HERPETOFAUNA AT THE FRONTLINE: SO MANY WAYS TO DIE...

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At the last UN COP27 climate summit in Egypt was mentioned for the first time the direct impact of warfare on global climate. There, Ukraine's environmental protection minister, Ruslan Strilets, has claimed that since February 24, 2022, the full-scale invasion of the russian army into Ukraine has caused large amounts of warming gases, estimated so far to 33 million tons, to be released into the atmosphere. Besides, since February 2022, Ukraine has gathered evidence of >2,000 "environmental crimes" including damage of water facilities, release of toxic chemicals, destruction of natural habitats, plant and animals, including endangered species that are under threat. Yet it is too early for scientists to access all parts of the country to properly assess environmental damages caused by the war in Ukraine.

War is not listed as one of the global threats to biodiversity due to the local scale of armed conflicts. As such, the impact of war on biodiversity could be viewed as a local threat (on a short time scale), nature being one collateral causalities amongst others, with severity from negligible to disastrous. Yet all wars do affect biodiversity to some levels that are difficult to assess and even more complex to forecast on medium-to-long terms. In the present article, we provide the first evidence of the impacts of the war on the herpetofauna in Ukraine, based on data that we – the authors (scientists, environmentalists, land managers and decision makers of Ukraine) gathered in the field but also testimonials from the front. Our aim is to contribute to the Ukrainian authorities' efforts in reporting proofs and assessing the overall damages caused by the russian aggression to seek compensation from russia after Ukraine's victory.

The full-scale invasion of the russian army into Ukraine began on February, 2022, yet war had been ongoing since 2014, with the annexation of the Crimean Peninsula and the occupation of the Donbas region. Areas and habitats under russian occupation since 2014 include the only places in Ukraine inhabited by Mediterranean herpetofauna, such as *Zamenis situla* (Linnaeus, 1758), *Darevskia lindholmi* (Lantz et Cyren, 1936), *Pseudopus apodus* (Pallas, 1775), as well as considerable parts of high density populations of *Vipera renardi* (Christoph, 1861), *Elaphe dione* (Pallas, 1773), *Dolichophis caspius* (Gmelin, 1789), and enormous territories of Steppe national parks and nature reserves — the most endangered biome in Europe. According to the information provided by NGO "Ukrainian Nature

Conservation Group", 44% of national parks, natural and biosphere reserves are/were within the war zone, under the temporary control of russian invaders or are inaccessible to Ukraine.

For 10 years now, the unprecedented daily crimes have been going on: against people, against humanity (e.g. Bucha genocide, March 2022), against peace, against democratic values of the modern world, ... and against nature. Unfortunately, the latest is the most vulnerable, since nature cannot defend itself against military weapons, nature cannot give a decisive military rebuff, and nature cannot represent its own interests in international courts. In addition, in contrasts to people and infrastructure casualties for which damages can be estimated (in terms of e.g., number of people killed, injured and refugeed, number of killed and maimed soldiers, who bravely defend their homeland, amounts of monetary losses), damages caused to nature are much more difficult to establish.

First of all, to assess the impacts of military actions on natural biotopes and local biota, it is necessary to conduct a thorough assessment of the losses of nature. As long active hostilities are going on and the aggressor continues to wage war, scientific direct observations at the front are simply impossible. All what we – the authors – can do is assumptions or extrapolations based on the scraps of information gathered from the de-occupied territories. Still, the number of killed animals, destroyed and polluted key habitats and biotopes are almost impossible to estimate at the moment. Most of the theoretical assumptions from the field for assessing the consequences for nature turned out to be unsuitable in the conditions of a full-scale war in the style, in which russia is waging and in which Ukraine is forced to first of all defend its citizens, its culture and its independence. No model has taken into account such a long-term, large-scale war with the use of hundreds of thousands of tons of bombs, billions of ammunitions, millions of soldiers, aviation, navy, artillery, drones, etc. At the beginning of the war, Ukraine itself was predicted to hold out for 3 days only... And yet, this article is written at the onset of the third year of conflict while Ukraine is still in fight for its independence. Meanwhile the count of consequences of military actions and impact on the environment reaches ₴ 2 390 billion (i.e. 56 billion €) according to some rough calculations (**https://ecozagroza.gov.ua/en**).

