A METHOD TO DETERMINE ECOCIDE FROM A LANDSCAPE PERSPECTIVE

THE NOVA KAKHOVKA DAM CASE IN THE RUSSIA-UKRAINE WAR

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INTRODUCTION

ABSTRACT

Focusing on the ongoing war in Ukraine as a case study, this project intends to create a method capable of determining whether ecocide events occur — a potential crime prosecutable by the International Criminal Court (ICC). The project considers data collection and its gaps, expressing and scaling ecocide through mapping, and quantification of severity informed by ecological and crises theory. The testing of the method also calls for adjustments in the legal ecocide proposals to make the case to adopt ecocide to the Rome Statute stronger and more relevant to the scope of ecocide. While centered on Ukraine, the methodology is designed for global applicability in various conflict situations.

FOREWORD SCOPE IN LANDSCAPE ARCHITECTURE

This project may not initially appear to be a conventional landscape architectural effort. Addressing ecocide might seem more appropriate for environmental lawyers, judicial authorities, or crisis management professionals. However, ecocide is an interdisciplinary issue that requires multiple perspectives. Relying on a single field to address ecocide is likely to have shortcomings.

In other words, while it may seem unconventional, a landscape architect's approach to addressing ecocide can indeed fall within the scope of landscape architecture. Landscape architects possess skill sets that are highly relevant, such as ecological knowledge, data collection, and expression through mapping and analysis. These tools are typically used to inform design, but they are also critical in identifying problems and making decisions based on empirical and moral perspectives. Many of these skills overlap with those of other professionals who address ecocide.

This diploma project presents one perspective and methodology for addressing ecocide. While there are limitations to what can be achieved, these limitations highlight the relevance of landscape architecture skills in a world increasingly focused on addressing the environmental crises. The ideas of what constitutes a crime according to the International Criminal Court (ICC) must evolve, and professional perspectives must adapt to tackle critical problems like ecocide.

Landscape architects do not necessarily need to address ecocide independently or directly in the field, but our skills should be applied to critical problems when opportunities arise. This project reveals the limitations of the field and where our skills can potentially overlap with other relevant areas in addressing such significant topics.

REFERENCE PAPER

INTRODUCTION

Today, we face two overarching challenges: the environmental and climate crises manifest in interlinked climate and biodiversity crises. Our ecosystems are complex networks dependent on global and local systems dynamics, revealing a domino-like effect in vulnerability. Habitats include flora, fauna, and human populations that depend on biodiverse habitats across all landscapes: terrestrial, aquatic, and marine ecosystems.

The 2022 Global Living Planet Index by the World Wildlife Fund states that from 1970-2018, the monitored wildlife populations have declined by 69%, primarily due to extraction, monoculture, and human urbanization. This grim statistic rises with the intensifying climate crisis. If warming cannot be kept under 1.5 degrees Celsius, there will be a danger that, shortly, biodiversity loss will be taken over by climate change as its driver.

As Sir Robert Watson put it, “Climate change and biodiversity loss are not only environmental issues but economic, development, security, social, moral and ethical issues too – and they must therefore be addressed together with the 17 UN Sustainable Development Goals (SDGs).”

These environmental problems are greatly multiplied by armed conflicts. As big a crisis as an armed conflict may be, it must be emphasized that an environmental crisis is the foundation of our existence, not just an additional problem. The notion of ecocide is very much a concern in peacetime as it is during wartime, and the issue of environmental destruction is the central problem that must be solved.

PAPER ABSTRACT

This paper investigates the historical development and legal implications of the term 'ecocide,' focusing on specific ecological damage in Ukraine. By examining the actions of a Ukrainian NGO utilizing open-source data, particularly in highlighting Russia's environmental aggression, the paper explores the potential for environmental war crimes. Additionally, it acknowledges the importance of third-party verification alongside governmental initiatives, recognizing the limitations and necessity of independent confirmation. Through comparative analysis and the exploration of crisis theories, the paper identifies substantial disparities between theoretical frameworks and the practical complexities encountered in documenting and prosecuting ecological harm.

ECOCIDE: JUDICIAL HISTORY AND DEVELOPMENT

Introduction to Ecocide

Arthur Galston, an American plant biologist, delivered a speech at the "War Crimes and the American Conscience" conference in Washington DC in 1970, elucidating the initial concept of ecocide:

> "After the end of World War II, and as a result of the Nuremburg trials, we justly condemned the willful destruction of an entire people and its culture, calling this crime against humanity *genocide*. It seems to me that the willful and permanent destruction of environment in which a people can live in a manner of their own choosing ought similarly to be considered as a crime against humanity, to be designated by the term *ecocide*. I believe that the most highly developed nations have already committed autoecocide over large parts of their own countries. At the present time, the United States stands alone as possibly having committed ecocide against another country, Vietnam, through its massive use of chemical defoliants and herbicides. The United Nations would appear to be an appropriate body for the formulation of a proposal against ecocide"[1]

Galston drew parallels to society's condemnation of the genocide after World War II, suggesting the United Nations should recognize mass environmental destruction as a crime against humanity. The United Nations did not adopt a convention to designate 'ecocide' as a prosecutable crime after the panel.

At the time, there was no globally recognized judicial institution tasked explicitly with prosecuting individuals for crimes such as genocide, despite the existence of the Geneva Conventions and various war crime cases like the Nuremberg and Tokyo trials.[2] In the 1990s, the United Nations Security Council organized the temporary International Criminal Tribunal to

[1] War crimes and the American Conscience
[2] An introduction to the International Criminal Court
By Schabas, William

address crimes in Yugoslavia and the Rwanda genocide.[3] The UNSC established tribunals to try crimes within a specific time frame and conflict; therefore, the consensus agreed on the importance of a permanent criminal court.[4] In 1998, 120 states adopted the Rome Statute, "the legal basis for establishing the permanent International Criminal Court," which took effect on July 1, 2002.[5]

In Article 5, the Rome Statute lists the four 'Crimes within the jurisdiction of the Court': The crime of genocide, crimes against humanity, war crimes, and the crime of aggression.[6] Under war crimes in Article 8(2)(b)(iv), the Rome Statute considers environmental damage to be 'other serious violations':

> *"Intentionally launching an attack in the knowledge that such attack will cause incidental loss of life or injury to civilians or damage to civilian objects or widespread, long-term and severe damage to the natural environment which would be clearly excessive in relation to the concrete and direct overall military advantage anticipated;"*[7]

According to the ICC Court Records and Transcripts, no case has been filed, presumably because of the "very high threshold of injury required under the article"[8]; more specifically, *intentionally* launching an attack that will cause 'widespread, long-term and severe damage to the natural environment.'.

Legal Ecocide Proposals

The push to recognize ecocide persisted following the establishment of the Rome Statute. Two prominent initiatives led by the Stop Ecocide Foundation (SEF) and the European Law Institute (ELI) aim to establish ecocide as a prosecutable crime under international law and European law, respectively. Both proposals refer to the existing Article 8 in the Rome Statute as a starting point, and the SEF proposal aims to amend the Article with their proposal.

In 2010, Polly Higgins, a Scottish barrister and founder of the Stop Ecocide Foundation, proposed to the UN Law Commission an amendment to the Rome Statute that would include ecocide as a crime along with its definition: *"the extensive damage to, destruction of or loss of ecosystem(s) of a given territory, whether by human agency or by other causes, to such an extent that peaceful enjoyment by the inhabitants of that territory has been or will be severely diminished."* After she died in 2019, The Stop Ecocide Foundation formed an Independent Expert Panel to create a legal definition of ecocide as a plausible crime prosecutable by the ICC and the elements characterizing the crime co-chaired by international lawyers Philippe Sands QC and Dior Fall Sow.[9] The panel released a draft text in June 2021.

[3] Resolution 955 (1994) / adopted by the Security Council at its 3453rd meeting, on 8 November 1994
[4] United Nations, 1998
[5] International Criminal Court, 2007
[6] Rome Statute of the International Criminal Court
[7] Rome Statute of the International Criminal Court
[8] European Law Institute, 2021
[9] Stop Ecocide Foundation, 2021

PROPOSAL – THE STOP ECOCIDE FOUNDATION

1) *For the purpose of this Statute, "ecocide" means 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.*

2) *For the purpose of paragraph 1:*

   a) *"Wanton" means with reckless disregard for damage which would be clearly excessive in relation to the social and economic benefits anticipated;*

   b) *"Severe" means damage which involves very serious adverse changes, disruption or harm to any element of the environment, including grave impacts on human life or natural, cultural or economic resources;*

   c) *"Widespread" means damage which extends beyond a limited geographic area, crosses state boundaries, or is suffered by an entire ecosystem or species or a large number of human beings;*

   d) *"Long-term" means damage which is irreversible or which cannot be redressed through natural recovery within a reasonable period of time;*

   e) *"Environment" means the earth, its biosphere, cryosphere, lithosphere, hydrosphere and atmosphere, as well as outer space.*

The European Law Institute (ELI) has actively participated in the discussion, paralleling the panel's efforts. The ELI aims to "define the aspects characterizing the crime of ecocide and the conditions for prosecution in the European framework" and collect support for its inclusion in the Rome Statute.[10]

PROPOSAL – THE EUROPEAN LAW INSTITUTE

Article 3(2) states "ecocide means any conduct as defined in paragraph 4 or 5, committed with intent, which may cause, or substantially contribute to causing, severe and longterm damage or severe and irreparable or irreversible damage to an ecosystem or ecosystems in the natural environment."

(3) "For the purposes of paragraph 2, a person has intent where:

(a) in relation to conduct, that person means to engage in that conduct; and

[10] European Law Institute, *Ecocide*, 2021

(b) in relation to a consequence, that person means to cause the consequence or is aware, or could not be unaware, of the substantial likelihood that it may occur.

CONCLUSION

The two proposals address aspects not fully delineated in Article 8: the precise definition of ecocide and the characteristics of intent. While the original Article mentions that the perpetrator must have 'knowledge' that the attack will cause *either* 'widespread, long-term, and severe damage to the natural environment,' it lacks clarity on what constitutes this knowledge[11]. The Stop Ecocide Foundation (SEF) proposal requires that 'knowledge' entails an awareness of the 'substantial likelihood' of damage resulting from the acts. For instance, if the primary aim is to destroy infrastructure but there is awareness of potential secondary environmental damage, this would be considered knowledge of intent. Notably, 'severe' is connected to both 'long-term' and 'irreparable,' rather than 'long-term' and 'irreparable' being considered independently.

In summary, the SEF and European Law Institute proposals offer more precise definitions of ecocide and intent than the original Article 8 in the Rome Statute. The SEF emphasizes awareness of the substantial likelihood of damage, and the International Criminal Court and the European Union have not officially adopted ecocide in legal jurisdiction.

WAR IN UKRAINE: CASE FOR ECOCIDE

On February 24, 2022, Russia launched the full-scale invasion of Ukraine. In a timeframe of two years, the Russian forces have caused immense environmental damage in Ukraine, including forest fires in protected regions, polluting water bodies, and, notably, the destruction of the Kakhovka Dam. In response, Ukraine is building a case against Russia for ecocide.

ICC Process for Trying Individuals

As stated before, the ICC has not adopted ecocide as a crime, and Article 8 currently considers "widespread, long-term, and severe damage to the natural environment" as a war crime, serving as a placeholder in this case. However, if an ecocide were adopted, the process would undergo significant changes for trying the defendant. The process for trying individuals for war crimes is a six-step process: preliminary examinations, investigations, pre-trial stage, trial stage, appeals stage, and sentence enforcement. The paper will examine the preliminary examination and investigation stages in trying individuals for war crimes, focusing on data collection to create a case, conduct an investigation, and issue an arrest warrant.

