shared their professional assessment of the situation on the Irpin River floodplain with UWEC Work Group.

They have studied these now flooded farmlands previously and use their article to reflect on ways to combine land restoration with nature conservation and improved farming efficiency.

In particular, they write:

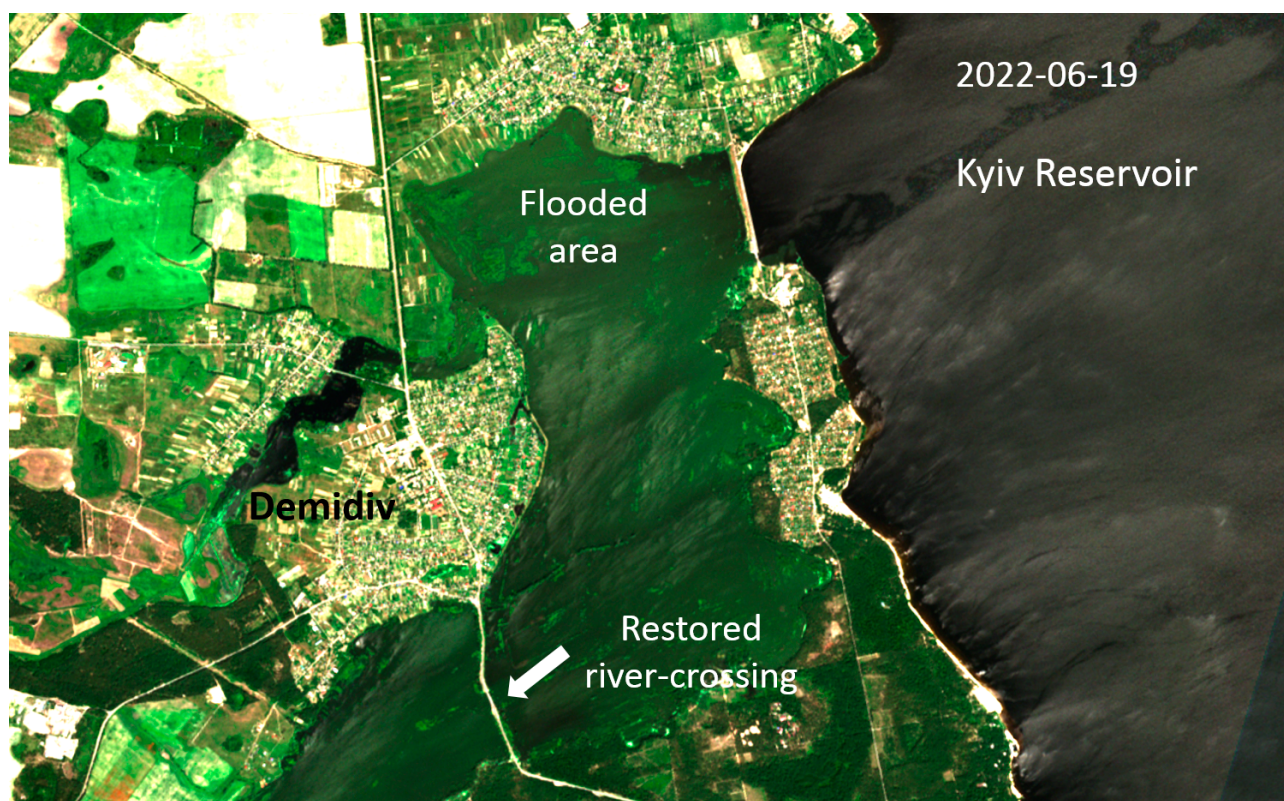
The plans for Kyiv hydropower station and reservoir officially describe this agricultural facility as “Protecting the Irpin city floodplain.” 1.4 km in length, Kozarivychi dam and its associated pumping station protected these lands by pumping Irpin waters into the reservoir at a rate of over 60 cubic meters per second. Roughly 2,500 hectares of these protected lands were used

mainly as pastures and hayfields. A network of drainage canals, partially silted and in need of dredging, facilitated reclamation of this land mass. These waterworks are also in need of repair. Groundwater in summer occurs mainly at a depth of 0.5-1.5 m.

The current ecological state of the area is clearly visible on Sentinel-2 satellite imagery as of 19 June 2022.

Even before the war, plans were afoot to update and renew the protective infrastructure for this floodplain, a fact that will facilitate attention returning to this project after the war is won.

Heated discussions between environmentalists and the business community about the expediency and extent of wetlands reclamation should be taken into account. Clearly there will no longer be such a dense network of drainage channels



Flooded Irpin River floodplain (19 June 2022). Credit: Kateryna Garbarchuk.



as originally built. But the protection of household plots and the buildings themselves of the inhabitants of Demydiv will, of course, be ensured. Much attention will also be drawn to optimizing the design and reducing operational costs of pump station between the Irpin River to the Kiev Reservoir.

It is quite obvious that there will no longer be such a dense network of drainage channels, but protection of household plots and residential buildings in Demydiv will, of course, be ensured. The need to optimize design and reduce pumping station operating costs from the Irpin River to the Kiev Reservoir is also an important focus.

Kyiv Environmental and Cultural Center (KECC) calls for creation of a memorial for nature

Volodymyr Boreyko, director of the Kyiv Environmental and Cultural Center, believes that the Irpin River should receive the title of "River-Hero" and become a military memorial.

KECC approached the Irpin City Council with a proposal to create a memorial to protect the river within Irpin city limits (15-km area begins 20 km upstream from the Kozarovychi dam, where flooding was only minor).

We call for approval of a decision to create the "River-Hero Irpin" local landscape refuge with a total area of 127.9 hectares located near the Irpin River on Irpin City Council lands in Buchansky District, Kyiv Oblast. A fragment of the Irpin River with a total length of 14,880

m would be protected, located where the river is roughly 10 m wide and includes two coastal protective strips 50 m wide. This territory is not divided into allotments, is not in private ownership, and is not suitable for agriculture.

The conservation site consists of the Irpin River and associated protective strips along its banks and is an important element for maintaining the hydrological regime of surrounding natural complexes. It is valuable habitat for rare plant species and is also used for recreation.

In addition, the Irpin River is of great historical importance as a site for Kyiv's defense over the last 1,000 years. Enemy infantry and cavalry struggled to cross the Irpin River's wide wetland valley that repeatedly defended ancient Kyiv. In the late 1930s, Kyiv's first line of defense was created along the Irpin River, with fortified emplacements built along the higher right bank. On 11 July 1941, units of the 13th German Panzer Division became bogged down in the valley wetlands and were partially destroyed by Soviet artillery. The Irpin's strategic and tactical importance has been proven once again today, when Kyiv's defenders blew up a bridge over the river and destroyed a pontoon bridge built by Putin's troops. As a result, enemy troops were stranded in the flooded and swampy valley of the "savior-river" that has defended Kyiv for thousands of years. A site schematic, justification, and sample agreement for the landscape reserve prepared by Makarovsky Village Council are attached.

Respectfully,

Volodymyr Boreyko,

Honored Conservationist of Ukraine,

Director of KECC

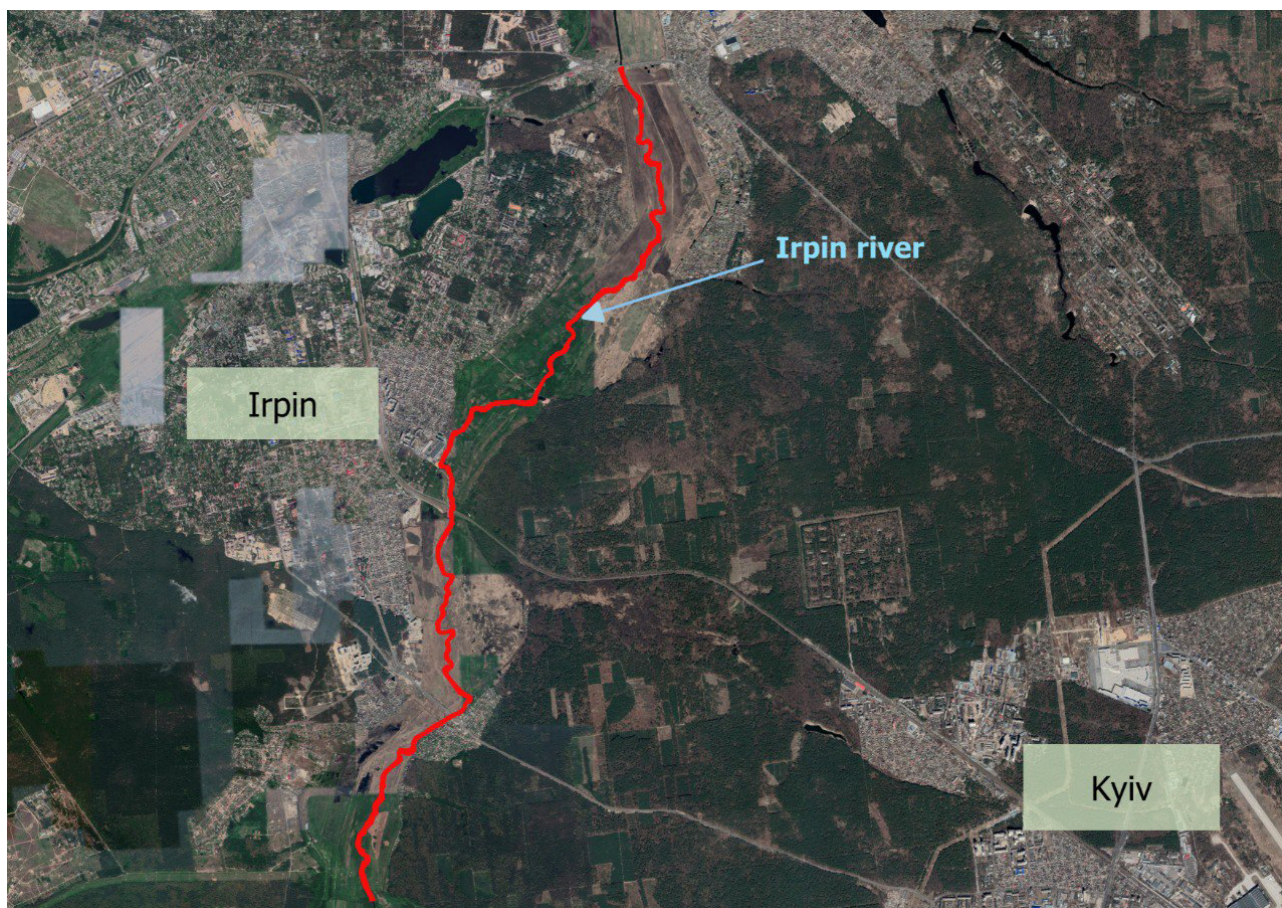


Diagram of the section of the river proposed for protection. Credit: Kateryna Garbarchuk.

In response to our question about the protection and restoration regimes for floodplain ecosystems, Vladimir Boreyko replied, We are not talking about periodic flooding of this area's floodplain, but we are talking about ending the possibility of developing this part of the floodplain. Creating a reserve is the only thing we can do to protect the currently intact section of the floodplain and river.