Presently, alongside our obligation to defend our nation, it is essential to gather whatever data is feasible under the prevailing circumstances. Since circumstances are such that we, the authors, are not operating on the frontline, it is our duty, as scientists and citizens,

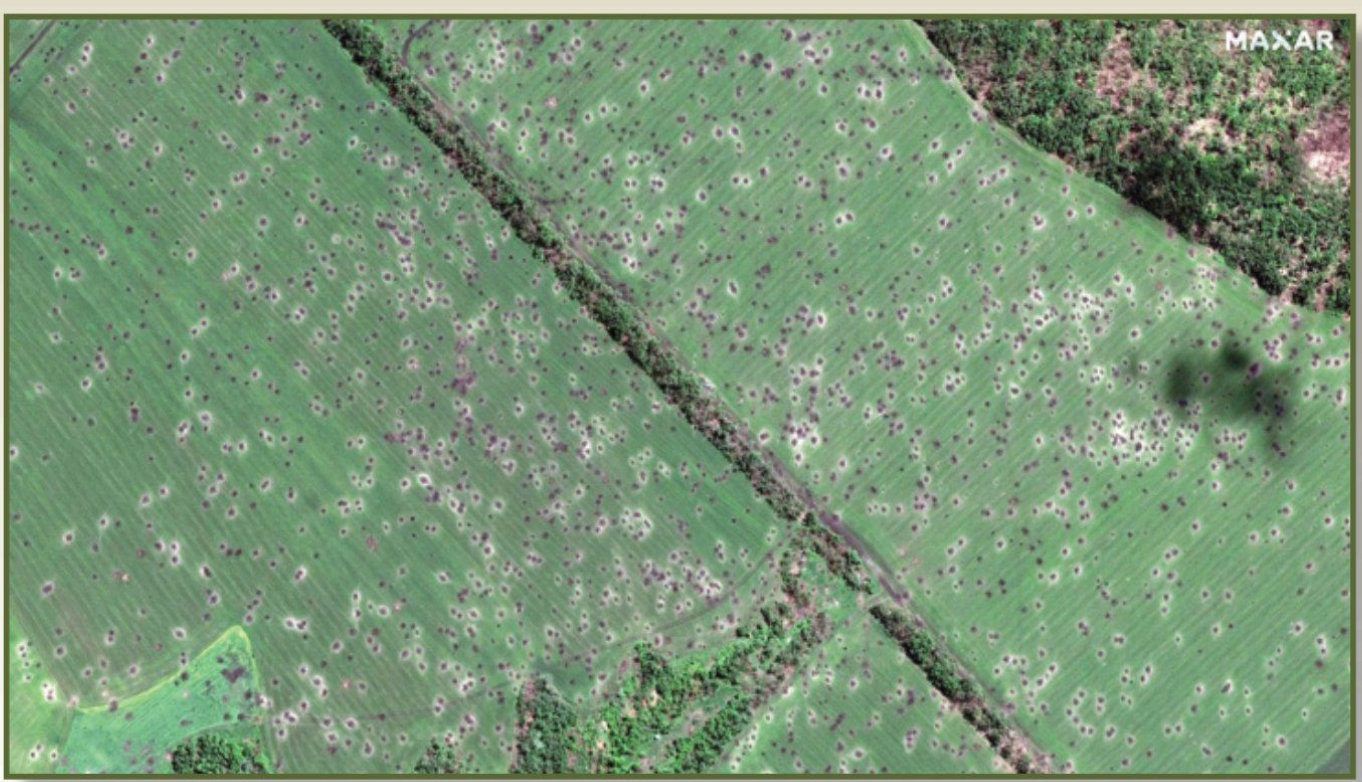

Figure 1. The example of artillery bombardment density of Ukrainian territory (photo: https://twitter.com/Maxar/..., 2022 (@Maxar)).

Figure 2. Fires started after rocket bombardment (left), and a crater after artillery shelling in Nature Park (NP) "Desniansko-Starohutskyi" (Sumy region, Ukraine) (right) (photo: Kubrakov S.).

to contribute to the maintain of our national natural patrimony as much we can, by spreading the results of our monitoring of biodiversity in Ukraine. We hope this data collected in the field of war will contribute for estimating the costs aggressors will own to our nation after Ukraine' victory, to the post-war reconstruction of our country, and on the longer term for the future generations of our country. The authors of this text, both members of the Ukrainian Herpetological Society and other experts from Ukraine and beyond who greatly supported research and conservation of Ukrainian herpetofauna after the beginning of the russian invasion, hope that this reconstruction will take into account the interests of nature and will have significant nature conservation components.

Nowadays, thanks to our biodiversity monitoring in the field, we persist in documenting the evidence of damages caused by war to nature (Vasyliuk et al., 2015; Zinenko et al., 2023; Nekrasova, Marushchak, 2023, Suriadna,

Figure 3. Snakes killed on the road after an intensive moving of military machines, 2016 (photo: Mykytynets H.).

Figure 4. One of two completely intact skeletons of young snakes (representatives of Colubridae, snakes included in Red Data Book of Ukraine), which were discovered in a hole from a projectile in the territory of the NP "Kamianska Sich" (currently de-occupied) in the Kherson region (photo: Khodosovtsev O., Kuzemko A.).