The office of the Prosecutor (OTP) of the ICC is tasked with determining whether the situation satisfies the legal requirements outlined in the Rome Statute to warrant an investigation by the OTP. The case must fall within the jurisdiction of the ICC, and the case must support the interest of justice. The examination can be initiated by 'information sent by individuals or groups, States, intergovernmental or non-governmental organizations; a referral from a State

[11] Article 8(2)(b)(iv) of Rome Statute

Party or the United Nations Security Council; or a declaration lodged by a State accepting the exercise of jurisdiction by the Court according to Article 12(3) of the Statute".[12]

If ecocide is adopted into the Rome Statute as a war crime, Ukraine as a state is permitted to initiate the examination. If the OTP warrants an investigation, evidence must be gathered to assemble a case.

Non-Governmental Organization Efforts: Ecoaction

At the start of the war, the NGO Ecoaction began compiling data on environmental harm to support Ukraine's government and its Ministry of Environmental Protection and Natural Resources. Initially, Ecoaction manually gathered open-source data, like news articles detailing environmental impacts in Ukraine. Subsequently, the ministry established its database for data collection, which remains inaccessible to the public. Ecoaction continued in gathering open-source information, refining its database, categorizing damages, and geolocating them on a public map titled "Potential Environmental Impacts Caused by Russian Aggression in Ukraine." The website states that this data will aid in planning future research missions to ascertain the extent of deterioration or destruction of nature. Employees and volunteers of Ecoaction collected the data from various open sources, including media reports and official statements. Ecoaction acknowledges that this is not a complete assessment and will not be until the end of the acts of hostilities.

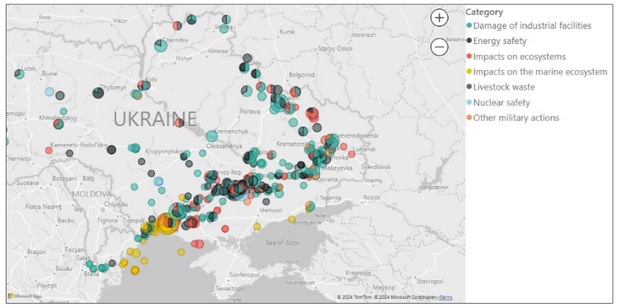
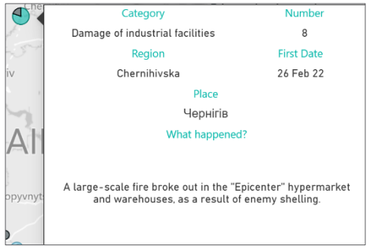


Figure 1

What can we already see from the mapping? Currently, the signage indicates the locations where damages occur and already naturally showcases where the battle line between Ukrainian and Russian forces is located (almost forming a heatmap). Besides this visualization, the map serves as a list of events for users. The map uses color to characterize damages, and the size of circles are scaled at different sizes, which are unknown but *presumably* refer to the scale of the impact.

[12] The International Criminal Court, Preliminary Examinations Process
[12] Figure of Ecoaction's "Potential Environmental Impacts Caused by Russian Aggression in Ukraine"

Each symbol on the map provides details, including category, number (scale?), region, first date, place, and a brief event description. For example, in Cherniv, a large-scale fire broke out in the "Epicenter" hypermarket and warehouses as a result of enemy shelling'. However, this data and its symbology do not answer aspects of the definition of ecocide.



Unanswered Questions and the Ecocide Definition

Currently, the mapping efforts do not illustrate whether the environmental impacts constitute ecocide, but perhaps the mapping can do so. While the mapped data outlines the events, such as enemy shelling, questions regarding intent and degree of environmental harm remain unanswered. According to the definition of ecocide provided by the Stop Ecocide Foundation, it is critical to determine whether there was *knowledge* of the substantial likelihood of *severe and widespread* or *severe and long-term* environmental damage. While the perpetrator's intention with the missile may not have been to cause a fire, can it be assumed that the perpetrator knew that a missile attack could result in such environmental damage? Furthermore, how can such damages be mapped if there is intent or knowledge?

These questions highlight the complexity of interpreting the mapped data visually and its implications for determining ecocide. Additionally, the existing datasets may not sufficiently address these demands, raising the need for further inquiry into data collection and analysis. This challenge questions whether the current symbology adequately represents the existing data or if additional data is required to answer the critical questions constituting ecocide.

ADDRESSING CRISIS

MAPPING CHALLENGES IN CRISES

This section explores mapping crises, gaps in data, and sources to fill the gaps through other means of crowdsourcing, as well as quantifying the severity of crises.

In times of crisis, such as war, gathering data and mapping are imperative but present significant challenges. Traditionally, a trained cartographer creates maps. In the case of gathering and mapping environmental damages in Ukraine, it is assumed that an expert in ecology or environmental fields would collect the data. In the context of war, it raises a dilemma: is it advisable to send such professionals to the front line to assess environmental damages? This situation leads to further inquiries: what are the most effective methods for data collection, and who should be responsible for these tasks?

This section examines the mapping process, focusing on who collects the data and the accessibility of the resulting mapping. Ukrainian President Volodymyr Zelenskyy initiated the High-Level Working Group on the Environmental Consequences of the War, which aims to assess war-related environmental damages, propose developments for judicial processes, and recommend strategies for sustainable reconstruction and recovery. Although the Ukrainian government is actively collecting data, a significant portion remains confidential, and the

methods for data collection are still evolving.[13] This professional yet private approach to data creation prompts questions regarding transparency and democratic representation in the data collection. The involvement of an international team in the Ukrainian state's representation introduces an element of balance from the state, which is in direct conflict with collecting evidence of the perpetrator's actions, potentially reducing national bias. There is a lack of raw data available to the public.

Crowdsourcing The concept of democratic data collection is relevant, contemplating whether Ukrainian citizens' widespread participation in data collection would constitute a democratic approach. This concept discusses crowdsourcing as a possible data collection and verification tool, particularly in crises.

Crowdsourcing in crisis mapping presents a transformative approach to gathering and analyzing data during emergencies. It gives power to the people, volunteers, and affected communities worldwide in crises. This method utilizes the availability of internet access and mobile technology to collect real-time data from a vast number of sources. Crowdsourcing allows for the fast collection of large volumes of information, including eyewitness reports, photographs, videos, and social media posts. This information is used to create detailed maps that reflect current conditions on the ground, such as the extent of natural disasters, conflict zones, or other humanitarian emergencies. It is important to note that professionals do not need to be the ones inputting the data or on the field. Instead, the professionals review the data, verify, and make conclusions.

Crowdsourcing democratizes the process of information gathering and crisis response, allowing anyone with internet access to contribute to vital mapping efforts. However, this approach also presents challenges, particularly regarding the accuracy and reliability of the data collected. Verifying the authenticity of crowdsourced information requires further review.

The Syria Tracker The Syria Tracker project offers a case study for crowdsourcing in humanitarian crises, estimating the death toll in Syria's conflict by combining automated data mining with crowdsourced human intelligence.[14] Initiated in 2011 by a team of volunteers from the US and Syria, the project began collecting reports shortly after the uprising's onset, cataloging over 10,000 deaths, with nearly 90% backed by video or photographic evidence. The platform utilizes a modified version of HealthMap software and various reporting methods (including social media and encrypted services) to avoid government surveillance. The data is mapped to provide an overview of the human cost in categories including the following categories: killed, chemical poisoning, missing/ detained, raped, and other categories. This effort aims to document violence, although challenges such as data verification, duplicate entries, and underreporting persist, highlighting the involvedness of accurately assessing war's impact through crowdsourced information.

Figure 2 Screenshot of the Humanitarian Tracker Project "Syria Tracker" homepage.

This case study is one of many crowdsourcing efforts to collect data to map. In this case, Syria has not been brought before the ICC for trial for crimes committed because Syria is not a party of the Rome Statute – there is no jurisdiction. Furthermore, the United Nations Security Council has the power to exercise jurisdiction, but Russia and China, members of the UNSC, vetoed resolutions referring the Syrian case to the ICC.

Aside from democratic data collection, this method can also be used for verification. In terms of quantity, crowdsourcing can provide reassurance of damages in an area. For example, if there is a forest fire, the confirmation of one person may only ascertain a fire in a small section. However, if numerous people document a fire in an area, it is not just confirmation of fire but triangulating testimony through images and description; perhaps a degree of fire can be calculated and mapped.

Verifying Crowdsourced Data Challenges associated with verifying information collected through crowdsourcing are examined, along with the critical issue of who should oversee these initiatives.

Concluding Thoughts

In past crises, data collection and transcription would have meant that more conventional figures in this business, like ecologists or environmentalists, would have to gather data—the dangerous and less effective way to be on the front line of help. This leads to further questions: What are the most effective data collection methods, and who should bear those responsibilities? Of course, the efforts of the Ukrainian government, most notably of the High-Level Working Group on the Environmental Consequences of the War and President Zelenskyy, suggest that those methods are changing fast and are often classified, raising questions about their transparency and democratic representation.

Crowdsourcing has emerged in democratic data collection and verification, especially in crises, and is recognized as a transformational approach. Supported by the internet and mobile technology, this crowdsourcing mechanism allows volunteers and affected communities to gather data in real-time. It is proper to mention an example demonstrating the considerable potential of crowdsourcing, developed in the Syria Tracker project, where automated data mining with human intelligence is applied to document and map conflict-related impacts. Regardless of the issues with data verification and the possibility of bias, crowdsourcing democratizes the information-gathering process and makes it faster and more pervasive.

Crowdsourcing is effective because of its ability to democratize data collection and its strength in providing reliable verification through triangulation from other sources. The process can help overcome the limitations of NGOs that cannot conduct assessments prior to conflict. The significance of the approach in providing public access to information and enhancing crisis

[13] From the 2024 High-Level Working Group on the Environmental Consequences of the War Report
[14] Mapping the human cost of Syria's uprising article by Jims Giles, 2012

response is in connecting gaps that have already been established with potential solutions that crowdsourcing may provide. In conclusion, even with the challenges at hand, the potential of crisis crowdsourcing in mapping is an innovative tool for conducting modern emergency response, giving power to the people through collective action and digital connectivity in the challenge of complex global problems. Crowdsourcing has made itself evident as one of the critical methodologies in ensuring that the environmental assessment of a crisis is democratic, accurate, timely, and one that can fill gaps in data like the Ukraine ecocide case.

UNDERSTANDING THE SEVERITY OF CRISES

This second section addresses crisis elements to provide a more fixed understanding of severity. The legal definition provided by the SEF addresses specific requirements but remains vague, allowing for interpretation. For example, ‘‘’*Severe’ means… very serious adverse changes, disruption, or harm to any element of the environment...”* This vagueness establishes ambiguity in determining what constitutes severity, specifically concerning ecocide cases from an ecological perspective. The case study of the dam destruction illustrates this ambiguity and highlights the relevance of considering additional crisis elements when quantifying severity.

Ecological Concerns and Catastrophic Failures

Global discussions about the destruction of the Nova Kakhovka Dam highlighted significant ecological concerns. Ecologists’ views emphasized that the dam had disrupted the hydrology and ecosystem functions of the Dnipro River, arguing that the landscape is better off without the dam.

Resilience in Ecological Systems

Furthermore, Ecological criticisms point out that dams pose severe risks of catastrophic failure beyond disrupting ecosystems. These structures are perhaps ticking time bombs, possibly causing environmental and humanitarian crises upon failure. There is a difference between controlled decommissioning and unexpected collapses, regardless of the cause. Gunderson states, “The speed, severity, and complexity of natural disasters continually challenge the ability of society to generate appropriate responses”; these responses can be perceived as a form of resilience.

Characteristics in Resilience

As in ecology, the ecosystem reacts to environmental changes, adapting to ensure stability. The concept of resilience in ecology addresses the ecosystem’s ability to withstand and recover from change. As defined by Holling (1973), resilience encompasses two different aspects of change in an ecosystem over time.

The first feature that characterizes resilience is the persistence of relationships in a system and the “ability of systems to absorb changes of state variables, driving variables, and parameters, and persist” (Holling 1973). As mentioned above, the traditional definition of resilience indicates the ability to return to a previous state once an event has passed. The second feature that characterizes resilience is “the size of a stability domain or the amount of disturbance

a system could take before it shifted into an alternative configuration” (Holling 1973). The second perspective of resilience indicates that a system does not necessarily need to return to its original state but can adjust and reorganize to a new state of stability.