Local experts advocate for creating wetland-based economy

Michael Succow, Stiftung representative Olga Denyshchyk, an Irpin wetlands expert, [shared her vision](#)

for the Irpin River. Her position is to preserve the wetlands by integrating them into suburban Kyiv's "green economy." Protection and expansion of the Irpin River floodplain's ecosystem services will allow Ukraine to quickly achieve carbon neutrality obligations and achieve climate policy goals.

«Ukraine has signed the Paris agreement, promising to be carbon neutral by 2050. In part, this means that, like other signatory nations, Ukraine plans to restore and re-wet all drained peatlands – the most effective natural means of carbon storage.

In the past, the Irpin River's floodplains stretched over 10,000 ha of peatlands, the deepest such deposits in the Kyiv area. After these peatlands were drained for agricultural



use in the 1950's and 1960's, the river itself was straightened and its floodplains destroyed. Until recently, peat fires were very common in the area, resulting in air pollution. The media has reported on illegal peat extraction as well.

Current flooding could be seen as an opportunity to rethink Irpin River management and restore the river and its wetlands. Positive results will include, but are not limited to ending peat fires, more water in the river, cleaner river water, cooling effects for the local climate, returning and increasing wildlife populations, and largely natural recreation zones. Last, but not least, the floodplain will serve as a fortification barrier on the road to Kyiv. All these changes will boost community initiatives, including local businesses.

Possible options include not only environmental restoration, work that is costly and not possible in all parts of the territory. Severely degraded peatlands could be re-wetted and used for [paludiculture](#) (peat cultivation and forestry on rewetted peatlands) to produce insulation materials and biofuels that will be in high demand in Ukraine. It is possible to create a mosaic landscape of natural, semi-natural, and industrial and agricultural areas to benefit local communities, wetlands, and climate.

Sadly, current floodplain management near the town of Irpin includes plans for construction of a new residential complex. Aside from environmental damage to the river, these initiatives will result in irreversible future financial losses.

With natural disasters caused by climate change, eventually the proposed complex on the Irpin floodplain could be flooded. Additionally, peat and organic floodplain soils are not suitable for construction; peat soils can subside 1-2 cm annually. The costs of repairing infrastructure damage and frequent maintenance will be huge.

The Irpin River and its peatlands and floodplains require careful professional assessment, monitoring, and ongoing work over the decades ahead. This complicated task cannot only be managed by national experts, but must absolutely involve international experts from countries where river restoration is a common practice.

Floodplain restoration

Irpin: Snake of peace

Vincent Mundy a Kyiv-based photographer and journalist, launched a discussion in May 2022 in The Guardian about the Irpin River's fate. He shared his photos and vision for the future of the river with the UWEC team:

I see the Irpin as a giant snake protecting Ukraine from invaders for thousands of years to come and a 3000 km² peace park of pristine riverine ecosystems unrestricted in flow or volume.

A highly-protected contiguous 162 mile-long wildlife corridor of wetland habitats, with grass and meadowlands surrounded by swamps, marshes and bogs; where water buffalo are as common as beavers and white-tailed eagles soar over flourishing colonies



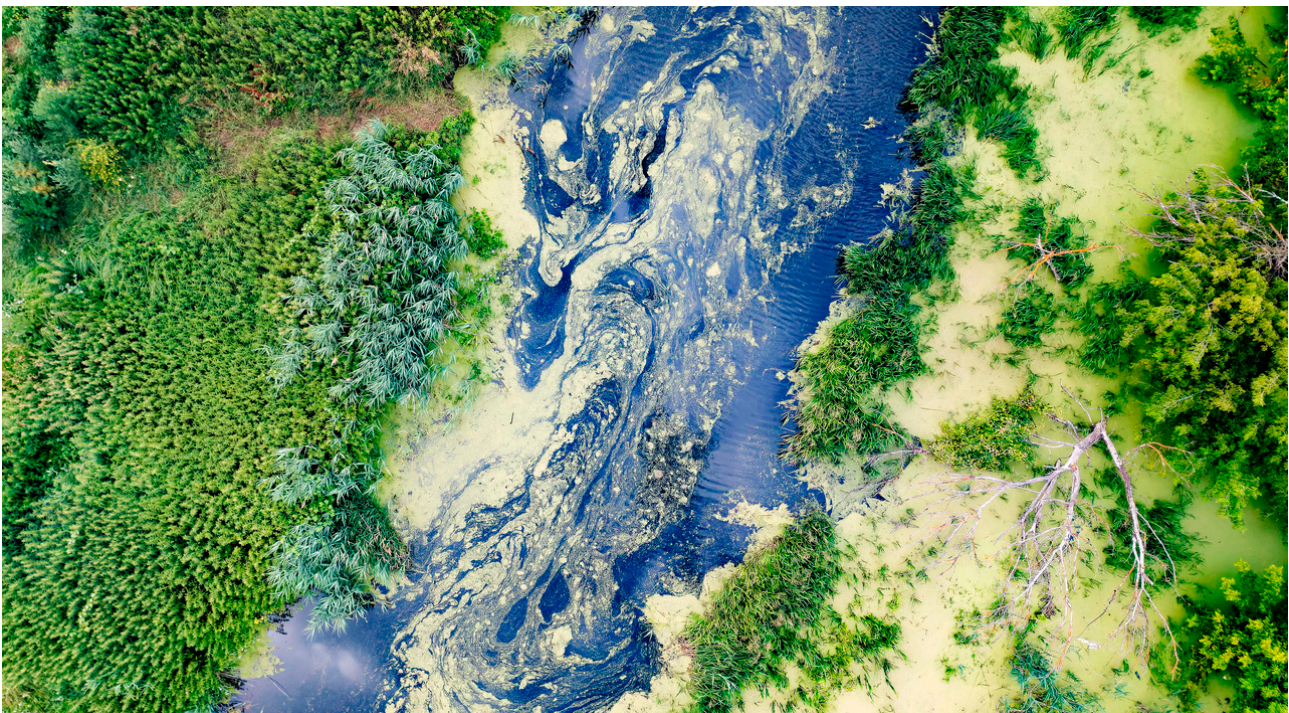
of rare migratory birds enjoying a rich diet of wild grasses, flowers, nuts, fruit, and fish.

In a wide buffer zone people from near and far come closer to the wilderness, for birdwatching, wildlife safaris, or just to

rewild the soul. Here an enterprising zone is carefully interwoven with the local ecology. Horticulture and aquaponics will flourish and “the snake of peace” will bring jobs, wealth, and global admiration for the Irpin, for Kyiv, and the nation.



The dam in Moschun was destroyed by the defending Ukrainian forces and the Russians became stuck in the ground which quickly became waterlogged. Credit: Vincent Mundy



The river Irpin near Rakiivka. Credit: Vincent Mundy



The river Irpin flows through formerly cultivated fields near Rakioka. Credit: Vincent Mundy



A section of the Irpin between the villages of Moschun and Rakioka. Credit: Vincent Mundy



A sign planed on the banks of the Irpin near Rakioka warns of mines. Credit: Vincent Mundy



A section of the Irpin between the villages of Moschun and Rakiivka which ecologists say would be the core area of ecological restoration. Credit: Vincent Mundy



Biodiversity hotspots: Craters formed by Russian shells dot the floodplains of the Irpin between the villages of Moschun and Rakiivka. Credit: Vincent Mundy



Conservation realism

Valeria Kolodezhna and Oleksiy Vasyliuk, experts at Ukrainian Nature Conservation Group, discussed the future of Irpin's wetland through the lens of harsh environmental realism and a "Why mess with success?" approach.

In their view, flooding the Irpin valley is definitely more beneficial for wildlife, as it will leave the area in a near-natural state and, even better, interfere with plans for large-scale development. The territory requires environmental monitoring, due to an exchange of introduced species between the river and the reservoir, as well as the river's technogenic pollution.

At first glance, Irpin's flooding helped to stop the distribution of floodplain land for development or plowing (previously occurring in violation of Ukraine's Water Code). It is obvious that for at least next year the floodplain will not be developed, because it is currently covered in 2,842 hectares of shallow waters. The environmental consequences of flooding are wider and more ambiguous than they may initially seem.

Flooding is accompanied by pollution and is fraught with disease outbreaks. Some of the flooded and plowed areas were, apparently, treated with organic fertilizers the previous autumn, and those substances are now dissolved in the water. Individual households in the villages of Kozarovychi and Demydiv were partially flooded, construction sites on the Irpin floodplain were flooded (for example, the Khutor Demydivo housing cooperative),

and chaotic landfills were flooded. Taken together, these issues constitute enormous environmental risks and threaten to spread infectious diseases.

People in rural areas often drink water from surface (unprotected) aquifers while also dumping waste in the same places. Apparently, not all flooded and submerged households are connected to centralized sewer systems; some houses are simply equipped with cesspools, now flooded. Consequently the Kyiv reservoir is polluted with household waste, and the stagnant nature of the newly formed waters accelerates eutrophication.

Russian forces abandoned many tanks and other military equipment in the Irpin basin, the fuel tanks of which contain remnants of fuel and lubricants. Fortunately for the river, most of the equipment was likely bogged down on approaches to the floodplain, although some oil products and oils still enter the river. When fish ingest or absorb fuels and lubricants, it results in destruction of the tissues in their gills and intestines, mucus secretion, respiratory failure, and metabolism issues. Of course, the use of such water in farming causes serious negative reactions in the human body.

It is important to remove remaining equipment in ways that have minimal consequences for environmental and public health. When water levels drop temporarily at the end of summer, it will be possible to do this with minimal damage to ecosystems. It is also important to organize ongoing water quality monitoring in both the most flooded areas and in wells in nearby villages.



Demydiv village, spring 2022. Credit: Ukrainska Pravda

As for fish populations, one should not assume that an increase in the surface area of water bodies has a universally positive effect on ichthyofauna. Restored connections with the Dnipro River and flooding of the tributary's shallow mouth are promising for the reproduction of fish from the reservoir. So, for example, in Kremenchug reservoir, a similar bay formed at the site of the flooded mouth of the Sula River, becoming Nizhnesulsky National Park – an important site not only for fish spawning, but also as nesting habitat for many water bird species. Another concern is that rheophilic fish species (those that rely on running water) cannot live in a flooded area. In addition, the Irpin River will be more actively colonized by alien (invasive) species originating in the Kyiv

reservoir; the Kozarovychi dam previously served as a protective barrier for the river. In turn, the Kyiv reservoir will become vulnerable to invasive species commonly found in the Irpin (sun perch, rotan, etc.).

The discussion about how to deal with flooded lands is more and more relevant today. Landowners and construction companies with plans to build in the river valley will, naturally, be in favor of restoring the status quo and pumping out floodwaters, despite the fact that pumping out such a significant volume is not easy and or cheap. Residents of the flooded village of Demydiv also wish to lower the water level below the level of their properties.

As we know from a [public statement](#) on 29 July 2022 by Vladimir Podkurganny, head



of the Dymersky community, water began being pumped out in July. But who made this decision and what is the decision's exact wording? At a minimum, it would help to understand whether pumping will continue only until the residential sector of Demydiv is freed from floodwaters, or is it planned to pump all the water out of the floodplain? Unfortunately, wartime conditions mean that we cannot get full answers to questions of this kind.