Mykytynets, 2023), including potential ecocide. The Independent Expert Panel for the Legal Definition of Ecocide defines it as "unlawful or wanton acts committed with knowledge that there is a substantial likelihood of severe and either widespread or long-term damage to the environment being caused by those acts" (**https://www.stopecocide.earth/legal-definition)**. In other words, ecocide is a deliberate destruction of nature by humans. Beyond the human tragedies caused by the full-scale aggression by the russia's army into Ukraine, the destruction of the Kakhovka dam in June 6, 2023, the constant fires of our forests, and the pollution of our water bodies with dangerous chemicals lead to mass deaths of living organisms (both plants and animals) and should be envisaged as local cases of ecocide. The full extent of these at least local ecocides and the scale of which we will be able to assess only after the war ends, have yet to be understood, as the active conflict makes comprehensive research impossible. However, the information gathered paints a grim picture of the environmental devastation caused by the war. This highlights the importance of taking environmental aspects into account in post-war recovery and reconstruction.

Worldwide, media have spread tons of images of Ukrainian people rescuing any forms of life from war, showing the most impressive rescue of animals from the Kyiv Zoo at the beginning of the full-scale invasion, or civilians evacuating pets (dogs, cats, birds, turtles but also cows and horses) from deadly situations, and even soldiers at the front taking care of disoriented, starving wild animals. There were also many reported cases of animals, abandoned by their owners that get stuck in some closed buildings where they were left to die or released into the wild by their owners or after their building had collapsed under bombardments. In the latter case, one may envisage that numerous representatives of exotic species formerly kept as pets (e.g. exotic turtles, snakes, birds, mammals) vanished in the wild where they may become new competitors for the native species and/or invasive for the ecosystems. One of such reported cases happened during the shelling of Kyiv in 2022, with the accidental release of a red slider pond slider (*Trachemys scripta* Thunberg and Schoepff, 1792)), which is considered as one of the 100 worst invasive species in the world (**https://acc.cv.ua/news/ukraine/cherepahu...**, 2022). Assessing how many similar cases took place during the period of war so far is hard to achieve... Assessing the global impact of voluntary and unvoluntary releases of exotic species at the scale of the territory of Ukraine is simply impossible. It is worth mentioning that each of the acts carried out by Ukrainian citizens with regard to an animal, whether it is a domestic, captive or wild species, and

whatever the conditions and risks in which they provided assistance, testifies to the compelling value that the Ukrainian people give to life itself.

In this article, we will focus on highlighting data that we have gathered regarding the effects of military actions on amphibians and reptiles, which are known to be sensitive to environmental conditions. Worldwide, habitat destruction, ecosystem degradation and water pollution have been shown to be major drivers of biodiversity loss and have led to a global decrease in amphibian and reptiles' populations. Many species are now threatened with local extinction due to the harsh conditions and inability to quickly adapt to such rapid environmental changes. Military conflicts are very particular cases where these direct drivers of biodiversity loss are extremely concentrated in time and space.

Disclaimer:

Although some of the examples below may apply to both sides of a military conflict, the authors emphasize that such things would never have happened if russia had not launched a full-scale war against an independent sovereign country in the centre of Europe in the 21st century.

Physical destruction

One of the most obvious and unequivocal factors negatively affecting amphibian and reptile populations on the front lines and in combat zones is their physical destruction or in other words – killing. Massive movements of heavy military machines that drive on areas and landscapes that are commonly not used in non-conflict contexts, especially meadows, forests but also highly remote places that used to operate as areas passively protected from human uses lead to much higher chances of killing of herpetofauna representatives. Additionally, bombardment as the most spectacular direct physical cause of death for everything that was on/nearby the site of impact, leaves almost no chances of escaping before impact of high-speed weapons for slow moving species (Fig. 1-4).

Road mortality of amphibians and reptiles has been reported as a major problem in peacetime. It leads to their reduction in numbers, a change in the spatial structure of populations, the impossibility of spreading. Research conducted between 2016 and 2020 on the roads of southern Ukraine showed that dead animals make up about 40% of all encounters in the spring, and up to 75-90% in some areas in the fall (Mykytynets, Suriadna, 2020). It should be noted that up to 35% of dead reptiles are species listed in the Red Data Book of Ukraine, the highest numbers of deaths being, for amphibians, the green toad *Bufotes viridis* (Laurenti, 1768) and the Pallas's spadefoot toad *Pelobates vespertinus* (Pallas, 1771) in the spring, and for reptiles, the dice snakes *Natrix tessellata* (Laurenti, 1768), the steppe vipers *V. renardi*, the sand lizards *Lacerta agilis* Linnaeus, 1758 and the steppe-runners *Eremias arguta* (Pallas, 1773) in the summer, while common grass snakes *Natrix natrix* (Linnaeus, 1758), smooth snakes *Coronella austriaca* Laurenti, 1768, Caspian