Vulnerability and Resilience

This concept of shifting to an alternative configuration still implies that preparedness for any disturbance is factored into a system. However, the concept of resilience also inherently implies the idea of vulnerability. The extent to which a system can absorb disturbances without fundamentally changing exhibits its resilience, but it also shows its vulnerability to being pushed across a critical threshold.

In principle, resilience and vulnerability are interconnected. Resilience reflects a system’s capacity to withstand and adapt to disturbances, while vulnerability indicates the susceptibility to harm and the potential for significant disruption. Quantifying the severity of an event requires an understanding of both resilience and vulnerability. A highly resilient system may withstand severe events with minimal disruption, whereas a vulnerable system might experience profound and lasting impacts even from more minor disturbances. Recognizing and addressing the vulnerabilities within systems can enhance resilience, reducing the overall severity of future events.

Speed of Onset and Crisis Severity

The concept of “speed of onset” is crucial in categorizing crises. This dynamic can drastically alter the severity and impact of a crisis, making rapid responses more challenging but necessary. The methodology incorporates Baron’s framework, which includes speed of onset among four critical elements visualized in a quadrant system. This helps to categorize and understand ecological disasters’ immediate and long-term impacts. Zobel and Khansa state, “The definition of resilience should incorporate not only post-event consequences but also pre-event preparedness and strategic planning,” again pointing to the relevance of vulnerability in such events and how the speed of onset is interrelated.

Concluding Approach to Crises

In conclusion, the analysis underlines the complexity of defining and quantifying the severity of ecological crises, particularly by legal frameworks and ecological resilience. The case of the Nova Kakhovka Dam demonstrates the ambiguity of legal meanings related to the severity of the disaster and, therefore, the need for a broader consideration of the elements of a crisis. In the case of Holling’s discussion of the topic, ecological resilience is a reversion to a former state and the reorganization to a new state. In this contrast, the character of vulnerability versus preparedness, earlier discussed, is mirrored. The vulnerabilities and the speed of onset must be considered in the approaches to managing crises to minimize future ecological disaster severity.

CONCLUSION

The paper examines the urgency of dealing with ecological crises in the context of ecocide and legal frameworks. The case of the Nova Kakhovka Dam shows the difficulties of specifying and

prosecuting the destruction of the environment as a crime. It highlights the connection between elements of an ecosystem, showing how the ecosystems are meant to adjust and reorganize as a response to disturbances and its relevance in applying to environmental crises. Legal definitions, including proposed definitions of both the SEF and the European Law Institute, offer guidelines for recognizing and responding to ecocide but ideas of ecology and crises can assist in making more substantial cases. The crowdsourcing of data collection and crisis mapping can also fill gaps and show what can be achieved more transparently and accurately to register the ecology in conflict zones such as Ukraine.

METHODOLOGY

METHOD OVERVIEW
INTERCONNECTED DEVELOPMENT BETWEEN METHOD AND TESTING

INTRODUCTION

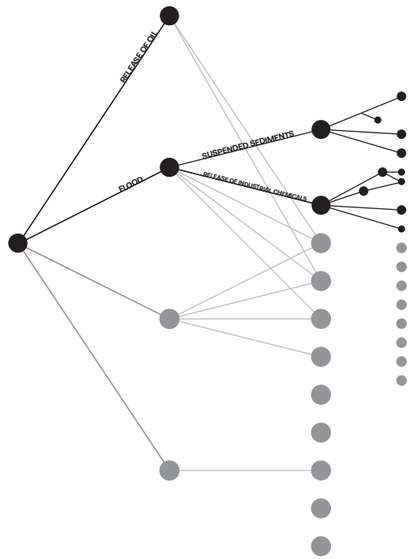
This section outlines the methodology used in this project, detailing the process of its execution and its application in developing a system to determine the occurrence of ecocide. The legal ecocide proposal served as the starting point for the system design, which was further refined by empirical knowledge of crises and ecology.

The system was tested with two environmental events during the Russian-Ukraine war. These tests not only determined whether ecocide events occurred and assessed the success of the system but also guided adjustments to the system. While the case studies assisted in these adjustments, it is critical to acknowledge that this approach also has shortcomings. Relying on only two specific events and the limited information available introduces bias to the system and may not encompass all types of events.

SIMPLIFYING COMPLEXITY: A STRUCTURED APPROACH TO CASCADING ECOLOGICAL DISASTERS

The overarching goal of the system was to utilize available data to fulfill the proposed legal requirements of ecocide, specifically to assess whether events caused severe and widespread or severe and long-term environmental damage. However, determining the scale of such events can be challenging. For example, in the case of a major flood, a cascade of related events often follows, forming a complex web which is of no surprise given the state that an ecosystem is a complex web itself.

For example, the Kakhovka Dam Case, what is often overlooked is that the flood was not the

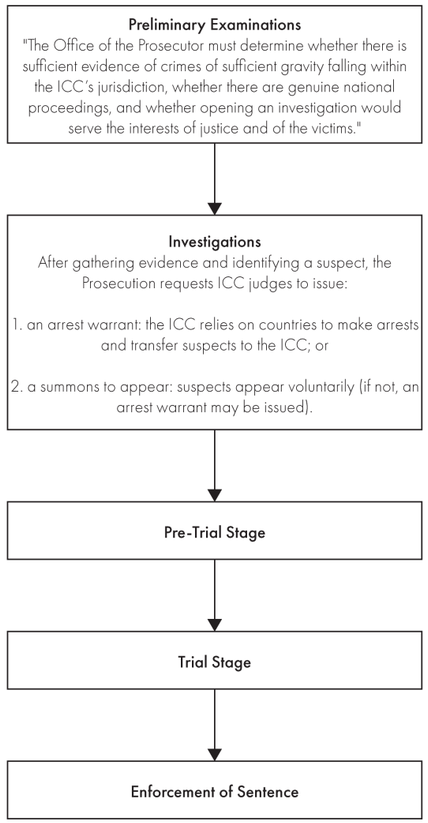


initial trigger; rather, it was the destruction of the Nova Kakhovka Dam. This destruction led to multiple significant incidents, including the immediate release of oil from the hydraulic power plant (HPP) and the removal of a critical energy source from the southern region of Ukraine. Each event initiated further events, creating an extensive web of damages.

The complexity of these events makes them difficult to quantify individually due to their interconnectedness, the ongoing state of war (a crisis in itself), and the challenges associated with unknown longevity. These factors are compounded by a lack of sufficient data, reflecting

some of the previously mentioned challenges.

According to the procedures of the International Criminal Court (ICC), a case must be established to initiate an investigation. To make a case, there must be a "reasonable basis to believe that crimes within the jurisdiction of the Court have been committed." The purpose of initiating an investigation is to gather resources to fill the gaps left by preliminary evidence and assumptions, ensuring that any eventual charges are fully supported by solid evidence.



ORIGINAL STRUCTURE OF METHOD

STOP ECOCIDE FOUNDATION LEGAL ECOCIDE PROPOSAL

For the purpose of this Statute, "ecocide" means 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.

For the purpose of paragraph 1:

"Wanton" means with reckless disregard for damage which would be clearly excessive in relation to the social and economic benefits anticipated;

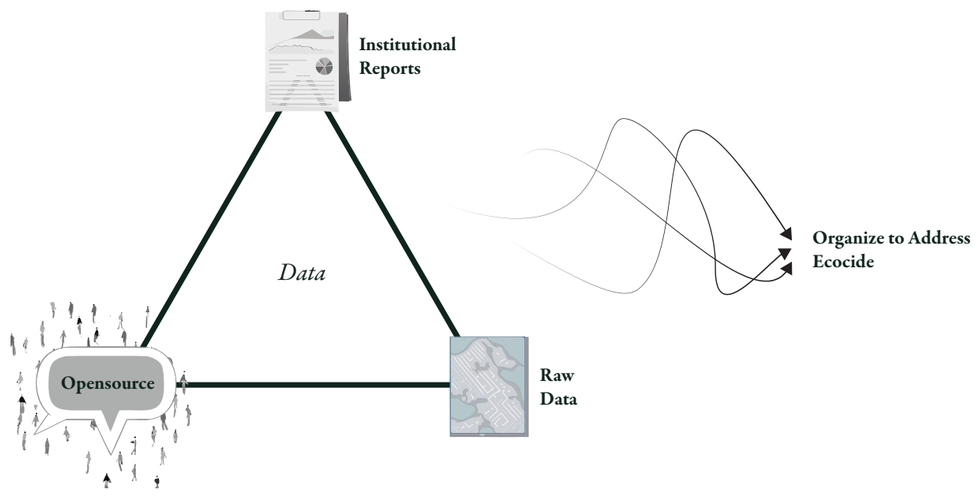
"Severe" means damage which involves very serious adverse changes, disruption or harm to any element of the environment, including grave impacts on human life or natural, cultural or economic resources;

"Widespread" means damage which extends beyond a limited geographic area, crosses state boundaries, or is suffered by an entire ecosystem or species or a large number of human beings;

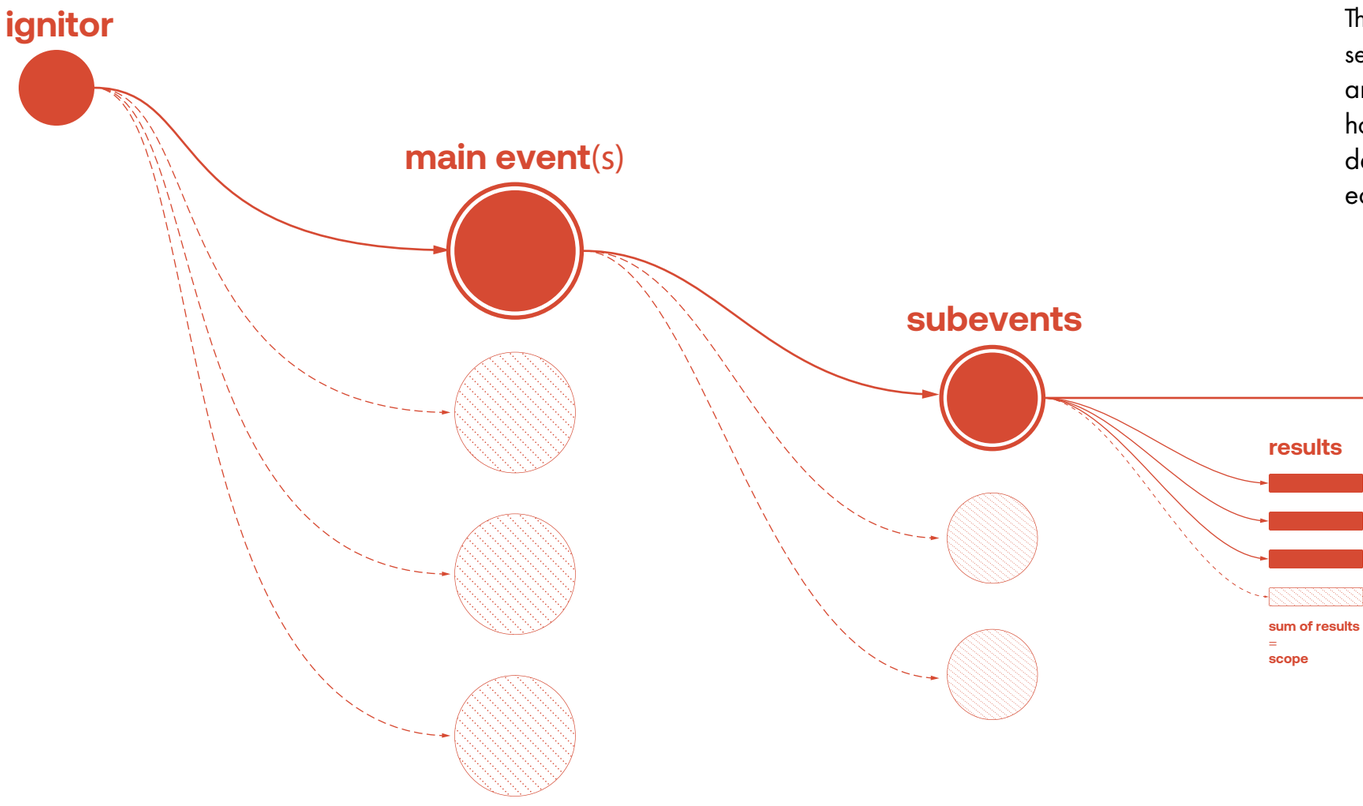
"Long-term" means damage which is irreversible or which cannot be redressed through natural recovery within a reasonable period of time;

"Environment" means the earth, its biosphere, cryosphere, lithosphere, hydrosphere and atmosphere, as well as outer space.