But objective reality will likely result in everything remaining as it is.

On the one hand, the flooded area remains an important defensive line, much more powerful than a small river and a reclaimed floodplain. On the other, a flooded floodplain has greater advantages in nature conservation terms. It cannot be plowed and built up; it will naturally transition from vegetable gardens and degraded meadows to ruderal vegetation (the first plants to colonize disturbed lands) in natural shallow-water biotopes. There will be no cause for worry about disturbance factors to bird colonies in these waters.

Thus, in the context of a post-war shortage of resources, maintaining the water body created after the dam was blown up will be the most environmentally friendly and economical way to manage this natural-anthropogenic complex. (For more information, see the [UNCG website](#))

To date, there is no publicly available information regarding any possible government decisions on the fate of the Irpin River valley.

The Ukraine Nature Conservation Group contacted state authorities seeking an answer about plans for the river. Through the Department of Ecology and Natural Resources of the Kyiv Regional State Administration (letter dated 03.08.2022, No. V.2290.2022) it became known that after receiving an appeal, pumping halted, and consideration of the question of flooded territory's fate was passed to Valerii Zaluzhnyi, commander-in-chief of the Ukraine Armed Forces. Perhaps this indicates that pumping occurred without proper government process and without accounting for Kyiv's defensive interests.

What conclusions can we draw at this stage?

First, we must acknowledge that the flooding of the Irpin valley is one of the two most significant landscape change events resulting from Russia's invasion of Ukraine. UWEC Work Group has already [written](#) about the second incident – the draining of a dammed reservoir on the Oskil River.

Such large-scale topographical changes have attracted the attention of many stakeholders: those seeking to develop the river valley and thus advocate its drainage; residents of Demydiv, who simply want to free their homes from water; the military, who need a flooded valley as an insurmountable water defense line; and conservationists



who insist on keeping the Irpin valley flooded and not only returning it to nature, but also guaranteeing that future development will not occur.

Ukrainian government representatives have not (yet) organized any dialogue regarding the river's future despite many differences regarding the unfolding events. The absence of such a dialogue increases tensions around this issue. There is no publicly accessible information about any official decisions regarding the flooding of the river valley or the opposite, pumping water out of the flooded area.

No solution to this problem will simultaneously satisfy all interested

parties. If Irpin valley flooding is allowed to remain, Ukraine will strengthen its defense capability and tangibly succeed in maintaining Irpin's international conservation status as a member territory of the European Emerald Network. That choice also means that if waters do not recede, dozens of houses in Demydiv will remain flooded unless new dikes are built to protect settlements.

As more official information about Irpin's fate becomes available at the state level, UWEC Work Group will continue reporting on this topic. We will also be ready to aid in identifying stakeholders for discussions about the future of the Irpin River. •



War and Rivers: a conversation with Eugene Simonov

*Interviewed with [Eugene Simonov](#) by Alexei Ovchinnikov
Translated by Jennifer Castner*

We continue our analysis of the influence of Russia's invasion of Ukraine on ecosystems. In this article, we discuss the ways that military hostilities have affected transboundary and those most "fluid" objects – rivers. Against the backdrop of climate change's catastrophic consequences, rivers are one of the most important elements and indicators for ecosystems. They are, of course, extremely susceptible to both pollution and to infrastructure

and landscape changes resulting from military operations.

We speak with [Eugene Simonov](#), coordinator of UWEC Work Group's team of experts, co-founder of the [Green Silk Road Network](#), and foreign agent of the Russian Federation, about the war's direct and indirect impacts and future restoration plans.

How important is the issue of river pollution caused by the military



incursion in Ukraine? What do we know about this issue? What is the difference between military and industrial pollution?

During active military operations, it is quite difficult to assess the condition of water bodies. However, this work is in process. CEOBS and ZOI Network recently published a very [useful report](#) on breakdowns of water supply infrastructure and damage to hydraulic engineering facilities, as well as subsequent health and disease impacts. I don't have anything to add to their analysis of the war's consequences for water use, but we should talk about river ecosystems. I have to repeat that it is pretty difficult to evaluate the war's direct influence on them.

If you can't perform regular monitoring, ongoing tracking for the presence of polluting substances in water, then you also cannot see trends. And trend data can be unpredictable – we don't know when bombardments and destruction that result in contamination of water bodies will occur.

In other words, we don't have the data necessary to understand the big picture. Environmentalists around the world believe that biological indicators are the most useful indicators related to the status of water bodies. Living beings react quickly to poisonous substances and other negative factors. So, if a water body is significantly polluted by toxins, we would observe fish dieoffs.

During this war, however, examples of large-scale dieoffs of ichthyofauna have been infrequent. So far, I have only seen two such reports related to freshwater habitats. One of these cases had to do with an accident at a water treatment facility.

Since there are few such cases and it is impossible to hide fish kills, we have reason to assume that river contamination does not yet have large-scale biological consequences. In my opinion, if this were an issue, it would be reported in mass media.

On the other hand, sooner or later all terrestrial pollution incidents will eventually enter the water system and chronic water pollution could be seen in a number of regions. The Donbas is the most problematic in this regard – it is here that the war is destroying the greatest number of industrial targets.

As for the difference between industrial pollution and that caused by such abnormal phenomena as armed hostilities – it is naturally significant. We can install treatment facilities at industrial sites. That's not possible during bombing. As a result, if any pollutants systematically end up in watercourses due to military operations, it will be much more difficult to clean up.

Since the war began, there have been several cases when dams and dikes were destroyed, resulting in flooding.



We already wrote about the [Oskil Reservoir](#) and about the aftermath of the disruption of Kozarovychi Dam on the Irpin River. Today, experts are actively debating the possibility of a bomb destroying Kakhovka Hydroelectric Power Plant. What ecosystem consequences related to that dam's possible destruction would you highlight? How dangerous is it?

I would not only mention flooding, but also a whole set of problems related to the destruction of hydraulic engineering structures during this war.

It's important to remember that each case is unique. Because, while damage to the dam at Oskil Reservoir simply led to the restoration of a more natural river flow regime and to the reservoir's draining, the destruction of the dam on the Irpin River poured the Kyiv Reservoir's waters out across the floodplain. These are completely different events, in terms of both consequences and impacts.

The greatest worry, from a primarily humanitarian perspective, is for the reservoirs on the Dnipro River. And right now – Kakhovka Dam. This dam could again suffer from either [artillery shelling](#) or be destroyed by a retreating army, as it was in August 1941, when the Dnipro Hydroelectric Station dam was blown up.

In the event that the dam is blown up, there will be a huge artificial wave of floodwater, dumping some portion of Kakhovka Reservoir water downstream.

It will result in changes to the riverbed, wash away vegetation, and erode riverbanks. Essentially, it will flood the entirety of the Dnipro River's historical floodplain below the Kakhovka Plant.

And don't forget the sediments carried in reservoir water. These sediments can potentially contain a considerable volume of toxic substances. This is, perhaps, one of the main threats when a dam is destroyed. Given that the reservoir is located in a large industrial and agricultural area, it may have significant accumulations.

However, I don't have any concrete data on the toxicity and location of those sediments in Kakhovka Reservoir. It could be assumed in the event of a break in the dam, toxic sediments immediately along the dam could be washed downstream. Other pollutants could remain along the Dnipro's banks, spread by dust storms and then covered by new vegetation.

There is the additional threat that draining the reservoir may affect the safety of Zaporizhzhia Nuclear Power Station. After all, Kakhovka Reservoir water is used to cool its reactors. Specialists and experts mention it from time to time. I understand them – there are much more likely threats, such as constant bombardments of the station itself.

The nuclear power station is fed by a huge cooling pond, separated from the reservoir by dikes and containing



43 million cubic meters of water. This means that temporary emptying of the reservoir will not affect the nuclear power station immediately. However, how much time and what measures are to be taken in the event that the reservoir is drained – these are pressing questions for engineers.

The last thing to note in the event of the dam's destruction is that there are many population centers on the left bank floodplain. All of them would immediately be under water, something that could lead to human losses. We don't know how quickly an evacuation could be executed during military operations.

About a quarter of a million hectares of irrigated lands are rely on Kakhovka Reservoir. These would cease to be irrigated. I don't think that those water intake structures are deep enough to endure the process of the reservoir draining. Their restoration would require a great deal of money and time. So, emptying of this reservoir, especially during seasonal irrigation, has the potential to be a big loss for agriculture.

Today there is a lot of talk about plans to restore Ukraine. What must be done when it comes to water management practices? What should our attitude toward rivers be when rebuilding the country?

It is important that restoration be seen as an opportunity to make something

better, more sustainable, and oriented toward environmental protection. A considerable part of today's destroyed cities are our Soviet legacy; these cities were planned and built without considering river basin management or landscape principles.

As for ideas, we must consider the basics. For example, restoration must occur against a backdrop of improved overall river basin management plans – where rivers are viewed as a holistic natural-technogenic system and people and nature coexist. It would be a mistake to restore infrastructure along rivers only on the basis of administrative divisions.

Basin-level planning must change in the spirit of European laws, all the more so since Ukraine has chosen this development path. It means that the [EU Water Framework Directive](#), a community action framework that devotes significant attention to river basin management, should be applied. The directive aims to bring water objects into “good ecological condition.” This means that basin management plans should provide for restoration of water ecosystems and their ecological functions. It also directs attention to water quality, artificial barriers located in basins, construction on floodplains, etc.

The natural flow of a considerable number of rivers was distorted during the era of Soviet industrialization and



“land improvement.” It is clear that a considerable number of factories destroyed during the war will not be rebuilt because these industrial centers are outdated and unneeded. The questions of what to build in their place and how ecological damage to rivers and water bodies inflicted by Soviet industry can be addressed will need to be answered. A recently adopted European Union [law](#) aimed at restoring ecosystems can help.

If we talk about specific projects rather than principles, then we should revisit urban planning practices in river valleys. For example, the frequent practice of building on floodplains should be ended. Also, Ukraine still has plans to build a considerable number of dams on rivers, including for electricity production, plans that are absolutely unjustified economically or ecologically, and the [European Union experience](#) proves it.

It is also important to involve local communities in discussions and solutions for the management of rivers and other water bodies. Environmental education is needed to demonstrate the pros and cons of different methods for regulating water flow. People themselves must decide what is useful for their region, instead of following orders coming from above.

The war has both direct and indirect consequences, including for organizations engaged in river

protection. I’ve heard that your colleagues recently faced retaliatory measures in Mongolia.

Yes, we really were faced with persecution that may itself be considered an indirect consequence of the war.

Back in 2014, I was extrajudicially expelled from Mongolia and appeared on a list of people posing a potential threat to that nation’s security. It had to do with the fact that I successfully convinced local officials and managers that there was no need to build large dams. I demonstrated to them that there are other means for solving water supply and electricity production challenges.

As a result of our numerous public statements in a variety of fora regarding the doubtful environmental safety and general usefulness of those projects, they did not build dams on rivers flowing into Russia. In early August, Mongolian officials and media announced the presence of a Russian government-led [espionage network](#) whose purpose was to purportedly prolong Mongolia’s energy dependence on Russia. This despite the fact that the country receives only 5% of electric power from Russia, but 15% from China.