Figure 5. Steppe viper (*V. renardi*) (Red Data Book of Ukraine) killed in a trench, most likely by trampling (Novodmytrivka village vicinity, Donetsk region) (photo: Kuzmenko Yu.).

whipsnake *D. caspius* and blotched snake *Elaphe sauromates* (Pallas, 1814) are frequently killed in spring and autumn. It should also be mentioned the mass death of green toadlets in the summer after metamorphosis during migration from water bodies. In certain periods, it can look like a bloody spectacle, as animals die by the hundreds with their density up to 10-20 individuals per 1 m^2. Following the surveys by Mykytynets & Suriadna (2020), the percentage of young individuals was quite significant (up to 75-100% in some areas) among the dead reptiles recorded on the roads during autumn migrations. During the military operations, the constant movements of military convoys and heavy equipment increases the load both on highways and dirt roads, leading to a significant reduction and even to the disappearance of some populations, especially those of rare species. This problem intensifies with the activation of the movement of huge numbers of military machines on the roads of steppe Ukraine (Fig. 3).

Amphibians and reptiles are relatively slow-moving vertebrates, and may also die in large-scale fires that occur extremely often in war zones. Usually, the intensity of the emergence of new sources of fire (for example, during intense shelling with incendiary munitions, multiple launch rocket systems, phosphorus bombs, heavy flame-throwing systems like TOS-1A "Solntsepiok") does not allow the animals to hide in burrows and in a matter of seconds covers a huge area causing lethal wounds to animals and killing them (Fig. 1, 4).

Another factor contributing to higher mortality of amphibian and reptile during war is the degree of knowledge, awareness and acceptance soldiers have for these species. It is widely known that in normal times already, these taxa suffer negative perception by public at large. Therefore, many stereotypes regarding amphibians, and even more reptiles, lead to human behaviours against them including removal - if not killing (Fig. 5). In the imagination of most ordinary people including soldiers, snakes are dangerous and deadly venomous, despite the reality being otherwise. However, for people who can die at

Figure 6. Fortunately, this time a soldier appeared to be a biologist and the European pond turtle *Emys orbicularis* (Linnaeus, 1758) trapped in a trench was rescued and released in a safe place far from the trench (Adamivka village vicinity, Donetsk region) (photo: Kuzmenko Yu.).

any moment for a hundred different reasons, eliminating at least one of them, however far-fetched and false, is an understandable step. Therefore, unfortunately, in most cases, the snake awaits killing. Beside large part of the Ukrainian troops is made up of mobilized soldiers who are not military personnel by profession, so that education and awareness is hardly included in their training course. At the front, trenches dug in natural biotopes become a kind of traps for frogs, lizards, turtles and snakes that fall into them. Being dug according to the norms of military engineering, they left almost no ways for such animals to get out. As a result, the latter die from hostilities or during intensive movement of people if not by intentionally will to get rid of any risk. Beside dugouts and trenches are likely to attract representatives of herpetofauna, especially snakes, due to the heat maintained in them, as basking places. Since military actions greatly disturb the overall ecological equilibrium of the habitats and landscapes, they lead to mass reproduction of rodents, which also attract snakes as food items. Consequently, snakes find themselves in direct contact with people much more often and therefore become their victims more frequently. At the same time, species other than snakes are welcomed by soldiers even in the worse context as pets but also as a bound to life (Fig. 6). There are many images of soldiers feeding foxes, wild boars, deers, owls or abandoned domestic animals, which is something people might not do in peace-times.

From the personal observations of one of the authors:

"A lot of common toads, spadefoot toads, water frogs, sometimes snakes and turtles got into the trenches. Steppe vipers, blotched snakes died under the wheels of transport. Many animals were trampled or injured while digging trenches. A lot of projectiles fell into reservoirs, destroying them, while many harmful substances got there. There were many dam destructions. In addition to these photos, I remember many snakes and frogs accidentally crushed or killed when digging trenches".

A separate case is the encounter of soldiers with snakes during the spring mating period or during hibernation. During these periods, snakes can gather in large groups: males trying to mate with a single female or animals of different sexes forming clusters in wintering places. The picture, which is a tangle of snakes, may cause horror and disgust in most of the military and, unfortunately, the corresponding reaction – killing them all (soldiers do not want to jeopardize their own health and life and remove any kind of risk in their surrounding) (Fig. 7).

Figure 7. Snakes slaughtered and tangled near trenches in the Kherson region, during the period of mating: common grass snakes *N. natrix*, dice snakes *N. tessellata* and Caspian whipsnakes *D. caspius* (Red Data Book of Ukraine), 2023 (photo: anonymous author).