Therefore, to make a case for ecocide, it is crucial to recognize that although the available data might not be sufficient to conclusively prove ecocide, there should be enough reasonable basis to proceed making a case. This basis could begin with the existing data and a narrative of the chain of events, using methods such as mapping and drawing on empirical knowledge of how known events lead to subsequent damages or further cascading events, thereby demonstrating that the sequence meets the criteria for ecocide. **Addressing the gaps of data from following the system is not necessarily a shortcoming, rather it reveals the gaps that directionally assist where the investigation process should focus and where future scenerios can be addressed beforehand.**



THE METHOD



The revised focus for quantifying the severity of ecological impacts incorporates the sub-event framework, enhancing the original ecocide proposal. Emphasis is placed on the temporal and spatial dimensions of ecological disturbances, encapsulated by the questions “how long?” and “how far?”

Furthermore, this approach integrates crisis theory from an ecological perspective, one familiar to landscape architects. Key concepts include “vulnerability”—viewed as the inverse of resilience, highlighting the susceptibility to damage—and “scope,” which measures the extent of impact as delineated by subsequent results of initial events. Additionally, the speed of onset is considered critical, acknowledging the rapid or gradual emergence of ecological crises and their profound influence on the overall severity assessment.

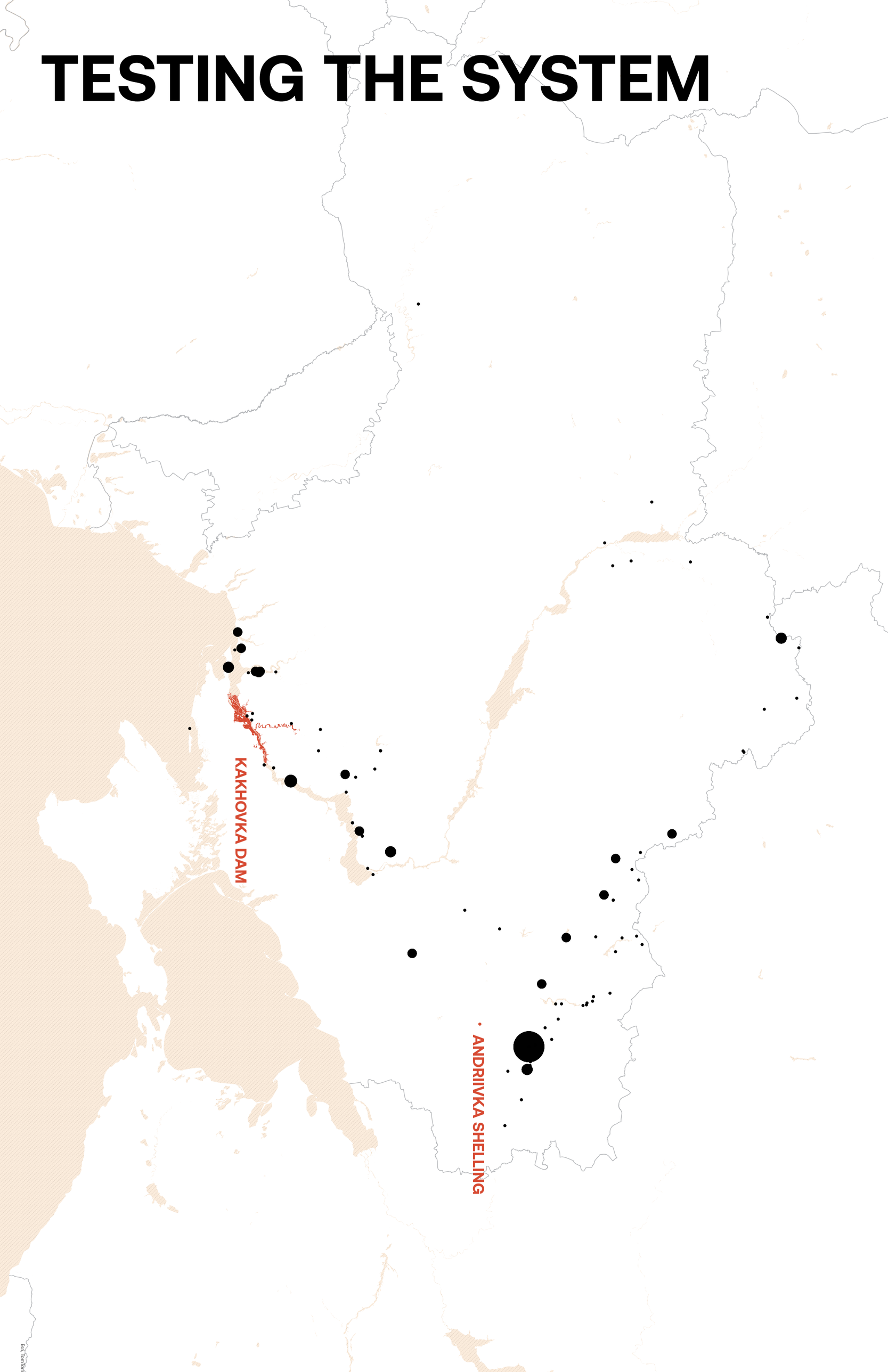
The significant difference between this approach from the legal proposal is the context of severity. Rather than assess whether events caused severe and widespread or severe and long-term environmental damage, the combination of how long (long-term) and how far (widespread) with the addition of speed of onset, vulnerability and scope determine whether an event is severe and therefore determining whether there is an ecocide case or not.

quantification of severity

HOW LONG?	a
HOW FAR?	b
SPEED OF ONSET	c
VULNERABILITY	d
SCOPE	e

$$e(a+b+c+d) = \text{severity}$$

TESTING THE SYSTEM

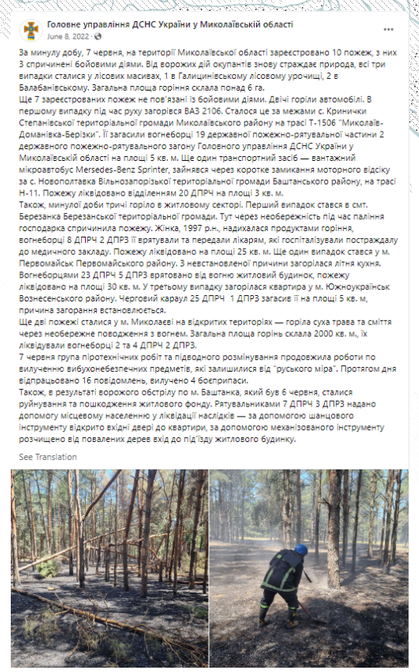


TESTING THE SYSTEM

ANDRIIVKA SHELLING

JUNE 9, 2022

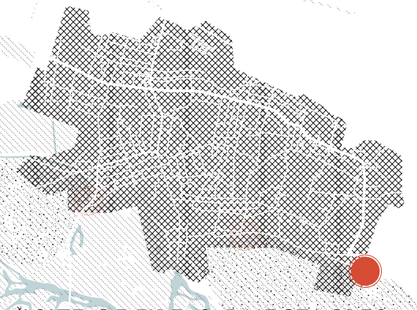
The information is sourced from a news article written by Alyona Ryazantseva and Dmytro Grebinnyk, using material from Yevhen Vasylenko, the spokesman of the Main Department of the Kharkiv Oblast State Emergency Service. He provided details about the fire near the village of Andriivka in the Izyum district.



Головне управління ДСНС України у Миколаївській області
June 8, 2022 ·

За минулу добу, 7 червня, на території Миколаївської області зареєстровано 10 пожеж, з них 3 спричинені бойовими діями. Від ворожих дій окупантів знову страждає природа, всі три випадки сталися у лісових масивах, 1 в Галицинівському лісовому урочищі, 2 в Балабанівському. Загальна площа горіння склала понад 6 га.
Ще 7 зареєстрованих пожеж не пов'язані із бойовими діями. Двічі горіли автомобілі. В першому випадку під час руху загорівся ВАЗ 2106. Сталося це за межами с. Кринички Степанівської територіальної громади Миколаївського району на трасі Т-1506 "Миколаїв-Доманівка-Берізки". Її загасили вогнеборці 19 державної пожежно-рятувальної частини 2 державного пожежно-рятувального загону Головного управління ДСНС України у Миколаївській області на площі 5 кв. м. Ще один транспортний засіб — вантажний мікроавтобус Mersedes-Benz Sprinter, зайнявся через коротке замикання моторного відсіку за с. Новополтавка Вільнозапорізької територіальної громади Баштанського району, на трасі Н-11. Пожежу ліквідовано відділенням 20 ДПРЧ на площі 3 кв. м.
Також, минулої доби тричі горіло в житловому секторі. Перший випадок стався в смт. Березанка Березанської територіальної громади. Тут через необережність під час паління господарка спричинила пожежу. Жінка, 1997 р.н., надихалася продуктами горіння, вогнеборці 8 ДПРЧ 2 ДПРЗ її врятували та передали лікарям, які госпіталізували постраждалу до медичного закладу. Пожежу ліквідовано на площі 25 кв. м. Ще один випадок стався у м. Первомайськ Первомайського району. З невстановленої причини загорілася літня кухня. Вогнеборцями 23 ДПРЧ 5 ДПРЗ врятовано від вогню житловий будинок, пожежу ліквідовано на площі 30 кв. м. У третьому випадку загорілася квартира у м. Южноукраїнськ Вознесенського району. Черговий караул 25 ДПРЧ 1 ДПРЗ загасив її на площі 5 кв. м, причина загорання встановлюється.
Ще дві пожежі сталися у м. Миколаєві на відкритих територіях — горіла суха трава та сміття через необережне поводження з вогнем. Загальна площа горінь склала 2000 кв. м, їх ліквідували вогнеборці 2 та 4 ДПРЧ 2 ДПРЗ.
7 червня група піротехнічних робіт та підводного розмінування продовжила роботи по вилученню вибухонебезпечних предметів, які залишилися від "руського міра". Протягом дня відпрацьовано 16 повідомлень, вилучено 4 боєприпаси.
Також, в результаті ворожого обстрілу по м. Баштанка, який був 6 червня, сталися руйнування та пошкодження житлового фонду. Рятувальниками 7 ДПРЧ 3 ДПРЗ надано допомогу місцевому населенню у ліквідації наслідків — за допомогою шанцового інструменту відкрито вхідні двері до квартири, за допомогою механізованого інструменту розчищено від повалених дерев вхід до під'їзду житлового будинку.

See Translation



SIZE OF FIRE: 2.5 HECTACRES

RESCUERS EXTINGUISHED A FOREST FIRE NEAR BALAKLIA IN THE KHARKIV REGION

"The rescuers together with the workers of the local forest farm extinguished the fire near the village of Andriivka in the Izyum district, where needles were burning in a pine forest.