These events resulted in accusations of “sabotage” and “participation in an espionage network” for my Mongolian colleagues and in particular for their cooperation with “foreign agents.” The latter is me. After all, in 2021 the Russian Federation declared me a foreign agent,



and the Mongolian special services now say that it was “cover” for my subversive activities.

In the beginning of August, the Minister of Justice also declared that anyone expressing doubt in strategic development projects in Mongolia, whether it be the construction of dams, coal-fired power plants, or water diversions, will be charged with sabotage and espionage. Money for the damage caused by “missed opportunities” for implementation of projects will be collected from these “saboteurs”.

More than 130 organizations worldwide have already [signed a letter](#) speaking out against the persecution of environmental and civil society activists in Mongolia.

In reality, Mongolia “creatively” borrowed a European model for criticizing power dependence on Russia and, having deformed it, used it to lay the blame at the feet of civil society. Such indirect consequences of the war in Ukraine may occur in other countries too, because, unfortunately, enemies of nature use military rhetoric and war-time fears for their own purposes.

Against the backdrop of the energy crisis precipitated by the war, have other countries begun more actively building hydropower plants? For example, Turkey?

From an energy sector perspective, hydropower plant construction has

no particular advantages. This year, the International Renewable Energy Agency (IRENA) finally [openly declared](#) that hydropower had become more expensive than solar or wind power. The hydroelectric power plant that we oppose in Mongolia will cost at least US\$3,000 per kilowatt of installed capacity. If China, from whom the Mongolian government plans to obtain financing, built a solar farm instead of a dam, it would be two or three times less expensive.

There are no economic or energy sector benefits in the construction of hydropower plants. But there are benefits from large-scale construction projects in the form of employing a large number of people. This is a short-term fix for dealing with economic crises, demonstrated vividly by China. That nation is planning grandiose new construction projects, especially on floodplains. However, they are not building hydropower plants known to be unprofitable, but other sorts of hydro-engineering structures instead.

Construction of hydroelectric power plants in Mongolia can be one way of overcoming its “power dependence” on Russia, while actually being harmful when viewed through a lens of long-term development objectives. This is taking place right now, for example, in the case of the highly questionable [Roghun hydropower plant](#) being built in Tajikistan; today, the European



bureaucracy is [considering](#) financing its construction.

Can you cite other examples of the way the war and the social, political, environmental conflicts that it provokes influence the situation with rivers?

There are some questions related to securing navigation on the Danube and about transboundary rivers shared by Russia and Ukraine, but we have not noticed any direct influence beyond that. However, if we look at it from a historical perspective, it can be observed that wars directly influence management of shared water basins, for example, the Amur and the Rhine.

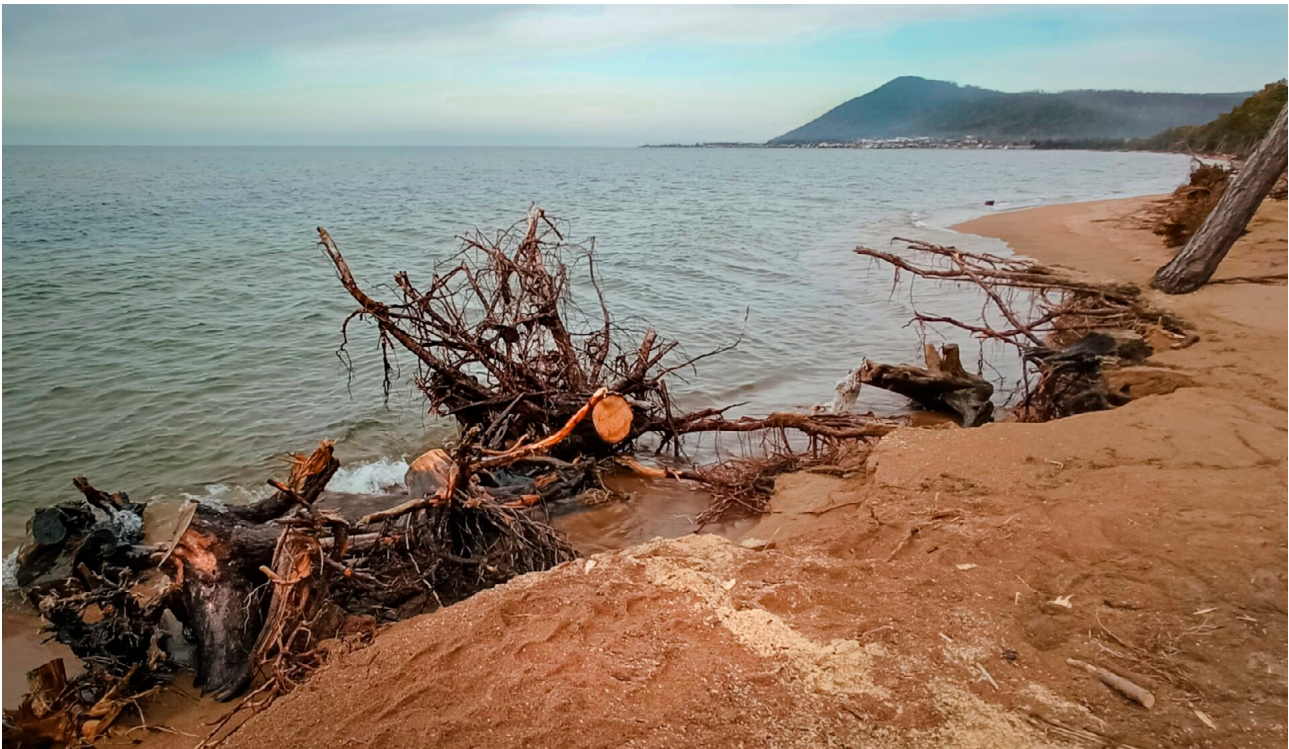
In the 1950s, the USSR and China agreed to create a cascade of dams that were meant to partition the transboundary Amur and Argun Rivers along their entire lengths. It would have resulted in the disappearance of living rivers and their transformation into a series of dammed lakes.

However, after the 1969 conflict on Zhenbao Island, the Amur dam scheme was put on hold, essentially saving the river. That plan only began to be discussed again in 1986, and since that time we have worked hard to convince the parties of the meaninglessness and hopelessness of this project. Still, it can

be concluded that a unique river was saved from technogenic transformation by an international conflict between countries in the mid-20th century.

Another example that impressed me is the Rhine River. If you go to the Alsace border area between France and Germany, on the German side you'll see an overgrown streamlet. On the French Alsace side, you'll see a huge channel containing roughly 90% of the Rhine's water. It appears to be a gross and violent "abduction" of a river from its natural conditions. The whole river was taken as a war indemnity, having artificially changed its channel after Germany lost in World War I. I consider this an important lesson: we must not destroy living rivers for the sake of achieving political ends. Resolving challenges following a war should not be destructive for nature and humiliating for people. We remember what the Treaty of Versailles entailed.

As a result, it is important to underline that until the war is over, we cannot discern best solutions for the future management and protection of rivers. When hostilities end, borders will be established, and it will be possible to plan how best to organize the sustainable use of rivers and how to ensure they provide the maximum ecosystem benefits while preserving their intrinsic naturalness. •



Lake Baikal at War

By [Eugene Simonov](#)

Russia's invasion of Ukraine and subsequent changes in political and economic cooperation between Russia and the world inevitably impact the Russian government's management of its internationally recognized biodiversity hotspots. Today, Russia has many fewer incentives to follow international laws and procedures in any sphere, nature conservation being no exception.

There is widespread disillusionment with all things Russian among western countries and international bureaucracies, further lowering incentives to cooperate with Russia in most international fora. Sanctions create both objective and assumed difficulties in acquiring modern technology,

including that for the purposes of both [environmental destruction](#) and environmental protection.

Finally, the "hardships of war" concept provided an important opportunity to the business world and government to try to [weaken restrictions](#) and add loopholes into already ailing environmental legislation, policies, and practices. In this analysis UWEC Work Group's Eugene Simonov explores how these and other factors have impacted the jewel of all jewels – the Lake Baikal World Heritage property.

Jewel of Russian nature

Lake Baikal is the oldest (25-30 million years old) and deepest



Delta of Selenge River has been decreased by 30% due to hydropower alteration of water level

(1,637 m) freshwater lake on the planet with the largest volume of fresh water (23,000 km³). At the time of Lake Baikal's inscription on the United Nations Educational, Scientific, and Cultural Organization (UNESCO) World Natural Heritage List in 1996, the World Heritage Committee (WHC) noted that the Lake meets all four natural criteria of the Convention concerning the "Protection of World Natural Heritage": geological, evolutionary, scenic landscapes, and biodiversity. It has unrivaled freshwater biodiversity and endemism: of the 2,595 species and subspecies of animals described to date, 56% of them are endemic.

A special law "On the Protection of Lake Baikal" was adopted in 1999

for the protection of its namesake. The law prescribes that any proposed development project in the Lake Baikal watershed is subject to a thorough Environmental Impact Assessment (EIA) and imposes many Baikal-specific limitations on land-use types and pollution.

Over the last decade, scientists have documented an alarming number of problems, mostly in the lake's near-shore zone. This zone is critical to the health of lakes in general, because it sequesters nutrients entering from land, harbors the majority of lake biodiversity, and is an essential energy source for lake food webs. Serious problems at Baikal include harmful algal blooms triggered by nutrient pollution, mass mortality of



Lake Baikal Shoreline is very sensitive to water levels alterations by Irkutsk hydropower

endemic sponges caused by pathogens, pollution from PCB compounds and microplastics, and unnaturally fluctuating lake levels.

Lake Baikal is far from being neglected by the Russian authorities, who regularly issue decrees, instructions, and orders intended to boost its protection, but their efforts lack tangible positive [results](#). Special orders signed by the President of Russia dated 12 September 2019 imply that past efforts to protect Lake Baikal have not yet achieved their goals, and that not all previous instructions have been implemented. In 2019, the President called on his government to introduce several urgent measures, but the government again failed to implement his orders. So, what

has the war contributed to this already problematic process?

“Infrastructure” projects exempt from EIA procedures

Baikal Natural Territory (BNT) is generally defined as the entire Baikal watershed located within Russia’s jurisdiction and adjacent industrial areas along the Angara River that may impact the lake through polluting emissions. It is situated along important transport routes, including the Trans-Siberian Railway and Baikal-Amur Mainline railway (BAM). In July 2020 Russia adopted a new federal law abolishing EIA requirements within Baikal Natural Territory’s boundaries for “primary



infrastructure” projects through 31 December 2024. Its main purpose is to accelerate exports of coal and other fossil resources to Asian countries.

On 25 March 2022, the Russian government [submitted an anti-sanction measure](#) for parliamentary approval of draft amendments to the law “On primary infrastructure.” These changes widen application of the simplifications noted above to include “modernization and expansion of (any) priority infrastructure projects” of national, provincial, and municipal significance. The second draft contained additional categories: “pipelines for oil, gas, and other products” and “other infrastructure proposed by the Russian government.”