All the three above-mentioned causes of mortality obviously also have indirect impacts on amphibians and reptiles due to habitat degradation via exposure to new pollutions of a wide range (hydrocarbures, chemicals, heavy metals), but also digging of trenches for soldiers' self-protection (amphibians and reptiles are killed intentionally or accidentally (Fig. 6, 7), habitat destruction for the remaining individuals that may face environmental conditions that are simply not filling their biological needs anymore, but also sharp reduction in the availability of prey that may either also have died or escaped to other places.

Destruction and pollution of key habitats

It is widely recognized that amphibians and reptiles are extremely dependent on some very specific habitats to which they return from generation to generation. Such habitats include spawning ponds, streams, canals, swamps, sandy slopes near ponds that serve as egg-laying places for turtles, wintering places for snakes and frogs, etc. Amid the war and continual frontline movement, such key habitats are quite often destroyed or transformed in such a way they can no longer serve to support the local population of some if not all of the species. Very often, such places are polluted by elements of fuel and lubricant materials that fall into the environment from damaged or destroyed military machinery, various chemical compounds (paints, lubricants, explosives and their derivatives, acids contained in the batteries, chemical weapons etc.) that are used in the army or poured into reservoirs from bombed enterprises and civil infrastructure facilities. For example, 1 T-80 tank holds from 1110 to 2210 liters of fuel: it is easy to anticipate the consequences for a small water body adjacent to a destroyed mechanism. If any amount of this fuel reaches a small lake or channel, it will render the area completely unsuitable for amphibian spawning for several years or decades.

Menace for water frogs and for science

As a particular example of the scale of hostilities' impact on the batrachofauna, there may serve the Siverskyi Donets center of diversity of water frogs (genus *Pelophylax* Fitzinger, 1881). The basin of Siverskyi Donets