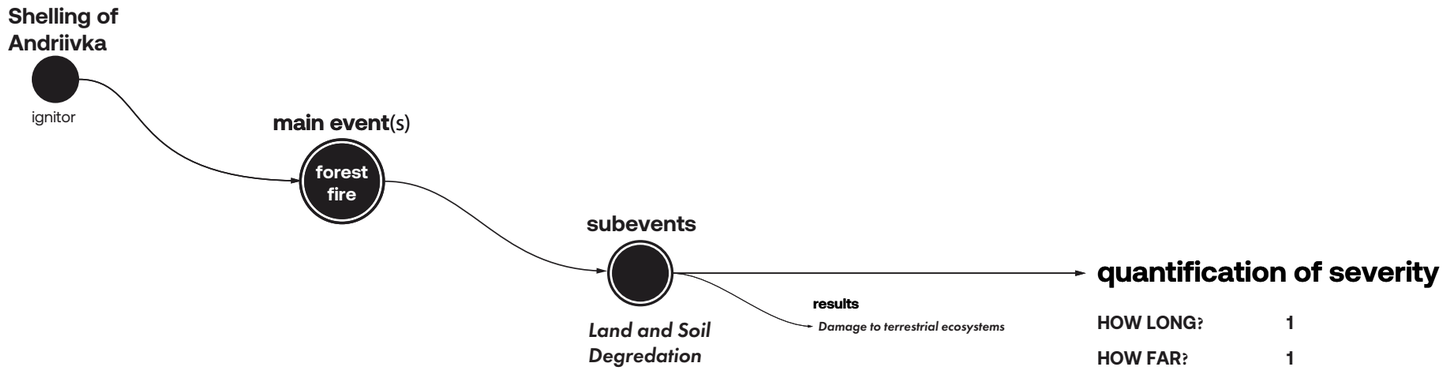
At first, the rescuers localized the fire on almost three hectares, Yevhen Vasylenko, the spokesman of the Main Department of the Kharkiv Oblast State Emergency Service, told Suspilno.

"At 10:30, a report was received about a fire in a forest farm near Andriivka, Izyum district. The units of this settlement, the local fire brigade, as well as equipment and people from the forest farm were sent there. ***The coniferous litter of the pine forest was burning. There was a threat of the fire spreading to the inhabited area.*** *point, to separate streets bordering the forest plantation," said Yevhen Vasylenko.*

The fire was caused by shelling*, says Vasylenko.*

"Departments of the State Emergency Service, together with the Forest Service, limited the access of the fire to the settlement, that is, there is currently no threat to the village. The fires are connected with constant hostilities. Most likely, a projectile hit the forest, there was mortar fire from tanks. From there to the line front - 3-5 km," said Yevhen Vasylenko.

Added 6:00 p.m. The rescuers extinguished all the fires in the forest. The area of the fire was about 2.5 hectares, *Vasylenko said."*



QUANTIFICATION RESULTS

The numbers were assigned to the given categories. Interrelated with the other categories, this onset speed is regarded as fast, but there is little vulnerability for several reasons:

First, landscapes have some resilience to fires, and at times, fires often support forest rebirth putting aside potential chemicals. In this case, there was preparedness due to human intervention—a factor that would place their ability to stop the fire on time at a score of 1 in the "how long?" category. The reason for this low score was the small spread of the fire, 2.5 hectares, which further justifies the score of 1 in the "How long?" category.

QUANTIFICATION OF SEVERITY

(LONGTERM) HOW LONG?	**1**
(WIDESPREAD) HOW FAR?	**1**
SPEED OF ONSET	**4**
VULNERABILITY	**1**
SCOPE	**1**

Categorizing cascading events is crucial to avoid unreasonable compounding in severity quantification. If all fire results were included under the scope category, leading to a high rating of 5, the severity quantification would exponentially increase. However, does the potential water degradation from smoke and gases warrant presence in the scope category, thus multiplying the overall severity? Introducing sub-events helps to eliminate unnecessary scope, ensuring a more accurate quantification of an event's severity.

In this case, using "land and soil degradation" as a sub-event to the main event – the forest fire -- helps better articulate the scope of the overall event. While land and soil degradation can lead to a complex web of cascading environmental damages, such as loss of livelihoods in some cases, we know this was not the case for this specific fire due to several reasons supported by other severity categories.

The results of land and soil degradation from this specific fire include:

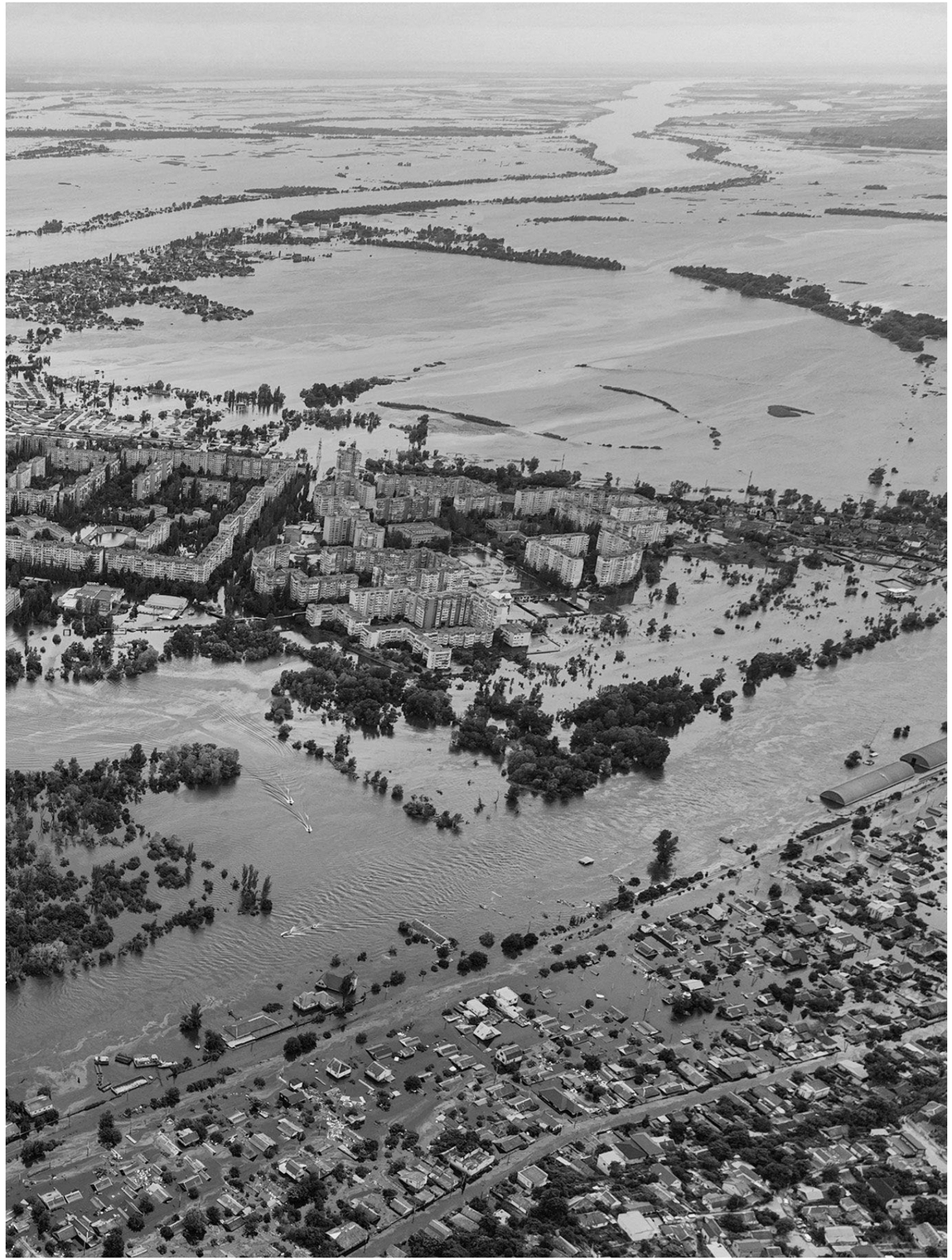
- Damage to terrestrial ecosystems

Two essential considerations arise here. First, "damage to terrestrial ecosystems" can be considered a sub-event and a main event. Second, there is a long list of further land and soil degradation results, such as nutrient loss, soil structure damage, erosion, disruption of soil microbial life, and soil compaction.

While there is no evidence to support that all these outcomes occurred in this case, the argument is not about assuming their occurrence—they are assumed—but about recognizing the limitations in over-categorizing events when it does not strengthen the case for ecocide.

The relevance of this method lies not just in simplifying and organizing events but in ensuring the hierarchy of events is comparable across all cases using the methodology, so the resulting quantification is meaningful. This approach is better understood after testing it with the dam case.

THE KAKHOVKA DAM CASE



IGNITOR DESTRUCTION OF THE NOVA KAKHOVKA DAM

JUNE 6TH, 2023: 2:15 TO 3 A.M.

ignitor

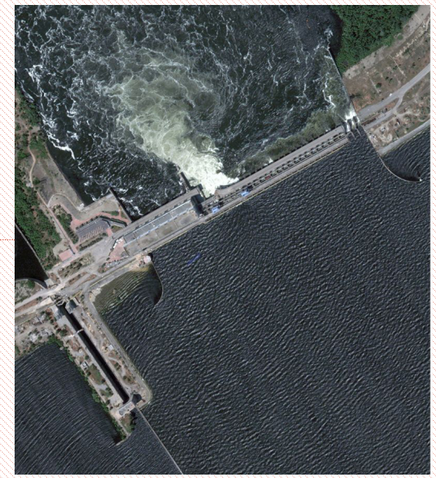
main event(s)

RUSSIAN OCCUPATION

FLOODING

KAKHOVKA DAM DESTRUCTION

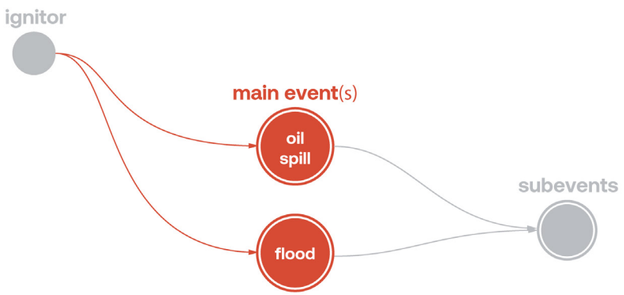
Prior to Explosion



https://edition.cnn.com/2023/06/08/europe/nova-kakhovka-destruction-theories-intl/index.html

MAIN EVENTS

JUNE 6TH, 2023: [TIME PERIOD OF FLOOD/



From the main event, we identify four primary events. We focus on the severity of these events by examining a specific subevent. For this test, the subevent of focus is the 'discharge of hazardous chemicals,' which results from **flooding and the release of oil.**