UWEC Work Group has [previously examined](#) how Russian civil society rose in protest and prevented the worst amendments from being adopted. The [final new law](#), enacted in May,

only expands to include weakened regulations for additional transportation infrastructure, “government funded social infrastructure,” “industrial projects undertaken for environmental purposes or for import substitutions,” and “oil and gas pipelines.”

Public pressure had successfully prevented any new relaxation of environmental standards within the World Heritage property’s boundaries, despite many new activities now permitted outside those boundaries. The new law also paves the way for Power of Siberia-II gas pipeline development within Tunkinsky National Park and immediately adjacent to the Lake Baikal watershed. That pipeline is intended to link gas fields that previously exported fuel to Europe with China’s large market by way of Mongolia.

This important episode shows that the actual intention to weaken environmental regulations in order to





export more natural resources to Asia predates the war, but became a more urgent priority for the government as sanctions were brought to bear.

Coastal development and tourism pressure

Tourism has always been considered the most important economic activity within the BNT, but without proper planning and oversight its impacts are detrimental to nature. The property lacks a comprehensive plan for managing visitors to the parks and nature reserves, turning tourism from a sustainable development opportunity into a “threat to the Outstanding Universal Value” of the World Heritage property.

The 2022 “anti-sanctions” measures package approved by the Russian government includes accelerating allocation of land for tourism and recreational development. When travel abroad is blocked by sanctions, Russian citizens will need more recreational opportunities.

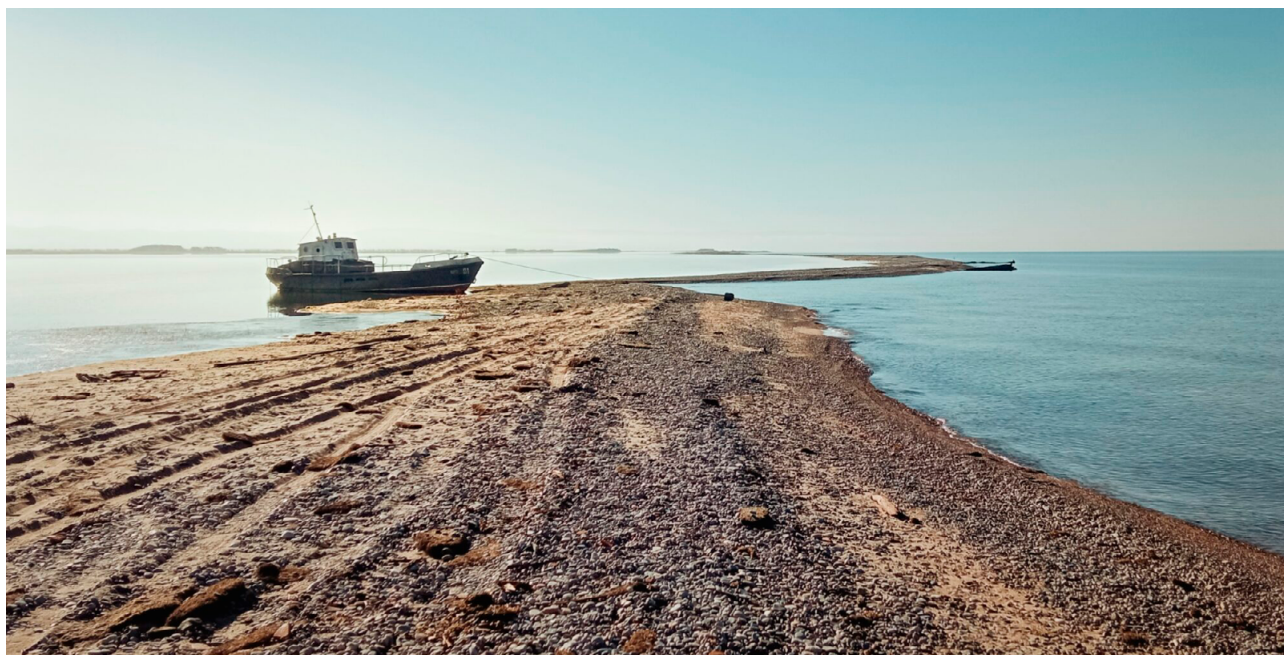
According to [Irkutsk media](#), on 2 March 2022 Russia’s principal development bank VEB convened an in-house meeting to discuss “areas of economic growth” aimed at greatly intensifying tourism at Lake Baikal in 2022 to overcome economic pressures.

After the onset of the Covid-19 pandemic, domestic tourism development became a high political priority, with Lake Baikal the best

known tourism attraction in the entire nation. Today, doubling and tripling the number of Russian tourists visiting the lake is a high priority for regional and national authorities alike, despite the fact it has the most detrimental consequences for the unique natural ecosystem.

Most coastal pollution and eutrophication results from poor management of tourist facilities and ill-organized tourist hordes trampling fragile coastal vegetation in Pribaikalsky National Park. In addition, previously protected lands are being privatized en masse using various “gray” schemes supported by local and regional officials. Local entrepreneurs are rapidly building new tourism facilities along the lakeshore.

The federal government is initiating most of the destructive large-scale activities. VEB is preparing a master plan for the city of Baikal. The plan envisions a 30-60% increase in the town’s population and massive development, including a huge influx of temporary workers, all of which may have additional negative impacts on the lake. The plan also includes construction of lucrative lakefront properties inside the usually off limits water-protection zone, land which does not currently contain housing or businesses. VEB is lobbying for an exemption from EIA procedures for its plan to build wooden multi-story buildings. President Putin urged the government to approve the



Baikalsk Master Plan in September 2022 to allow speedy implementation. However, because VEB's "Center for Baikal Development" fell under western sanctions in late February 2022, its ability to implement planned activities with due rigor will likely be reduced.

Unrestrained and expedited development of domestic tourism infrastructure to replace now-inaccessible international tourism destinations is the most [obvious and intensifying](#) source of negative impacts on the Lake.

Baikalsk Pulp and Paper Mill (BPPM) – remediation of a former industrial area

BPPM closed in 2013 after dumping waste for decades directly into Lake Baikal. Since that time, inaction and disagreements between Irkutsk regional authorities and the BPPM Creditors Council (whose members include

VEB, En+Group, and other actors with often conflicting interests) mean that stakeholders have been unable to develop a comprehensive plan or reach agreement about the site's reclamation and rehabilitation.

Without plans, waste, including reservoirs filled with roughly 6.5 million tons of the mill's lignin sludge, remain on site and at risk for accidents. With the new international political and economic reality, including March 2022 sanctions affecting the site, most reclamation activities were postponed for one year or more as critical imported equipment became unavailable.

The absence of proper wastewater treatment equipment is being addressed by lowering environmental requirements. Any changes in the site's protection regime, either proposed or implemented in order to "enable BPPM remediation" bring serious threats to bear on Lake Baikal.



In this respect, the activities of Rosatom's subsidiary company "FEO," tasked with cleaning up BPPM sludge ponds are especially opaque and worrying. In 2021, this company spent 400 million rubles from the state budget on unproven reverse-osmosis equipment, but it failed to meet the strict allowable impact limits for wastewater set to be discharged into Lake Baikal.

To solve the problem they have proposed that allowable concentrations for the discharge of multiple industrial pollutants in the lake and its tributaries be increased, some of those by 1,000%. This proposal does not contain or refer to any reasonable assessment of the consequences of such a move or possible alternative solutions. Nor does it consider the implications of allowing increased discharge of pollutants throughout the Baikal Natural Territory. Under likely pressure from FEO, Russian Academy of Sciences President Alexander Sergeev signed a letter approving some of these unreasonable regulatory changes in an attempt to silence the provincial academics opposing it.

Thus, lack of access to technology (or lack of desire to develop it) coupled with lucrative opaque contracts for "environmental remediation" create irresistible temptations to further weaken the environmental requirements preventing corrupt companies from getting multi-million ruble governmental contracts on their own terms.

Managing "salvage timber" forests

As wartime hardships accumulate, various actors seek to extract ever greater quantities of natural resources. It is no surprise that on 8 July 2022, several members of the Russian Duma and Senate [proposed to amend](#) the law "On Protection of Lake Baikal" in order to enable salvage logging in forests located in the Central Ecological Zone of Baikal Natural Territory, or, in other words, well within the boundaries of the World Heritage property.

Under the existing national forestry management system, salvage logging can only take place at a significant scale as a commercial activity financed by the proceeds of saleable harvested wood. In practice, allowing salvage logging near Lake Baikal is equivalent to allowing ordinary commercial logging, which, in the BNT, is also one of the main causes of forest fires, the majority of which are sparked near infrastructure facilities and logging sites.

In Siberia, [forest experts](#) and activists have repeatedly documented that "salvage logging" is the single most corrupted forest management activity, with at least a dozen high-profile criminal cases investigated over the last 3 years. Past regulatory and industry practices show that forests not destroyed by a specific fire or those that regrow after fires will be allotted for salvage logging. As a result, the condition of remaining



forests will worsen, and fire hazards will increase as road infrastructure grows, further increasing the accessibility of forests. The amendment now under consideration is being promoted under the guise of “improving the local economy” and “salvaging at-risk forests.”

Similar to UWEC Work Group’s analysis of the [gold-mining industry](#), the Russian government may seek to decrease socio-economic hardships in Siberian regions by easing access to natural resources for a wider spectrum of local stakeholders and explicitly at the expense of environmental safeguards.

World Heritage Convention – Stalled Mechanisms

For two decades Russia [has been ignoring](#) recommendations and decisions issued by the [World Heritage Committee](#), which issues a new decision

on Lake Baikal almost every year. By 2021 the State Party of the Russian Federation had failed to implement at least eight assessments required by the Committee to improve various aspects of Lake Baikal’s management, ranging from water level regulation to forest fire impacts on water quality, from its general plan for legal improvements to EIAs for special economic zones supporting tourism development at the lakeshore.

In 2021, the World Heritage Committee [raised](#) the question of inscribing Lake Baikal on the list of “World Heritage in Danger” at its 45th Session (then scheduled for summer 2022 in Russia) and prepared to send a reactive monitoring mission, consisting of its own and IUCN’s experts. The mission was scheduled for March 2022.

Such decisive steps prompted the Russian government to take the situation more seriously and task



numerous officials with preparations for the upcoming mission. Russia even submitted an unusually long and informative (but still largely substandard) [“State of Conservation Report”](#) on Lake Baikal to the World Heritage Center in early 2022. During the same period, members of the Rivers without Boundaries coalition, Greenpeace, and other CSOs were preparing for meetings between the mission delegation and local activists.

However, after 24 February 2022, international companies canceled Russia’s aviation licenses, ending transport connections between Siberia and the rest of the world, and the UNESCO Mission was no longer feasible. There is little chance of it still taking place in 2022.

Additionally, because the 45th World Heritage Committee Session did not take place as planned in Kazan, Russia in June 2022, further communication between Russian agencies and UNESCO has been understandably constrained.

Lake Baikal World Heritage site is the first victim of disrupted environmental cooperation mechanisms between Russia and the rest of the world.