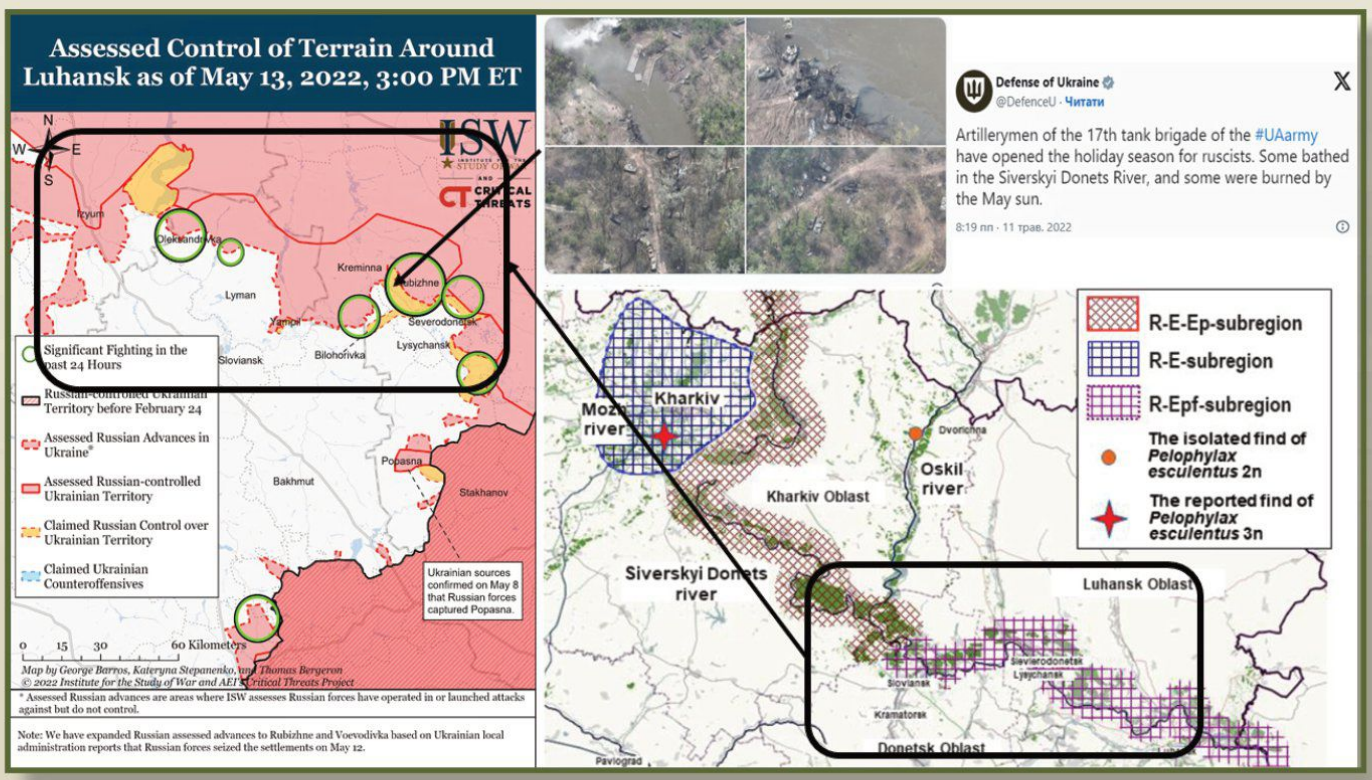

Figure 8. The impact of the war with the russian occupier in the area of the Siverskyi Donets lower reaches (left; sources on the image); the intensity of bombing and the scale of the involvement of equipment at only 1 small site (top; twitter.com/DefenceU); typology and distribution of complex water frogs population systems of the Siverskyi Donets basin (Drohvalenko et al., 2021).

river has the long-lasting history of thorough studies of a rare phenomenon - the hemiclonal reproduction. In the areas of Siverskyi Donets basin in Kharkiv, Donetsk and Luhansk regions, the population systems of water frogs reach the maximum of their discovered diversity in the entire Ukraine (Fig. 8, bottom) - and in the very this areas, somewhere directly along the Siverskyi Donets river channel, the frontline had been laying for for a long time and somewhere has laid till now. The northern part of the Ukrainian flow of Siverskyi Donets (e.g., Staryi Saltiv village) for long had been that borderline where russian forces secured their positions, and the areas of its great tributary Oskol river, particularly near the Dvorichna city and NP "Dvorichanskyi" - suffer from the shelling till the moment. These areas are not only the regions of long-term studied model population systems with triploid animals but also inhabited by only recently described, unknown before part of *Pelophylax esculentus* (Linnaeus, 1758) range. All of them now and for long are inaccessible for scientific investigations at least due to the significant level of explosive contamination, and at most - due to the constant heavy shelling and the menace of new combat clashes.

The lower stretches of Ukrainian Siverskyi Donets flow, covering the Donbas region, has appeared to be the region maximally loaded with hostilities during all the period of war (Fig. 8, left and top) and partially occupied by the moment. And the very this territory, according to research, is inhabited by the most intriguing and unique water frog populations systems among known, whose biological principles of functioning is still at the stage of studying. The physical destruction and various unliquidated contamination of biotopes together with the massive contamination of unexploded ammunition of all kinds, mining and the constant danger of shelling even on the already liberated or those yet to be liberated by Armed Forces of Ukraine (abbreviated as ZSU or AFU) territories makes the quite perspective investigations of this species complex almost impossible for years if not for decades.

Shortly before the full-scale war, the region of the mouth of the Dnipro River near Kherson also appeared to be no less intriguing as an area probably inhabited by relict populations of pool frogs *Pelophylax lessonae* (Camerano, 1882) and complex, quite interesting hybridogenic systems. It may undoubtedly suffer the same fate as the eastern center of diversity, since liberation from the russian invaders took place only for the right-bank Kherson region. While the left bank, on the other hand, became the scene of intense artillery shelling and large-scale engineering and sapper work by the russian invaders (Fig. 8).

Furthermore, the ecological catastrophe resulting from the destruction of the Kakhovka dam by the russians, followed by the subsequent flooding, undoubtedly exacerbated the situation. Being dependent on a wide floodplains network, the population systems of water frogs hypothetically may not recover their current situation, so interestingly, the state (and almost any researchers) will not have full access to these territories for all the reasons mentioned above.

A comparable fate partially jeopardizes the scientific potential of studying the batrachofauna, particularly water frogs, in the Chornobyl Exclusion Zone. The study of the large, undescribed diversity of hybridogenic population systems on the territory of the Chornobyl radiation-ecological biosphere reserve only reached its beginning before the invasion (in 2020-2022). And it apparently shall operate with the a priori limited material in the future: due to the already existing contamination and mining left after the departure of russian troops, and the absolute necessity to strengthen defense measures from the Ukrainian side (building the fortifications and military infrastructure). Fortunately, this region suffered on a lesser scale from the physical destruction of its biotopes.

Besides the significant importance of water frogs as the most numerous amphibians in the Ukrainian water bodies, being necessary members of wetland ecosystems maintenance – both as the elements of the trophic chain and as a kind of "transporter" links for substances on land and in water, – the field of hemiclonal reproduction study seems incredibly interesting from a scientific point. Both of these roles of water frogs are difficult to overestimate: an essential ecosystem service for nature is combined with an extraordinary potential for population, cytological and molecular-genetic studies for humanity and our scientific progress. Both of these roles are under existential threat in certain regions due to non-specific but pervasive effects of hostilities. The primary responsibility for the destruction lies on the russian aggressor and occupier.