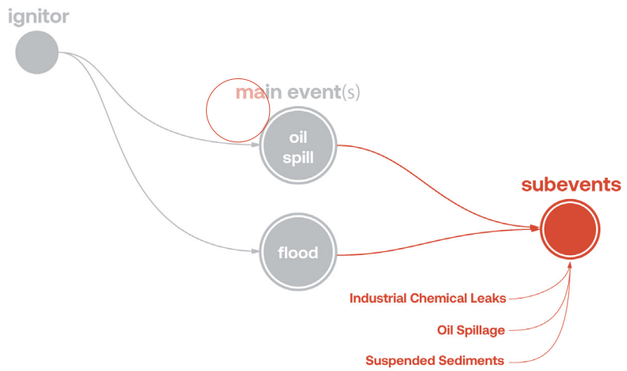
Prior to Explosion

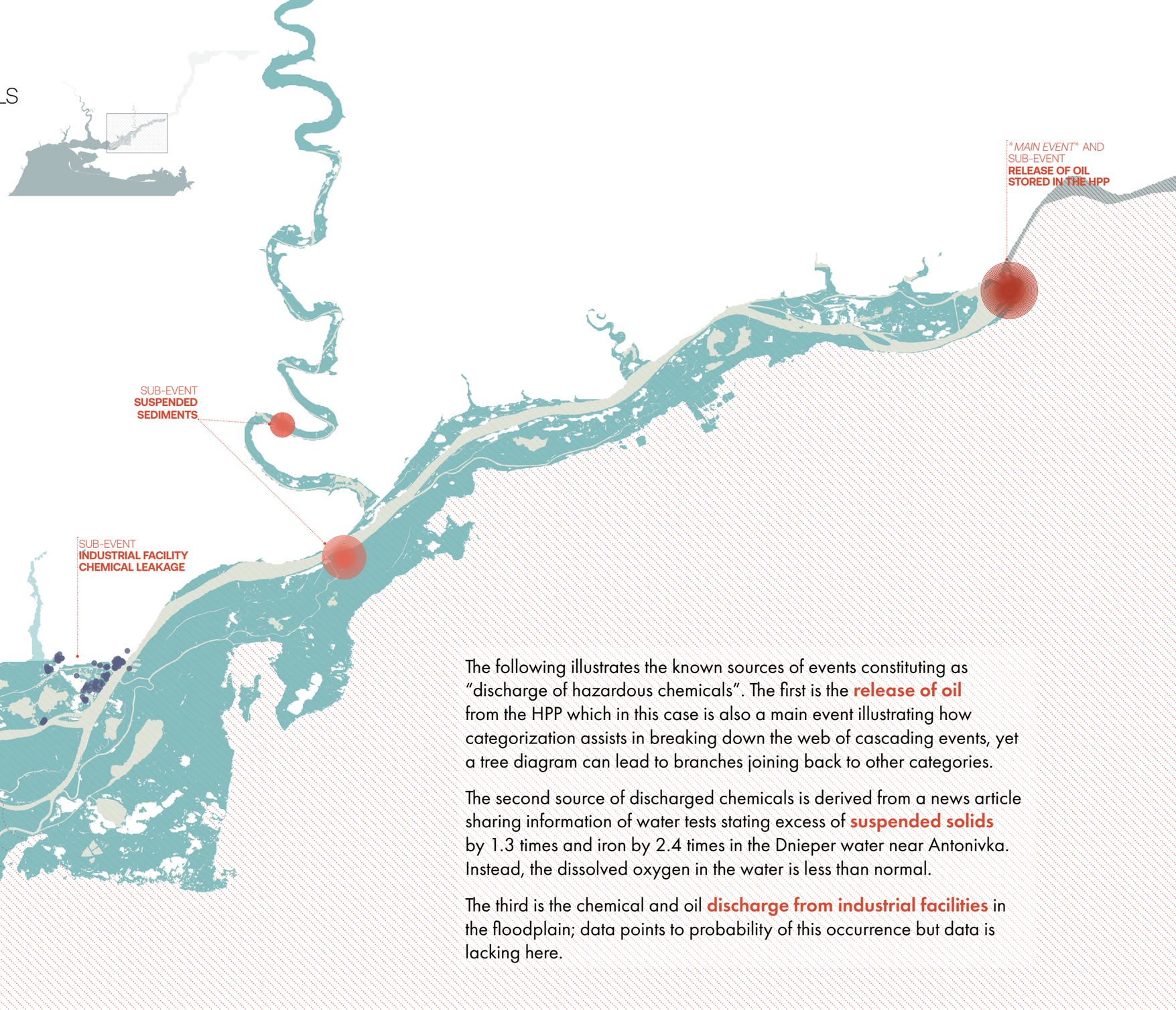
After Explosion

https://edition.cnn.com/2023/06/08/europe/nova-kakhovka-destruction-theories-intl/index.html

THE KNOWN

SUBEVENT DISCHARGE OF HAZARDOUS CHEMICALS





The following illustrates the known sources of events constituting as "discharge of hazardous chemicals". The first is the **release of oil** from the HPP which in this case is also a main event illustrating how categorization assists in breaking down the web of cascading events, yet a tree diagram can lead to branches joining back to other categories.

The second source of discharged chemicals is derived from a news article sharing information of water tests stating excess of **suspended solids** by 1.3 times and iron by 2.4 times in the Dnieper water near Antonivka. Instead, the dissolved oxygen in the water is less than normal.

The third is the chemical and oil **discharge from industrial facilities** in the floodplain; data points to probability of this occurrence but data is lacking here.

OIL SPILLAGE

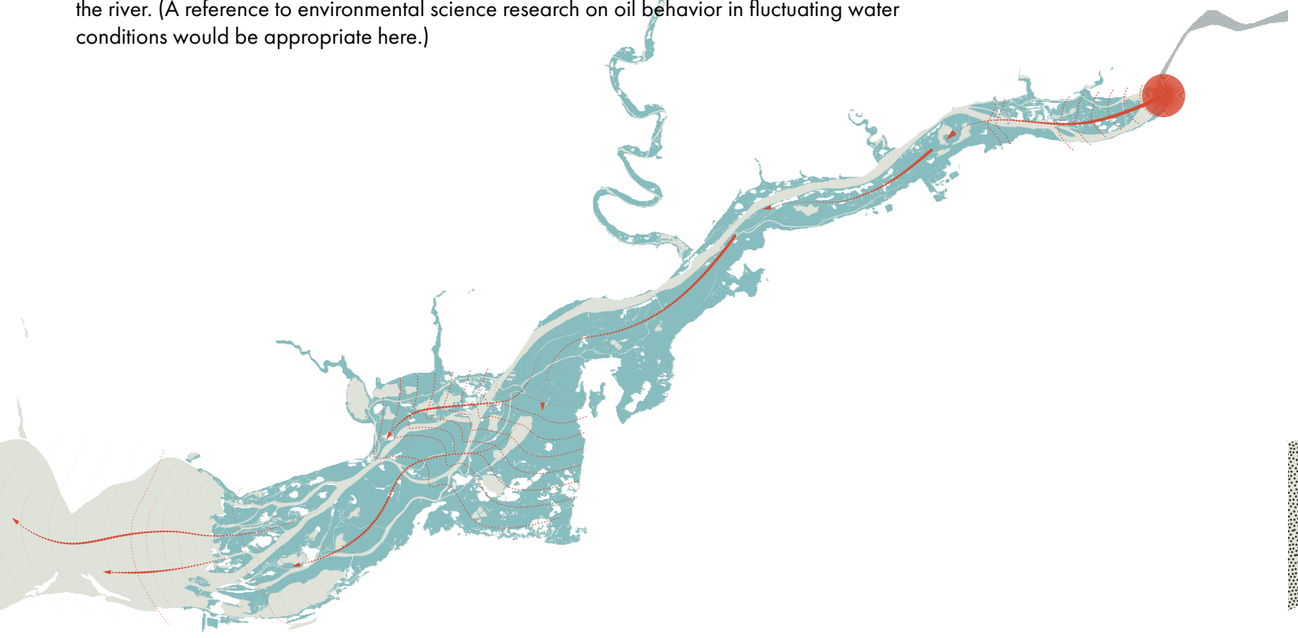
WHAT IS KNOWN

the information available states that between ***150 to 450 tons of oil was released*** from the HPP.

Typically, oil spilled into rivers accumulates along the banks, where it sticks to plants and grasses. This occurrence affects the local flora and potentially disrupts the ecological function of riverbank habitats. (EPA, Emergency Management documents)

Relevant Empirical Knowledge

Collection and Impact of Oil as Water Levels Change As water levels recede, oil previously dispersed can collect and become more concentrated along the banks and in shallow waters. This section should include visual aids to demonstrate how oil collects in different areas of a river over time, significantly impacting local ecosystems both along and across the river. (A reference to environmental science research on oil behavior in fluctuating water conditions would be appropriate here.)



ASSUMPTIONS

Though more frequent, Oil spill occurrences are often referencing in ocean and marine landscapes. Freshwater ecosystems are sensitive to such externally introduced materials. In river environments, the water current assists in the dispersal of oil, carrying contaminants far downstream. This dynamic illustrates not only the widespread distribution of oil along the river but also its movement perpendicular to the river's general flow, especially as water levels change in a flood event.

Events point that the oil drifted down the Dnipro river reaching the Black Sea resulting in the death of 95,000 tons of fish and dolphins on shores of Bulgaria and Turkey.

https://edition.cnn.com/europe/live-news/russia-ukraine-war-news-06-20-23#h_bcdd402e841278fe36e768168f55deb4

CHEMICAL LEAKS FROM INDUSTRIAL FACILITIES

WHAT IS KNOWN

We know there are industrial facilities in the floodplain and Satellite imagery has shown oil releases from specific facilities, indicating that, like oil, water currents can transport these chemicals The precise chemicals involved and the extent of their spread are still under investigation. The extent of chemical leakage from industrial facilities during floods remains less understood.

RELEVANT EMPIRICAL KNOWLEDGE

Chemicals and industrial waste can contaminate soil, water bodies, and groundwater, leading to long-term environmental degradation. Pollutants can persist in the ecosystem, affecting flora and fauna over an extended period.

PAX_REPORT_Kakhovka_FIN

ASSUMPTIONS

We assume that submerged chemical storages that water can mobilize the chemicals into the waterbody. We assume the forces of floods can break free these storages and carry the pollutants downstream.

SUSPENDED SEDIMENTS

WHAT IS KNOWN

According to the "The State Ecoinspection of the Southern District found an excess of suspended solids by 1.3 times and iron by 2.4 times in the Dnieper water near Antonivka. Instead, dissolved oxygen in water is less than normal."

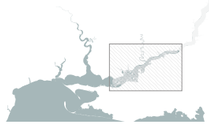
Increased water velocity during floods can stir up sediments from the riverbed and flooded areas, leading to higher concentrations of suspended sediments; in this case iron These sediments can transport adsorbed contaminants further downstream, altering the physical and chemical composition of the river. While the suspended sediments typically settle after a shorter period of time after currents settle, resulting events can persists longer

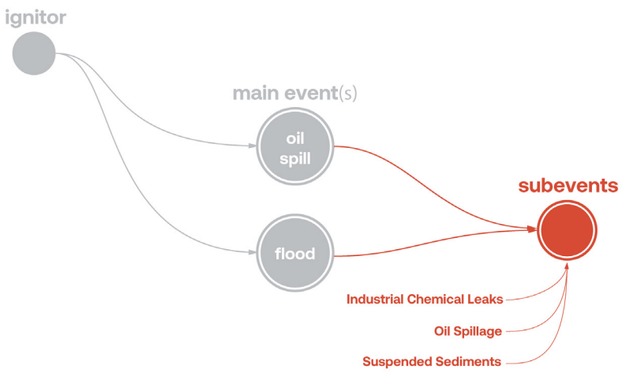
ASSUMED

If suspended sediments occur in these two sites, we assume that similar conidtions occur in similar environmetns both upstream, downstream. Furthermore, it is assumed, like with chemicals and oil, that these sediments are spread into the further waterbodies.

ASSUMED AND PROBABLE

SUBEVENT DISCHARGE OF HAZARDOUS CHEMICALS





This map illustrates assumptions regarding the dispersal of hazardous chemicals, based on an understanding of chemical dynamics in water bodies.