Baikal’s Future

It is clear that the Lake Baikal World Heritage property is in grave danger. Taking into account observed widespread environmental degradation

and the systemic problems facing Lake Baikal (e.g., the absence of an effective management system), this property deserves to be inscribed on the List of World Heritage in Danger. In a time of peace, such a move could trigger development of a comprehensive plan for solving Lake Baikal’s accumulated problems. Such a decision on the part of the UNESCO World Heritage Committee would be consistent with the spirit of President Putin’s instructions issued in September 2019, instructions that still await implementation.

Unfortunately, the current political situation makes such a move potentially counterproductive in the near future, since it would very likely be interpreted by the vast majority of stakeholders as another political sanction imposed on Russia and therefore intentionally repudiated by relevant Russian agencies.

[Recent success](#) in preventing legislators from opening the Baikal Natural Territory to wider infrastructure development shows that some mechanisms to prevent further deterioration of the ecosystem are still available to the conservation community.

There is, however, a great likelihood that all branches of the Russian government will opt to solve war-time problems at the expense of Lake Baikal’s ecological health. •

All photos credit: Eugene Simonov



War and the Sea: How hostilities threaten the coastal and marine ecosystems of the Black and Azov Seas

By Sofia Sadogurskaya, Expert, NGO Ecoaction Climate Program

Active marine hostilities and Russian warships currently stationed in the northwestern region of the Black Sea not only block Ukraine's seaports, putting the world at risk of global famine, but also create man-made disasters that seriously affect the coastal and marine ecosystems of the Black and Azov Seas.

Protected areas under threat

The Azov-Black Sea coast in southern Ukraine is a kaleidoscope of unique coastal and marine habitats, including estuaries, lagoons, islands, salt marshes, and seagrass meadows, which, together, are home to hundreds of rare species. Many protected areas created to preserve this diversity are



Image 2. Fires on Kinburn Spit (May 2022). Source: Sentinel satellite data

found here. Today, these protected areas and water bodies face potential destruction. The Black Sea Biosphere Reserve, National Parks Azovo-Syvasky, Dzharylgatskyi, Meotida, and others are squarely in crosshairs of hostilities and a humanitarian crisis. Here, the war renders it impossible to ensure the safety of protected area employees or implement conservation measures to ensure proper protection and preservation of rare species.

Territories of many protected areas were also affected by fire. The total surface area of fires in Ukrainian forests has increased a [hundredfold](#) since the beginning of 2022 (compared to the same period in the previous year). These fires have affected many reserves in coastal areas in Mykolaiv and Kherson regions: Biloberezhya

Svyatoslava National Nature Park, Kinburn Split Regional Park, Black Sea Biosphere Reserve, and the Lower Dnipro National Nature Park. In May, the Kinburn Spit Park, located on the Black Sea coast and home to unique coastal habitats, burned. It was not possible to extinguish the fire due to Russia's occupation and minefields. The nesting places of wild birds and the largest orchid field in Europe were under threat. The full extent of the damage is difficult to assess at this time, but preliminary estimates suggest that the fires damaged almost [2,000 hectares](#) of forest and coastal ecosystems, resulting in the deaths of rare animal species and harm to Kinburn Split's unique sand habitat flora. Fires of this scale had not been seen on the Kinburn Peninsula since World War II.



Military equipment movements and construction of fortifications lead not only to the physical destruction of soil and vegetation, but can also pose a threat to coastal marine habitats. Biotopes in the swash and surf zones containing unique biodiversity among the sand and shells, may also be damaged during coastal minelaying, explosions, and sand mining from beaches for use in building fortifications.

The consequences of Russia's military actions for coastal ecosystems can already be seen in some nature reserves on the Crimean Peninsula, occupied since 2014. In particular, the condition of Opuk Nature Reserve, essentially converted into a military training ground, is very revealing. Bombing, military equipment movements, detonation of acoustic bombs in the sea, and troop landings during Russian military exercises have

all distorted local coastal, steppe, and estuarine habitats.

Threats to underwater ecosystems

Underwater marine ecosystems are also affected by hostilities. Remains of sunken ships and missiles, anchor usage, and munitions explosions can damage underwater communities on the seafloor. The greatest biological diversity is usually concentrated in benthic seagrass or algal communities, so damage to them may be a determining factor for the entire ecosystem. While the remains of sunken ships can serve as the foundation of new habitats on artificial "reefs" colonized by aquatic organisms, damage stemming from long-term pollution still far outweighs any potential benefits.



Image 3. Consequences of Russian military exercises near Opuk Nature Reserve (Crimea, 2016). Photo credit: Russian Ministry of defense



In addition, warships do not only disturb the delicate balance of underwater ecosystems when they sink. Vessels can also accidentally introduce non-native invasive species into regions where such species were not previously present. This, in particular, can happen through the discharge of ballast water, generally governed in peacetime by laws and regulations and overseen by relevant authorities. In the early 1980s, Atlantic comb jelly *Mnemiopsis* (a jellyfish relative) was introduced in Black Sea via ballast water. This biological invasion shook the entire Black Sea ecosystem and resulted in huge economic losses due to reductions in anchovy stocks.

Unfortunately, history shows incidents where military actions

introduced invasive species into new habitats with disastrous effects. At the end of World War II, American troops accidentally [introduced](#) Brown tree snakes to Guam Island in the Pacific Ocean, leading to the destruction of ten of twelve native forest bird species and significantly affecting the island's ecosystem as a whole.

Animals suffer both above and below the water's surface

Military actions can also directly affect marine animals, threatening their existence. Underwater explosions cause a shock wave that can travel long distances underwater, stunning fish and killing other organisms. This effect has already been observed in Ukraine's



Image 4. Russian marine anchor mines, washed ashore off Odesa during stormy weather (May 2022). Photo credit: NGO Pivden.



Image 5. A dead dolphin on the coast of the Tuzlivsky Lymany National Nature Park (April 2022). Photo credit: Ivan Plachkov.

freshwater bodies during this war. In particular, the Irpin River near Kyiv was threatened with ecological [disaster](#) by the sheer number of carcasses of fish killed by airstrikes. This is primarily a result of the anatomical structure of bony fishes, which have a gas-filled swim bladder that bursts readily in the event of large pressure drops.

Explosions can also pose a serious threat to marine mammals, especially those that are already vulnerable, listed in Ukraine's Red Book, and protected by many international conventions. There were specific cases in the Baltic Sea in 2019 where several porpoises (small cetaceans found in the Black Sea) [died](#) as a result of damage to their hearing organs caused by explosions during removal of World War II mines in the sea.

Scientists in Black Sea countries began to [record cases](#) of dolphin mass mortality at the start of active sea-based hostilities in early March. Cases have been documented on the coasts of Ukraine and Turkey, where an extremely large number of White-sided dolphins washed ashore, a rare event on those coastlines. Dead and disoriented dolphins with wounds and extensive burns, most likely received as a result of explosions, were found on the coasts of Bulgaria and Romania. Scientists say that mass dolphin mortality in the Black Sea may be the result of a combination of several simultaneous factors. Detailed research is needed, but preliminary data already indicate that Black Sea dolphins are another innocent victim of this war.



In addition to explosions, warships and submarines, now continuously patrolling the Black Sea with the use of sonar, can also pose a threat to dolphins. The acoustic frequency used by cetaceans coincides with marine sonar frequencies, a fact that may damage the animal's hearing. Dolphins rely on echolocation for most biological aspects of their lives, and the use of sonar technologies can affect their behavior and ability to survive.

The Azov-Black Sea coast of Ukraine generally plays a key role in the conservation of many European bird species. Active hostilities [threaten](#) the survival of such rare species, are a habitat disturbance, and interfere with nesting and migration. Russia's seizure of eastern Ukraine is a striking example of the war's impact on birds. Prior protection of sand spits on the Azov coast and creation of Meotida National Nature Park in 2009 resulted in a rapid increase in populations of rare wetland birds. Great black-headed gulls, Dalmatian pelicans, Oystercatchers, and many other species listed in Ukraine's Red Book nested in the park. This diversity immediately vanished when the war came to Kryva Kosa Spit in 2015. In subsequent years, only certain species continued to nest there in small numbers.

Wartime pollution of the marine environment

Sinking of warships, aircraft, and other military equipment can lead to

oil spills toxic to marine life and can poison the marine environment for decades. According to expert estimates, hostilities during World War II resulted in more than 15 million tons of oil being spilled into the Atlantic Ocean alone. In the Pacific Ocean, where hostilities also occurred, hundreds of sunken ships still lie in numerous straits between islands. Although this underwater ship graveyard, known as the Iron Bottom Sound, attracts tourists and divers, oil products, chemical compounds, and unexploded shells from these ships still [pose a danger](#) to people and the marine and coastal environments, as well as to the region's fisheries.

Unfortunately, past events have provided significant experience in addressing the impacts of oil spills on the marine environment. The largest oil spill in the marine environment occurred specifically as a result of war. In 1991, during the Persian Gulf War, up to 11 million barrels of oil were [spilled into that sea](#), resulting in serious environmental consequences for the region. Spilled oil destroyed nesting sites for endangered sea turtles and birds, damaged beaches, coastal habitats, and seagrass beds, and killed thousands of rare herons, flamingos, and other bird species.

In addition to pollution by petroleum products, ammunition itself poses an additional threat, sometimes causing significant environmental [pollution](#)



Image 6. Remnants of Russian missiles in seaside lagoons, Tuzlivsky Lymany National Nature Park. Photo credit: Ivan Rusev.

from chemicals and metals. Some munitions may use highly toxic chemical compounds, including white phosphorus, which emits a poisonous gas, causes severe burns when ignited, and poisons soil and water when released into the environment. Phosphorus is largely insoluble in water and can persist [for decades](#) in salty seawater in oxygen deficient conditions.

To this day, chunks of white phosphorus still wash ashore on German beaches in the Baltic Sea. Roughly 1.2 tons of phosphorus [ended up in the sea](#) near Usedom following World War II bombing. Tourists are still seriously burned after finding remnants of white phosphorus on beaches, often mistaken for Baltic amber due to its appearance.

Even rocket shells and bullets themselves are often made of materials that can be environmentally toxic. In particular, lead – one of the metals

most often used in bullets and shells – can negatively affect various organs in vertebrates, including the nervous system. Shells or debris left over after hostilities end can also poison birds, which often swallow small stones to aid digestion. The toxic effects of munitions residues can have significant consequences for marine organisms, disrupting food chains in ecosystems.

[Chemical weapons](#) can have an even more catastrophic effect on the marine environment. Many compounds developed as chemical warfare agents highly toxic to humans are also toxic to other vertebrates at high concentrations. They can affect some aquatic organisms and accumulate and persist for years in the natural environment. Unfortunately, our knowledge of the effects of chemical weapons on marine ecosystems is not theoretical either. Hundreds of thousands of metric tons of chemical



munitions (sulfur mustard, lewisite, and nerve agents) [were buried](#) at sea after World War II, long before the world adopted the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. Such residues still pose a threat to human life and marine biodiversity.

Destruction of coastal infrastructure, an additional threat to the sea

Additional pollution can be caused by infrastructure destruction. Some environmentally-hazardous facilities are found in the coastal zone: ports, oil storage facilities, sewage treatment plants, industrial sites, landfills, etc.