Large-scale disasters: a step further from casualties to ecocide

So far, the largest man-made disaster during the entire war was the destruction of the Kakhovka Hydro Power Plant (HPP) dam, June 6, 2023 (Fig. 9). Kakhovka was the second-largest reservoir in Ukraine by area (2,155 km2 [832 sq mi]). After the destruction of the dam by detonation, about 70% of the contents of the reservoir (more than 15 km^3 of fresh water) surged into the Black Sea, washing everything along the Dnipro riverbed on its way. In addition

Figure 9. Consequences of the destruction of Kakhovka dam both for people, infrastructures and nature (photo: https://maximum.fm/zatoplenu..., 2023)..

Figure 10. Edible frogs *P. esculentus* found in Odesa after they were carried on the garbage and pushed to the seashore by the waves after the destruction of Kakhovka dam (photo: Nekrasova O.).

to the water-carried pollution (oils, garbage, toxic industrial sediments from the bottom etc.), it also washed into the Black Sea, representatives of the herpetofauna that had lived around and in the water bodies below the reservoir or near them (Suriadna, 2023). As a consequence, European pond turtles *E. orbicularis*, members of *P. esculentus* complex - *Pelophylax ridibundus* (Pallas, 1771) and *P. esculentus* (Fig. 10), and other amphibians and reptiles have been flushed into salty seawater. Some drowned in the water whereas some others drifted on garbage up to the coast of the Mykolaiv and Odesa regions, where the luckiest were rescued by caring residents and eventually delivered to veterinary clinics, terrariums, zoos and freshwater local water bodies.

Not being well adapted to saltwater, most of the freshwater species could not survive, and a few ended up on the coast with piles of drifting debris. The simultaneous release of such masses of fresh water into the sea led to a local decrease in its salinity, which also led to the death of marine inhabitants (Fig. 11-13).

The unique population of Danube newt *Triturus dobrogicus* (Kiritzescu, 1903) that are known to occur in the Dnipro floodplains suffered the most after the Kakhovka dam was destroyed. Its rare representatives mostly fell under the flow of water and a large proportion of them were most likely flushed out into the sea (Fig. 12-14). Currently, from the open sources, social networks and personal contacts, about 480 specimens of the Danube newt were found on the shores of Odesa. Only 177 were found alive (the actual number of dead animals may be some orders of magnitude higher; data may be refined if ever possible).

Beside the destruction of a huge quantity of representatives of most species that used to leave downstream the Kakhovka dam, it is essential to highlight the consequences of full drainage of the reservoir itself and its neighboring water bodies, which for years

Figure 11. Dead terrestrial, marine and freshwater animals found in Odesa after the destruction of Kakhovka dam (photo credit: Nekrasova O.).

Figure 12. Only a few dead Danube newts washed up on the coast of the Odesa region, NP "Tuzlivski Lymany" after the destruction of Kakhovka dam (photo: Brusentsova N.).