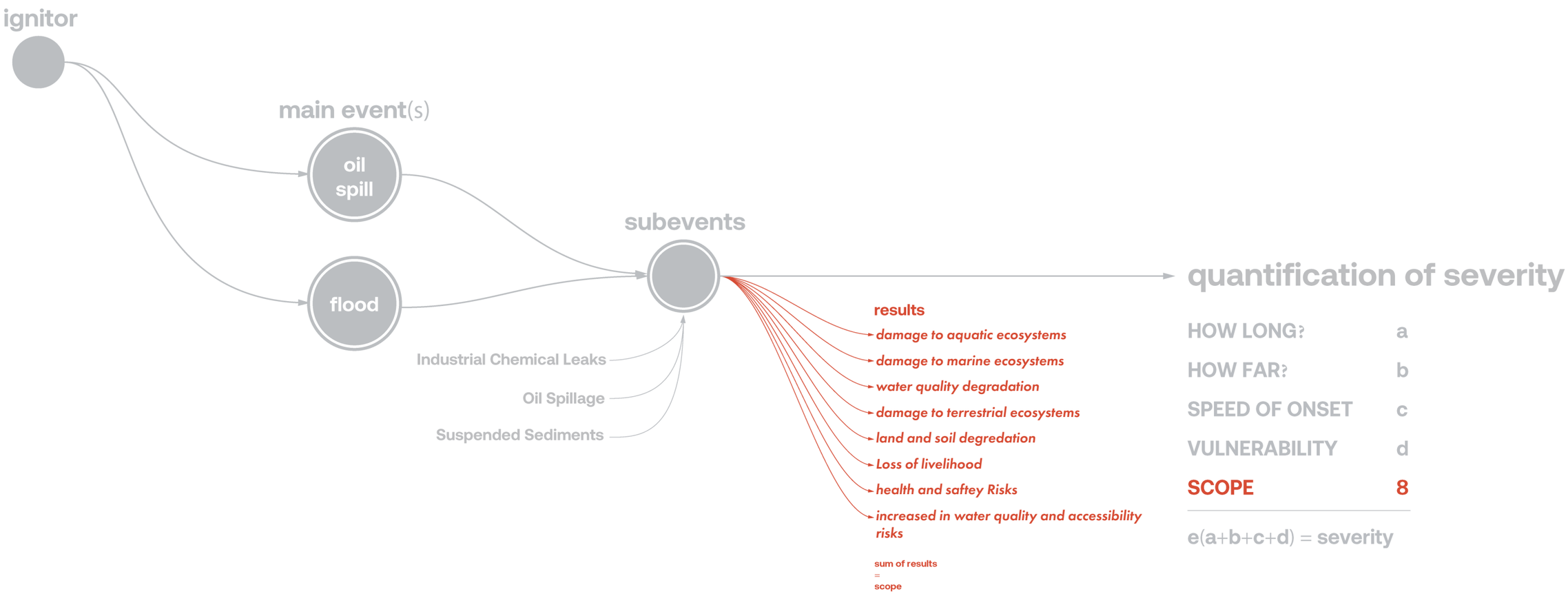
MAIN EVENT AND SUB-EVENT
RELEASE OF OIL STORED IN THE HPP

KAKHOVKA DAM DESTRUCTION

SUB-EVENT
SUSPENDED SEDIMENTS

SUB-EVENT
INDUSTRIAL FACILITY CHEMICAL LEAKAGE

RESULTS


ignitor
main event(s)
oil spill
flood
subevents
Industrial Chemical Leaks
Oil Spillage
Suspended Sediments
results
damage to aquatic ecosystems
damage to marine ecosystems
water quality degradation
damage to terrestrial ecosystems
land and soil degredation
Loss of livelihood
health and saftey Risks
increased in water quality and accessibility risks
sum of results
=
scope
quantification of severity
HOW LONG? a
HOW FAR? b
SPEED OF ONSET c
VULNERABILITY d
SCOPE 8
e(a+b+c+d) = severity

RESULTS SUMMARY

DAMAGE TO AQUATIC LIFE AND ***MARINE LIFE***

OIL SPILL

Toxicity to Wildlife: Many components of crude oil are toxic to fish, invertebrates, and amphibians. Exposure can lead to direct mortality or long-term health issues such as reduced growth, impaired reproduction, and increased susceptibility to disease.

Bioaccumulation: Oil compounds can accumulate in the tissues of organisms, leading up the food chain through bioaccumulation and potentially affecting predators, including humans who consume fish and wildlife from the contaminated area.

INDUSTRIAL FACILITIES

Immediate Toxicity: Direct exposure to toxic chemicals and oil can be lethal to fish, amphibians, and macroinvertebrates. Even sub-lethal concentrations can impair reproduction, growth, and immune function in aquatic species.

Bioaccumulation and Biomagnification: Toxins can accumulate in the tissues of organisms, increasing in concentration up the food chain, thereby affecting predators and eventually humans.

SUSPENDED SEDIMENTS

- Primary Impact: Direct toxicity to aquatic organisms.
- Chronic effects on fish and invertebrates.
- Secondary Impact: Influence on plant and algae growth.
- Provision of excess nutrients or reduction of light penetration through increased turbidity.

Marine Ecosystems? Category itself!!!

- Elevated iron levels can have chronic effects on aquatic life, including toxicity to fish and invertebrates at higher concentrations and over prolonged exposure.
- Iron-rich conditions can affect plant and algae growth by either providing excess nutrients or by blocking sunlight due to increased turbidity, each with its own set of ecological consequences.

WATER QUALITY DEGRADATION

OIL SPILL

Water Quality Degradation

- Contamination: Oil spills introduce large amounts of pollutants into river systems. These hydrocarbons can dissolve or form emulsions, severely degrading water quality.
- Oxygen Depletion: The decomposition process of oil consumes oxygen, leading to lower dissolved oxygen levels, which can suffocate aquatic life.
- Turbidity Increase: Oil mixed with river sediments increases water turbidity, which reduces light penetration and can disrupt photosynthesis in aquatic plants.

INDUSTRIAL FACILITIES

Chemical and Oil Spillage

Release of Contaminants: Floodwaters can overwhelm industrial storage facilities, leading to the spillage of stored chemicals and oil into the surrounding environment. This includes not only liquid products but also soluble materials and gases.

Spread and Dispersion: The dynamics of floodwaters can rapidly spread these contaminants over a wide area, affecting both the river and its floodplain.

2. Water Quality Degradation

Increased Pollution: The introduction of industrial chemicals and oil into a river can significantly degrade water quality. Key pollutants might include hydrocarbons, heavy metals, solvents, and other toxic substances.

Persistent Contamination: Certain chemicals can persist in the environment for long periods, undergoing complex chemical transformations that might produce new toxic substances.

SUSPENDED SEDIMENTS

Primary Impact: Alteration of sediment composition.

- Effect on benthic organisms.
- Disruption of habitats for various aquatic life forms.

Iron particles eventually settle onto the river or lake beds. This accumulation can alter the sediment composition, which can affect benthic (bottom-dwelling) organisms and disrupt the habitat for various aquatic life forms.

- Accumulated iron in sediments can be remobilized in the future, especially during disturbances like subsequent floods or changes in water chemistry, leading to recurring impacts

DAMAGE TO TERRESTRIAL ECOSYSTEMS

OIL SPILL

Terrestrial and Riparian Impacts

Vegetation Damage: Oil can coat the roots and leaves of riparian (riverbank) plants, inhibiting their ability to photosynthesize and absorb nutrients, leading to plant stress and death.

Loss of Habitat: Contamination can make riverbanks and adjacent habitats unsuitable for wildlife, leading to loss of biodiversity and disruption of local ecosystems.

Industrial Facilities

Vegetation and Soil Contamination: Chemicals and oil can contaminate soil and vegetation. This affects plant health and can lead to the death of sensitive species, altering habitat structures and food resources for terrestrial wildlife.

Long-Term Soil Fertility: Contaminants can alter soil pH, nutrient availability, and microbial activity, potentially reducing soil fertility and affecting land use for agriculture and forestry.

Suspended Sediments

Interaction between aquatic and terrestiral fauna/ riparian ecosystems

Loss of Livelihood

The significance of this category lies in the delineation between events that constitute ecocide and those that contribute to it, highlighting both strengths and shortcomings. The idea that the landscape represents the relationship between humans and nature is crucial in understanding ecocide. The destruction of agriculture leads to a possible loss of livelihood. However, many agricultural practices also disrupt ecological systems. The discharge of hazardous chemicals damages the land resources that agriculture requires for success, further contributing to the loss of livelihood. In this context, should human life be considered part of the ecosystem? Should this be included in the "scope" of ecocide? On the other hand, the destruction of infrastructure should not be considered an ecocide event in itself. But, like the dam, it has cascading effects that contribute to events considered as ecocide; in this case, the "loss of livelihood" is considered a resulting factor within the "scope" of ecocide.

Agricultural Damage:

The floodwater can submerge the agricultural lands, ruin the crops, and make the soil not cultivable in the future. From the oil and chemical effluents, the soil becomes contaminated. The overall fertility of the soil gets deteriorated, which undermines the capacity of the farmers to grow food.

Fishing Industry Impact

The use of contaminated water bodies may lead to the death of the fish and other aquatic life, therefore causing devastation to the local fishing industry, which most communities rely on for an income and to feed their people.

Infrastructure Destruction:

The flooding can destroy or damage infrastructure like homes, businesses, and transportation networks, disrupting economic activities and leaving people stranded with no means of livelihood.

QUANTIFICATION OF SEVERITY

VULNERABILITY

When assessing vulnerability at scale, particularly in the context of the discharge of hazardous chemicals, several critical elements must be considered. These elements include the speed at which the event occurs, the extent of its reach, and its duration. In quantifying such events, it becomes apparent that they are linked, often manifesting as environmental crises compounded by concurrent crises, such as warfare.

Vulnerability, in this context, refers to the susceptibility to inevitable disasters. Preparedness encompasses both the readiness to respond to sudden-onset disasters and the capacity to facilitate effective responses. This readiness is a fundamental aspect of resilience in the face of multi-event disasters. In the scenario described, the primary events—the sudden discharge of hazardous chemicals—are characterized by swift onset and rapid dispersal. While not as abrupt as a flood or an unprecedented attack, they nonetheless pose significant challenges. Despite some level of preparedness, the ability to mitigate the long-term and widespread impacts is hindered by various factors.

The context of warfare exacerbates these challenges. Depleted resources and dispersed attention due to other war-related events further strain preparedness efforts. The location of the chemical discharge incident along the line of Russian occupation complicates matters, as the battlefront creates additional obstacles to completing tasks related to preparedness and post-event management.

Moreover, the expansion of Russian occupation in the region over the past year has made it exceedingly difficult to monitor and address the challenges posed by such events. Consequently, efforts to moderate, test, understand, assess, and address the consequences of the chemical discharge incident are impeded by factors stemming from the ongoing war and occupation.

SPEED OF ONSET

The speed of onset of the sub-event “discharge of hazardous chemicals” onset from the sources of the chemicals and the way they were discharged. The release results from the two main events: the flooding and the oil release from the HPP.

While the flood itself was sudden, the oil discharge from the HPP was sudden, but not as quick as the flood. While some events close to the source were sudden, the extensive spread of chemicals downstream allowed for more preparedness and, therefore took longer to manifest than the initial discharge.

HOW FAR?

In reference to to SEF, the dispersal of hazardous chemicals fufills the requirements of “widespread”. The dispersal of hazardous chemicals In the flooding zone itself stretches around 85 kilometers. In reference to perpendicular section to the transect along the Dnipro river, the chemicals likely spread to not only the aquatic ecosystem of the river, but the wetlands and other ecosystems outside the river ecosystem.

The Dnipro River below the Kakhovka Dam itself can constitute as widespread, an entire ecosystem itself containing or contiguous with numerous more.

But further more we can assume based on General empirical knowledge that if these hazardous chemicals enter a river waterbody, ones which are not absorbed into sediments can be dispersed to further waterbodies; in this case the Dniprovs’ka Gulf and into the Black Sea – a body of water which is also shared by state borders of Ukraine, Romania, Bulgaria, Turkey, and Georgia

Therefore, the category widespread is quantified with a scale of 5.