The seaports of Ochakiv and Mykolaiv were repeatedly attacked, the bridge over Dniester Estuary was shelled five times and completely destroyed, and heavy battles were fought on the territory of the Azovstal plant, located directly on the Azov coastline in Mariupol. Shelling damage to such facilities can lead to leakage of hazardous substances into the marine environment, endangering biodiversity and public health.

On 14 March, Russia shelled sewage treatment plants in Vasylykivka near Zaporizhzhya. A pump station was

destroyed and unfiltered wastewater flowed directly into the Dnipro River, ultimately flowing into the Black Sea. Attacks on treatment facilities and water distribution facilities can cause serious damage and release sewage waters and quantities of organic compounds into the marine environment. This can ultimately lead to marine pollution and algal blooms under certain weather conditions.

Past experience from previous military conflicts illustrates the possibility of devastating consequences for the marine environment. Unfortunately, this war has already had clear negative consequences, and the ecosystems of both the Black and Azov Seas are both under threat. Munitions explosions and marine vessel movements kill dolphins, destroy unique habitats, and damage protected areas. Constant shelling threatens marine pollution from petroleum products and poisonous chemicals. These seas are currently inaccessible to researchers and we can only approximate impacts through satellite imagery and fragmentary data. Thus, the real and full extent of the damage to marine ecosystems due to the war remains impossible to assess while active hostilities continue. •

Main image credit: Euromaidan Press



Mass dolphin mortality in the Black Sea: a military perspective

By Valeriia Kolodezhna and [Oleksii Vasyliuk](#)

Translated by Jennifer Castner

In recent weeks, UWEC experts have received repeated queries about the issue of mass dolphin mortality on the Black and Azov Seas. Readers wonder about a possible connection with the Black Sea Fleet and other units of the Russian armed forces. An August 2022 media announcement about the death of [3,000-5,000](#) dolphins is the reason behind this interest.

When discussing the environmental impacts of the war, people primarily think of land impacts. In fact, war has no less [impact on the sea](#), and marine biodiversity is more sensitive to military impacts than in land-based ecosystems, primarily because water bodies are all interconnected. Toxins, noise pollution, and changes in chemical composition and water temperature affect all



inhabitants of the oceans and seas one way or another. After all, sea creatures have no way to escape the water.

The three cetacean species found in the Black and Azov Seas were already facing the threat of extinction before the military conflict began. These include two dolphin species – Common bottlenose dolphin (*Tursiops truncatus*) and Common dolphin (*Delphinus delphis*) – and one small cetacean – Harbor porpoise (*Phocoena phocoena*). [The dolphin species are listed](#) in Ukraine's Red Book, as well as on IUCN's Red List, the Black Sea Red Book, and the international Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea, and Contiguous Atlantic Area ([ACCOBAMS](#)).

Dolphins are affected by some of the very same factors that affect people: munitions explosions, gunfire, and many types of pollution. However, there is one impact (involving sometimes deadly results) that is critical for dolphins but unfamiliar to humans.

Potential causes of death for cetaceans

Dr. Pavel Goldin, biologist and senior researcher at the Schmalhausen Institute of Zoology (Ukrainian Academy of Sciences) and projects coordinator at the Ukrainian Science Center of Ecology of the Sea (UkrSCES), has written at length on the possible reasons for cetacean mortality.

According to Goldin, there are several working hypotheses for such significant cetacean mortality. The first involves an increase in infectious disease, possibly stemming from sewage entering the sea or a naturally occurring illness. Another hypothesis is related to the acoustic trauma caused by military combat and explosions and other underwater noise disturbances. Lastly, there may be some other as yet undiscovered or poorly understood factor.

Another likely possibility is the interaction of several factors at once. [It is possible](#) for two different infections to occur in combination with acoustic pollution. Infection, acoustic trauma, and some type of toxicity could co-occur.

In order to understand what is really occurring, it is critical to perform autopsies on dead animals, collect samples, and conduct analysis. This work is largely taking place in Turkey, where Ukrainian researchers are also employed.

This article will take a look at several factors that could be key to understanding the war's impacts on dolphins and the entire Black Sea ecosystem.

Marine pollution caused by infrastructure destruction

Chemical and acoustic marine pollution are top-level threats.

When wastewater treatment facilities and irrigation systems are damaged or destroyed, wastewater enters natural



water bodies. This waste is untreated and thus rife with biological agents and organisms, some of which can be pathogens.

Just such a case occurred at the Azovstal metallurgical plant (Mariupol, Donetsk Oblast), where protracted combat operations took place 18-20 May 2022. In addition to damaged residential areas, Russian armed forces leveled warehouses, reservoirs, and tanks containing as yet unprocessed toxic substances.

These substances [could quite possibly have entered the sea](#), but researchers cannot yet make that determination – they simply do not have the water access needed to study the issues. In addition, Russian forces dropped the equivalent of [714 metric tons of TNT](#) explosive on the site, located directly on the Azov Sea coastline.

[There was an earlier strike on 14 May 2022](#) on the Azovstal plant using 9M22S incendiary ammunition with thermite layers. [A video of this shelling](#) clearly shows how the incendiary mixture pours into the sea.

Given that the Azovstal plant is a large industrial site on the shoreline of the Azov Sea, scientists believe that most of the chemical products of these explosions end up in the sea due to air currents and rainwater runoff.

Another source of marine pollution is spent rocket fuel dumped into the water by submarines launching missiles.

That explosive contains heavy metals, plasticizers, and stabilizers.

In today's conditions, dolphins are especially vulnerable in their position at the top of the trophic pyramid in the sea environment. They are the final link when it comes to the accumulation of heavy metals and other pollutants.

Acoustic pollution

A dolphin's perception is based largely on acoustic signals, and the species uses echolocation to navigate in water. They depend on sonar to receive and transmit signals to orient themselves.

Submarines emit signals at frequencies that are perceptible to these cetaceans. However, these mechanical signals are louder than dolphins themselves and can become a source of stress and acoustic trauma, damaging the dolphin's inner ear, which is used for both navigation and hearing. As a result, the dolphin is essentially "blind."

Unable to orient themselves, dolphins cannot find prey and begin to starve. They can also become confused and panicky, accidentally swimming into rocks or stranding themselves on shore. Others die from [exploding naval mines](#).

Ultrasonic and other ship noise can chase dolphins into fishing gear or cause them to strand themselves on the shore. Goldin also noted that military action



can provoke the sea's transformation into an environment that is simply not suitable for cetaceans, sometimes over a long period:

"Noise pollution can also disrupt many fish populations and force them to migrate. This upsets the ecosystem balance, resulting in additional dolphin mortality. This chain reaction can threaten entire sub-populations, requiring many years to recover."

Golden proposed the following criteria to evaluate environmental impacts:

These are some criteria for determining uniqueness and lethality. They could be applied, for example, if tomorrow, God forbid, the Russian navy destroys a specific unique area in a nature reserve, wildlife refuge, or biosphere reserve. Such places exist on the seafloor, for example, in the northwestern Black Sea, exactly where intense hostilities are occurring. It's no secret for researchers that the battleship Moscow sank there. The vessel was towed directly into the middle of a national marine refuge, where it sank.

So, the first criterion is uniqueness: when irreversible damage is done to a unique ecosystem, it is a very big loss. If the damage is reversible, then the damage estimate depends on the time it takes for the ecosystem to recover. One area may need five years, while another might need 50 years. Some sites can be restored thanks to human efforts, while in other cases, it will be of little help.

The second criterion to examine is lethality. That is, who will die, how many individuals will die under the influence of

a particular factor. These factors include mortality from toxins, highly lethal or persistent, that is, long-acting factors. Ammunition and munitions contain a lot of similar dangerous chemical compounds, for example, chlorine and its compounds.

Disease-causing agents also fall under the category of lethality. These may enter the sea as a bacteriological weapon, or accidentally as a result of damage at an agricultural site. Their distribution leads to disease in marine animals, including these same dolphins. We discovered this pollution mechanism even before the large-scale war, when dolphins began to suffer from toxoplasmosis caused by effluent leaving Russian agricultural farms in the Krasnodar region. Marine noise pollution is also a deadly factor for cetaceans."

Can reported mortality estimates be trusted?

Scientists are noting an increase in cetacean mortality this year. Also, there are more frequent cases of encountering beached dolphins – that is, self-stranding. This may also be due pressure on them stemming from baseline underwater noise originating from Russian military vessels. It is [mainly the rarer](#) Harbor porpoises and Common dolphins that die.

The first series of deaths were noted in March in Turkey, when numerous (100+) Common dolphins were stranded on the shore. Further, similar incidents were recorded in Bulgaria and Ukraine,



primarily along the Crimean Peninsula. Subsequently, there were reports of similar events happening in Russian waters. Isolated cases were recorded in the northwestern Black Sea, in Romanian and Ukrainian sectors.

Scientists are still far from an accurate quantitative assessment. But, [in their opinion](#), it can be argued that this mortality spike is quite significant, perhaps the biggest in the last decade. To date, we are talking about **several hundred (not thousands!)** cases of dolphin strandings, confirmed in photos and videos. Of these, more than one hundred were in Ukraine – mostly along Crimea and southern Odesa regional shorelines.

The number of dead animals is most likely still greater than the number of those who washed ashore. However, many media reports of “thousands of dead dolphins” are still greatly exaggerated.

In each country, scientists work in their own national waters, and specifically in the 12-mile exclusive zone. Ukrainians do not have this option. Mines and other threats mean that there is a direct ban

on going to sea and exploring the coast. A few sites within the city of Odesa’s borders are almost the only place in Ukraine where scientists have at least limited access to the coastline. As a result, Ukrainian scientists must work either in another country (Turkey or Bulgaria) to gain physical access to our common sea or work remotely using satellite monitoring data.

Currently, scientists are busy determining the scale and causes of this increased mortality among cetaceans in the Black Sea basin. Until data collection and analysis is complete, hypotheses are the only information available. Experts plan to publish the results of their analysis by the end of 2022.

How can people help gather data and determine causes of death in wildlife?

Anyone who vacations, lives, or visits the Black Sea coast can help scientists!

If you see a dead dolphin or porpoise on the shore, please contact researchers by telephone or messenger platform: +38 067 390 01 18 (WhatsApp) +38 095 548 65 53 (WhatsApp, Telegram, Viber).

Readers can also report dead cetaceans via [Facebook](#) •

Image credit: day.kyiv.ua



Pollution of the Bug estuary following damage to Mykolaiv's main wastewater treatment facility

By [Oleksii Vasyliuk](#) (UNCG) and Eoghan Darbyshire (CEOBS)

The war in Ukraine has seen attacks on or disruption to wastewater treatment infrastructure in Rubizhne, Chernihiv, Skadovsk, Sloviansk, Mariupol, Siverodonetsk, Lysychansk, Popasna, Mykolaiv, Vasylivka, and likely elsewhere. Eleven separate attacks on water facilities were reported on one day alone, April 19th. These included damage to, and/or the de-energisation of filter stations, pumping stations, and sewage treatment plants across

the Donetsk and Kharkiv regions¹. Such an intensity of attacks on [water infrastructure](#) suggests that its targeting may be part of a deliberate strategy.