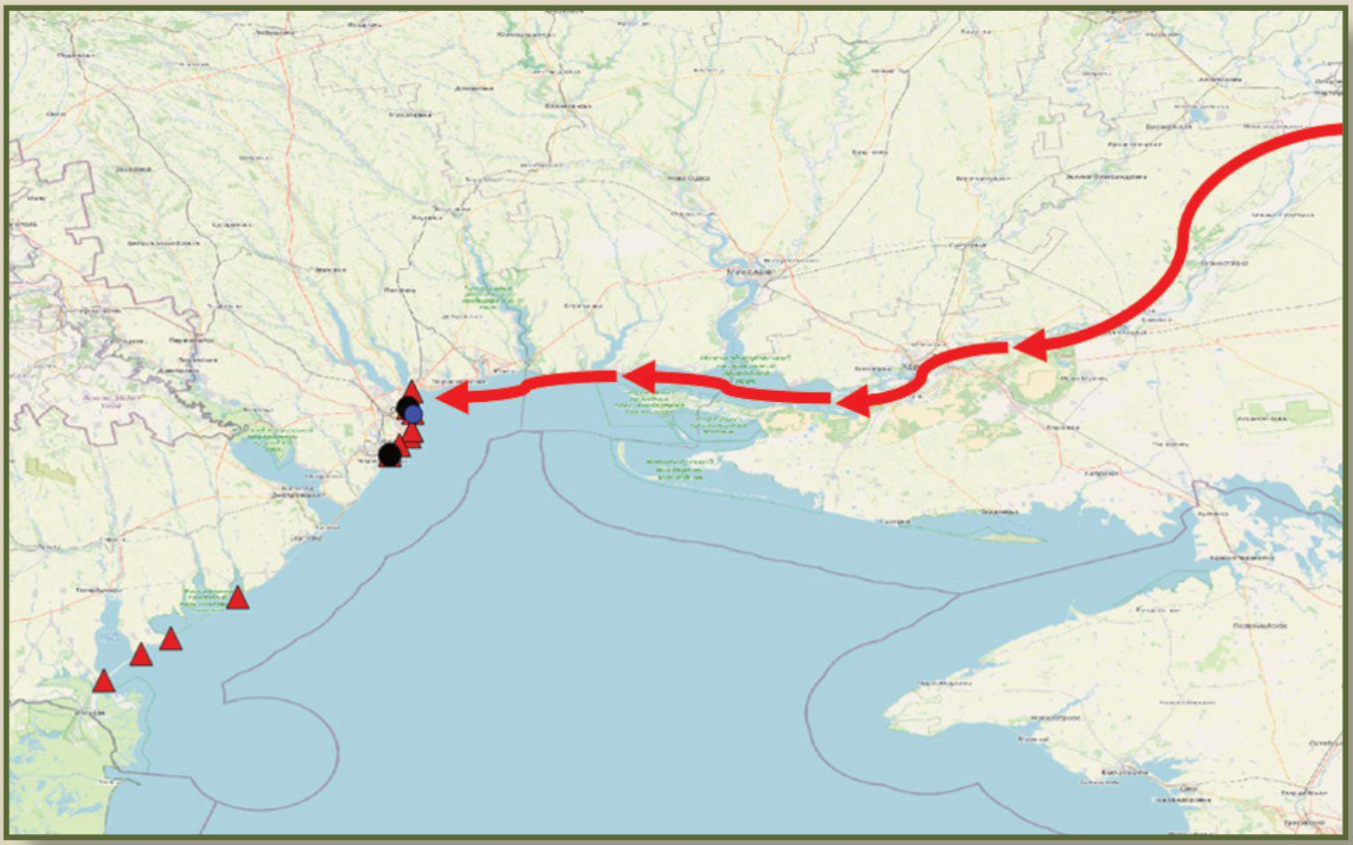

Figure 13. The suggested scheme of the movement of water masses after the destruction of Kakhovka dam with drifting animals that were detected on the coast of the southern regions of Ukraine. Red triangles – Danube newts (*T. dobrogicus*), black circles – European pond turtles (*E. orbicularis*), blue circles – members of the water frog complex (*Pelophylax sp.*) (map used: OSM).

Figure 14. Dead water frogs and fish under the ice in the upper part of Kakhovka reservoir during winter dormancy, 2023 (photo: Suriadna N.)

Figure 15. Drained areas of Kakhovka reservoir after the destruction of the dam by the russia's army in June 2023 (photo: Drapaliuk A.).

Figure 16. Dead European pond turtle *E. orbicularis* and 2 water frogs, near Zaporizhzhia, upstream the upper Kakhovka reservoir after the destruction of the dam by the russia's army in June 2023 (photo: Suriadna N.).

served as the spawning grounds and supported the life of many species of amphibians and reptiles. Nowadays, the surface area of the former Kakhovka reservoir, has since then become a huge dried-out area. Even though natural ecological successions and processes will gradually lead to a new ecosystem, most species, including amphibians and reptiles, that used to rely on the water reservoir may not encounter any conditions anymore suitable to settle back (Fig. 15, 16). The destruction of the Kakhovka dam by russia's army is most likely so far, the biggest tragedy of the war in Ukraine in terms of human casualties and displacement, infrastructure degradation and destruction. Here we present field evidence that this is also a major ecological tragedy that should be classified as an ecocide to be attributed to the actions of the russian army to destroy not only the nation of Ukraine, but also every living being it belongs to.

Table 1. The presence of rare species of amphibians and reptiles protected at the national level in the territories affected by the destruction of the Kakhovka HPP.

Class	Total number of species	Species of Red Data Book of Ukraine	
		number	% of total
Amphibia	11	1	9
Reptilia	13	5	38,5

Russian aggression continues in Ukraine with devastating consequences on people, biodiversity and ecosystems in Ukraine but also on the other side of the front, at the European scale and beyond. As far as amphibians and reptiles are concerned, physical killings of animals, degradation and destruction of key habitats, and potential risks of biological

invasions are clear threats to these species (some of them being already threatened before war) but also for human health. The full extent of the environmental disasters that occurred and still do due to ongoing russian aggression that disregards international environmental obligations should be monitored, with a specific focus on proofs of ecocides, with two major objectives: assessing the damages caused by the aggressor to seek for compensation from russia after victory, and estimating the best restoration strategies to be implemented for habitats and biodiversity. All together are key steps for the best reconstruction of our country and for most sustainable preservation of our Ukrainian culture and spirit. It is already clear that urgent actions are needed to reduce further damage and plan for post-war recovery. Only through the joint actions of the global community can significant progress be made in combating the consequences of all crimes, including environmental ones, committed by russia and ensuring the bright future of Ukraine.

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