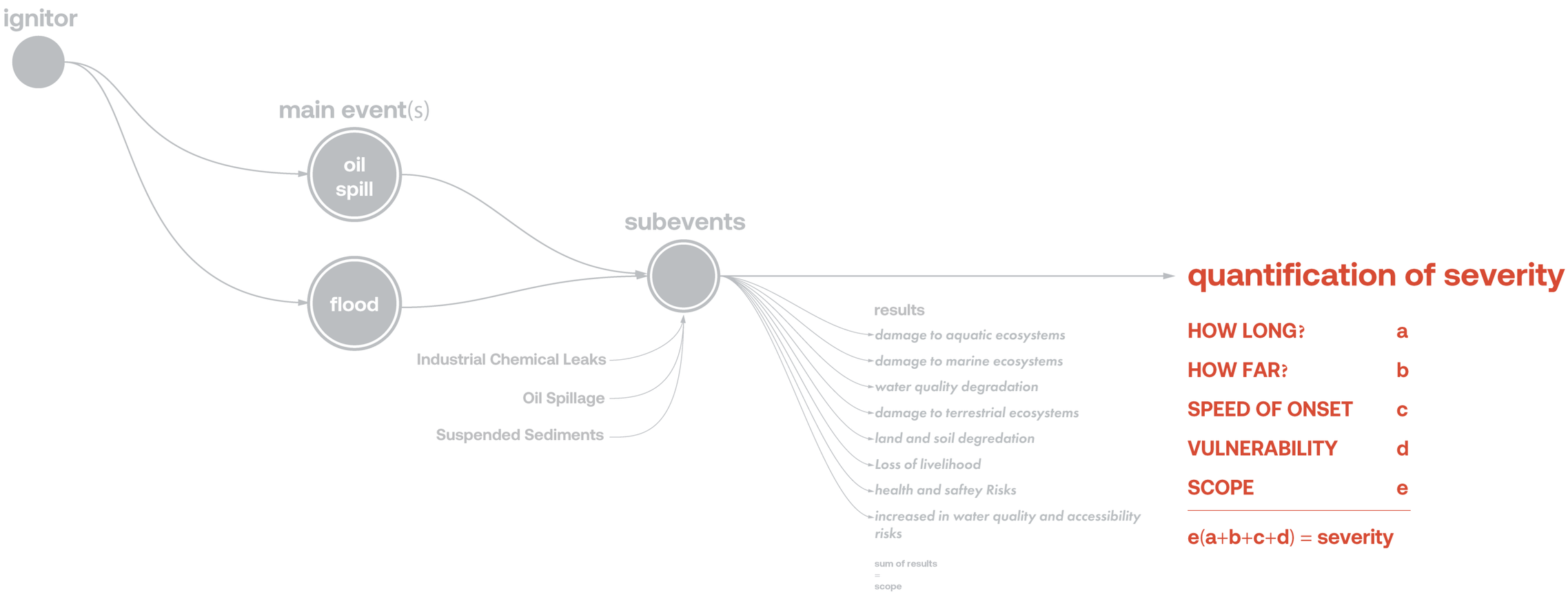
HOW LONG?

The discharges of hazardous chemicals and oil are likely to have long-term impacts since these substances will remain in the environment for long periods, affecting water quality and the health of the soil and biodiversity. Continuous problems with food chains and human health, combined with the inability to remediate the area during war, particularly point out the long-drawn nature of the environmental crisis. This justifies the assumption of a long-term impact on the region categorizing “how long?” a scale of 5.

QUANTIFICATION OF SEVERITY

(LONGTERM) HOW LONG?	5
(WIDESPREAD) HOW FAR?	5
SPEED OF ONSET	4
VULNERABILITY	4
SCOPE	8

QUANTIFICATION OF SEVERITY

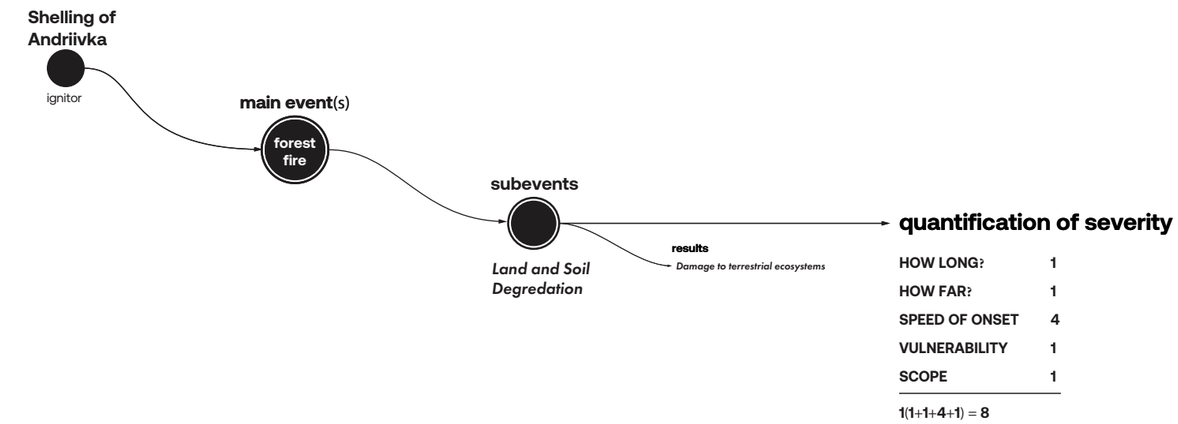


RESULTS

The system was tested using two cases: the fire in Andriivka and the Destruction of the Nova Kakhovka Dam.

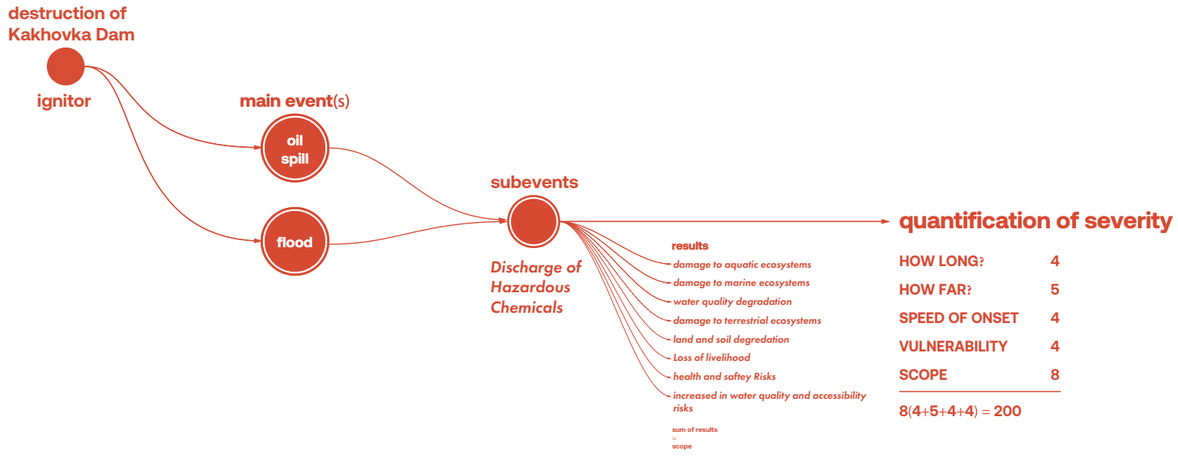
The fire in Andriivka scored 8, while the dam scored 200, a notably higher score than the fire case. The difference between the two cases lies in the number of cascading events and the complexity of the dam case, which challenges the system's ability to categorize events and quantify them. However, the results suggest that the fire is probably not an instance of an ecocide.

It should also be noted that only one sub-event was tested using the methods.



HOW LONG?	1
HOW FAR?	1
SPEED OF ONSET	4
VULNERABILITY	1
SCOPE	1

1(1+1+4+1) = 8



HOW LONG?	4
HOW FAR?	5
SPEED OF ONSET	4
VULNERABILITY	4
SCOPE	8

8(4+5+4+4) = 200

DISCUSSION

However, the quantification still shows a clear and drastic difference.

In the case of the forest fire caused by shelling, the outcome would likely change if carpet shelling occurred over a wide area. In that scenario, the sub-event "land and soil degradation" would presumably cascade into a longer list of results, assuming it crosses a wide range of ecosystems. This would make it more difficult to prepare for and therefore likely to last longer.

Considering the two examples and the resulting numbers, it is likely that the number constituting ecocide must be between 8 and 200. This leaves room for arguments about what number should be considered as constituting ecocide.

While the number constituting ecocide is still unknown, this methodology, with the assistance of theories in crises and ecology, suggests that the discharge of hazardous chemicals from the dam destruction points to ecocide.

Challenges in Research:

The complexity of natural systems presents one of the primary challenges in research. The system categorizes the events to address the complexity. Categorization helps to structure information, facilitate analysis, and allow for the development of multiple arguments.

Importance of Categorizing Events:

Categorizing types of events is crucial for understanding the specific requirements and necessary preparations for each event. Preparation is essential to address the unique needs associated with different events. It is crucial to allocate resources and personnel to collect relevant information; for example, crowdsourcing can significantly contribute to data collection and should not be left to the investigation stage.

Implications for Ukraine and Other Cases:

The significance of categorizing events and determining instances of ecocide is essential for Ukraine and other potential cases. Addressing ecocide in the presence of the International Criminal Court (ICC) aims to secure some form of reparation. Importantly, it should be noted that an act of ecocide has legal consequences beyond fundamental moral implications, both in times of peace and times of war.

Ignitor

Destruction of the Nova Kakhovka Dam

Main Events

Reduced Water Level in Kakhovka Reservoir

Flooding

Oil Leak

Loss Of HPP

Sub Events

Results

Quantification of Severity

Infrastructure Damage

- Loss of Livelihood
- Discharge of Hazardous Chemicals
- Damage to Municipal Infrastructure
- Disruption of Community/ Social Services

Scope

How Long?	*5*
How Far?	*5*
Speed of Onset	*5*
No Resilience	*5*
Scope	*4 + 1*
Average	5

Discharge of Biological Hazards

- Healthcare System Strain
- Damage to Terrestrial Wildlife
- Altering of Nutrient Cycles
- Increase of Waterborne Disease

Scope

How Long?	*3*
How Far?	*4*
Speed of Onset	*3.5*
No Resilience	*3*
Scope	*4 + 1*
Average	3.5

Marine And Aquatic Ecosystem Destruction

- Loss of Livelihood
- Damage to Terrestrial Ecosystems
- Loss of Ecosystem Services
- Increase of Waterborne Disease

Scope

How Long?	*3.5*
How Far?	*5*
Speed of Onset	*5*
No Resilience	*3*
Scope	*4 +5*
Average	4.3

Destruction of Agriculture

- Loss of Livelihood
- Damage to Sector Productivity

Scope

How Long?	*3.5*
How Far?	*5*
Speed of Onset	*5*
No Resilience	*3*
Scope	*2*
Average	3.7

Discharge of Hazardous Chemicals

- Health and Safety Risks
- Loss of Livelihood
- Increase in Water Quality and Accessibility Risk
- Damage to Marine and Aquatic Ecosystems
- Land and Soil Degredation
- Damage to Terrestrial Ecosystems
- Loss of Ecosystem Services

Scope

How Long?	*4*
How Far?	*5*
Speed of Onset	*4*
No Resilience	*4*
Scope	*8 + 2*
Average	5.4

Proper Cooling of ZNPP Reduction

- Health and Safety Risks
- Loss of Livelihood
- Damage to Municipal Infrastructure
- Disruption of Community/ Social Services
- Disruption of Energy Supply
- Potential Crisis Risk

Scope

How Long?	*1*
How Far?	*1*
Speed of Onset	*5*
No Resilience	*1*
Scope	*2*
Average	2

Removal of Dam Produced Energy

- Health and Safety Risks
- Loss of Livelihood
- Damage to Municipal Infrastructure
- Disruption of Community/ Social Services
- Disruption of Energy Supply

Scope

How Long?	*1*
How Far?	*5*
Speed of Onset	*5*
No Resilience	*5*
Scope	*5*
Average	4.2

The following diagram is an early adaptation illustrating the cascading events resulting from the destruction of the dam. While this is not finalized according to the quantified severity and the criteria for ecocide, it highlights additional sub-events that should be considered for Ukraine. This helps in more accurately understanding the scale of severity that may qualify as a possible case of ecocide.

The following diagram is an early adaptation illustrating the cascading events resulting from the destruction of the dam. While this is not finalized according to the quantified severity and the criteria for ecocide, it highlights additional sub-events that should be considered for Ukraine. This helps in more accurately understanding the scale of severity that may qualify as a possible case of ecocide. In addition to the Kakhovka Dam case, Ukraine still considers the large number of environmental damages from the war.