The World Health Organization has [warned](#) that damaged infrastructure can mean the spread of infectious diseases, both due to the lack of clean water and damage to sewage pipelines. The bombing of cities and towns likely resulted in dozens of broken pipelines and inoperable pumping stations,



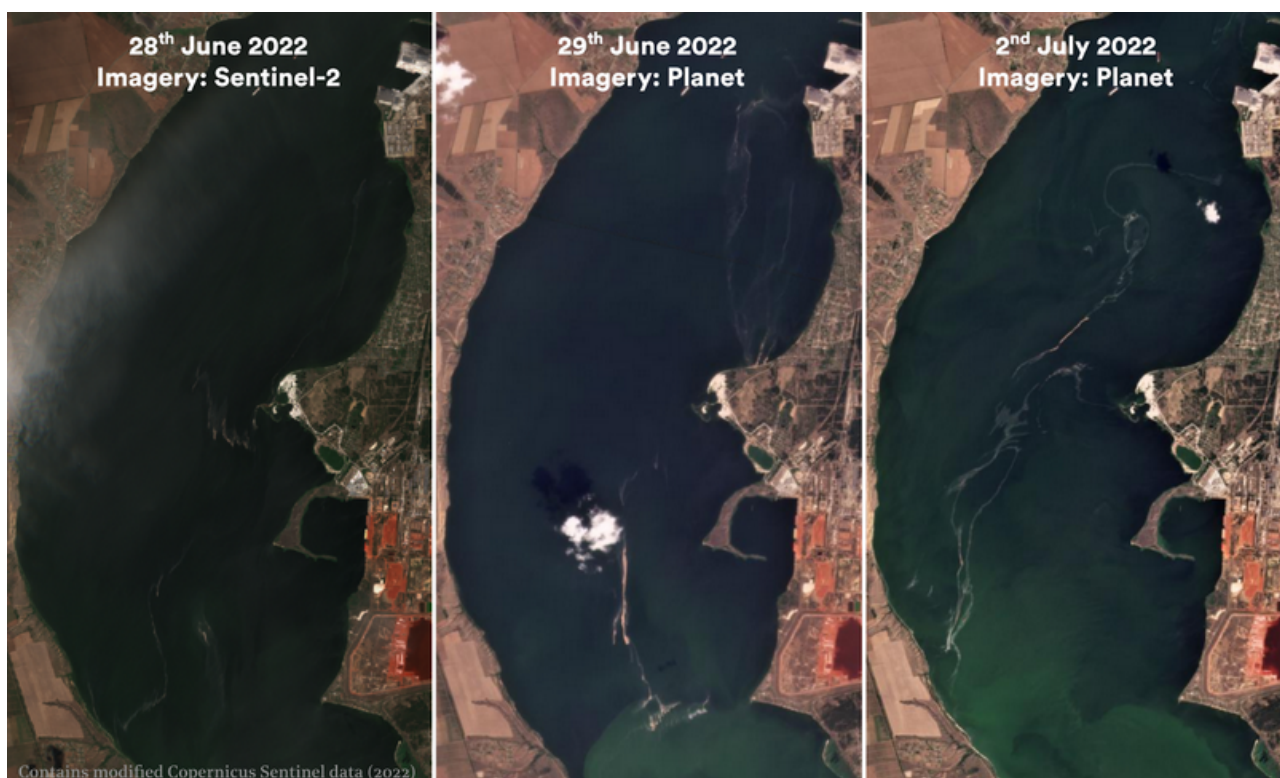
[leaving](#) hundreds of thousands of people without access to safe water. This is, of course, bad news for civilians in these locations, who are deprived of these essential environmental services. But, is there also the potential for damage to ecosystems?

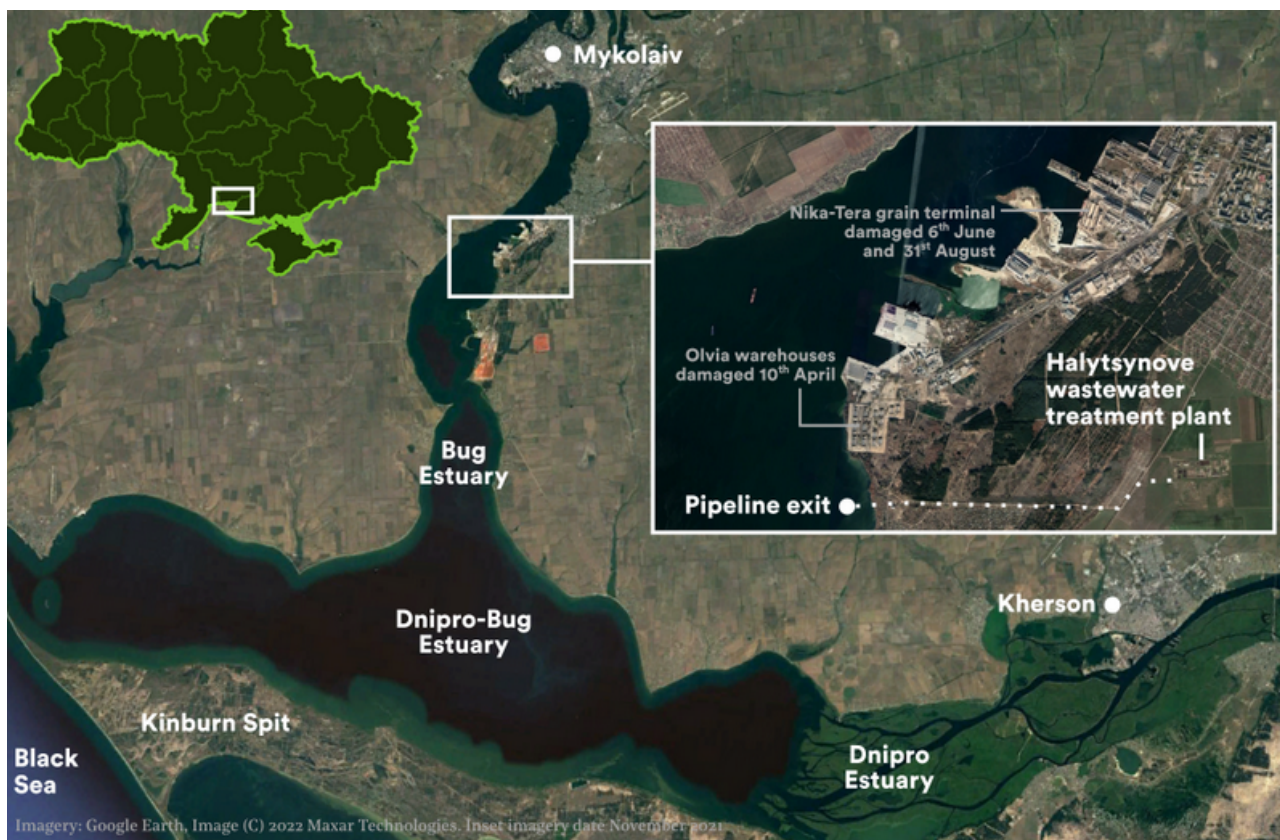
Most wastewater facilities have pipelines that release treated water into freshwater or marine environments. In peacetime this is regulated and monitored. However, when the facility is damaged and not properly functional, these pipelines can be used to discharge raw sewage and/or treatment chemicals. This can be harmful to [ecosystems](#), both through the direct effects of toxic substances, such as heavy metals, phosphorus or nitrogen, but also more indirectly through changes to temperature and concentration of dissolved oxygen and suspended solids

leading to eutrophication. Discharge of sewage has so far been reported to be happening in the city of [Vasylivka](#), with raw sewage entering the Dnipro River.

Here, we show what appears to be an unreported discharge into the Bug estuary, south of Mykolaiv, between 28 June and 15 July. The pipeline from which the discharge emanates is connected to the Halytsynove wastewater treatment facility 3.5 km inland, which treats 83% of Mykolaiv's sewage.

To our knowledge there have been no reports from Mykolaiv on this discharge. The discharge is first visible in satellite imagery on [28 June](#), and extends approximately 15 km along the Bug estuary on [29 June](#). It is brown in color, indicating sediment or sewage, and spreads along the Bug estuary in long filaments. The volume of the discharge reduces after 3 July and becomes less





brown in color, but remains visible until 15 July. It can clearly be seen to be emanating from a pipeline exit at 46.8194°N, 31.9439°E.

The common estuary of the Southern Bug and Dnipro rivers, where the waste was directed, is an important area for nature and home to the Biloberezhzhia Sviatoslava National Natural Park. The estuary is also included in two Emerald Network areas - [Dniprovsko-Buzkyi Lyman](#), [Biloberezhzhia Sviatoslava National Nature Park](#) - because of its important aquatic habitats. It is important for many species protected by the Bern Convention, Habitat Directive and Bird Directive, including nine species of fish, two amphibians, one reptile, 66 birds, two mammal species and the *Unio crassus* mollusk.

One key reason for its protected status is because the Dnipro-Bug estuary is very important for bird migration. It is here that the flow of migratory birds is divided into those that migrate along the Dnipro and those that migrate along the Southern Bug River. It is also here, near the town of Ochakiv and on the Kinburn Spit, that there are stations that monitor bird migrations every year. The area around the Kinburn Spit is [classified](#) as an Important Bird Area. Thus, pollution of the Dnipro-Bug estuary may threaten many rare species and also threatens Ukraine's ability to comply with multilateral conservation agreements.

While small discharges are common from this pipeline, this seems to be the most significant discharge in at least



the past five years². It is therefore likely to be connected to the conflict. The facilities were [attacked](#) on 7 March, but, despite damage to electrical systems and reserve equipment, it was reported that the plant could continue to operate. We could find no further reports of damage, although there was a grass fire adjacent to the wastewater treatment plant on 4 June³, which is indicative of shelling. The nearby [Nika-Tera](#) and [Olvia](#) port storage facilities have suffered large fires because of the war, and these burns and the firefighting of them may have released hazardous into the estuarine environment.

There are ongoing water supply [problems](#) in Mykolaiv. The 70-km pipeline that supplies Dnipro River water to the city and the wastewater plant is [understood](#) to be damaged in several places, and most of it lies within

occupied areas. The water network was instead filled with water pumped from the Southern Bug and groundwater wells on 16 May – i.e., before the discharge at the end of June. Note, this water is more saline and requires more advanced treatment.

Mykolaiv now plans to build new water treatment facilities for supplying drinking water and to [install](#) at least 100 separate small water purification systems in the city by winter. According to Borys Dudenko, director of Mykolaivvodokanal MCP, French specialists are [working](#) to select the location of a new water intake site for Mykolaiv, focusing on the South Bug River. Any new wastewater treatment plants ought to be built in a sustainable way to meet Ukraine's 'green recovery' goals, one of the seven '[Lugano Principles](#)'. •

1. According to the State Environmental Inspection of Ukraine (Letter No. 10-556/22 dated 19.05.2022)

2. Based on a manual review of all Sentinel-2 scenes since the instrument was launched into orbit in late 2016 where the cloud-cover was no greater 50%. The most similar event was on 23 August 2019, but covered a much smaller area and appeared more dilute.

3. A fire hotspot was detected on the NASA FIRMS platform



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